ECOLE NOTRE DAME DE LA PROVIDENCE

DE KARUBANDA

NGOMA SECTOR

<u>HUYE DISTRICT</u>

ORDINARY LEVEL PHYSICS NATIONAL EXAMINATIONS AND MARKING SCHEMES

FROM 2002 TO 2019

COMPILED BY HUNGURIMANA Dieudonné

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Top 10 study tips

1. Have all your materials ready before you begin studying: pencils, pens, papers, calculators if necessary etc.
2. Be positive. Make sure your brain holds on to the information you are learning by reminding yourself how important it is to remember the work and get the marks.
3. Take a walk outside. A change of scenery will stimulate your learning. You'll be surprised at how much more you take in after being outside in the fresh air.
4. Break up your learning sections into manageable parts. Trying to learn too much at one time will only result in a tired, unfocused and anxious brain.
5. Keep your study sessions short but effective and reward yourself with short, constructive breaks.
6. Teach your concepts to anyone who will listen. It might feel strange at first, but it is definitely worth reading your revision notes aloud.
7. Your brain learns well with colours and pictures. Try to use them whenever you can.
8. Be confident with the learning areas you know well and focus your brain energy on the sections that you find more difficult to take in.
9. Repetition is the key to retaining information you have to learn. Keep going – don't give up!
10. Sleeping at least 8 hours every night, eating properly and drinking plenty of water are all important things you need to do for your brain. Studying for exams is like strenuous exercise, so you must be physically prepared.

" If you can't explain it simply, you don't understand it well enough".
Albert Einstein

On the day of the exam ...

1. Make sure you have all the necessary stationery for your exam, i.e. pens, pencils, eraser, protractor, compass, calculator (with new batteries). Make sure you bring your ID document and examination admission letter.
2. Arrive on time, at least one hour before the start of the exam.
3. Go to the toilet before entering the exam room. You don't want to waste valuable time going to the toilet during the exam.
4. Use the 10 minutes reading time to read the instructions carefully.
5. This helps to 'open' the information in your brain. Start with the question you think is the easiest to get the flow going.
6. Break the questions down to make sure you understand what is being asked. If you don't answer the question properly you won't get any marks for it. Look for the key words in the question to know how to answer it.

Try all the questions. Each question has some easy marks in it so make sure that you do all the questions in the exam.

7. Never panic, even if the question seems difficult at first. It will be linked with something you have covered. Find the connection.
8. Manage your time properly. Don't waste time on questions you are unsure of. Move on and come back if time allows.
9. Check weighting – how many marks have been allocated for your answer? Do not give more or less information than is required.
10. Write big and bold and clearly. You will get more marks if the marker can read your answer clearly.

Source: Alfie Bouwer, Sivalingam Chetty et al; 2014, ***Mind the gap, Life sciences study guide grade 12,*** Department of basic education, Pretoria, South Africa.

Note: Through the questions herein are fully answered, it is highly recommended that you first read and understand the question, make your trials and then compare with what is given in the solution. It is also advisable that you read through the book several times before the final examinations.
I am certain that if a student can answer all these questions in this document with ease, he/she should be able to pass with a distinction in the ordinary level national physics examination.

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'' *Everyone is a genius. But if you judge a fish by its ability to climb a tree, it will spend its whole life believing that it is stupid.* ''
Albert Einstein

''*Never say you have failed until you have reached your last attempt, and never say it's your last attempt until you have succeded.* ''

'' *There are no secrets to success. It's all about preparing, hard work and learning from failure.* ''

ORDINARY LEVEL NATIONAL EXAMINATIONS 2002 / 2003

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculators and mathematical instruments.

SECTION A: ANSWER ALL QUESTIONS (55 MARKS)

1. A stone is thrown into the air at an angle of 70° as shown in the figure below. The same stone is again thrown with the same force and speed at an angle of 30°.
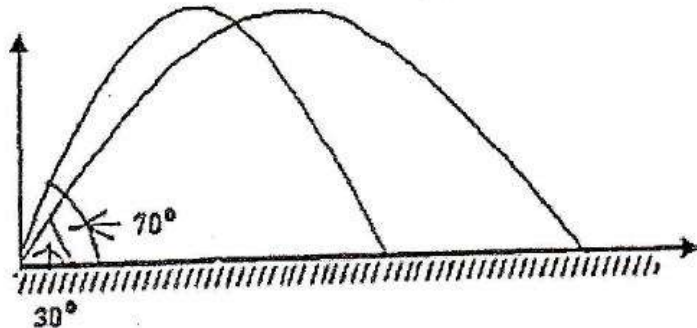
   a) For which angle does the stone travel the farthest? **(1 mark)**
   b) Why does the stone fall to the ground each time? **(1 mark)**
   c) At which of the two angles should a high jumped leave the ground in order to jump the highest? **(1 mark)**

2. By mid-day, land can get much hotter than water in the sea.
   a) Copy the diagram below and show how the air will move between the land and the sea at that time. **(2 marks)**

   b) What is the name given to the process in 2 (a) above by which the air moves? **(1 mark)**
   c) A piece of iron of mass 200 g and specific heat capacity 460 J/kg.K cools down from 120°C to 70°C. Calculate the heat lost. **(2 marks)**

3. a) i) What kind of lens is shown below? **(1 mark)**
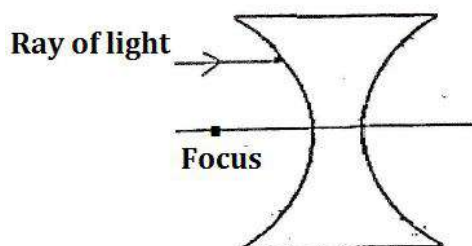
   ii) Copy the diagram in your answer book and complete the ray of light as it travels through the lens. **(1 mark)**
   b) An object is placed 4 cm in front of the above lens. A vertical image is produced 1 cm from the lens.
   i) What is the magnification produced by the lens? **(1 mark)**
   ii) If the image is 1.5 cm tall, how tall is the object? **(2 marks)**

4. a) Draw a diagram to illustrate how one may magnetize iron nail by using a bar magnet. **(1.5 marks)**

b) Copy the diagram below and insert arrows in the magnetic compasses A, B and C around the bar magnet and hence label the poles of the magnet. **(2 marks)**
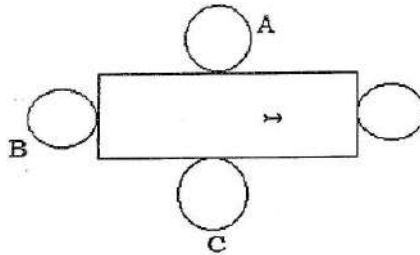
5. a) A boy raises a hammer and then hits the nail. State the energy changes which occurs. **(2 marks)**
   b) The potential energy of a 5 kg mass is 100 J. Calculate how high the mass is from the ground. Take g = 10 m/s². **(2 marks)**

6. Two light charged balls are suspended on nylon threads and then released. Immediately the balls come to rest with the treads making equal angles with the vertical as shown in the diagram below.
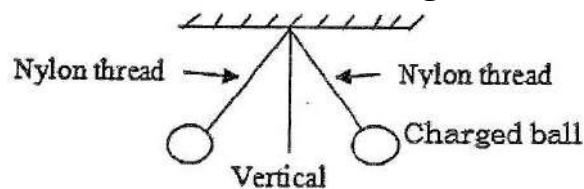
   a) What can you say about the charges on the ball? **(1 mark)**
   b) What would happen to the balls if somebody touches one of the balls? **(1 mark)**
   c) A steady current of 2 A flows passing a point, find the charges which pass the point in 3 seconds. **(1.5 marks)**

7. a) Name the simple machine that can be used to lift small masses in laboratory. **(1 mark)**
   b) State why the efficiency of the machine in 7 (a) is less than 100%. **(1 mark)**
   c) A machine lifts a mass of 150 g through a vertical height of 8 cm. Calculate the work done. **(2 marks)**

8. a) The density of sea water is greater than the density of pure water. Why? **(1.5 marks)**
   b) The volume of a substance is 280 cm³ and its mass is 336 g. Calculate the density of the substance. **(1 mark)**
   c) State the differences between density and relative density of substance? **(1.5 marks)**

9. a) A tall person is more likely to fall down than a short person if the two persons are climbing the same hill. Why? **(2 marks)**
   b) Draw a cone seated on a plane surface in unstable equilibrium position. **(1 mark)**
   c) Calculate the distance x when the figure below balances. **(2 marks)**
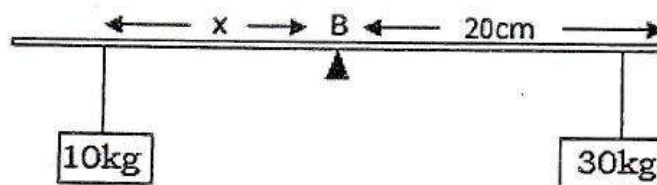
10. a) Name the unit that is the same as a watt. **(1 mark)**
    b) A person takes 1 minute 15 seconds to run a distance of 100 m. Calculate the person's power if his weight is 600 N. **(2 marks)**

11. The figure below shows forces E and F acting on a falling drop of water to the ground.
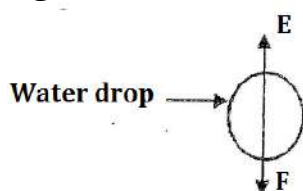
    a) Name force
       i) E **(1.5 marks)**
       ii) F **(1.5 marks)**
    b) State what causes force E **(1 mark)**
    c) What would happen to the drop of water if forces E and F are equal? **(1 mark)**

12. a) Methylated spirit is said to be a volatile liquid. What does this mean? **(1 mark)**
    b) When a drop of methylated sprit is put on the skin, the skin feels cold and the drop disappears. Explain this effect. **(2 marks)**
    c) In which domestic electrical appliance is a volatile liquid used? **(1 mark)**

13. A boy swings a ball attached to the end of a string in horizontal circle above his head as shown in the diagram below.
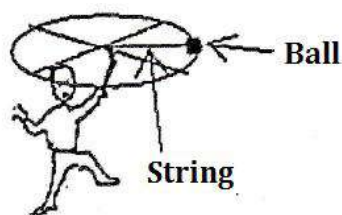
    a) Name the force in the string pulling inwards on the ball **(1 mark)**
    b) What happens to the force in the string when the speed increases? **(1 mark)**
    c) In which direction does the ball move when the string breaks? **(1 mark)**

14.
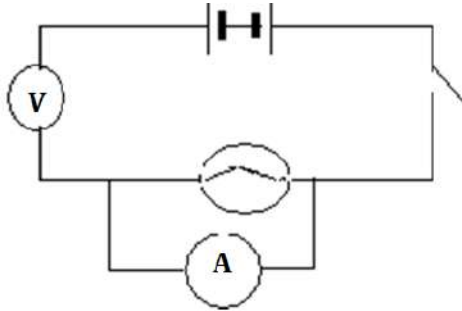
a) From the electric circuit above there are three mistakes. What are the three mistakes? **(1.5 marks)**

b) Draw the electric circuit above correctly so that the voltmeter reads the potential difference across the cells and the ammeter reads the current flowing in the circuit. The switch should be on. **(2 marks)**

c) Electric lamps in houses are connected in parallel and not in series. Why? **(1.5 marks)**

SECTION B: Attempt any THREE questions in this section. (3O marks)

15. a) Below is a bimetallic strip made from brass and iron joined together. When heated, the metals expand but by different amounts as shown in the diagram.
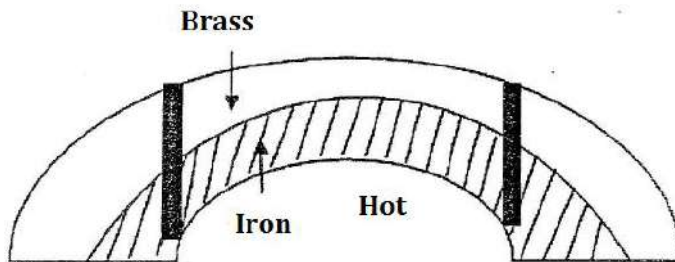
i) Which of the two metals expands faster? **(1 mark)**

ii) Draw the bimetallic strip when it has cooled down. **(1 mark)**

b) A bimetallic strip is used to control the operating electric iron. See a simple diagram below.
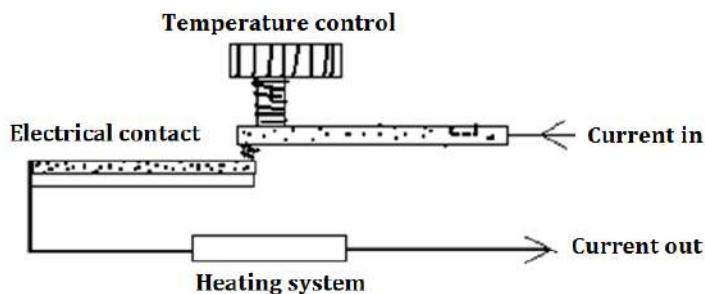
From diagram above

i) What is the use of electric current? **(1 mark)**

ii) How does the bimetallic strip work? **(3 marks)**

c) A Solid substance was heated and the graph below shows how the temperature of the substance changed as the heat was given to it.
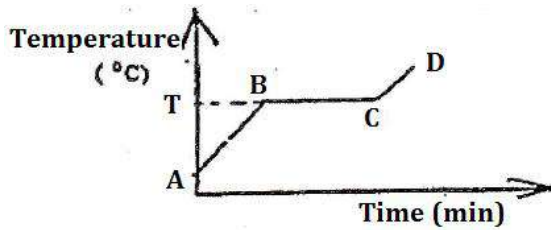
i) What does the temperature A represent? **(1 mark)**
ii) Why does the temperature from B to C not change while the substance is being heated? **(1 mark)**
iii) What is the temperature T of substance called? **(1 mark)**
iv) What is the state of substance from C to D? **(1 mark)**

16. a) Given a drinking glass, a piece of paper and some water, draw well labelled diagrams to show that the air of the atmosphere exerts pressure in all directions. Give a brief explanation. **(2 marks)**
    b) Below is a diagram of a simple lift pump. The piston is going down.
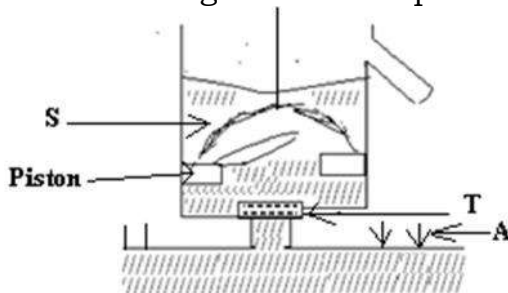
    i) Name parts A, T and S. **(1.5 marks)**
    ii) Explain what is happening to the water as the piston moves down. **(2 marks)**
    iii) Briefly explain what happens when the piston moves up. **(2.5 marks)**
    c) A mass of 20 kg rests on a square surface measuring 0.2 m by 0.2 m. Calculate the pressure exerted by the mass on the surface. Take g = 10 m/s². **(2 marks)**

17. a) What is meant by an annular eclipse? **(1 mark)**
    b) With an aid of a well labelled diagram show umbra and penumbra shadows form. **(3 marks)**
    c) The figure below shows a simple camera.
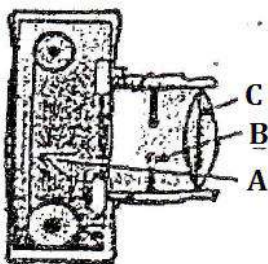
    i) Name parts labelled A, B and C. **(1.5 marks)**
    ii) What is the use of part B? **(1.5 marks)**
    iii) Which part of the camera is similar in action to part A of the camera? **(1.5 marks)**

d) i) An oblique ray of light travels from air and continues through the water. State the relationship between the ray of light in the air, the normal and the ray of light in water. **(1.5 marks)**
  ii) Draw diagram to show this relation in 17 (d) i) above. **(1.5 marks)**

18. a) What is meant by a uniform velocity? **(1 mark)**
  b) Sketch a graph of a body moving with a uniform velocity. Label distance on Y-axis and time on X-axis. **(2 marks)**
  c) Write the standard unit of acceleration. **(1 mark)**
  d) The initial velocity of a moving body is 10 m/s. In 5 s time, the velocity of the body reaches 30 m/s. The body maintains the velocity.
    i) Calculate the acceleration of this body. **(2 marks)**
    ii) Calculate the distance moved by the body during the 5 s. **(2 marks)**
    iii) What distance does the body travel in 45 minutes times? **(2 marks)**

19. a) State Ohm's law. **(2 marks)**
  b) Copy the simple circuit below and insert: **(2 marks)**
    i) A switch, S_1, to control current flow through lamp C
    ii) A voltmeter to measure voltage across lamp B.
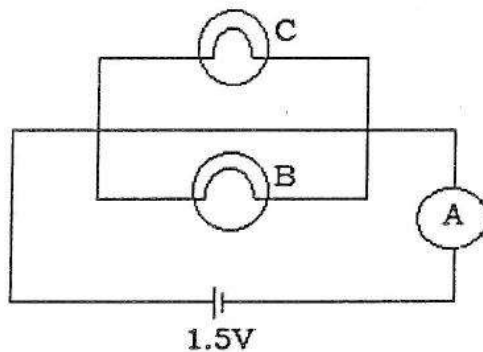
c) Calculate the electric current flow recorded by the ammeter, in the circuit if resistance of lamp C is 2 Ohms and that of lamp B is 3 Ohms. **(2 marks)**
  d) Draw a simple electric bulb and describe briefly how it gives off light. **(4 marks)**

SECTION C: Answer only one question in this section. **(15 MARKS)**

20. Describe an experiment to demonstrate that light travels in a straight line. Use any necessary diagram to make your answer clear.

21. You are provided with the following apparatus: eureka can, 2 beakers, water, balance, Newton balance and metal. Describe an experiment to verify Archimedes' Principle for a metal in water.

22. You are provided with dilute Sulphuric acid in a beaker, copper plate (electrode), Zinc plate (electrode), connecting wire and a bulb.
  a) With an aid of a well labelled diagram explain how an electric current is produced by a simple cell.
  b) How do you show that the electric current is produced by the simple cell?

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MARKING SCHEME OF ORDINARY LEVEL PHYSICS
NATIONAL EXAMINATION 2002/2003

Section A: Answer all questions

1. (a) *The stone travels the farthest at the angle of 30°*
   (b) *Because of the gravity force or weight or Earth attracts.*
   (c) *For the angle of 70°*

2. a)
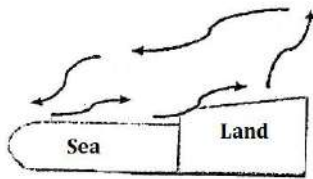
   b) Convection.
   c) Heat lost: Q = 0.200 X 460 X (120 -70) = 4 600 J

3. a) (i) *Diverging lens*
      (ii) *Refraction rule for diverging lens*
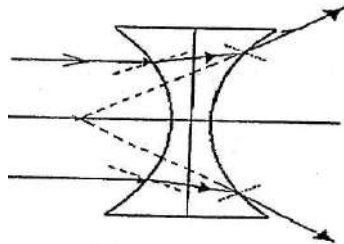
   Incident ray travelling parallel to the principal axis will refract through the lens and diverge, never intersecting.

   (b) (i) *Magnification:* $Y = \frac{q}{p} = \frac{1}{4} = 0.25$

   (ii) *Height of the object:* $Y = \frac{h'}{1.5} = 0.25 \Leftrightarrow h' = 0.04\ cm$

4. **(a) Magnetization by single touch**
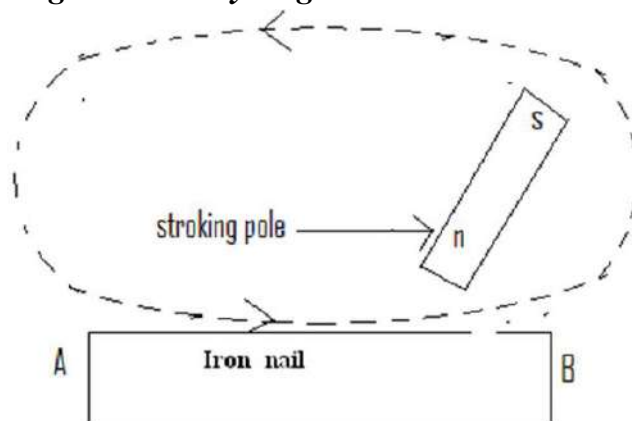
b)
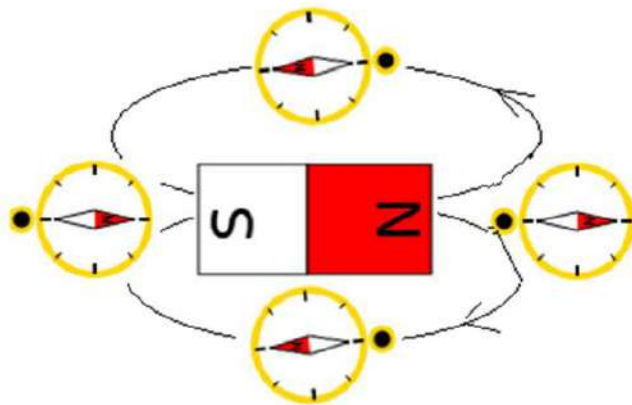
5. *(a) Potential energy in his muscles – kinetic energy- calorific energy, sound energy and light energy.*

   (b) Using $PE = mgh \Rightarrow h = \frac{PE}{mg} = \frac{100}{5 \times 50} = 2\ m$

6. *(a) The charges of the same sign and the same amount of charges.*
   (b) If somebody touches one of the balls, it become discharge and the force of repulsion between the balls disappear and we will observe the attraction between the balls charged and non-charged ball.
   (c) Q = It = 2 X 3 = 6 C

7. *(a) Pulley, tongs.*
   (b) Friction force
   (c) Work: W = mgh = 0.150 X 10 X 0.08 = 0.12 J

8. *(a) It contains impurities (minerals)*

   (b) Density: $\rho = \frac{m}{V} = \frac{336 \times 10^{-3}}{280 \times 10^{-6}} = 1\ 200\ kg/m^3$

   (c) ***Density*** *is defined as the* ***ratio of mass divided by volume while*** *Relative density of a substance is defined as the ratio of the mass or weight of a given volume of the substance to the mass or weight of an equal volume of a standard substance.*

9. *(a) The centre of gravity of a tall person is away from the earth.*
   (b) A cone in unstable equilibrium

   (c) Using principle of equilibrium: $10 \times g \times x = 30 \times g \times 20 \Leftrightarrow x = 60\ cm$

10. (a) Watt = Joule per second

(b) Power: $P = \frac{wd}{t} = \frac{600 \times 100}{75} = 800\ W$

11. (a) i) E = air resistance, ii) F = gravitational force, weight of the drop.

(b) Air moved

(c) The drop of water will fall under gravity only (Free fall motion).

12. (a) It evaporates easily.

(b) The body gives up heat to the droplet and the droplet evaporates (disappears) or drop absorbs heat and cools the body.

(c) Fridge, freezer or refrigerator.

13. (a) Centripetal force

(b) The force in the string increases its strength

(c) Tangent to the trajectory or horizontally.

14. (a) Voltmeter is in series instead to be in parallel, Ammeter is in parallel instead to be in series, the generator is misrepresented.

(b)
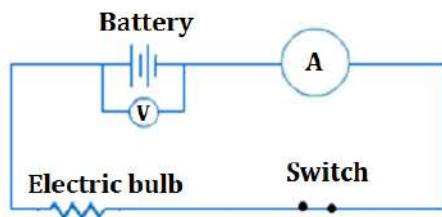
(c) The light is the same in all lamps. If a lamp stops, the others continue to illuminate, you can turn on or off a lamp independent of the others.

SECTION B: Attempt any THREE questions in this section

15. (a) (i) Brass

(ii)
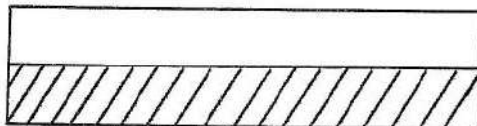
(b) (i) It is used to heat the heating element.

(ii) The current between, there is contact with the bimetallic strip which is heated, it expands into curving (bend) and cut the power. As it cools, it regains its original shape and restores the current.

(c) (i) Initial or ambient temperature

(ii) B to C: Temperature remains constant throughout the duration of the merger.

(iii) T: Melting

iv) C and D: Liquid state

16. *(a) **Inverting a glass of water***
    Prove of existence of atmospheric pressure by inverting a glass of water covered by a sheet of paper. When the glass was turned downwards, water remained inside. Atmospheric pressure keeps the paper into contact with the upturned glass, thus keeping the water in the glass.
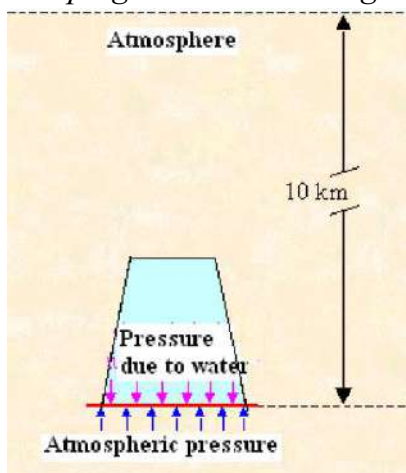
   (b) i) A: Air pressure or atmospheric pressure; T: Valve or cylinder valve cap; S: Valve piston.
     ii) Water from the cylinder rises above the piston.
     iii) The valve close S, T valve opens, the water rises in the cylinder, the water above the piston flows.
   (c) Pressure: $P = \frac{F}{A} = \frac{mg}{A} = \frac{20 \times 10}{0.2 \times 0.2} = 500\ Pa$

17. *(a) **A lunar eclipse** occurs when the earth is between the sun and the moon and its shadow darkens the moon.*
    (b)
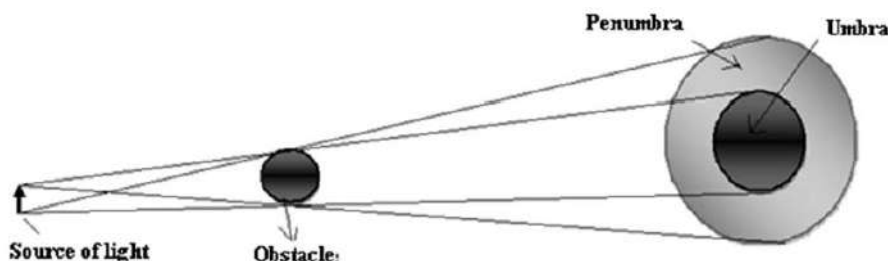
   (c) i) A: Sensitive film or film; B: Diaphragm; C; objective or converging lens.
     ii) B is used to adjust the light
     iii) Diaphragm
     iv) Retina
   (d) i) The incident ray, the refracted ray are on opposite sides of the normal at the point of incidence and all three are in the same plane.
     ii)

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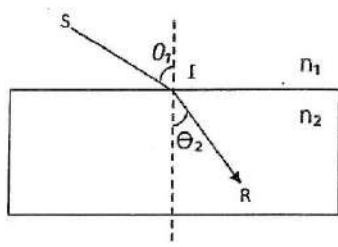
18. *(a) Uniform velocity: The velocity is independent of time or does not change or does not vary or acceleration is zero.*

    (b) Distance time graph of a body moving with a uniform velocity:
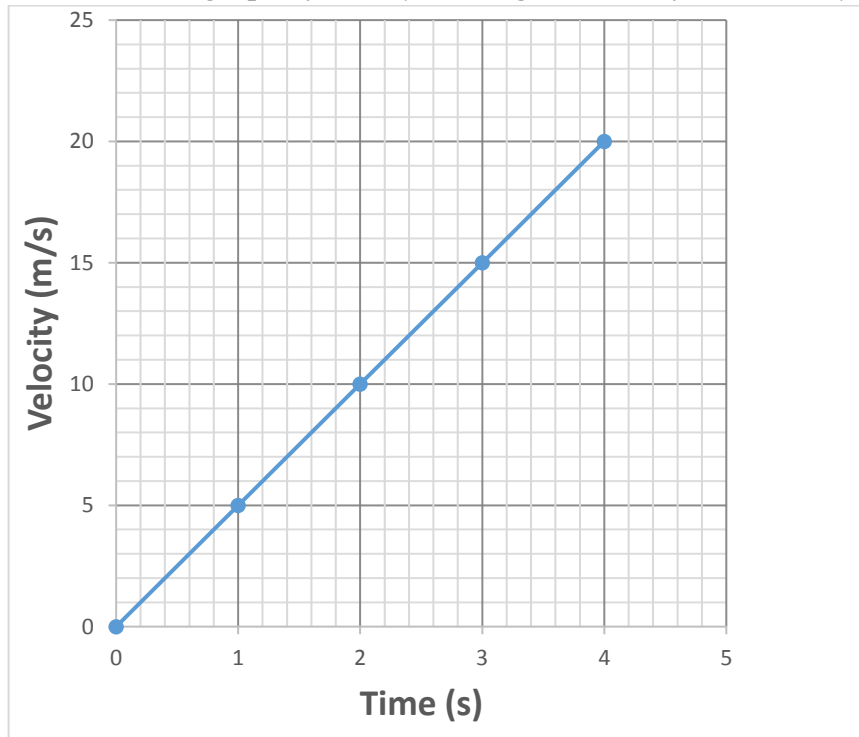
(d) i) Acceleration: $a = \dfrac{\Delta V}{t} = \dfrac{30-10}{5} = 5\ m/s^2$

ii) Distance moved by the body:

$$S_1 = \tfrac{1}{2}at_1^2 + Vt_1 = \tfrac{1}{2} \times 4 \times 5^2 + 10 \times 5 = 100\ m$$

iii) Distance S_2 moved by the body: t2 = (45 X 60) – 5 =2695 s

$$S_2 = Vt_2 = 30\ X\ 2695 = 80\ 850\ m$$

Total distance S = S$_1$ + S$_2$ = 100 m + 80 850 m = 80 950 m

19. *(a) Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) through it where the constant of proportionality is the resistance (R):*

    (b) (i) (ii)
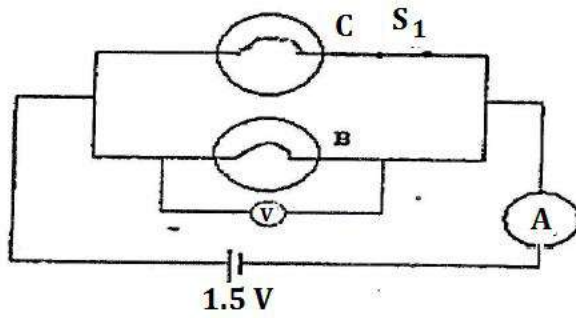
(c) Equivalent resistance: $\frac{1}{R} = \frac{1}{R_C} + \frac{1}{R_B} \Leftrightarrow R = \frac{R_C R_B}{R_C + R_B} = \frac{2 \times 3}{2 + 3} = 1.2\ \Omega$

Electric current: $I = \frac{U}{R} = \frac{1.5}{1.2} = 1.25\ A$

d) Electric bulb anatomy
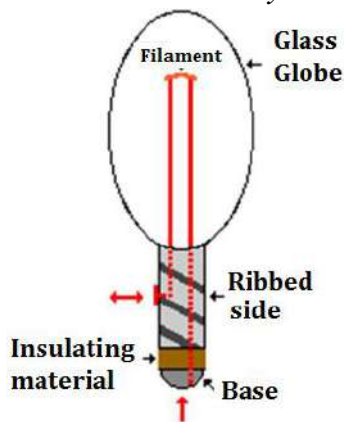
A light bulb is a relatively simple device consisting of a filament resting upon or somehow attached to two wires. The wires and the filament are conducting materials which allow charge to flow through them. Due to the joule effect, the filament produces light.

SECTION C: *Attempt one question from this section*

20. *In a transparent, isotropy and homogeneous medium light propagates along straight lines. We can demonstrate by a simple experiment with three cardboard screens having small holes in their centers. These are set up so that the holes are in straight line. Light from a candle placed at A can then be received by an eye at B. if, however, one of the screens is moved so that the holes are no longer in a straight line the light is cut off.*
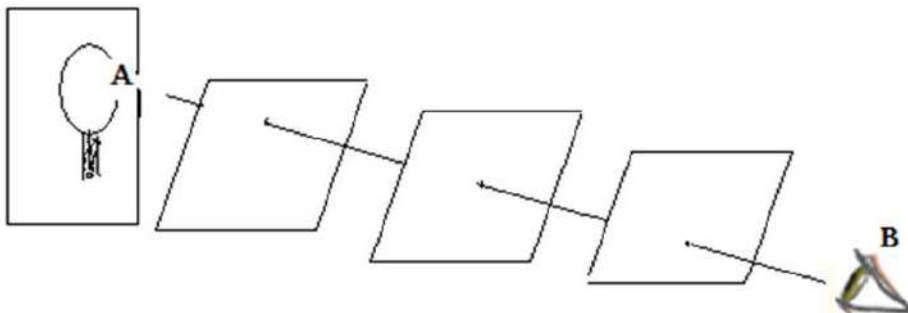
21. **Experimental Verification of** *Principle of Archimedes*
- Place a Eureka can (over-flow vessel) on a table and place a beaker under its spout as shown in figure below.
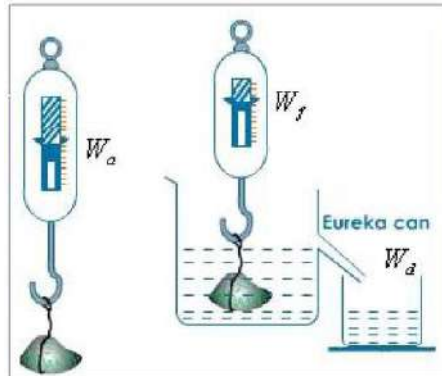
- Pour water into the can till the water starts overflowing through the spout.
- When the water stops dripping replace the beaker by another one of known weight: W_b
- Suspend a stone with the help of a string from the hook of a spring balance and record the weight of the stone: W_a
- Now, gradually lower the body into the Eureka can containing water and record its new weight in water when it is fully immersed in water: W_f
- When no more water drips from the spout, weigh the beaker containing water: W_{bw}
- Weight of water displaced: $W_d = W_{bw} - W_b$
- Apparent loss of weight of the stone: $B = W_a - W_f$

- You will notice that $Wa = B = \rho_f g V_d$. Thus, the apparent loss of weight of the body, or the upthrust on the body equals the weight of the water displaced i.e **when a body is totally or partially immersed in a fluid it experiences an upthrust equal to the weight of the fluid displaced.**

22. *a)*
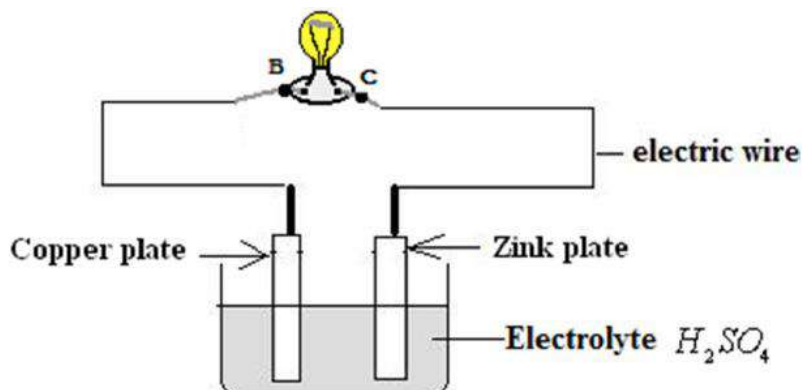
(b) The movement of electrons in the circuit causing electrical current in the lamp.

ORDINARY LEVEL NATIONAL EXAMINATIONS 2003 / 2004

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working.

SECTION A: ANSWER ALL QUESTIONS **(55 MARKS)**

1. Name two instruments which can be used to measure, accurately, the diameter of a small metal sphere. **(2 marks)**

2. a) Copy the diagram below and complete it. **(2 marks)**
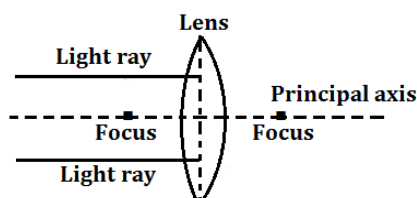
   b) A person sees only far objects clearly.
   i. Which vision defect would cause this? **(1 mark)**
   ii. Which type of lens would correct this defect? **(1 mark)**

3. A body has mass and weight. Which of the two quantities:
   a) Is a vector? **(1 mark)**
   b) Is measured in Newtons? **(1 mark)**
   c) Remains the same at any place? **(1 mark)**

4. The mass of a body is 0.026 kg and its density is 1.3 kg/m³. Calculate the volume of the body. Express the answer in standard form. **(2 marks)**

5. A uniform meter rule is pivoted at 45 cm mark. A mass of 5 g placed at 5 cm mark balances the meter rule horizontally. Calculate the mass of the meter rule. **(2.5 marks)**

6. a) Define the term pressure. **(1 mark)**
   b) What effect does lower air pressure have on boiling point of water? **(1 mark)**

   c) The mass of the rectangular block below is 16 kg.
   i. Calculate the pressure exerted on the ground by each of the surfaces A and B. Take g = 10 N/kg. **(2 marks)**
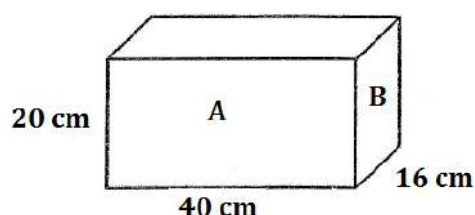
   ii. What conclusion can you make from your answers about the area in contact with the surface and the pressure exerted? **(1 mark)**

7. a) State 3 methods of heat transfer. **(3 marks)**
   b) A girl boils water in a saucepan on a stove. Identify the methods of heat transfer that takes place. **(1 mark)**

8. Copy the bar magnets below and show the magnetic field lines of force around them. Label the neutral point. **(2.5 marks)**

```
N     S   S       N
```
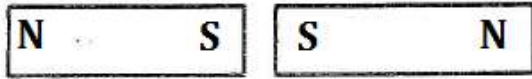
9. a) Identify the difference between distance and displacement of a moving body. **(2 marks)**
   b) A man walks 4 km away from his home and then returns to his home. Determine:
   i. The displacement and distance of this movement. **(1 mark)**
   ii. The average speed if the whole journey takes 2 hours. **(1 mark)**

10. a) State the unit of power **(1 mark)**
    b) In loading a lorry a boy lifts 25 kg bag of sugar through a height of 2 m. Calculate:
    i. The work done. Take g = 10 N/kg **(2 marks)**
    ii. The Power developed if the boy takes 2 seconds to load the lorry. **(2 marks)**

11. a) State the laws of electrostatic charges. **(2 marks)**
    b) A current of 2 A flows for 3 seconds. Calculate the charge passing a point. **(2 marks)**

12. a) What is the difference between speed and velocity? **(1 mark)**
    b) The initial speed of a car is 20 km/h. After 30 minutes the speed of the car is 50 km/h, calculate the acceleration. **(2 marks)**

13. a) An electric current flows through a high resistance conductor. What effect does the current have on the resistance? **(1 mark)**
    b)
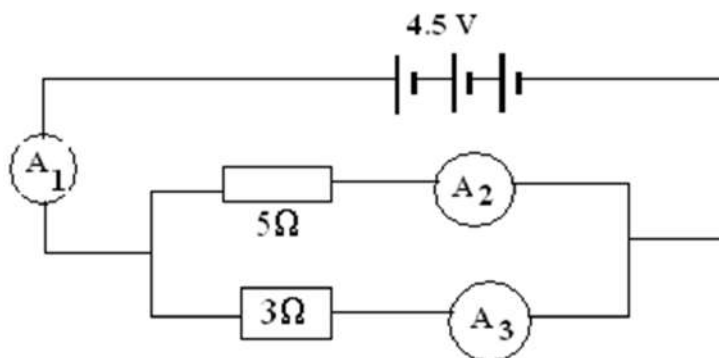
(4 marks)
   From the electric circuit above, calculate the current recorded by ammeters A1, A2 and A3.
   c) Calculate the cost of running three 100 W lamps and six 60 W lamps for 10 hours if electric energy costs 50 frs per kWh. **(2 marks)**

14. a) Which is the source of energy that enables plants to make food in their green leaves? **(1 mark)**
    b) A child picks up a stone and then releases it. List thee energy changes which occur. **(3 marks)**

15. a) Copy and complete the diagram below showing clearly: incident ray, the normal, angle of incidence and angle of reflection. **(2 marks)**

Mirror
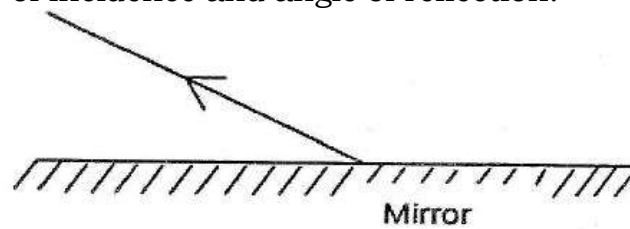
b) State the relation between the angle of incidence and angle of reflection. **(1 mark)**

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. a) State the 3 states of matter and explain the differences between them. **(3 marks)**
b) A mass of air can have different volumes without changing its mass. Why? **(1 mark)**
c) A bottle of milk remains cool when it stands in water in a clay pot in warm surroundings. Why? **(4 marks)**
d) Explain what is meant by diffusion of liquids. **(2 marks)**

17. i) State and explain the factors which affect resistance of a conductor wire at constant temperature. **(4.5 marks)**
ii) What is meant by the resistivity of a conductor material? **(1.5 marks)**
iii) A resistance of 20 Ω is needed from a long resistance wire of radius 0.7 mm and resistivity 1.0×10^{-6} Ωm. How long is the resistance wire needed? **(2 marks)**

18. a) i) Copy the diagram in your answer book and complete it. **(2 marks)**
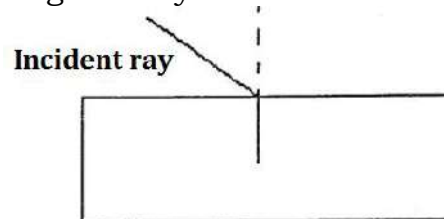
Incident ray

ii) On the diagram label the refracted ray and emergent ray. **(2marks)**
iii) What can you say about incident ray and emergent ray? **(1 mark)**
b) Copy the diagram and complete it, label the angle of deviation. **(1 mark)**
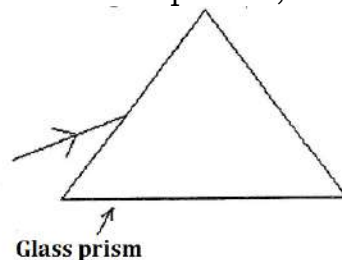
Glass prism

c) A light ray incident to a triangular glass prism is separated into different colours.
i) What is this process called? **(1 mark)**
ii) What causes the separation of colours? **(1 mark)**

iii) Which colour is bent most **(1 mark)**
iv) Which colour is bent least? **(1 mark)**

19. a) i) With the aid of a diagram show how pressure in a liquid increases with depth of the liquid. **(3 marks)**
ii) Name another quantity, besides depth of a liquid, on which variation of pressure in liquids depends. **(1 mark)**
b) The density of lake water is 1000 kg/m³. The pressure at a point A below the surface of the lake water is 45000 Pa. Calculate the depth of the point A under the surface of the lake water. **(2 marks)**
c) It is better to use a liquid in hydraulic machines than a gas. Why? **(2 marks)**
d) Give two examples where transmission of pressure in liquids is applied. **(2 marks)**

20. a) Define the term specific heat capacity. **(2 marks)**
b) Determine heat given out when an iron ball of mass 3 kg and specific heat capacity 440 $J/kg.K$ cools from 200°C to 100°C. **(2 marks)**
c) Water is used to cool car engines and in the radiators of central heating systems. Why is water a better liquid to use in cooling engines? **(3 marks)**
d) A shiny object and a black object are left in the sun. Which on the two objects becomes hot? Explain your answer. **(3 marks)**

SECTION C: Answer only one question in this section. **(15 MARKS)**

21. The electric circuit below may be used to determine the unknown resistance of a conductor.
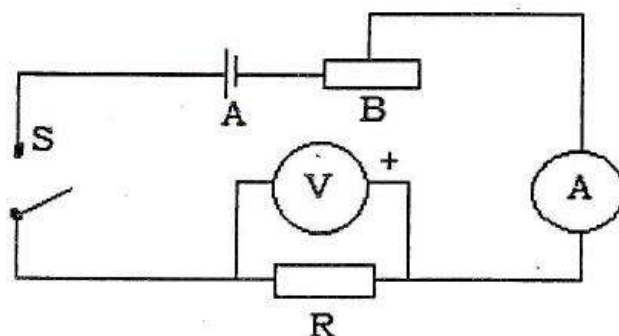
a) What is the use of part A? **(1 mark)**
b) Name the part B and state its function. **(2 marks)**
c) i) The ammeter has a low resistance. Why? **(2 marks)**
   ii) Name instrument labelled and state its function. Explain why it has a high resistance. **(3 marks)**
d) Small currents should be used in this experiment. Why? **(2 marks)**
e) Write an equation connecting the resistance, R, potential difference V and current I. **(1 mark)**
f) Results below were obtained from this type of experiment. Copy the table in your answer book and complete it. Calculate the mean resistance. **(4 marks)**

Voltmeter reading (V)	Ammeter reading (A)	Resistance (Ω)
1	0.5	
2	1.1	
3	1.6	
4	2.0	
5	2.6	
6	3.0	

22. You are provided with a clock, electric immersion heater of known power, small pieces of ice, a beaker and funnel. See the apparatus below. A beam balance is provided to determine the mass of water.
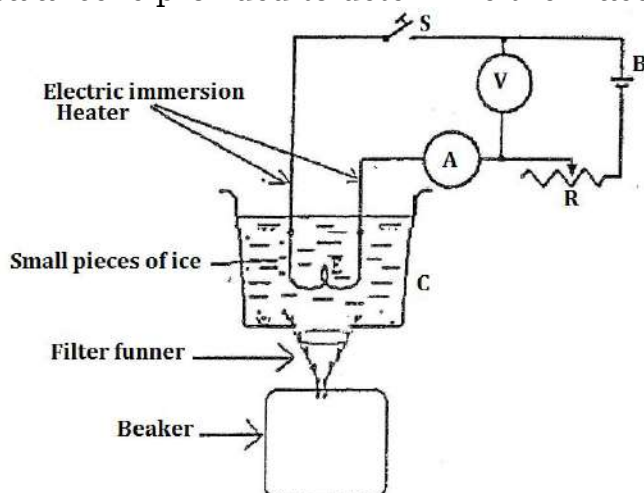
a) State what is meant by specific latent heat of fusion of a substance. **(2 marks)**

b) Describe how you would use the apparatus above to determine the specific latent heat of fusion of ice. **(9 marks)**

c) Why is the immersion heater better than a Bunsen burner flame in this experiment? **(2 marks)**

d) Mention a possible cause of error in the experiment. **(2 marks)**

23. a) You are provided with a beam balance, a beaker, a measuring cylinder (250 cm³), water, test tube and a thin thread. Describe how you may determine the density of the test tube. Show clearly how you arrive at the final results. All necessary calculations should be shown. Mention any precautions you take. (Ignore the mass of air in the test tube). **(11 marks)**

b) A pupil carried out the experiment above and obtained the following results.
   - Mass of test tube = 26 g
   - Volume of water in tube = 40 cm³
   - First level of water in the measuring cylinder = 20 cm³
   - Level of water in the measuring cylinder + the test tube full of water = 70 cm³.

Calculate the density of the test tube and express the answer in kilograms per cubic meter. **(4 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2003/2004

Section A: Answer all questions

1. *Vernier calliper, micrometer screw gauge,*

2. *a)*
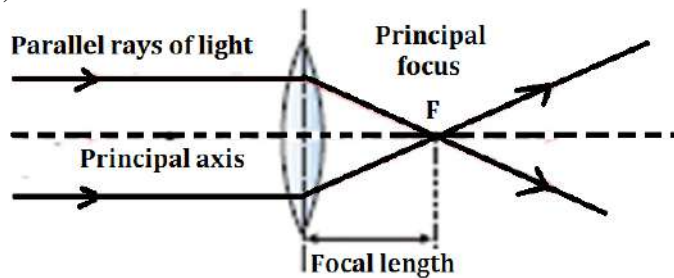
   b) i) Farsightedness (hyperopia) or Presbyopia.
   ii) The farsighted eye is assisted by the use of a converging lens.

3. *a) Weight*
   b) Weight
   c) Mass

4. $\rho = \frac{m}{V} \Rightarrow V = \frac{m}{\rho} = 2 \times 10^{-2} \ m^3$

5.
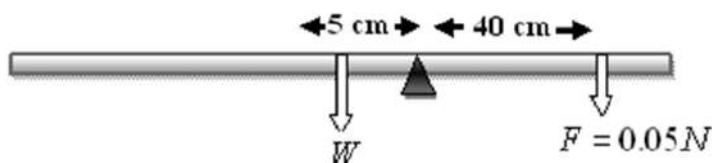
   Condition of equilibrium: $0.05 \times 40 = 5W \Rightarrow W = 0.4 \ N \Rightarrow m = 0.04 \ kg$

6. *(a)* **Pressure** *(symbol "P") is the force acting normally per unit area applied in a direction perpendicular to the surface of an object.*
   (b) It decreases the boiling point.
   (c) i) pressure exerted on the ground by area A: $P = \frac{F}{A} = \frac{16 \times 10}{0.2 \times 0.4} = 2\ 000 \ Pa$

   ii) Pressure exerted on the ground by area B: $P = \frac{F}{A} = \frac{16 \times 10}{0.16 \times 0.2} = 5\ 000 \ Pa$

   iii) If the force is concentrated on a small area, it will exert higher pressure than if the same force is distributed over a larger surface area.

7. (a) Conduction, convection and radiation
   (b) Conduction and convection

8.
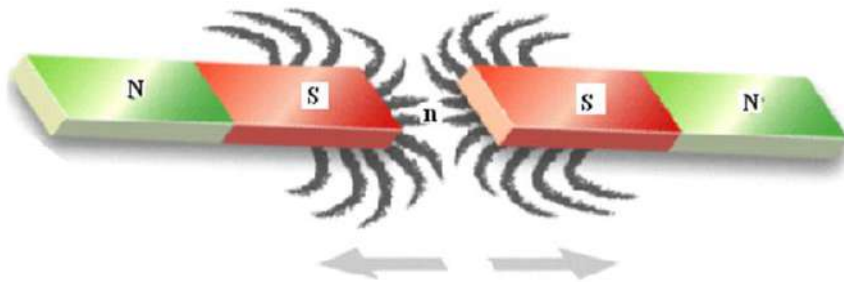
9. a) Distance is a scalar quantity describing the length of the path between two points along which the particle has travelled while displacement is a vector quantity; defined as distance moved in specified direction or the change from its initial position to its final position.
   b) i) Displacement is zero, distance = 8 km
   ii) Average speed: $V = \frac{\Delta S}{\Delta t} = \frac{8\,km}{2\,h} = 4\,km/h$

10. a) The unit of power is a Watt. (W)
    b) i) Work done: W = Fh = mgh = 25 X 10 X 2 = 500 J
    ii) Power: $P = \frac{W}{t} = \frac{500}{2} = 250\,W$

11. (a) Like charges repel and unlike charges attract each other. This is called the **basic law of electrostatic charges.**
    (b) Using $I = \frac{Q}{t} \Rightarrow Q = It = 2 \times 3 = 6\,C$

12. (a) **Speed** describes how fast something is moving; it is scalar quantity while velocity describe how fast something is moving in specific direction; it is a vector quantity.
    (b) Acceleration: $a = \frac{\Delta V}{\Delta t} = \frac{50-20}{0.5} = 60\,km/h^2$

13. (a) Heat effect or Joule effect
    (b) Equivalent resistance: $\frac{1}{R} = \frac{1}{R_C} + \frac{1}{R_B} \Leftrightarrow R = \frac{R_C R_B}{R_C+R_B} = \frac{5\times3}{5+3} = \frac{15}{8}\,\Omega$
    Electric current: $I_1 = \frac{U}{R} = \frac{4.5\times8}{15} = 2.4\,A$
    Electric current: $I_2 = \frac{U}{R_2} = \frac{4.5}{3} = 1.5\,A$
    Electric current: $I_3 = \frac{U}{R_3} = \frac{4.5}{5} = 0.9\,A$
    c) Energy: E = Pt = [(100 X 3) + (60 X 6)] 10 = 6.6 KW
    Cost = 50 X 6.6 = 330 RFw

14. a) The sun

(b) Potential energy in his muscles – kinetic energy- calorific energy, sound energy and light energy.

15. a)
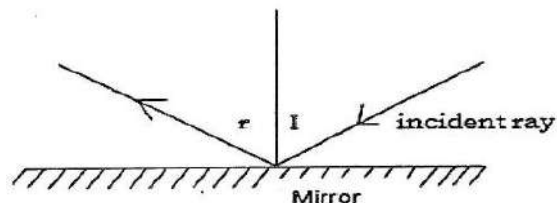
b) The angle between the reflected ray and the normal (angle of reflection) is the same as that between the incident ray and the normal (angle of incidence).

SECTION B: Attempt any THREE questions in this section

16. a)

Solids	Liquids	Gases
Particles are very closely packed thus rigid	Particles are loosely packed thus can flow	Particles are very loosely packed and can flow
Voids are extremely small thus incompressible	Voids are relatively larger thus slightly compressible	Voids are very large thus highly compressible
Particle motion is restricted to vibratory motion about a fixed position.	Particle motion is very slow	Particle motion is very rapid and also random. These random movements enable gases to diffuse.
Inter-particle force is very large thus very dense	Inter-particle forces are intermediate resulting in low density	Inter-particle forces are negligible. Thus imparting very low density
Solids have a "definite" or "fixed" shape, and size they resist a change of that shape. They also occupy a definite volume	A liquid "deforms" and takes the shape of its container. It has little resistance to shear forces that would change the form it takes, but they have a definite volume.	Gases have no definite shape and expand to fill all available space

(b) Gases have no definite shape and expand to fill all available space.
(c) The clay pot and water are bad conductor of heat.

*(d) **Diffusion** is the natural tendency of molecules to flow from higher concentrations to lower concentrations.*

17. *i) The length of the wire (in m). The longer the wire, the more resistance that there will be.*

   The cross-sectional area of the wire (in m^2); The wider the wire is, the less resistance that there will be to the flow of electric charge. When all other variables are the same, charge will flow at higher rates through wider wires with greater cross-sectional areas than through thinner wires.

   ii) The resistivity of the material (in Ωm). Some materials are better conductors than others and offer less resistance to the flow of charge. Silver is one of the best conductors but is never used in wires of household circuits due to its cost. Copper and aluminium are among the least expensive materials with suitable conducting ability to permit their use in wires of household circuits.

   (iii) $R = \varphi \dfrac{L}{A} \Leftrightarrow L = R \dfrac{A}{\varphi} = \dfrac{20 \times \pi (0.7 \times 10^{-3})}{10^{-6}} = 30.77\ m$

18. *a) i) and ii)*

Incident ray

Refracted ray
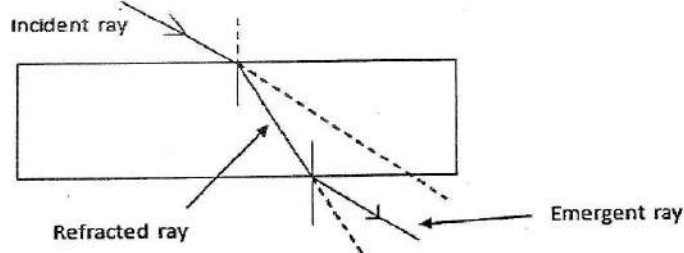
Emergent ray

iii) The change in angle of the light ray is the same when it enters and leaves the glass. The direction of incident ray is parallel to the direction of emergent ray. The two rays are parallel.

b)

Glass prism
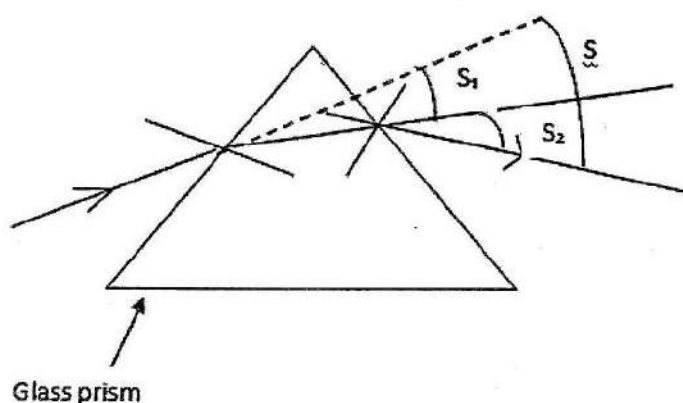
*c) i) **Dispersion** (the separation of white light into its component colours by a prism)*

ii) The index of refraction is different for each colour

iii) Violet (deviated most)

iv) Red (deviated least)

19. a) i)

ii) Density

b) $P = \rho gh \Leftrightarrow h = \dfrac{P}{g\rho} = \dfrac{45\,000}{10 \times 1000} = 4.5\ m$

c) Liquids are incompressible, communication integrals

d) Hydraulic press (brake), Elevator,

*20. a) **Specific heat capacity**, often shortened to **specific heat**, is the measure of the heat energy required to increase the temperature of a unit quantity of a substance by a unit of temperature.*

b) Heat given out: $Q = mc\Delta T = 3 \times 440\ (200 - 100) = 132\,000\ J$

c) It has the higher specific heat capacity and is less expensive

d) Black object since it absorbs more heat energy.

SECTION C: Attempt one question from this section

21. a) A: Producing electricity.

b) B: Rheostat for adjusting the amperage and varying resistance

c) i) Not to diminish the intensity in the circuit.

*ii) A **voltmeter** is an instrument used for measuring the electrical potential difference between two points in an electric circuit. To not deviate much from the current in the voltmeter*

d) Avoid heat would distort the results

e)

Voltmeter reading (V)	Ammeter reading (A)	Resistance (Ω)
1	0.5	**2.0**
2	1.1	**1.8**
3	1.6	**1.9**
4	2.0	**2.0**
5	2.6	**1.9**
6	3.0	**2.0**
Mean resistance $= \dfrac{2 + 1.8 + 1.9 + 2 + 1.9 + 2}{6} = 1.9\ \Omega$		

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

22. a) The **specific latent heat of fusion** is the amount of energy required to convert 1 kg of a substance from solid to liquid without a change in the temperature of the surroundings, all absorbed energy goes into the phase change.

(b) To find the specific latent heat of fusion of ice:
- Weight the empty beaker, m1
- Connect the heater
- Stopwatch triggers the onset of the 1st drop
- Stop the clock when we have a measurable quantity and it determines the duration t.
- Weigh the beaker containing the liquid base, m_2
- Calculate:
  ○ The mass of liquid: $m = m_2 - m_1$
  ○ Quantity of heat provided by the water heater: $Q = Pt$
  ○ Heat absorbed by water: $Q = mL_f$
  ○ Heat absorbed by water = quantity of heat provided by the water heater

  i.e. $mL_f = Pt \Rightarrow L_f = \frac{Pt}{m}$

 c) It is easy if we know power to calculate the amount of heat.

d) Read error and loss of heat

23. a) Determination of test tube density by direct measurement of volume and mass.

1. Using the beam balance, determine and record the mass of the test tube m.

2. Determine the initial volume of the measuring cylinder: V_i.

3. Fill the test tube of water and use the measuring cylinder to measure the volume of that water volume: V_1.

4. Holding the string, lower the test tube containing water into the water until it is completely submerged. Record the new water level: V_2.

5. Determine the volume of the test tube: $V_2 = V_i + (V + V_1)$
$$\Rightarrow V = V_2 - (V_i + V_1)$$

6. Calculate the density using this volume and the mass: $\rho = \frac{m}{V}$

b) Volume of test tube:
$$V_2 = V_i + (V + V_1)$$
$$\Rightarrow V = V_2 - (V_i + V_1) = 70 - (20 + 40)cm^3 = 10\ cm^3$$

Density: $\rho = \frac{m}{V} = \frac{26}{10} = 2.6\frac{g}{cm^3} = 2\ 600\ kg/m^3$

Physics I
010
19th Nov. 2005   08.30 – 11.30 am

REPUBLIC OF RWANDA

NATIONAL EXAMINATIONS COUNCIL
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2005

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working.

SECTION A: ANSWER ALL QUESTIONS   **(55 MARKS)**

1. a) Explain why a piece of iron sinks in water but an iron ship floats in water.   **(2 marks)**
   b) Calculate the mass of cement of 0.4 cm³ and a density of 3000 kg/m³.
   (1 mark)

2. a) State the difference between mass and weight.   **(2 marks)**
   b) The weight of body on the moon is less than the weight of the body on the earth. Why?   **(1 mark)**

3. Why are gases squeezed more easily than liquids?   **(2 marks)**

4. a) The figure below is a uniform meter rule and O is its centre of gravity A. Identify quantity A.   **(1 mark)**
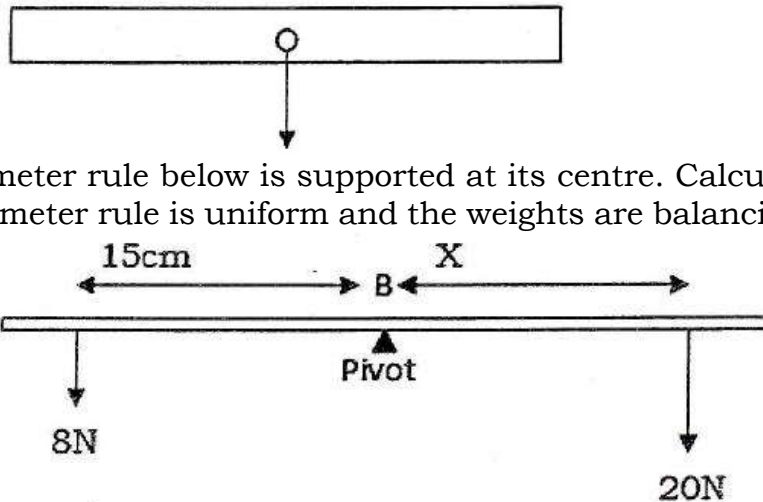
   b) The meter rule below is supported at its centre. Calculate the distance X if the meter rule is uniform and the weights are balancing.   **(2 marks)**

5. The formation of the food we eat depends on the sun. Explain.   **(3 marks)**

6. The diagram below shows a box with openings at M and N. A lighted candle is placed in the box shown.
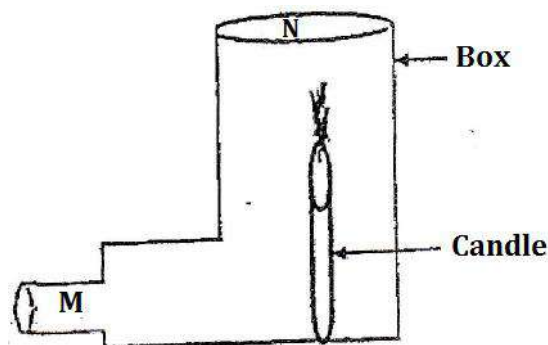
   a) Copy the diagram and label arrows to indicate the direction of hot air and cool air.   **(2 marks)**
   b) Name the process of air movement being illustrated in the diagram.
   (1 mark)
   c) On a hot day, it feels better when a person is near a lake. Why? **(1 mark)**

7. a) State the laws of reflection of light. **(2 marks)**
   b) Copy the diagram in your answer book. Using ray construction, show the position of the image of point A in the mirror. **(2 marks)**

A

Mirror

8. a) Mention the main heat effects when objects are heated. **(3 marks)**
   b) A piece of wood is burnt completely and becomes ash. Which is this heat effect? **(1 mark)**

9. The diagram shows a bar magnet and one magnetic field line.

A   B
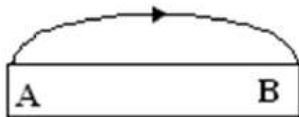
   a) Copy the diagram and draw two more magnetic field lines **(2 marks)**
   b) Which of the poles A or B is **(2 marks)**
      i. A North pole?
      ii. A South poles?

10. a) Copy the diagram and complete the circuit to show how you would connect: **(2 marks)**
    A voltmeter to measure the potential difference across resistor D.
    An ammeter to measure the current through D.

S

R

D
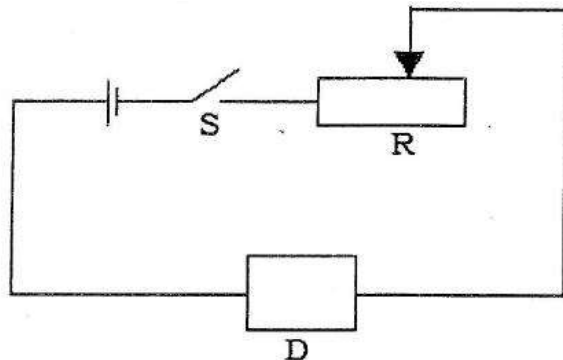
   b) Why are components R and S used in the above electric circuit?
   (2 marks)

11. a) What is meant by specific heat capacity of substance? **(2 marks)**
    b) A mass of water is heated and its temperature rises from 45°C to 55°C. Calculate the mass of water if the heat energy supplied is 21 000 J. Specific heat capacity of water = 4 200 J/kg°C. **(2 marks)**

12. a) Name the unit of pressure. **(1 mark)**
    b) What is the pressure on a surface when a force of 200 N acts on an area of 0.5 m²? **(1 mark)**

c) Explain why knife edges are sharp. **(2 marks)**

13. a) State what is meant by friction. **(2 marks)**
    b) How does friction help us to walk on land? **(1 mark)**
    c) Friction can damage parts of engines in vehicles. How is the friction reduced? **(1 mark)**

14. John's weight is 600 N and runs 10 m in 12 s. Marry weighs 700 N and runs the same distance as John in 14 s.
    a) Calculate the power developed by each person. **(2 marks)**
    b) Who of the two persons is more powerful? Explain your answer. **(2 marks)**

15. a) Explain in terms of electron movement how electric charges are produced by rubbing. **(2 marks)**
    b) An electrically charged body insulated from everything else is touched with a rod of material, one end of which is held in the hand. Identify the type of rod if the body **(2 marks)**
        i. Retains its charges
        ii. Loses its charges rapidly.

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. a) The diagrams below show the paths of rays of light through the blocks of glass.
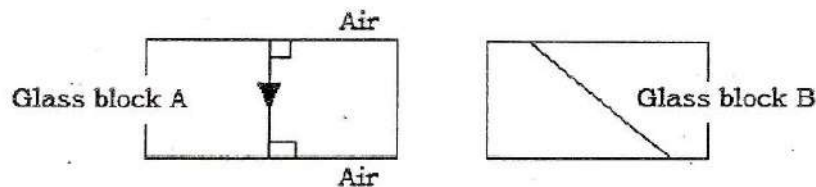
i. Copy the diagram and show paths of rays of light through the air before and after passing through the blocks of glass. **(2 marks)**
ii. On glass block B, label equal angles A and B, and the second pair X and Y. **(2 marks)**
b) i) Copy the diagram and use ray diagrams construction to show the formation of image of the object X in the converging lens.
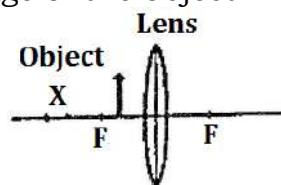
ii) State the relation between the size of the image formed and size of object X. **(1 mark)**
c) Name an optical instrument where a converging lens is used. **(2 marks)**

17. a) What is meant by specific latent heat of fusion of a substance? **(2 marks)**

b) The graph below represents a cooling curve of a hot liquid.
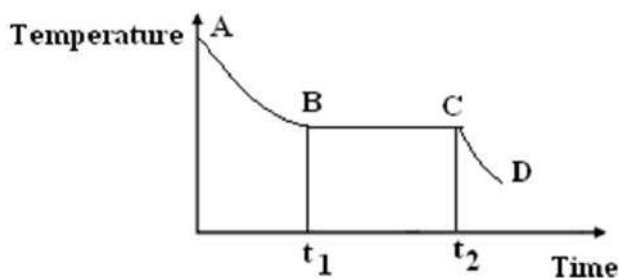
Use the idea of particles to explain what is happening from:
   i. A to B   **(2 marks)**
   ii. B to C   **(2 marks)**
   iii. C to D   **(2 marks)**
c) What is the heat lost between B and C called?   **(1 mark)**
d) Given that mass of the hot liquid is 0.2 kg and the heat it loses from time t_1 to t_2 is 40 000 J, calculate the heat loss per kg.   **(1 mark)**

18. a) Which property of light do shadows rely on to occur?   **(1 mark)**
b) Draw a diagram to show umbra and penumbra shadows are formed at the same time.   **(3 marks)**
c) State the condition for an eclipse to occur.   **(1 mark)**
d) A pinhole camera consists of a box with a small hole in a metal plate at one end and a screen of frosted glass at the other end. What is the use of
   i. The small hole?   **(1 mark)**
   ii. The box?   **(1 mark)**
   iii. The frosted glass?   **(1 mark)**
e) The height of the image of an object observed on the screen of a pinhole camera is 3 cm and the distance from the screen to the pinhole is 15 cm away from the pinhole. Calculate the height of the object if the object is 30 cm away from the pinhole camera.   **(2 marks)**

19. a) List in order, energy conversions taking place when a torch bulb is lit.   **(2 marks)**
b) What advantage and disadvantage does the torch battery have over the car battery?   **(2 marks)**
c) Circuits below show different ways of arranging batteries in a circuit.   **(2 marks)**
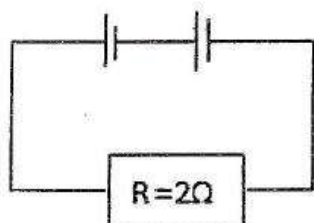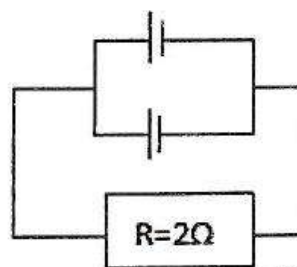
   i. Identify each type of battery arrangement.   **(2 marks)**
   ii. If the batteries are identical and each has a potential difference of 1.5 V, calculate the current through the resistance R in each circuit.   **(2 marks)**

iii. What advantage does the arrangement in Fig B have over Fig A?
(1 mark)

20. a) Name states of equilibrium. **(3 marks)**
    b) State how a body can be made more stable. **(2 marks)**
    c) The diagram below is an equilateral triangle cardboard. Copy it and label with an O its centre of gravity. Explain how you determine the position of O. **(2 marks)**
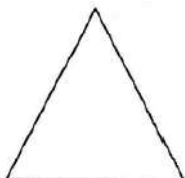
    d) Explain how passengers make the vehicles more likely to roll over.
    (2 marks)

SECTION C: Answer only one question in this section. **(15 MARKS)**

21. A student did an experiment to find out how the length of a spring increases when different weights were added. The table shows the results.

Weight (N)	1	2	3	4	5	6	7
Length (mm)	23	26	29	32	35	49	66

    a) Draw a graph of length against weight using these results. **(12 marks)**
    b) What is the original length of the spring? **(1 mark)**
    c) By how many millimeters did the 1.7 N weight cause the spring to stretch? **(1 mark)**
    d) What is the length of the spring when the spring reaches its elastic unit? **(1 mark)**

22. The table below shows how the speed of a moving body changes with time.

Time (s)	5	10	15	20	25	30	40
Speed (m/s)	20	30	40	50	50	60	70

    a) Plot the graph of speed against time using these results. **(12 marks)**
    b) Estimate the initial velocity of the moving body. **(1 mark)**
    c) Put letter A on any part of the graph where the velocity is constant.
    (1 mark)
    d) For how long is the speed constant? **(1 mark)**

23. A student did an experiment to find out how the pressure of a gas varies with its volume at constant temperature. The table below shows the results obtained.

P (units)	3	4	6	12
V (units)	23	26	29	32
1/V				

a) Copy table above and complete it. **(4 marks)**
b) What happens to the volume of the gas as the pressure increases?
(1 mark)
c) Plot the graph of pressure against 1/Volume **(8 marks)**
d) Estimate the volume of the gas when the pressure is 9 units. **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2005

Section A: Answer all questions

1. a) The density of a bar of iron greater that of water so it sinks in water. The boat has an iron hallow form that makes the average density of the whole is less than the density of water, where it floats.

   b) $\rho = \frac{m}{V} \Leftrightarrow m = \rho \times V = 3000 \times 0.4 = 1200 \, kg$

2. a)

Mass	Weight
Is constant regardless of the area.	Change with altitude and location.
Is a scalar quantity	Is a vector quantity
Quantity of matter in an object.	Is force of gravity acting on an oject.
Is measured in kg	Is measured in Newton
Is measured by a balance.	Is measured by Newton balance

   b) The acceleration due to the gravity on the Moon is less than that of on the earth.

3. Intermolecular distance of solid is large than that of liquid.

4. a) Weight

   b) Condition of equilibrium: $8 \times 15 = 20 \times x \implies x = 6 \, cm$

5. The sun is the source of energy for Photosynthesis in green plants.

6. a)
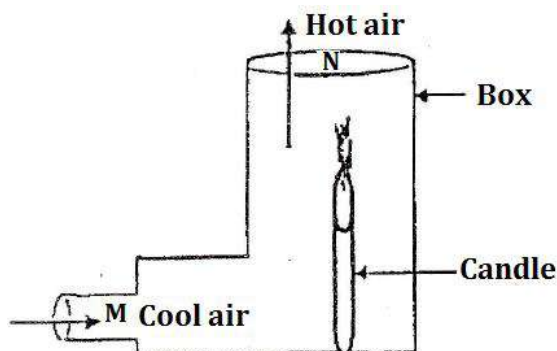
   b) Convection

   c) The lake during the hot day, cool air moves toward the ground or evaporate of the lake creates a convection current of fresh air to the ground or sea breeze.

7. a) *The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane. The angle between the reflected ray and the normal is the same as that between the incident ray and the normal.*
b)
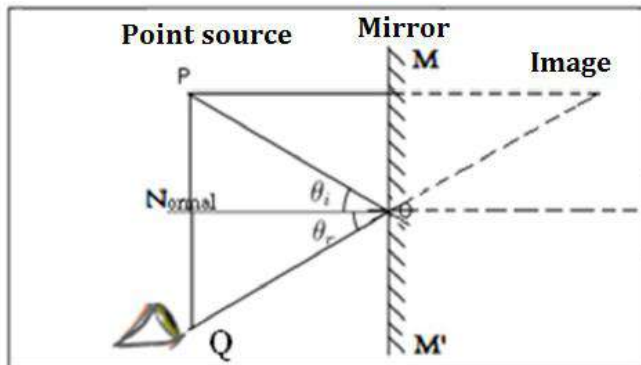
8. a) *Expansion, physical change of its state or chemical change (combustion), light effect, heat energy and increasing of temperature*
b) *Combustion*

9. a)
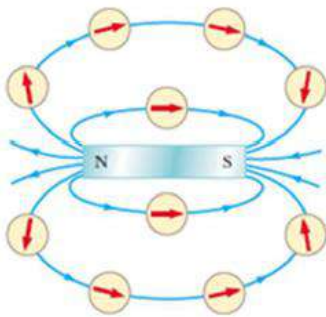
b) *A: North; B: South*

10. a)
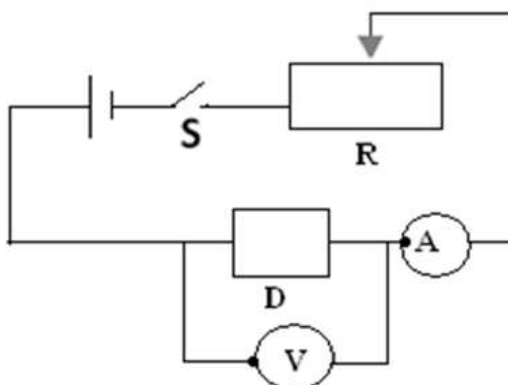
b) *R: Rheostat: to vary the amperage; S: Switch: to open or close the electrical circuit.*

11. a) The heat capacity of a body is the heat required to rise its temperature by 1K. The SI unit of heat capacity is J/K. The heat capacity µ of an object is the proportionality constant between the heat Q that the object absorbs or loses and the resulting temperature change ΔT of the object.

That is, $Q = \mu \Delta T(T_f - T_i)$

b) Mass of water: $Q = mc\Delta T \Leftrightarrow m = \dfrac{Q}{c(T_f - T_i)} = \dfrac{2100}{4200 \times 10} = 0.05\ Kg$

12. a) The SI unit for pressure is Pa

b) Pressure: $P = \dfrac{F}{A} = \dfrac{500}{0.5} = 400\ Pa$

c) The reason is, the flat side has a greater surface area(less pressure) and so it does not cut the fruit. When we take the thin side, the surface area is reduced and so it cuts the fruit easily and quickly because the pressure is increased.

13. a) The friction force is the force exerted by a surface as an object moves across it or makes an effort to move across it. The friction force often opposes the motion of an object.

b) Avoid slipping

c) For lubrication

14. a) Mary's power: $P = \dfrac{Fd}{t} = \dfrac{700 \times 10}{14} = 500\ W$

John's power: $P = \dfrac{Fd}{t} = \dfrac{600 \times 10}{12} = 500\ W$

b) Mary is as powerful as John. Since they have the same power.

15. a) In two bodies floating against each other, there is electron transfer. The body that loses electron becomes positively charged and the body which gain electron become negatively charged.

b) i) Insulator (plastic, dry wood,…)
   ii) Good conductor (metal)

SECTION B: Attempt any THREE questions in this section

16. a) i) and ii)
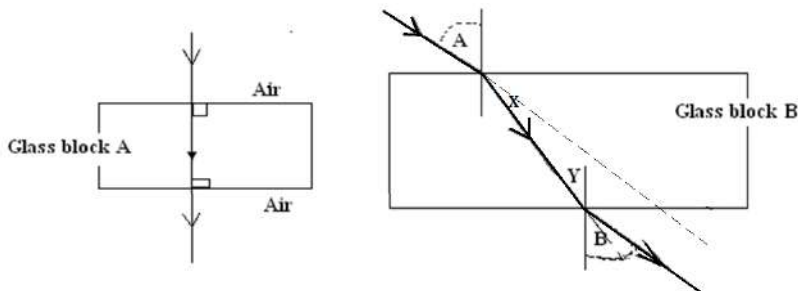
b) i)
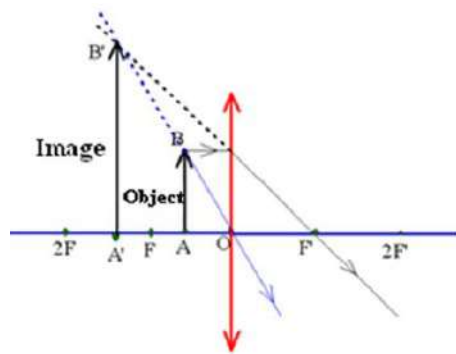
ii) The object is located in front the focal point (F), (Object between lens and F), the image is: behind the object, virtual, erect and larger than object

c) Eye telescope, Microscope, camera, magnifying glass…

17. *a) The **specific latent heat** of fusion **(melting)** of substance is the amount of energy required to convert 1 kg of a substance from solid to liquid without a change in the temperature of the surroundings -- all absorbed energy goes into the phase change. The SI unit is J / kg.*

    b) i) A to B: the particles lose energy and become increasingly tight and reduced vibration (disturbances) and hence lower temperature.

    ii) B to C: Particles lose more energy; the liquid solidifies at constant temperature.

    iii) C to D: The body become stronger still loses energy and intensity of vibrations of particles continues to decrease until it reaches room temperature.

    c) The heat lost between B and C is called the latent heat of solidification.

    d) Heat loss per kg: $L_s = \frac{40\,000}{0.2} = 200\,000\ J/kg$

18. *a) Shadows are formed because light travels in straight lines.*

    b)
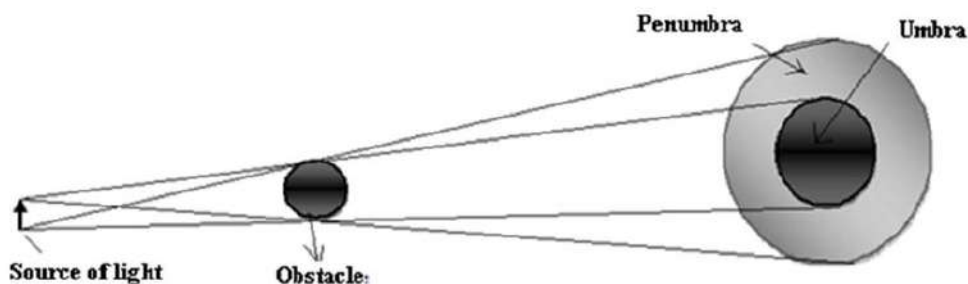
    *c) **Eclipse** occurs when the moon is between the sun and the earth or when the earth is between the sun and the moon and all are aligned.*

    d) i) The little hole to create a point source to have a clear image

    ii) The box darkroom to prevent entry of unwanted light.

    iii) Frosted glass: Receive the image (screen) or allow observing the image.

    e) The height of the object: $\gamma = \frac{h'}{h} = \frac{q}{p} \Rightarrow h = \frac{h'p}{q} = \frac{3 \times 30}{15} = 6\ cm$

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19. a) Chemical energy – electrical energy – heat energy – light energy (radiation)
   b)

Advantage	Disadvantage
Cheap	Lower intensity
Not heavy	With polarized light (short term)

   (c) i) Fig. A: Series connection and fig. B: Parallel connection
   ii) In circuit of Fig. A: $I = \dfrac{E}{R} = \dfrac{1.5 \times 2}{2} = 1.5\ A$

   In circuit of Fig. B: $I = \dfrac{E}{R} = \dfrac{1.5}{2} = 1.75\ A$

   iii) The circuit in Fig. B consumes less energy and if one battery is defective, the circuit can operate without problems.

20. a) Stable equilibrium, unstable equilibrium and neutral (static) equilibrium.
   b) Increase the support base; lower center of gravity
   c)
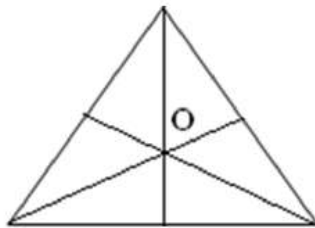
   O is the intersection of medians (heights or diagonal or mediators).
   d) When the center of gravity vehicle- passenger is high, the vehicle may be reversed at any angle.

SECTION C: Attempt one question from this section

21. a)
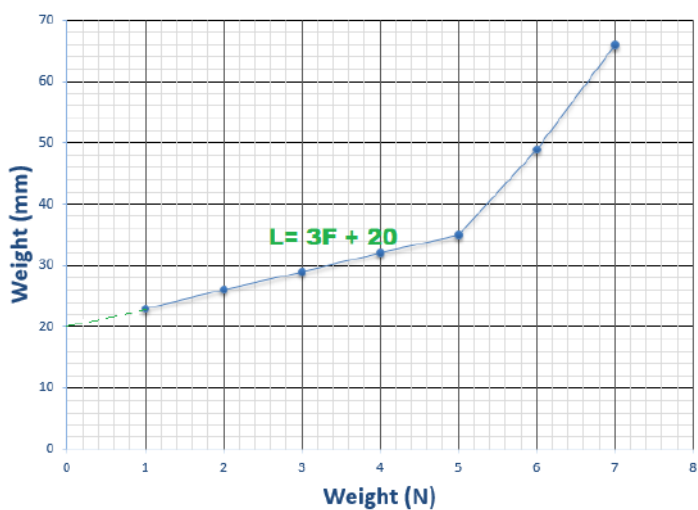
   b) The original length is 20 mm

c) *From the equation:* $= 3F + 20 \Rightarrow L = 3 \times 1.7 + 20 = 25.1\ mm$, *and hence the spring stretched 25.1 – 20 = 5.1 mm*

d) *When the spring reaches its elasticity limit, its length is 35 mm.*

22. *a) and c)*
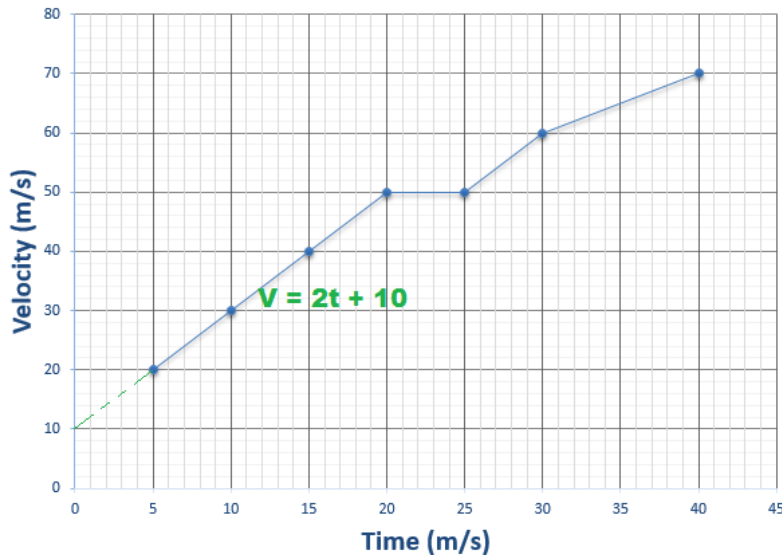
(b) *Initial speed of the moving body = 10m/ s*

(d) *The speed is constant for 25s - 20s = 5s*

23. *a)*

P (units)	3	4	6	12
V (units)	23	26	29	32
1/V	0.25	0.33	0.5	1

b) *The pressure is inversely proportional to the volume or when pressure increases, volume decreases.*

c)
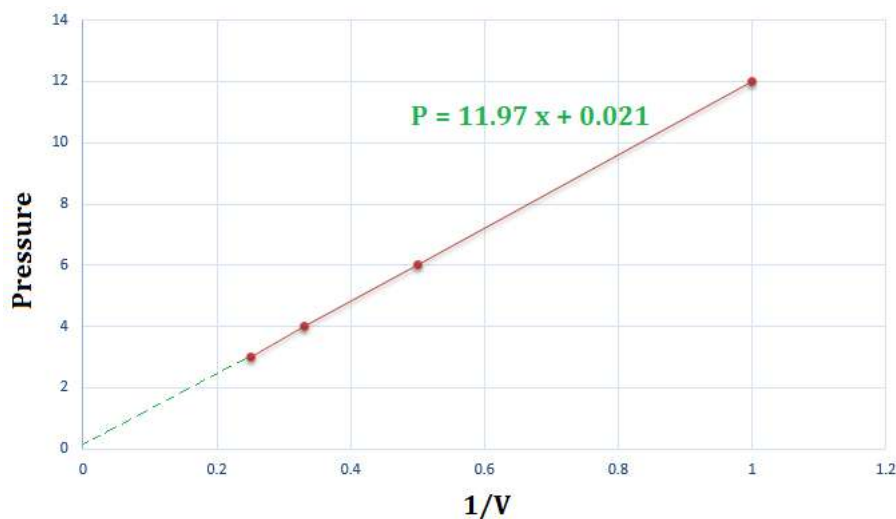
d) *From equation of that graph:* $P = 11.97x + 0.021, if\ P = 9 \Rightarrow x = \frac{9-0.021}{11.97} = 0.750\ and\ hence\ x = \frac{1}{V} \Rightarrow V = 1.33$

Physics I

010

03th Nov. 2006   08.30 – 11.30 am

ORDINARY LEVEL NATIONAL EXAMINATIONS 2006

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working

SECTION A: ANSWER ALL QUESTIONS   **(55 MARKS)**

1. a) What is meant by term density?   **(2 marks)**
   b) The mass of solid is 45 g and its volume is 5 cm³. Calculate the density of solid.   **(2 marks)**

2. Which of the following quantities are vectors: weight, mass, density, velocity and volume?   **(2 marks)**

3. The uniform meter ruler below is pivoted at its centre. If the meter ruler balances, calculate mass A.   **(2 marks)**
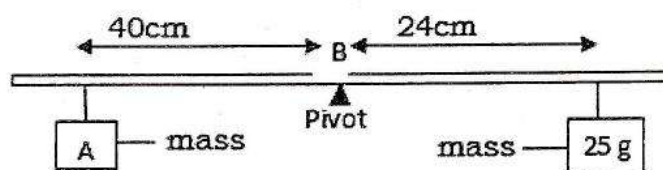
4. a) Calculate the pressure on a surface when a force of 30 N acts on an area of: **(3 marks)**
      i. 0.2 m²
      ii. 0.1 m²
   b) Explain why a nail is pointed at one end.   **(2 marks)**

5. a) What are the three methods of heat transfer?   **(3 marks)**
   b) By which method of heat transfer does the heat from the sun reach the Earth?   **(1 mark)**

6. a) The diagram below shows an incident ray of light and a plane mirror. Copy the diagram in your answer book and complete it to show what happens to the incident ray. Label reflected ray, angle of incidence and the angle of reflection.   **(4 marks)**
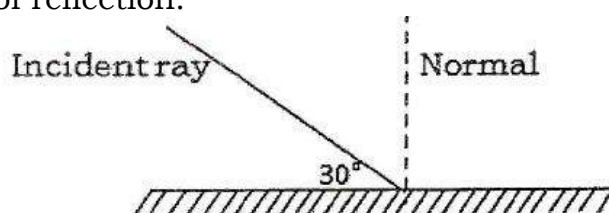
   b) What is the size of angle of incidence?   **(1 mark)**

7. Which of the following statements are correct? (Write the letter which corresponds to the answer required).   **(2 marks)**
   a) The molecules in a solid vibrate about a fixed position.
   b) The molecules in a liquid are arranged in a regular pattern.
   c) The molecules of a gas occupy all the space available.

8. a) State one law of refraction of light.   **(2 marks)**
   b) Copy the diagram below and complete it to show the path of light through the water.   **(2 marks)**
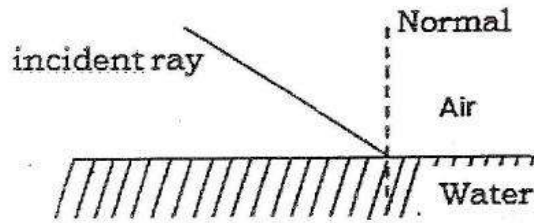
9. a) What is meant by acceleration of moving body? **(1 mark)**
   b) A body moves with a steady increase of velocity from 28.8 km/h to 72 km/h in 6 seconds. Find the acceleration. **(3 marks)**

10. The diagrams below show repelling bar magnets.
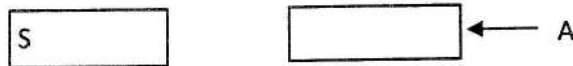
   a) Identify magnetic pole A. **(1 mark)**
   b) Copy the diagrams in your answer booklet and draw magnetic field lines of force around the magnets. **(2 marks)**
   c) Label the neutral point, N. **(1 mark)**

11. a) What are the two kinds of electric charges? **(2 marks)**
    b) A current of 4 A flows in an electric circuit. What charge passes each point in 5 seconds? **(2 marks)**

12. The weight of a stone in air is 11 N. When the stone is wholly submerged in water, its weight is 7 N.
    a) What is the weight of displaced water? **(2 marks)**
    b) Determine the mass of displaced water. (Take 1 kg of water to weigh 10 N). **(2 marks)**

13. a) What is a fuse? **(2 marks)**
    b) Why are fuses used in electrical appliances? **(2 marks)**

14. An 8 KW electric cooker is used for 4 hours a day. What is the cost of using the cooker for 5 days if 1 KW costs 140 Frw and a tax of 15% is added to the coast? **(2 marks)**

15. How much heat is needed to change 40 g of ice at 0°C to steam at 100°C? **(4 marks)**

   Specific latent heat of ice: 340J/g
   Specific heat capacity of water: 4.2 J/g and
   Specific heat of steam: 2300J/g

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. a) With the aid of a diagram show that pressure in water increases with depth. **(3 marks)**
    b) Calculate the pressure water exerts at 8 m below the surface of the water in a lake. Assume the density of water, $\rho = 1000 kg / m^3$ and $g = 10N / kg$. **(2 marks)**

c) Water supply reservoirs are often made on high hills or mountains. Why? **(2 marks)**
d) In a hydraulic press, a force of 10 N is applied to a piston of area 0.4 cm². The area of the other piston is 3.0 m². What is: **(3 marks)**
  i. The pressure transmitted through the liquid?
  ii. The force on the other piston?

17. a) What is the difference between potential energy and kinetic energy? **(2 marks)**
  b) An orange fruit of mass 0.1 kg falls from its tree 3 m high to the ground.
    i. State the energy changes which occur as the orange falls to the ground. **(2 marks)**
    ii. Calculate the potential energy possessed by the orange before it falls. Take g = 10 N/kg **(2 marks)**
    iii. Calculate the kinetic energy of the orange as it hits the ground. **(2 marks)**
    iv. Does the orange stop immediately after it has hit the ground? **(1 mark)**

18. a) Draw an electric circuit diagram which has 2 torch batteries in series, a switch, connecting wires, a lamp and an ammeter. **(3 marks)**
  b) If the voltage for each torch battery is 1.5 V and the resistance of the lamp is 0.6 Ω, calculate the current. Ignore the internal resistance of batteries. **(3 marks)**
  c) Mention only two accidents that electricity may cause in a home. Explain how these accidents may be avoided. **(4 marks)**

19. a) State heat effects **(4 marks)**
  b) Explain how a wet shirt dries up when it is left outside on a hot day. **(2 marks)**
  c) Why is mercury a better liquid to use in laboratory thermometer than water? **(4 marks)**

20. a) The sun is a luminous object. Why? **(1 mark)**
  b) Why is the moon non-luminous? **(1 mark)**
  c) Light is a form of energy. Explain how you can use energy from the sun light to burn a piece of paper. You may use a diagram to illustrate your answer. **(4 marks)**
  d) i) Copy the diagram below and use rays to show how the image of object is formed in a converging lens.
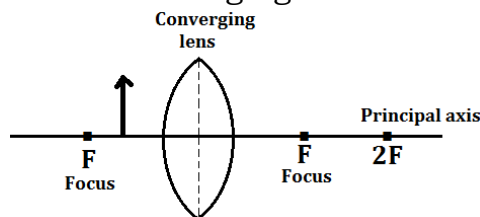
ii) State the nature of the image.

SECTION C: Answer only one question in this section.   **(15 MARKS)**

21. You are required to find the density of an irregular stone (stone without a definite geometrical shape).
    a) List the apparatus you may use.   **(5 marks)**
    b) Describe how you carry out the experiment to determine:
       i. The volume of the stone   **(5 marks)**
       ii. The mass of the stone   **(2 marks)**
    c) State any sources of errors and how you may avoid the errors. **(2 marks)**
    d) Write the equation you may use to calculate the density of the stone.
                                                                      (1 mark)

22. An electric kettle is used to heat some water. The table below shows the variation of the temperature of the water with time.

Time (s)	0	10	20	50	80	100	120	140
Temperature (0°C)	20	20	20	44	68	84	100	100

    a) Draw a graph to reflect this information. Plot temperature on y-axis and use a scale of 1 cm to represent 10°C and time on x-axis. Use a scale of 1 cm to represent 20 s.   **(12 marks)**
    b) Why is the temperature of water constant for 20 s?   **(1 mark)**
    c) What time does it take for the water to boil?   **(1 mark)**
    d) What is happening to the energy supplied to the water after boiling?
                                                                      (1 mark)

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2006

Section A: Answer all questions

1. a) **Density** is defined as the **ratio of mass divided by volume** or $(\rho = \frac{m}{V})$ and measured in of kg/m^3.

   b) Density: $\rho = \frac{m}{V} = \frac{45}{5} = 9 \frac{g}{cm^3} = 900 \; kg/m^3$

2. *Weight, velocity*

3. *Condition of equilibrium:* $A \times g \times 40 = 25 \times g \times 24 \Rightarrow A = \frac{23 \times 24}{40} = 15 \; g$

4. a) i) *Pressure* $P = \frac{F}{A} = \frac{30}{0.2} = 150 \; Pa$

   ii) *Pressure* $P = \frac{F}{A} = \frac{30}{0.1} = 300 \; Pa$

   b) *If the force is concentrated on a small area, it will exert higher pressure than if the same force is distributed over a larger surface area. Allowing the nail to penetrate easily when hit.*

5. a) *Conduction, convection and radiation*
   b) *Radiation*

6. a)
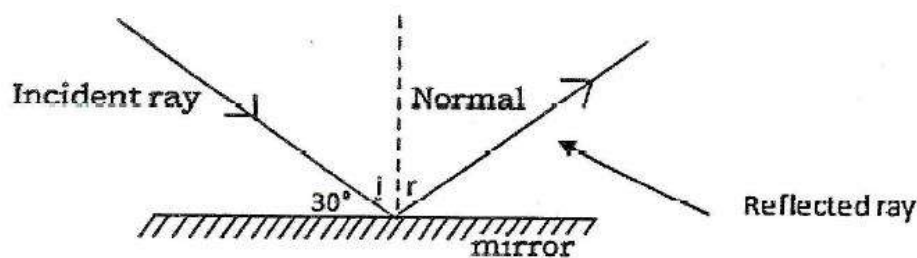
   b) *Angle of incidence is $90^o - 30^o = 60^o$*

7. *(a) and (c) are correct*

8. a) *The incident ray, the refracted ray are on opposite sides of the normal at the point of incidence and all three are in the same plane.*
   b)
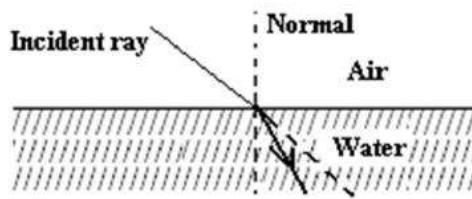
9. a) **Acceleration** is defined as the rate of change of velocity with time. $a = \frac{\Delta V}{\Delta t}$

   b) Acceleration: $a = \frac{\Delta V}{\Delta t} = \frac{20-8}{6} = 2 \ m/s^2$

10. a) A is South.

    b)
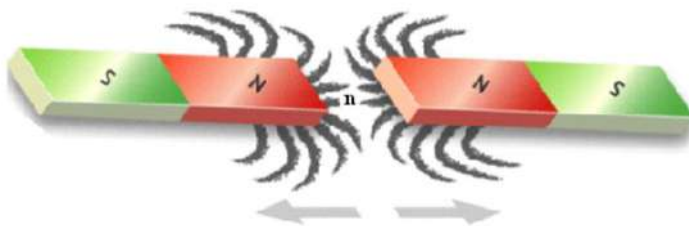
11. a) Positive charge and negative charge.

    b) $I = \frac{Q}{t} \Rightarrow Q = It = 4 \times 5 = 20 \ C$

12. a) Weight of displaced water: Wd = Wa – Wf = 11 – 7 = 4 N

    b) Mass of displaced water: $m_d = \frac{W_d}{g} = \frac{4}{10} = 0.4 \ kg$

13. a) A fuse is an electrical device used to cut the current when it exceeds a certain value.

    b) The fuse protects against electrical surges. Or where the fuse cuts the current, it cannot enter the unit for damage

14. Energy consumed: $Q = Pt = 8 \times 4 \times 5 = 160 \ KWh$

    Cost of energy consumed: $160 \times 140 = 22\ 400$

    Tax: $22\ 400 \times 0.15 = 3360$

    Total cost: $22\ 400 + 3360 = 25\ 760 \ Frw$

15. Energy to melt ice: $Q_1 = mL_f = 40 \times 340 = 13\ 600 \ J$

    Energy to rise the water temperature from 0 to 100:

    $Q_2 = mc\Delta T = 40 \times 4.2 \times 100 = 16\ 800 \ J$

    Energy to change water to steam: $Q_3 = mL_v = 40 \times 2300 = 92\ 000 \ J$

    Total energy required:

    $\quad Q = Q_1 + Q_2 + Q_3 = 13\ 600 \ J + 16\ 800 \ J + 92\ 000 \ J = 122\ 400 \ J$

SECTION B: Attempt any THREE questions in this section

16. a)

b) $P = \rho g h = 1000 \times 10 \times 8 = 80\ 000\ Pa$

c) The pressure increases with depth. At the bottom of a hill, there is great pressure, so water can flow with great speed from the summit.

d) i) Pressure transmitted through the liquid: $P = \dfrac{F_1}{A_1} = \dfrac{10}{0.4} = 25\ Pa$

   ii) The force on the other piston:

$P = \dfrac{F_1}{A_1} = \dfrac{F_1}{A_1} \Leftrightarrow F_2 = \dfrac{F_1 \times A_2}{A_1} = \dfrac{10 \times 3}{0.4} = 75\ N$

17. a) Potential energy may be defined as the energy possessed by an objects or bodies due to their position or state of strain or the position of their parts. Potential energy is energy deriving from position. Potential energy is referred to as stored energy because it can be looked at as energy which will be used when time comes for it to be used while Kinetic energy is the form of energy possessed by moving bodies. Kinetic energy of a body is dependent upon both the body's mass and speed.

b) i) Potential energy – Kinetic energy – Sound energy – heating energy

   ii) Potential energy: PE = mgh = 0.1 X 10 X 3 = 3 J

   iii) Loss of Potential energy = gain in Kinetic energy when h = 0

   Loss of potential energy: $\Delta PE = mgh - mg \times 0 = 3\ J$ ie. KE = 3 J

   iv) Non, because it has energy.

18. a)
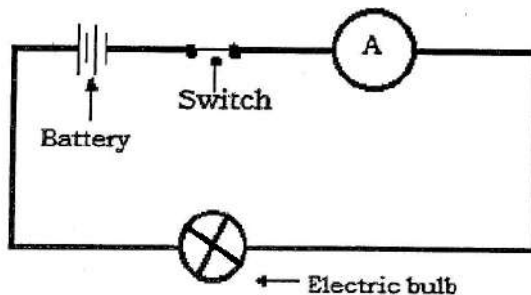
b) Electric current: $I = \frac{E}{R} = \frac{2 \times 1.5}{0.6} = 5\ A$

c) Electric shock: isolate the conductors
Fire: install fuses; isolating conductors
Damage to equipment: getting land use fusible; stabilizers

19. *a) The effects of heat: increases the volume (expansion), increase the temperature, change the physical state of body, change chemical state (combustion), increase the internal energy.*
b) The heat from the sun by radiation heats the water contained in the liner, the water gets hot and evaporates from the shirt.
c) Water is unsuitable for use in thermometers, not only because it freezes at $0^{o}C$ but also because of its irregular expansion, it is not a good conductor of heat.
Mercury is a better liquid to use in a laboratory thermometer because:

- *It is a good conductor of heat,*
- *It has a low specific heat capacity and is opaque*
- *It has a high boiling point and a lower freezing point*
- *It has a high coefficient of cubical expansivity (it expands easily)*
- *It expends regularly and not stick on walls of thermometer /high cohesive*

20. *a) The sun provides the light from itself.*
b) The Moon did not own light; it reflects light received from the sun.
c)
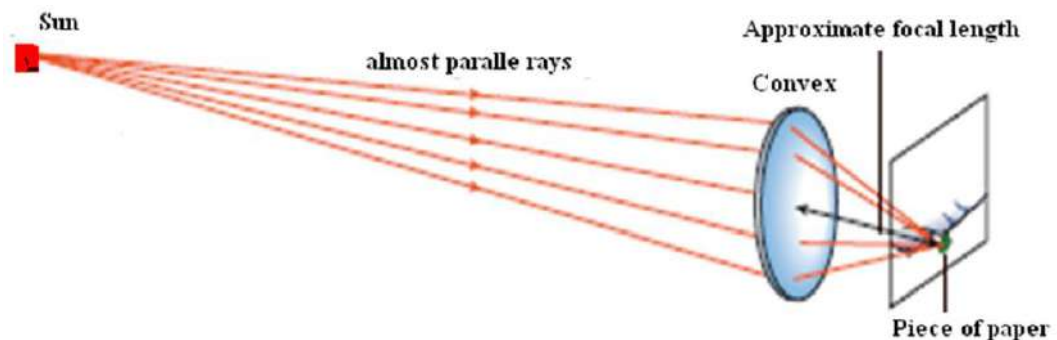
d) (i)
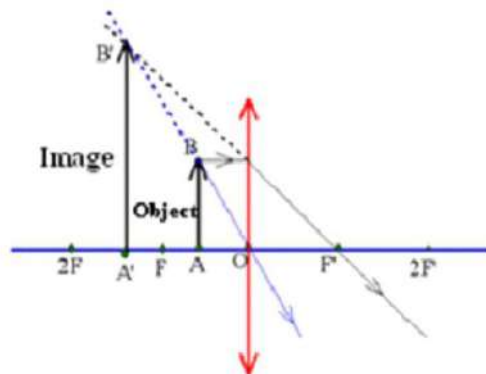
(ii) The object is located in front the focal point (F), (Object between lens and F), the image is: behind the object, virtual, erect and larger than object.

SECTION C: Attempt one question from this section

21. **a) Apparatus required:** *1 measuring cylinder 100 cm³, beam balance; String, stone, water.*

    b) i) Volume:
    Fill the measuring cylinder of a certain quantity of water and note the water level: V1

    Holding the string, lower the stone into the water until it is completely submerged. Record the new water level: V2

    Determine the volume of the stone: V = V2 - V1

    *ii) **Mass:** Check if the needle of scale is at zero balance. Using the beam balance, determine and record the mass of the stone provided: m.*

    *c) **The sources of errors and how to correct it.***

    Balance disordered (needle point different from zero at the start): adjust the balance to zero or use another balance well settled.

    Read error: properly placed before the face of the meter to avoid parallax errors; proceed cautiously

    Water can be lost when you put the stone in water: be careful when putting the stone in water

    The meter may be inaccurate: using the device which is more accurate.

    d) Density: $\rho = \frac{m}{V}$

22. *a)*
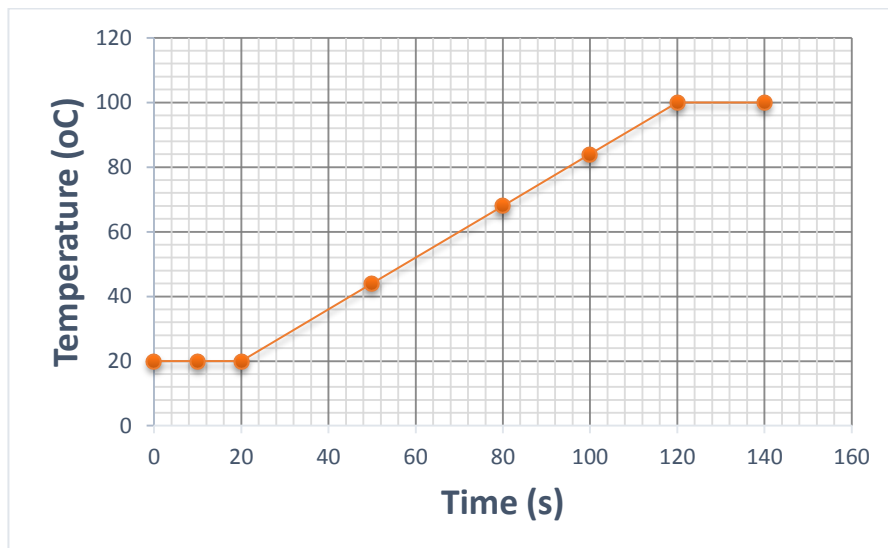
b) The heat is warming the kettle

c) It takes 120 s for water to boil

d) After boiling, the heat is used to ensure the transition phase. It is used to turn water into steam.

PHYSICS I

010

12th Nov. 2007   08.30 – 11.30 am

ORDINARY LEVEL NATIONAL EXAMINATIONS 2007

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working.

SECTION A: ANSWER ALL QUESTIONS   **(55 MARKS)**

1. (a) What is the difference between density and relative density? **(2 marks)**
   (b) Calculate the mass of 6 cm^3 of copper. The density of copper is $9g/cm^3$.
                                                             (1 mark)

2. (a) What is meant by the term weight?   **(2 marks)**
   (b) Calculate the weight of a body whose mass is 80 kg. (10 N/kg) **(1 mark)**

3. Air is used to fill tyres of vehicles. Why is air better than using water to fill tyres?   **(3 marks)**

4. Wearing high heeled shoes may damage a wooden floor. Why?   **(3 marks)**

5. Uniform meter ruler is freely pivoted at 30 cm mark and it balances horizontally when a body of mass 40 g is hung from the 2 cm mark. Draw a diagram of the arrangement and calculate the mass of the meter rule.
                                                           (3 marks)

6. (a) The diagram below shows a diverging mirror. Copy and complete it to show the formation of image   **(2 marks)**
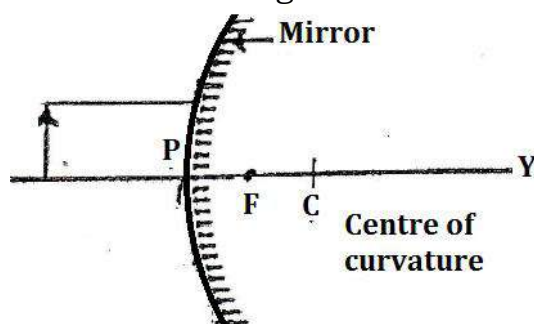
   (b) What is the nature of the image formed in the diverging mirror?
                                                         (2 marks)

7. With aid of a diagram explain what is meant by dispersion of white light.
                                                       (4 marks)

8. Convert: (a) $5°C$ to Kelvin scale   **(2 marks)**
           (b) $373K$ to Celsius scale   **(2 marks)**

9. The diagrams below are of a bimetallic strip before heating and after heating.
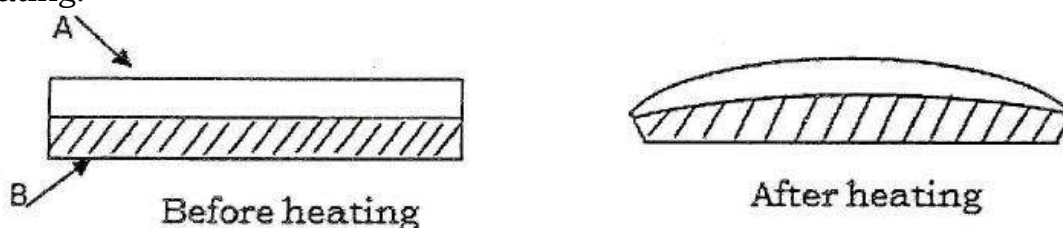
   (a) Explain why the strip bends as it becomes hot.   **(2 marks)**

(b) Why does metal A bend outwards? **(1 mark)**
(c) Draw the bimetallic strip when it has cooled down again. **(1 mark)**

10. (a) Define heat capacity of a substance. **(2 marks)**
    (b) A piece of iron of mass 100 g cools from 90°C to 30°C. How many joules of heat are given out? Specific heat capacity of iron is 460$J/kg.K$ **(2 marks)**

11. (a) Explain what is meant by uniform acceleration. **(2 marks)**
    (b) A car is uniformly retarded and brought to rest from a speed of 90 km/h in 20 s. Find its acceleration. **(2 marks)**

12. (a) In Kigali the boiling point of water is less than 100°C. Why? **(2 marks)**
    (b) With the aid of a diagram show that air of the atmosphere exerts a force. **(2 marks)**

13. Observe the Pulley system below and answer question below.

Effort = 70 N

Load = 120 N
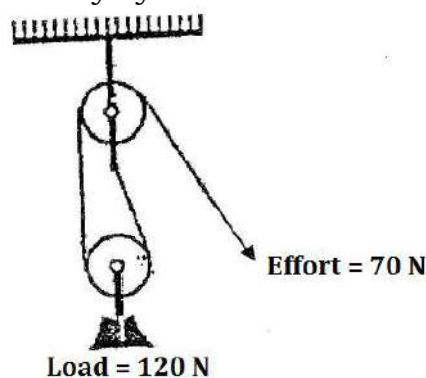
   (a) Determine: i) Mechanical advantage **(1 mark)**
                   ii) Velocity ratio **(1 mark)**
                   iii) Efficiency **(1 mark)**
   (b) Why is the pulley system not 100% efficient? **(1 mark)**

14. (a) State the law of magnet poles. **(1 mark)**
    (b) How would you test that a material is a magnet? **(2 marks)**
    (c) State one property of magnets. **(1 mark)**

15. Two cells each having an e.m.f of 1.5 V and an internal resistance of 3 Ω are connected in parallel. Find the current when the cells are connected to 1 Ω resistor. **(4 marks)**

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. (a) A thin sheet of cardboard is cut to the shape below. Describe with a diagram an experiment to find its center of mass. **(5 marks)**
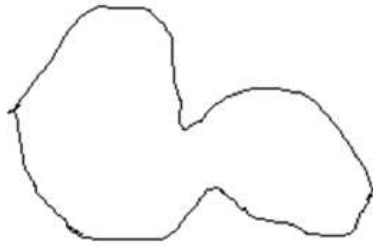
(b) Copy and label with a dot the centre of mass of each of the three objects below. **(5 marks)**
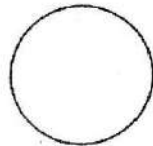
Rectangular body   circular body   Equilateral triangular body
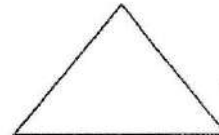
17. (a) List down four sources of heat energy in Rwanda. **(2 marks)**
    (b) List the energy changes which take place when an electric bell is switched on. **(4 marks)**
    (c) Which energy changes will occur when we exert a force to lift a weight? **(2 marks)**
    (d) What is the energy source of most liquid and gaseous fuels? **(1 mark)**
    (e) Give an example where energy from the sun is converted to electrical energy. **(1 mark)**

18. (a) Draw a ray diagram to show the formation of an image by a diverging lens. State also the nature of image. **(4 marks)**
    (b) What is the function of an objective lens in the compound microscope? **(2 marks)**
    (c) Which lens is used to correct short sightedness? **(1 mark)**
    (d) Find the position of the image of an object placed 8 cm from a diverging lens of focal length of 110 cm. **(3 marks)**

19. (a) Identify the common electrical symbols below: **(3 marks)**
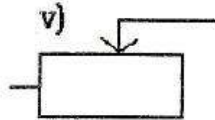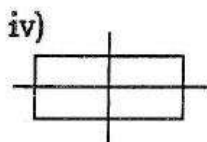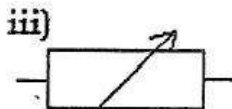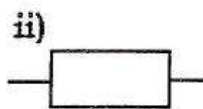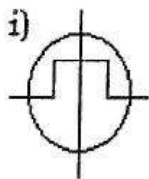
(b) State Ohm's law. **(2 marks)**
(c) What is the potential difference across the 10 Ω resistor in the figure below if the current is 3 A? **(2 marks)**
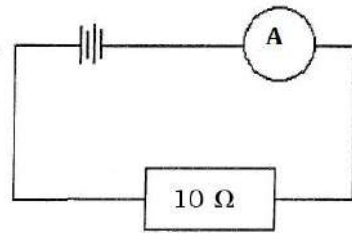
(d) Why does an ammeter have a low resistance? **(1 mark)**
(e) What is meant by electromotive force of a cell? **(2 marks)**

20. (a) Differentiate between latent heat of fusion and latent heat of vaporization. **(3 marks)**
(b) What effect does a decrease in pressure have on melting point of a substance which expands on solidifying? **(2 marks)**
(c) Explain why pieces of ice at $0°C$ added to a drink at room temperature are more effective in cooling the drink than an equal mass of water at $0°C$ **(3 marks)**
(d) How much heat will change 20 g of ice at $0°C$ to water at $0°C$? Specific latent heat of fusion of ice is 336 J/g. **(2 marks)**

SECTION C: This question is compulsory. (15 MARKS)

21. This question is compulsory and must be answered on the graph paper provided at the end of your answer booklet. The table below shows the motion of moving body.
(a) Use the above data and plot a graph of velocity on Y-axis against time on X-axis. **(8 marks)**

Time (s)	0	1	2	3	4	5	6	10	15
Velocity (m/s)	0	5	10	15	15	15	15	30	0

(b) From your graph, determine:
  i. The acceleration for the first 3 s. **(2 marks)**
  ii. The time the acceleration is constant. **(1 mark)**
  iii. The deceleration. **(2 marks)**
  iv. The distance moved by the body during the first 3 s. **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS
NATIONAL EXAMINATION 2007

Section A: Answer all questions

1. **(a) Density** is defined as the **ratio of mass divided by volume** ($\rho = \frac{m}{V}$) while the specific gravity (relative density) of a substance is defined as the ratio of the mass or weight of a given volume of the substance to the mass or weight of an equal volume of a standard substance.
The relative density has no units and is therefore independent of the system of measure you use to determine it. But density must be expressed in terms of suitably chosen units of mass and volume (kg/m^3 in SI units).
(b) $\rho = \frac{m}{V} \Rightarrow m = \rho \times V = 9 \times 6 = 54\ g$

2. (a) Weight of an object is the gravitational attraction (pull) for that body by another body e.g. earth or moon. Weight is a force and so its unit is Newton, symbol N.
(b) Weight: $W = mg = 80\ X\ 10 = 800\ N$

3.

Water	Air
Inexpansible	Expansible
Heavy	Very light compared to water
Very slight compression	Compressible

4. The high heels have a small surface in contact with the wood. When the surface is small, the pressure is great, great pressure is damaging the wood floor.

5.
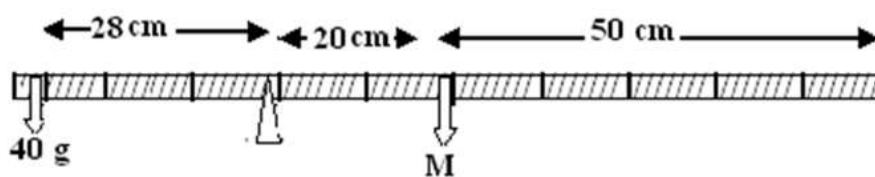
Condition of equilibrium: $40 \times 12 = M \times 20 \Leftrightarrow M = 56\ g$

6. (a)
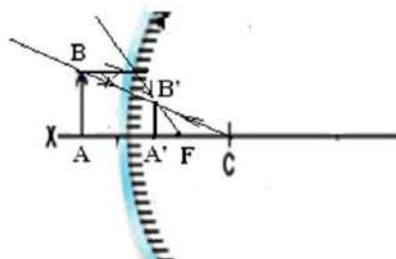
(b) The convex mirror gives virtual images only. These are always erect and smaller than the object and formed between P and F.

7. *(a) **Dispersion** is separation of colours by glass (or other materials) due to their speed differences in glass. The variation of refractive index n with wavelength λ is called **dispersion.***

(b)

White Light

Glass Prism

Red
Orange
Yellow
Green
Blue
Indigo
Violet
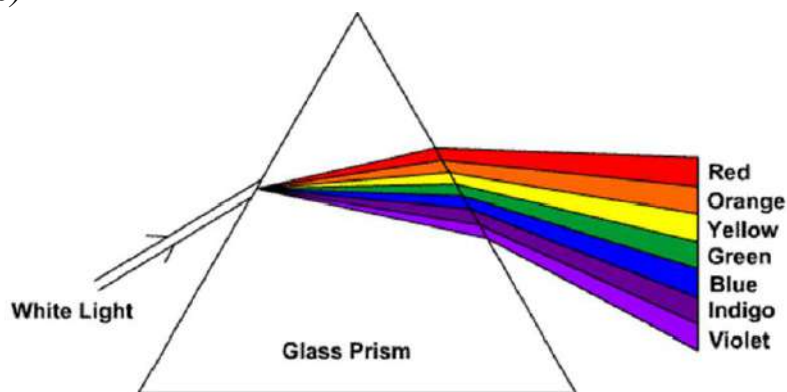
8. *(a) $5°C = 5 + 273 = 278K$*
   (b) $373K = 373 - 273 = 100°C$

9. *(a) The metals expand differently; A expands more rapidly than B*
   (b) A has a high coefficient of expansion
   (c)
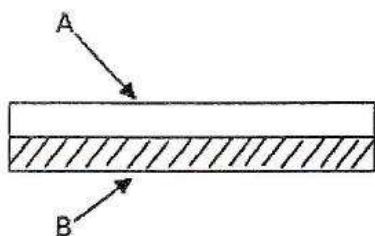
10. *(a) The heat capacity of a body is the heat required to rise its temperature by 1K. The SI unit of heat capacity is J/K. The heat capacity μ of an object is the proportionality constant between the heat Q that the object absorbs or loses and the resulting temperature change of the object. That is, $Q = \mu\Delta T = \mu(Tf – Ti)$*
    (b) Heat given out: $Q = mc\Delta T = mc(Tf – Ti) = 0.1 \times 460 (90 – 30) = 2\ 760\ J.$

11. *(a) When the velocity of a body is changing, the body is said to be accelerating.* ***Acceleration** is defined as the rate of change of velocity with time. $a = \frac{\Delta V}{\Delta t}$ When the acceleration is constant both in direction and in magnitude, the point is said to be undergoing **uniformly accelerated motion**.*
    (b) Acceleration: $a = \frac{\Delta V}{\Delta t} = \frac{0-25}{5} = -5\ m/s^2$

12. (a) *The boiling point of water decreases with decreasing pressure. The atmospheric pressure in Kigali is less than atmospheric pressure at sea level. Thus the boiling point in Kigali is below 100ºC.*

(b) Crushing can experiment

Take an empty plastic gallon milk jug with a screw top. Fill it about a quarter of the way full with very hot water. Cap it tightly and let it stand for about an hour. What did you expect to happen? What did happen? The excess atmospheric pressure outside the can causes it to collapse inward. This plastic bottle was closed at approximately 2,000 m altitude, and then brought back to sea level. It was crushed by air pressure.

Hemispheres of Magdeburg

In 1654, a German scientist named Otto von Guericke carried out his famous demonstration that two teams of eight horses could not pull apart two joined hemispheres when the air within had been evacuated. Using a piston in a cylinder, he also showed that when a vacuum was created on one side of the piston, the atmosphere would move the piston and a considerable mass through a distance, thus performing work. This became the basic principle of the Newcomen steam engine (1712).
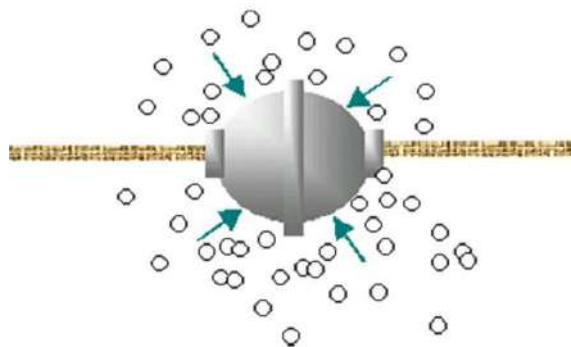
Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

Inverting a glass of water

Prove of existence of atmospheric pressure by inverting a glass of water covered by a sheet of paper: when the glass was turned downwards, water remained inside. Atmospheric pressure keeps the paper into contact with the upturned glass, thus keeping the water in the glass.

Collapsing Can Experiment

The effect of the enormous atmospheric pressure can be demonstrated by removing air from a can using a vacuum pump. The can collapses as the air pressure inside the can becomes less than the atmospheric pressure outside.

13. (a) i) Mechanical advantage: $MA = \frac{L}{E} = \frac{120}{70} = \frac{12}{7}$

    ii) Velocity ratio: $VR = \frac{2}{1} = 2$

    iii) Efficiency: $\eta = \frac{MA}{VR} = \frac{12/7}{2} = 85.7\ \%$

    (b) Some energy is lost due to friction force between the pulleys and strings.

14. *(a) The pole of the same name repel; the poles of opposites attract.*
(b) Bring the magnet material: repulsion indicates that the material is a magnet.
Put the material in the iron fillings: if iron fillings are concentrated at the tip of the material when the material is a magnet.
(c) The magnets attract strongly ferromagnetic materials such as iron steel and cobalt, nickel.
The south magnet attracts the magnetic north.
You cannot isolate the poles of a magnet.
The magnetic power is concentrated at the top.

15. The current $I = \frac{E}{R+\frac{r}{2}} = \frac{1.5}{1+\frac{3}{2}} = 0.6\ A$

SECTION B: Attempt any THREE questions in this section

16. (a) **In Step 1**, you hang the object from any point and you drop a weighted string (plumb line) from the same point. Draw a line on the object along the string.
For Step 2, repeat the procedure from another point on the object you now have two lines drawn on the object which intersect.

General shape
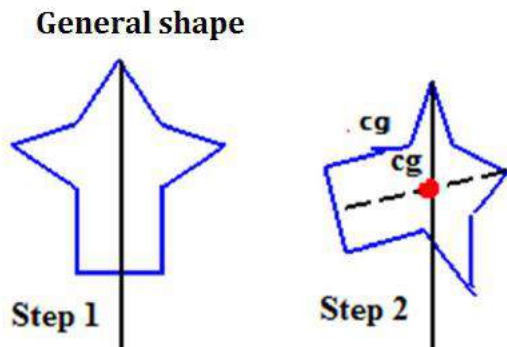
The center of gravity is the point where the lines intersect. This procedure works well for irregularly shaped objects that are hard to balance.

(b)
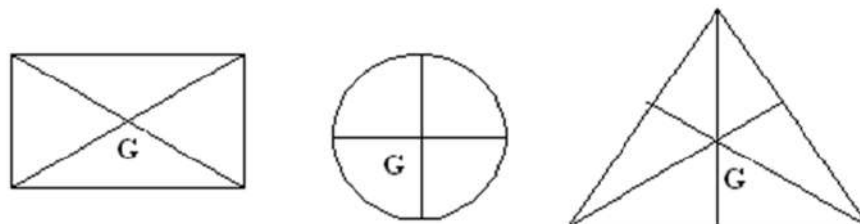
(c) Under the principle of lever: the higher the lever arm is long. The lower the effort needed to carry the load.

17. (a) Firewood, electricity, curved, sun, biogas, gas…
(b) Electrical energy – mechanical energy - sound energy – heat energy
(d) Crude oil or biomass
(c) Photovoltaic cells.

18. a)
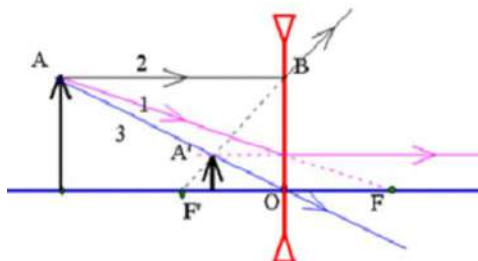
For all positions of object, the image is virtual, erect and smaller than the object, and is situated between the object and lens.
(b) The objective lens is essentially a magnifying glass and was designed with a very small focal length. The objective forms a real enlarged, inverted image of a

small object O placed just outside its principal focus F and is just inside its principal focus of the second lens

(c) Diverging lens

(d) Using lens equation: $\frac{1}{p} + \frac{1}{q} = \frac{1}{f} \Leftrightarrow q = \frac{pf}{p-f} = \frac{8 \times (-10)}{8+10} = -4.4\ cm$

19. *(a) i) Bulb*
    ii) Resistance
    iii) Variable resistance
    iv) Fuse
    v) Rheostat
    vi) Galvanometer

(b) Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) through it where the constant of proportionality is the resistance (R):

(c) Potential difference: ΔU = RI = 3 X10 = 30V

(d) The ammeter is connected in series with a battery and resistance. Thus, it must have low resistance to avoid additional resistance in the circuit.

(e) The e.m.f. of a cell is the potential difference across the terminals of the generator (battery or cell) in an open circuit.

20. *(a) The **specific latent heat of fusion (melting)**. is the amount of energy required to convert 1 kg of a substance from solid to liquid (or vice-versa) without a change in the temperature of the surroundings -- all absorbed energy goes into the phase change while, the amount of energy required to convert 1 kg of a substance from liquid to gas (or vice-versa) without a change in the external temperature is known as the **specific latent heat of vaporization (boiling)** for that substance.*

(b) The increase of pressure lowers the melting point.

(c) Ice needs more energy than water to reach thermal equilibrium with drink. i.e the drink lose amount of energy to melt ice and amount of energy to raise the temperature of melted ice.

(d) Amount of heat: $Q = mL_F = 20 \times 336 = 6\ 720\ J$

SECTION C: This question is compulsory

21. a)
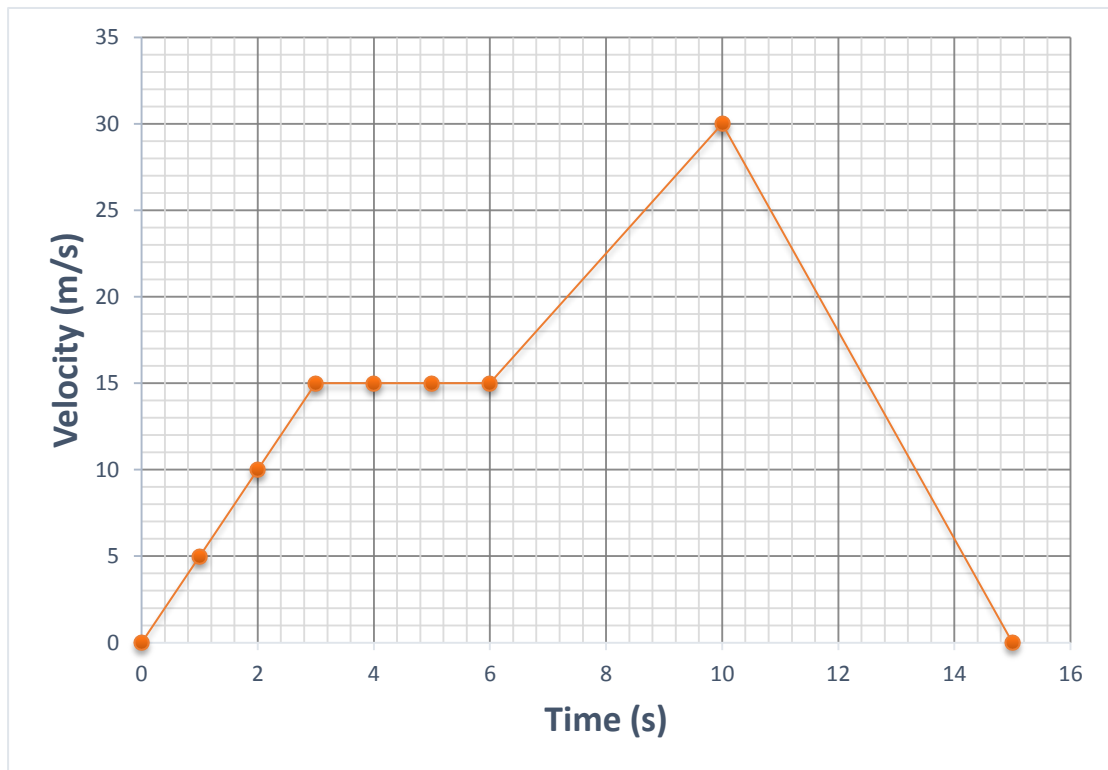
(b) i) Acceleration: $a = \frac{\Delta V}{\Delta t} = \frac{15-0}{3} = 5\ m/s^2$

ii) Acceleration is constant for 3 s.

iii) Acceleration: $a = \frac{\Delta V}{\Delta t} = \frac{0-30}{15-10} = -6\ m/s^2$ *hence deceleration is* $6\ m/s^2$

iv) Distance moved during 3 s: $S = \frac{1}{2}at^2 = \frac{1}{2} \times 5 \times (3)^2 = 22.5\ m$

PHYSICS I

010

03/11/2008   08.30 – 11.30 am

ORDINARY LEVEL NATIONAL EXAMINATIONS 2008

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working

SECTION A: ANSWER ALL QUESTIONS (55 MARKS)

1. a) Which instrument would you use to measure accurately very small length as diameter of thin wire? **(1 mark)**
    b) How do you determine a vernier scale which uses a millimeter scale? **(2 marks)**

2. a) Why does a piece of dry wood float on water? **(1 mark)**
    b) A cylindrical metal has a diameter of 14cm and a height of 5 cm. Find its mass if its density is 19g/cm³. (Take $\pi = \frac{22}{7}$ Express the answer in kg. **(2 marks)**

3. a) Explain why speed is a scalar quantity while velocity is a vector quantity. **(2 marks)**
    b) Give one other example of a vector quantity. **(1 mark)**

4. a) A liquid has no definite shape. Why? **(1 mark)**
    b) Explain why the volume of air changes without changing its mass. **(2 marks)**

5. a) A force of 10N is exerted on the ground. The area in contact with the force is 0.002 m². Calculate the pressure exerted by the force. **(2 marks)**
    b) What effect does the increase of the surface area in contact with the force have on the pressure exerted in 5 (a). **(1 mark)**

6. a) State Archimedes' principle. **(2 marks)**
    b) A ship of mass 1030 tons floats in sea-water. What volume of sea-water does the ship displace? Density of sea-water is 1030kg/m³. **(2 marks)**

7. a) Name the force which keeps a body to move in a circle. **(1 mark)**
    b) What is meant by angular velocity? **(2 marks)**
    c) State the unit of angular velocity. **(1 mark)**

8. a) Explain what is meant by static friction. **(3 marks)**
    b) Give one reason why friction is important in our daily lives. **(1 mark)**

9. a) A force of 100N is used to push a wheel barrow 300m away. Calculate the work done by the force. **(2 marks)**
    b) An electric motor is used to raise a load in a vertical height of 2.5m in 4s. Calculate the power of the motor. **(2 marks)**

10. Explain how a convection process takes place in water. Use a labelled diagram to make your answer clear. **(4 marks)**

11. a) A beaker contains 15Og of water at 20°C. Three grams of ice at 0°C are added to the water which is stirred until the ice melts completely.
    a) Calculate the amount of heat required to melt ail the ice completely. **(1 mark)**

b) Determine the final temperature of the mixture after all the ice has melted. Assume no heat is lost or gained by the system. Specific heat capacity of water is 4200 J/Kg, Specific latent heat of fusion of ice is 336000 J/Kg. **(3 marks)**

12. During rain, it's not good to take shelter under a tall tree. Explain why. **(4 marks)**

13. a) An electric current flows through a tungsten filament for a while. How is the tungsten filament affected by the electric current? **(2 marks)**
    b) Find the resistance of the filament of a lamp rated at 12V 2.4 W. **(2 marks)**

14. a) Name any two methods of making a magnet. **(2 marks)**
    b) Explain why heating a magnet demagnetizes it. **(2 marks)**

15. a) With the aid of a diagram, show how umbra and penumbra shadows are formed at the same time. **(3 marks)**
    b) How do you produce the umbra shadow only? **(1 mark)**

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. a) List all the energy changes which occur when a pendulum swings. **(3 marks)**
    b) A car of mass 1000 kg moves at an average speed of 16m/s.
    i) Where does the energy to move the car come from? **(1 mark)**
    ii) What is the kinetic energy of the car? **(2 marks)**
    c) A 50 kg stone is thrown 15m upwards into the air.
    i. What will happen to the stone? Explain. **(2 marks)**
    ii. Find the maximum potential energy of the stone. G =10 m/s^2. **(2 marks)**

17. a) Draw a diagram of a mercury barometer (simple barometer) and label it. **(4 marks)**
    b) What would be observed if the barometer was taken up a high mountain? Explain your observation. **(4 marks)**
    c) What is the difference between a mercury barometer and an aneroid barometer? **(2 marks)**

18. a) Describe how you can determine the lower fixed point of temperature and upper fixed point of temperature of a mercury thermometer. **(4 marks)**
    b) Why is mercury a better liquid to use in thermometers? **(3 marks)**
    c) Describe the structure of a clinical thermometer and explain how it functions? **(3 marks)**

19. a) What is the difference between altering current and direct current? **(2 marks)**
    b) How does an earth wire in domestic electrical wiring stops someone from getting an electric shock? **(2 marks)**

c) Why is a circuit breaker more efficient as a safety device than a fuse? **(2 marks)**

d) Two resistors, 4 Ω and 2 Ω respectively are connected together so that the total resistance is less than 2 Ω. Draw an electric circuit of the arrangement and calculate the total resistance in the circuit. **(4 marks)**

SECTION C: Answer only one question in this section. **(15 MARKS)**

20. a) Define the term density of a substance. **(2 marks)**
    b) State the unit of density **(1 mark)**
    c) In an experiment to determine the density of a metal, a number of pieces of the same metal are used. Their masses and corresponding volumes are in the table below.

Volume (cm³)	2	3	4	5	6
Mass (g)	18	27	36	42	54

   i) Plot these results on a graph paper. Mass should be on the Y-axis and volume on the X-axis. Indicate on the graph with letter X the result which is not correct. **(8 marks)**
   ii) Draw the graph through the correct points. **(2 marks)**
   iii) Does your graph pass through the origin? Explain your answer.
   iv) Determine the density of the metal from the graph. Show on your graph any measurements you have made in order to determine the density of the metal. **(2 marks)**

21. a) State Ohm's law. **(2 marks)**
    b) Draw a simple electric circuit you may use to verify Ohm's law. Label all the circuit components. **(3 marks)**
    c) Below are the results obtained in an experiment to verify ohm's law:

Electric current (A)	0	0.5	1.0	1.5	2.0
Potential difference (V)	0	2.0	3.0	6.0	8.0

   i) Plot these results on a graph paper. Potential difference, V must be on the Y-axis and electric current I, on the X-axis. Indicate on your graph with letter X the result which is wrong. **(8 marks)**
   ii) Determine the resistance from the graph. Show on your graph the measurements you made. **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2008

Section A: Answer all questions

1. a) Micrometer screw gauge, its accuracy is 0.01mm
   b) The edge of card board has 9 mm long this card board is divided into ten equal divisions each small ' division on the card board is one tenth of 9 mm shorter than the smaller divisions of the scales.

2. a) The density of dry wood is less than that of water.
   b) $r = \dfrac{d}{2} = \dfrac{14\ cm}{2} = 7\ cm$

   $\rho = \dfrac{m}{V} \leftrightarrow m = \rho \times V = 19 \times \dfrac{22}{7} \times 7^2 \times 5 = 14\ 630\ g = 14.63\ kg$

3. a) Speed is a scalar quantity because it can be described fully by magnitude only while velocity is a vector quantity because it can be described by both magnitude and direction.
   b) Vector quantity: force, weight, displacement, acceleration etc.

4. a) Liquid has no definite shape because the attraction force between the molecules of liquid is less, then it takes the shape of the container.
   b) The volume of air change without changing its mass because it can be compressible means that we can increase or decrease its volume using external force and it can also occupy all volume given (Expansibility).

5. a) $P = \dfrac{F}{A} = \dfrac{10\ N}{0.0002\ m^2} = 50\ 000\ {N}/{m^2} = 50\ 000\ Pa$
   b) The increase of the surface area in contact with the force, decreases the pressure exerted.

6. a) Any non-porous object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object.

   $B = W_f = m_f g = P_f g\ V_{displaced}$

   b) $m = 1\ 030\ t = 1\ 030\ 000\ kg;\ \rho = 1\ 030\ \dfrac{kg}{m^3}$

   $\rho = \dfrac{m}{V} \leftrightarrow V = \dfrac{m}{\rho} = \dfrac{1\ 030\ 000\ Kg}{1\ 030\ {Kg}/{m^3}} = 1\ 000\ m^3$

7. a) Centripetal force
   b) Angular velocity is the angle swept by radius per unit time.
   c) The S.I. unit for angular velocity is rad/s

8. a) Static friction is the force that opposes relative sliding motion of two surfaces in contact when they are trying to move each other.
b) Friction is very important because it enables us to move, to write, to make fire, to break a vehicle etc… It is also a nuisance because it wears the soles of our shoes and the car tires, causes unnecessary heat and undesirable noise, lowers efficiency of a machine etc.

9. a) $W = F\,d = 100\,N \times 300\,m = 30\,000\,J$
b) $P = \dfrac{W}{t} = \dfrac{120 \times 2}{4} = 75\,W$

10. Convection in water
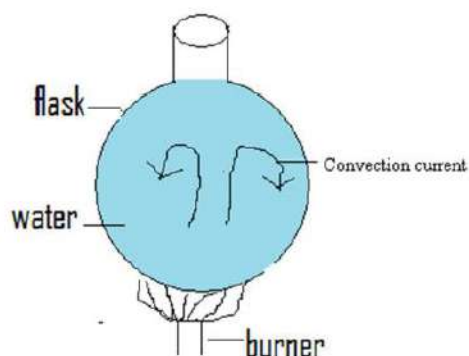
When the water at the bottom is heated, it expands, becomes less dense and rises to surface as the cold water at the surface moves down to replace the hot water. The sawdust shows this movement. Streams of warm moving fluids are called convection currents. Instead of using sawdust, one can use potassium permanganate.

11. a) $Q_F = mL_F = 0.003 \times 336\,000 = 1\,008\,J$
b) $Q_L = Q_G I.e.\, m_2 C(t_2 - t_f) = mL_F + mC(t_f - t_1)$
   $0.15 \times 4\,200(20 - t_f) = 0.003 \times 33\,600 + 0.03 \times 42\,000(t_f - 0)$
   $t_f = 18.04\,^0C$

12. We can have an accident caused by thunder (lightning). The cloud charged negatively will be connected with earth which is charged positively using that tall tree; this connection causes the ionization of air molecules near to the tall tree which makes thunder when you are near to that tree we can have an accident caused by thunder.

13. a) The tungsten filament will be heated and will have a red colour.

b) $P = UI$ and $I = \dfrac{U}{R} \leftrightarrow P = \dfrac{U^2}{R} = \dfrac{12^2}{2.4} = 60\,\Omega$

14. a) ***Magnetization by induction***

When a piece of unmagnetized steel is placed either near to or in contact with a pole of a magnet and then removed, it is found to be magnetized i.e. it becomes a magnet itself. This is called induced magnetism. The material is said to have induced magnetism in it. Tests with a compass needle show that the induced pole nearest the magnet is of opposite sign to that of the inducing pole.

Magnetization by contact.

When the steel piece is brought near iron fillings, the iron fillings are not attracted. After rubbing (stoking) from end to end, several times in the same direction with one pole of a magnet the steel piece against the bar magnet, we observe that it can attract the iron fillings.

Magnetization by electric current

When we kept the steel piece above the iron fillings, the iron fillings were not attracted. After the steel bar is placed inside a coil with many turns of insulated copper wire (solenoid) to which the battery is connected current is switched on for a few seconds and then switched off. The steel ban is found to be magnet with its N pole near the positive.

b) Heat the magnet until its red hot, and then let it cool while pointing east and west. No magnetism remains because the heat makes the molecules of the magnet to be in disorder. Iron loses its magnetism at 750°C, Nickel at 360°C and cobalt at 1100°C.

15. a) ***Extended source of light: Umbra and Penumbra***
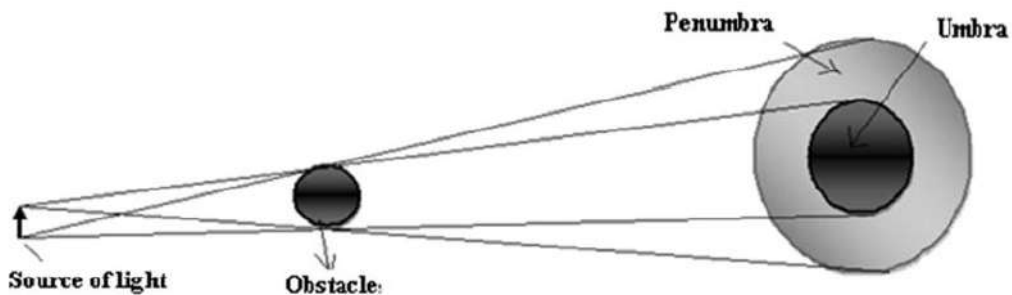
b) ***Punctual source of light: Umbra***
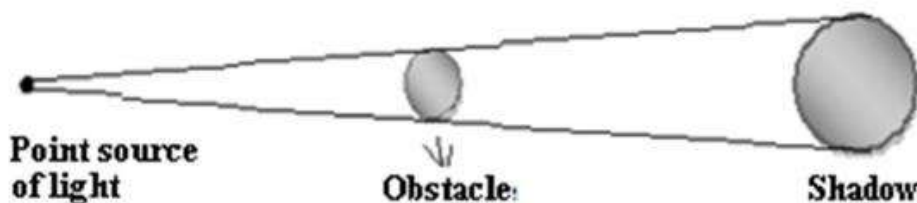
SECTION B: *Attempt any THREE questions in this section*

16. a) Energy change in Simple pendulum
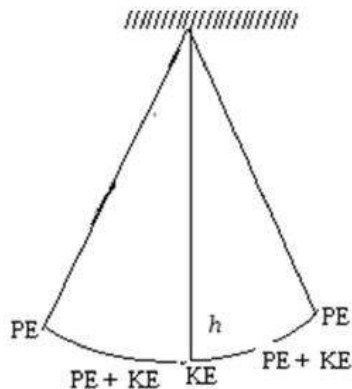
b) i) From fuel.

ii) $K.E = \frac{1}{2}mV^2 = \frac{1}{2} \times 1\,000 \times 16 = 128\,000\,J$

c) i) The stone returns to the ground. It returns to the ground because the velocity of that stone becomes zero.

ii) PE = mgh $= 50 \times 10 \times 5 = 7\,500\,J$

17. **a) Simple barometer**
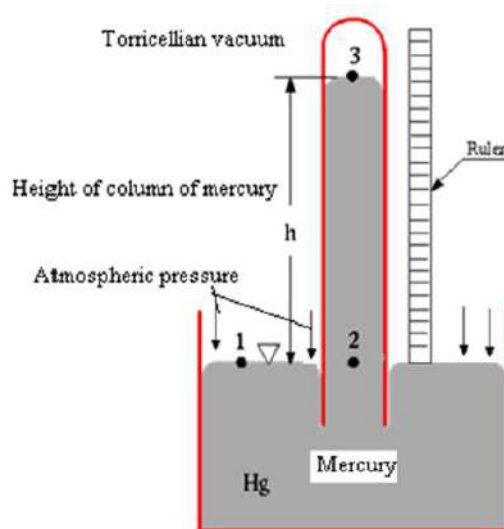
b) The level of mercury in the tube decreases as the height of the Torricellian vacuum increases. The decrease of mercury in the barometer means that the atmospheric pressure decreases because when the height of mountain increases the pressure decreases.

c) Mercury barometer uses a liquid (mercury) in its functioning while the aneroid barometer uses circular scale in its functioning fixed metallic box. In the mercury barometer the atmospheric pressure of region makes the increase or decrease of height of column mercury in the tube while in an aneroid barometer, the atmospheric pressure of the region makes the contraction or expansion of metal box in order to show the pressure of that region.

18. a) To mark the lower fixed point or freezing point, the thermometer is placed in melting ice. After the stability of mercury in the thermometer, mercury takes a fixed point. This mark can be labelled as the lower fixed point and the indicator will always return to this mark when the thermometer is placed at ice point. To make the upper fixed point or steam point, the thermometer is placed in the steam above boiling water and the mercury in the tube rises up and takes a fixed point and the indicator will return to this mark when the thermometer is at steam point and this point is labelled as the upper fixed point.

b) Mercury is a better thermometric liquid because:
- It is easily seen, because it is opaque and silvery.
- It does not wet the glass which contains it (highly cohesive). No mercury remains on the sides of the tube when the mercury level falls and it expands regularly.
- It is a good o conductor of heat and soon reaches the same temperature as its surroundings. It has a high boiling point (357°C)
- It has a small heat capacity, so it takes only a little heat from hot objects.
- It does not like alcohol, vaporize easily and distil on to the upper part of the bore like.

19. a) In alternating current (AC or ac) the movement of an electric charge periodically reverses direction. In direct current (DC), the flow of an electric charge is only in one direction.

b) The neutral wire is earthed by the electricity supplier company. It is crossed by a current. If accidentally you touch the neutral wire, you do not have a risk of being electrocuted. It connects the earth to the metallic cage of the appliances and does not allow it to become live when there is an accidental contact between the live wire and the metallic cage of the appliance. In this case, a big amount of current flows to the earth and the fuse melts, opening in such a way the circuit and the contact with the human is no longer dangerous.

c) A circuit breaker is more efficient as a safety device than a fuse because it does not melt easily and it opens the circuit easily if an accident comes.

d) $R_1 = 4 \ \Omega$ and $R_2 = 2 \ \Omega$
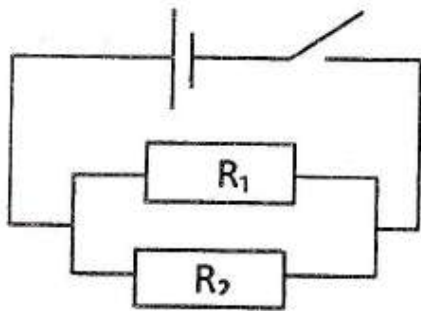
$$R = \frac{R_1 \times R_2}{R^1 + R_2} = \frac{3}{4} \ \Omega$$

SECTION C: Attempt one question from this section

20. a) Density is defined as the ratio of mass divided by volume. $\rho = \dfrac{m}{V}$

b) The S.I. unit of density is kilograms/cubic meter or kg/m^3.

c) i)
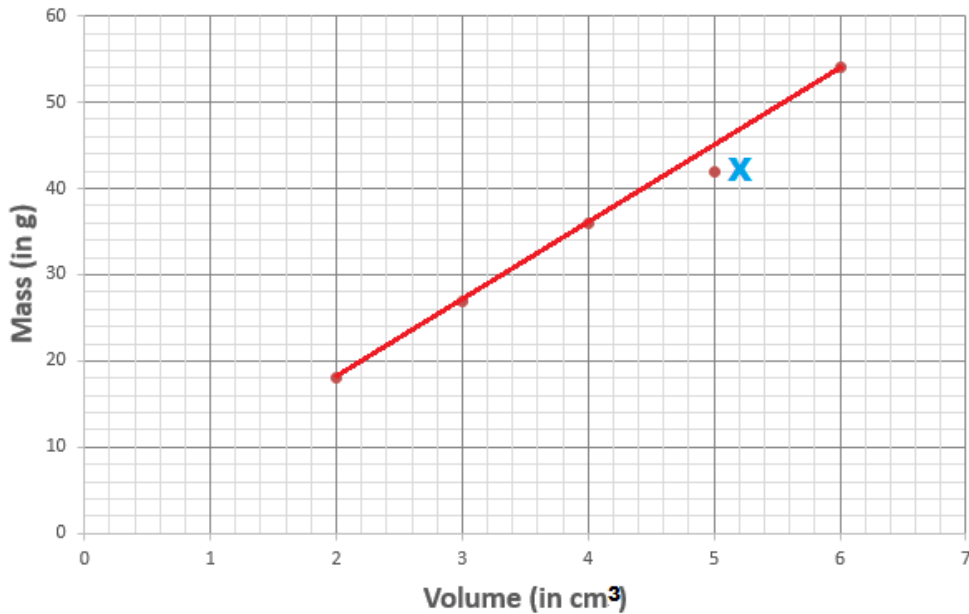
ii) The graph does not pass through the origin because we cannot find the object of mass zero and the volume zero. Also the density of that object does not have meaning.

iii) $\rho = \dfrac{\Delta m}{\Delta V} = \dfrac{54-18}{6-2} = 9 \ g/cm^3$

21. a) Ohm's law states that the voltage (V) across a resistor is proportional to the current (l) through it, where the constant of proportionality is the resistance (R)

b) Circuit to verify Ohm's law

c) i)

ii) $R = \dfrac{\Delta U}{\Delta I} = \dfrac{8 - 2}{2 - 0.5} = 4\ \Omega$

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

Physics I

010

03rd Nov. 2009   08.30 – 11.30 am

ORDINARY LEVEL NATIONAL EXAMINATIONS 2009

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

Show all your working

SECTION A: ANSWER ALL QUESTIONS   (55 MARKS)

1. (a) Why is the density of the ocean water greater than the density of rain water?   **(2 marks)**
   (b) 5000 cm³ of paint has a mass of 6.5 kg. Calculate the density of the paint.   **(2 marks)**

2. (a) What is force?   **(1 mark)**
   (b) Name any 2 types of forces.   **(2 marks)**

3. Give a molecular explanation of why the viscosity of some fluids decreases when the temperature of the liquids increases.   **(2 marks)**

4. The hind tyres of a tractor are larger than those of a car. Give a scientific explanation for this difference.   **(4 marks)**

5. The pressure in water pipe at a mouth of a tap is 3x10³ Pa. What is the height of the water pipe? $g = 10m/s^2$ and the density of water is $1000kg/m^3$.   **(4 marks)**

6. A train increases its speed steadily from 10 m/s to 20 m/s in 1 minute. Find:
   (a) The average speed of the train during this time in m/s.   **(2 marks)**
   (b) The distance the train travels while increasing its speed. **(2 marks)**

7. A tall person is more likely to fall while climbing a mountain than a short person. Why is this possible?   **(3 marks)**

8. (a) How much work is transferred when a load of 5000 N is lifted through a distance of 300 m?   **(2 marks)**
   (b) What is the power of a person weighing 600 N who runs up stairs in 2 s? The stairs are made of 10 steps each 15 cm high.   **(2 marks)**

9. (a) Calculate the K.E for a car of mass 900 kg travelling at a speed of 30 m/s.   **(2 marks)**
   (b) Calculate the potential energy of a mass 900 kg that has been lifted a distance of 20 m. $g = 10N/kg$ **(2 marks)**

10. (a) State any two methods of heat transfer.   **(2 marks)**
    (b) Explain why on a cold day the metal handle bars of a bicycle feel cold than the rubber grips.   **(3 marks)**

11. (a) What is the difference between boiling and evaporation?   **(2 marks)**
    (b) What mass of cold water at $10°C$ should be added to 50 kg of hot water at $90°C$ so that the final temperature of water is $58°C$? The specific heat capacity of water is $4200J/kg.°C$.   **(2 marks)**

12. (a) Which are the types of electric charges?   **(2 marks)**

(b) Find the charge when a current of 4 A flows for 5 minutes.   **(2 marks)**

13. (a) Write the equation linking resistance, potential difference and current.
(2 marks)
(b) Find the potential difference across a 20 Ω resistor if a current of 0.5
A flows.   **(2 marks)**
(c) Why might a filament lamp blow at the moment you switch it on?
(1 mark)

14. What is the use of soft iron pieces called keepers?   **(2 marks)**

15. (a) What is the difference between reflection of light and refraction of light?
(2 marks)
(b) Differentiate between regular reflection of light and diffuse reflection.
(2 marks)

SECTION B: Attempt any THREE questions in this section. (3O marks)

16. (a) Differentiate between a vector quantity and a scalar quantity and give
two examples of each quantity.   **(4 marks)**
(b) What is meant by a non-uniform velocity?   **(1 mark)**
(c) A car moving with a velocity of 10 m/s accelerates uniformly at the rate
of 3 m/s² to reach $34 m/s$ Find:
    i. The time taken.   **(2 marks)**
    ii. The distance travelled in this time.   **(3 marks)**

17. (a) What is meant by
    i) e.m.f of a battery   **(2 marks)**
    ii) Internal resistance of a battery?   **(2 marks)**
(b) A battery of e.m.f 1.50 V has a terminal p.d. of 1.25 V when a resistor
of 25 Ω is joined to it. Calculate the current flowing, the internal
resistance r and the terminal p.d when a resistor of 10 Ohms replaces
the 25 Ω resistor.   **(6 marks)**

18. (a) How can you distinguish between a converging lens and a diverging
one?   **(4 marks)**
(b) Explain the meaning of the focal length of a lens.   **(2 marks)**
(c) Draw a diagram showing how a converging lens can form a real image
the same size as the object.   **(2 marks)**
(d) State any two characteristics of the image formed by a diverging lens.
(2 marks)

19. (a) What is meant by the term heat capacity of a substance? State the unit
of heat capacity.   **(3 marks)**
(b) The food takes longer to cook in boiling water at higher point on a
mountain than at bottom of a mountain. Explain.   **(4 marks)**
(c) Why does the water have maximum density at $4°C$?   **(1 mark)**
(d) 9.9x10⁵ J of heat is required to change 3 kg of ice at $0°C$ to water at
$0°C$. Find the specific latent heat of fusion of ice.   **(2 marks)**

20. (a) Why is electricity transmitted at high voltages? **(2 marks)**
    (b) Explain the work of transformers. **(5 marks)**
    (c) Main electricity supply is dangerous. How is it made safe to use?
    (3 marks)

SECTION C: Attempt one question from this section. (15 MARKS)

21. The table 1 represents the variation of time with velocity of moving body.

Time (s)	Velocity (m/s)
0	0
2	5
4	10
6	15
8	20

Table 1

    (a) Plot a velocity-time graph (velocity along Y-axis and time along X-axis) using the data in table 1. **(9 marks)**
    (b) Show on the graph how you determine the gradient of the graph.
    (3 marks)
    (c) Calculate the gradient. **(2 marks)**
    (d) What does this gradient represent? **(1 mark)**

22. A student heated some water and recorded temperature, $\theta°C$, and corresponding time, t minutes. See table 2.

Time, t (minutes)	Temperature θ (°C)
2	35
4	44
8	65
12	86
14	95
16	95

Table 2

    (a) Plot a graph of temperature, $\theta°C$ (along Y-axis) against time, t minutes (along X-axis). Use data in table 2. **(9 marks)**
    (b) Draw the best fit line and show how you determine the gradient of the graph. **(3 marks)**
    (c) Calculate the gradient. **(2 marks)**
    (d) What is the initial temperature of the water? **(1 mark)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2009

Section A: Answer all questions

1. (a) The ocean water contains minerals which has greater density than density of rain water which is pure.

   (b) $Density = \frac{m}{V} = \frac{6.5}{0.005} = 1\ 300\ kg/m^3$

2. (a) Force is something which tries or tends to change an object's state of rest (**static effect**) or that of uniform motion (**dynamic static**) in straight line. It is also defined as a push or a pull on a body. Whenever there is an interaction between two objects, there is a force upon each of the objects.

   (b) Friction Force, gravitational force, Spring Force, Nuclear Forces, Electrical forces, Magnetic forces

3. As the temperature increases, the particles gain more energy and the vibration between them becomes more rapid.

4. A bus or truck is heavy. It may have large tires, so that its weight is spread over a large area. This means that the pressure on the ground is reduced; so it is less likely to sink in soft ground.

5. $P = \rho gh \leftrightarrow height: h = \frac{P}{\rho g} = \frac{3\ 000}{1\ 000 \times 10} = 0.3\ m$

6. A train increases its speed steadily from 10 m/s to 20 m/s in 1 minute. Find:

   (a) The average speed of the train during this time $V = \frac{10+20}{2} = 15m/s$

   (b) The distance the train travels while increasing its speed:

   $S = V \times t = 15 \times 1 = 15m$

7. The center of gravity of a tall person is high and makes him to be unstable; hence he is therefore likely to fall down. Or the center of gravity of a tall person is high. A slight force would exert turning force out of the body of a tall person and hence fall down.

8. (a) Work transferred $W = Fd = 5000 \times 300 = 1500\ KJ$

   (b) The power of a person $P = \frac{Wd}{t} = \frac{600 \times 10 \times 0.15}{2} = 450\ W$

9. (a) The K.E for this car $KE = \frac{1}{2}mV^2 = \frac{1}{2} \times 900 \times 30^2 = 405\ 000\ J$

   (b) The potential energy of that mass: $= 900 \times 10 \times 20 = 180\ 000\ J$

10. (a) Conduction, convection and radiation
    (b) The metal handle bar of a bicycle is a good conductor of heat and it can also lose heat fast to the cold surrounding so at cold day the metal handle bar of a bicycle feels colder. Or the rubber grip is poor conductor of heat so the metal handle bar of a bicycle cannot lose heat or gain it so it does not feel cold as the metal handle bar of a bicycle.

11. a)

Boiling (Vaporization)	Evaporation
Occurs at the surface and inside the liquid.	Occurs only at the surface of the liquid.
Occurs when the liquid attains its boiling point at the same pressure.	Takes at all temperature below the boiling point.
Temperature does not change during boiling.	Temperature may be change during evaporation

(b) $m_1(t_f - t_1) + m_2(t_f - t_2) = 0$

$$m_1 = \frac{m_2(t_f - t_2)}{t_f - t_1} = \frac{50(90-58)}{58-10} = 50 \, kg$$

12. (a) Positive charges and negative charges.
    (b) Q = It = 4 × 5 × 60 = 1 200 C

13. (a) Ohm's law: U = IR
    (b) U = IR = 0.5 × 20 = 10 V
    (c) The electrons which light the bulb in a flashlight do not have to first travel from the switch to the filament. Rather, the electrons which light the bulb immediately after the switch is turned to on are the electrons which are present in the filament itself. As the switch is flipped, all mobile electrons everywhere begin marching; and it is the mobile electrons present in the filament whose motion are immediately responsible for the lighting of its bulb. As those electrons leave the filament, new electrons enter and become the ones which are responsible for lighting the bulb.

14. These keepers become strong induced magnets, and the opposite induced poles at their ends neutralize the poles of the bar magnets. In other words the magnetic dipoles in domains of both magnets and keepers form closed loops with no free poles. Consequently the demagnetizing effect disappears.

15. (a) The change of direction or bending of light passes from one material or medium to another is called **refraction** while When light rays hit the smooth surface of a mirror, they bounce off in a straight line.

*(b) If a parallel beam of light falls on a plane mirror it is reflected as a parallel beam and **regular reflection** (specular reflection) is said to occur. Most surfaces however **reflect light irregularly and the rays in an incident parallel beam are reflected in many directions**. Reflection by a rough surface such as paper of the book is irregular and is **called irregular or diffuse reflection**.*

The diagram below depicts two beams of light incident upon a rough and a smooth surface.

A regular reflection   A diffuse reflection
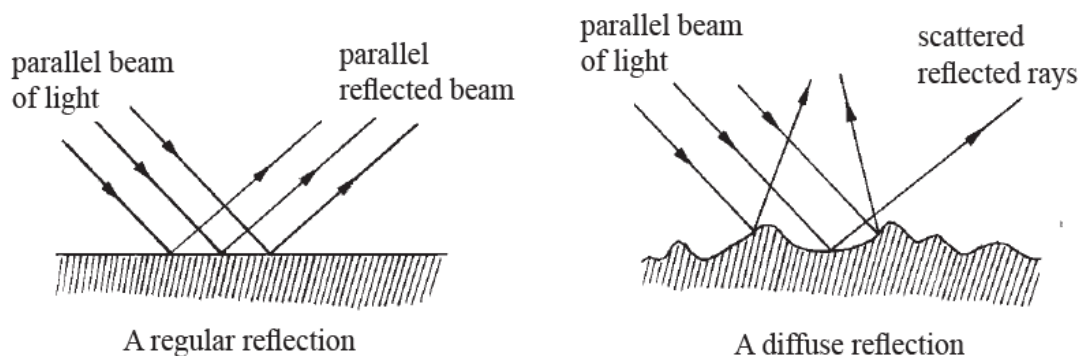
SECTION B: Attempt any THREE questions in this section

16. *(a) A **scalar quantity** is defined by its magnitude only. It is non-directional in nature. Thus area is a scalar quantity because when stating an area we do not have to state the direction of the area. Other examples of scalars are: mass, length, time, density, volume, speed, etc.*

*All quantities that have both the magnitude and direction of measurement are called **vector quantities**. Examples of vectors are: weight, velocity, acceleration, etc.*

*(b) A body is said to move with **non-uniform velocity** if its rate of change of distance moved with time in a specified direction is not constant.*

(c) (i) The time taken: $t = \frac{v-u}{a} = \frac{34-10}{3} = 8\ s$

(ii) The distance travelled: $s = \frac{1}{2}at^2 + ut = \frac{1}{2} \times 3 \times 8^2 + 10 \times 8 = 176\ m$

17. *(a) (i) The e.m.f of a generator is the potential difference across the terminals of the generator (battery or cell) in an open circuit.*

*(ii) The **internal resistance** of an active receptor is the measure of its capacity to absorb heat energy by the joule effect when a current is flowing through it.*

(b) $U = RI \leftrightarrow I = \frac{U}{R} = \frac{1.25}{25} = 0.05\ A$

Internal resistance: $r = \frac{e-U}{I} = \frac{1.50-1.25}{0.05} = 5\ \Omega$

Electric current: $I = \frac{U}{R} = \frac{U}{10}$

The terminal pd $U = e - \frac{r \times U}{10} = 1.5 - \frac{5 \times U}{10} \leftrightarrow U = 1\ V$

18. (a) *Parallel incident rays to the converging lens meet at a point while Parallel incident rays to the diverging lens diverge as they emerge out of the lens*
(b) Focal length of a lens is distance between focal point and optical center of lens.
(c) The object is located at 2F, the image is: at 2 F, real, inverted and the same size as object.
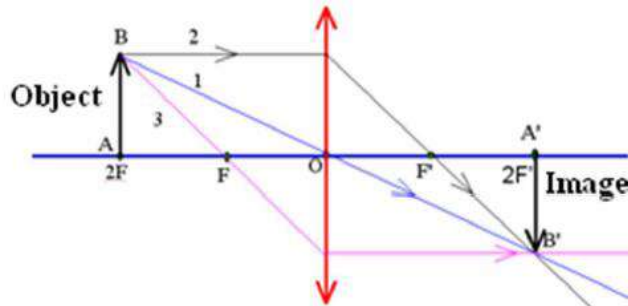
(d) Inverted or erect, virtual or real, enlarged or reduced.

19. (a) *The heat capacity of a body is the heat required to rise its temperature by 1K. The SI unit of heat capacity is J/K*
The heat capacity μ of an object is the proportionality constant between the heat Q that the object absorbs or loses and the resulting temperature change of the object. That is, $Q = \mu\Delta T = \mu(T_f - T_i)$
(b) The boiling point of water at the bottom of a mountain is higher than that at the high point of a mountain.
(c) The water has minimum volume at $4°C$.
(d) The specific latent heat of fusion of ice: $L_f = \frac{Q}{m} = \frac{990\,000}{3} = 330\,000\,J/Kg$

20. (a) *The power delivered to the factory is P = UI. The economy requires the waste power, $P = I^2R$ to be small but it also requires the cables to be thin, and therefore cheap to buy and connect. So the economical way to transmit the power is to make current I as small as possible, this means making the potential difference U as high as possible.*
(b) A transformer is an electric device that transfers electrical energy from one circuit to another by electromagnetic induction. In transferring this energy, a transformer steps up or steps down the voltage or electromotive force from the source. By switching the current on and off in one coil, an electromotive force is induced in another coil. The circuit that induces the electromotive force is called the primary circuit, while the circuit where the electromotive force is induced is called the secondary circuit. Although the two coils are not connected, changes in current in the primary circuit induces an electromotive force in the secondary circuit.
(c) Each circuit has a fuse or cut out which opens it automatically when current is higher than some defined value. The neutral wire is earthed by the electricity supplier company. The current is again closed with help of a switch.

SECTION C: Attempt one question from this section.

21. *(a) and (b)*
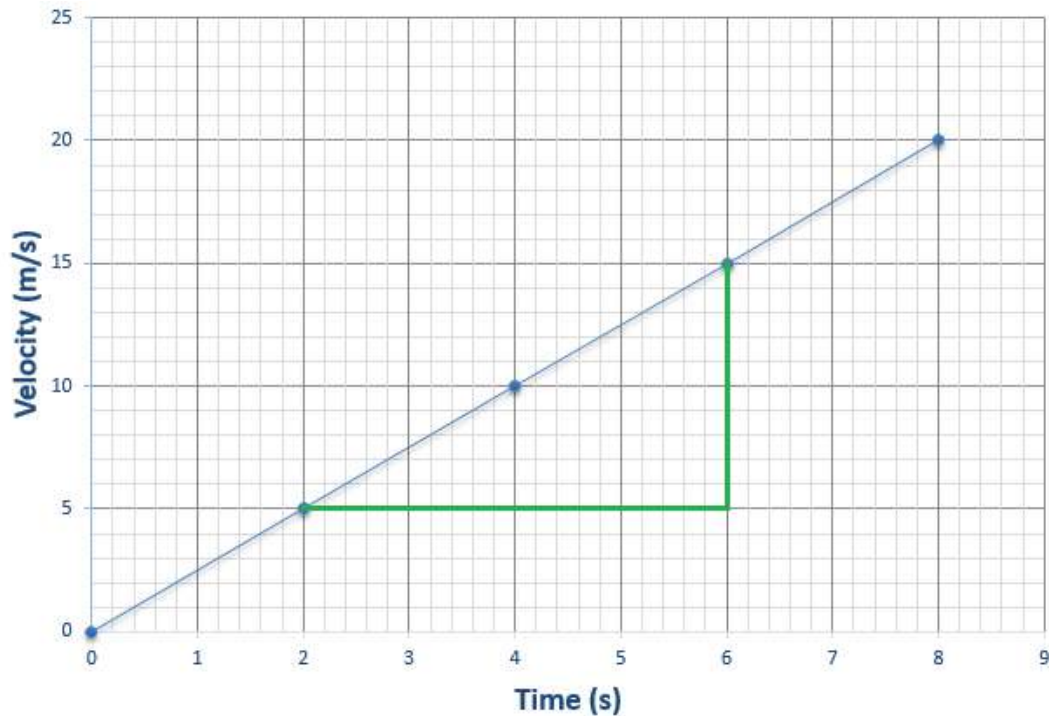
(c) Gradient: $grad = \dfrac{\nabla v}{\Delta t} = \dfrac{15-5}{6-2} = \dfrac{10}{4} = 2.5$

(d) It represents the acceleration

22. *(a) and (b) Graph of temperature, $\theta °C$ (along Y-axis) against time, t minutes (along X-axis).*
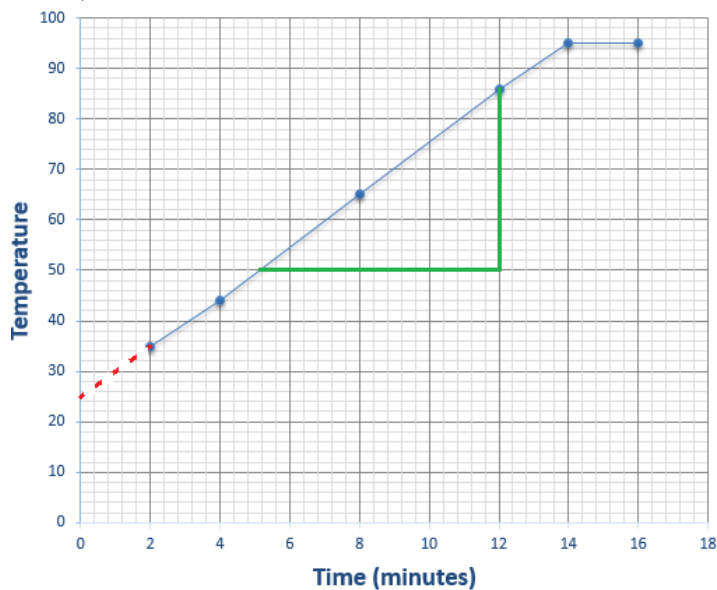
(c) The gradient is $grad = \dfrac{86-50}{12-4.5} = \dfrac{45}{5} = 5$

(d) θ = 24.5°C.

RWANDA NATIONAL EXAMINATIONS COUNCIL

P.O BOX 3817 KIGALI-TEL/FAX : 586871

ORDINARY LEVEL NATIONAL EXAMINATIONS 2010

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

SECTION A: ANSWER ALL QUESTIONS   (55 MARKS)

1. Explain what is meant by average speed. State the unit of average speed.
                                                    (3 marks)

2. A force of 25 N acts on mass of 5 kg starting from the rest. Find the acceleration.   **(3 marks)**

3. What is the difference between mass and weight? State the unit of each quantity.   **(4 marks)**

4. Draw a cone (a) In a stable equilibrium, (b) In unstable equilibrium and (c) In a neutral equilibrium.   **(3 marks)**

5. Calculate the power of a pump which can lift 300 kg of water through a vertical height of 8 m in 10 s, g = 10 m/s^2.   **(3 marks)**

6. (a) What is meant by the term density of body?   **(2 marks)**
   (b) A body has a volume of 15 cm^3 and mass of 27 g what is its density? Give the answer in kg/m^3.   **(3 marks)**

7. The diagram shows a balancing uniform rod. Calculate force W. **(4 marks)**
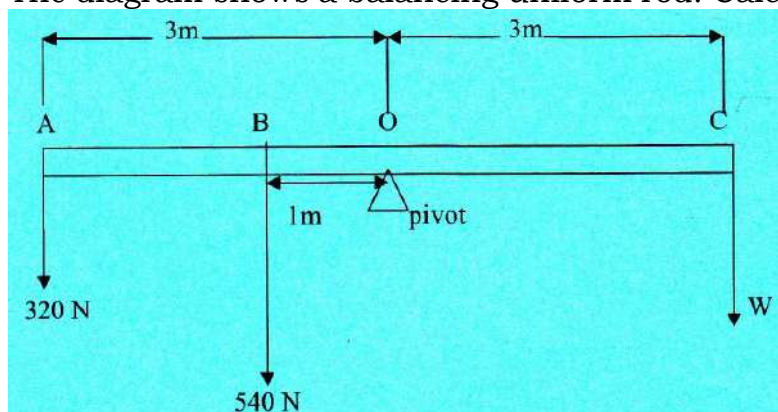
8. Show how a ray of light from the air passes through a glass block and explain why the ray behaves as you have shown in your diagram.
                                                    (5 marks)
9. Draw an electric circuit composed of a dry cell, connectors, a resistors, ammeter and voltmeter to read the voltage across the resistor. **(4 marks)**

10. A student dropped iron filings into sugar bowl by accident. Explain how sugar can be separated from the mixture.   **(3 marks)**

11. (a) List energy changes which occur when a torch is switched on.
                                                    (2 marks)
    b) Which are other sources of electricity other than hydroelectric power in Rwanda?   **(3 marks)**

12. Two cells each having an e.m.f of 1.5 V and internal resistances of 2 Ω are connected (a) In parallel and (b) In series. Find the current in each case when the cells are connected to a 1 Ω resistor. **(4 marks)**

13. (a) State Archimedes 'principle. **(2 marks)**
    b) A piece of a metal is weighed
        i. In air
        ii. Fully submerged in water
        iii. Fully submerged in a salt solution
    The results obtained, but not in correct order, were 6 N, 5 N and 8 N.
    Which reading was obtained for b (i), b (ii) and b (iii)? **(3 marks)**

14. Explain how heat is transferred in water. **(4 marks)**

Section B: Answer only THREE questions (30 marks)

15. (a) Define the term specific heat capacity of a substance. **(3 marks)**
    (b) A piece of Aluminium of mass 600 g is heated from 25°C to 100°C. How much heat is supplied if the specific heat capacity of aluminium 900 J/kg.K? What is the heat capacity of this metal? **(7 marks)**

16. (a) What is meant by
        (i) Potential energy? **(2 marks)**
        (ii) Kinetic energy? **(2 marks)**
    (b) An orange of mass 80 g falls from its tree 2 m high above the ground. Calculate the potential energy of the orange before it falls its tree.
    Find the kinetic energy of the orange as it hits the ground. **(6 marks)**

17. (a) Distinguish between a converging lens and diverging lens. **(3 marks)**
    (b) What is meant by the term focal point of a lens? **(1 mark)**
    (c) An object 1 m tall stands vertically on the principal axis of a converging lens of focal length 4 cm. Determine the nature of the image if the object is 8 cm from the optical center of the lens. **(6 marks)**

18. (a) Which instrument would you use to measure atmospheric pressure?
    (1 mark)
    (b) With aid of a diagram show and explain that air of atmosphere exerts force. **(7 marks)**
    (c) Calculates the pressure exerted by water at 10 m below the surface of the water in a lake. $g = 10N / kg$ and density 1000 kg/m³. **(2 marks)**

19. A car of mass 15000 kg travelling at 72 km/h is brought to rest in 5 s. Find
    (a) The average deceleration **(4 marks)**
    (b) The average breaking force. **(3 marks)**
    (c) The distance moved during the deceleration **(3 marks)**

Section C: Answer only ONE question. (15 marks)

20. (a) Draw a labelled electric diagram which you can use to determine the unknown resistor in a circuit. **(4 marks)**
    (b) A student carried out an experiment to determine the resistance of a conductor.
    The table shows the results obtained:

Potential difference /V	Current / A
1.2	0.6
2.2	1.1
4.0	2.0
6.4	3.2

    (i) Plot a graph (potential difference along Y-axis and current along X-axis). **(7 marks)**
    (ii) What law may be determined from the graph? **(1 mark)**
    (iii) Find the resistance of the conductor from the graph. **(3 marks)**

21. A student curried out an experiment to determine the density of a liquid. Different masses of the liquid were measured and their respective volumes. The table below shows the results obtained.

Mass /g	Volume / cm³
4	5
8	10
12	15
16	20
20	25
24	30

(a) Plot a graph of mass (Y-axis) against volume (X-axis). **(9 marks)**
(b) Does the graph start from the origin? Explain your answer. **(4 marks)**
(c) Determine the density of the liquid from the graph.
Show on the graph how you get your answer. **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2010

Section A: Answer all questions

1. The speed of a car keeps on changing at different instants, It never constants, so average speed is that obtained when the total distance covered in any direction divided by the total time taken to cover the distance. Or $v = \frac{d}{t}$ where v is average speed, d total distance covered and t time taken to cover the distance. The unit of average speed is m/s.

2. Data and unknown: F = 25N; m = 5kg; a = ?
   Using Newton's second law: $F = ma \Longleftrightarrow a = \frac{F}{m} = \frac{25}{5} = 5m/s^2$

3.

Mass	Weight
Is constant regardless of the area.	Change with altitude and location.
Is a scalar quantity	Is a vector quantity
Quantity of matter in body.	Is force of gravity acting on body
Is measured in kg	Is measured in Newton
Is measured by a balance.	Is measured by Newton balance

4. Types of equilibrium

Stable   Unstable   Neutral equilibrium
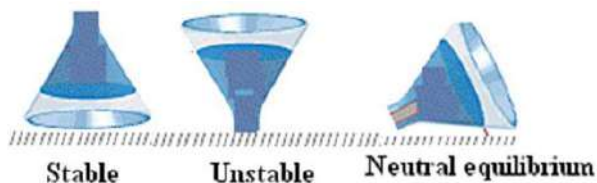
5. Work done: $W = mgh = 300 \times 10 \times 8 = 24000\ J$
   Power: $P = \frac{W}{t} = \frac{24\ 000}{10} = 2\ 400\ W$

6. (a) Density of body is the quantity of matter in a body or $\rho = \frac{m}{V}$ where ρ is density, m is mass and V is the volume. Unit of density is kg/m^3.
   (b) Data: $m = 27g = 27 \times 10^{-3} kg$, $V = 15cm^3 = 15 \times 10^{-6} m^3$
   $$\rho = \frac{m}{V} = \frac{27 \times 10^{-3}}{15 \times 10^{-6}} = 1\ 800 kg/m^3$$

7. Anticlockwise moment = clockwise moment

   $320 \times 3 + 540 \times 1 = W \times 3 \Rightarrow W = 500N$

8.
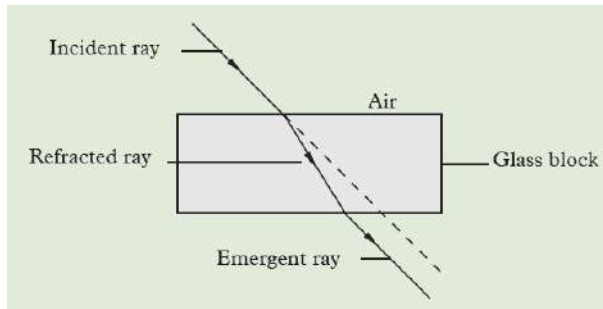
 A light as it enters the glass block its speed changes hence the direction changes so is the case when the refracted emerges from the block to the air. Incident ray and refracted ray are parallel.

9.
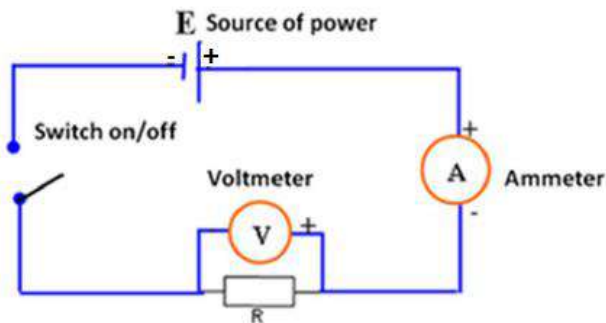
10. *Iron filings are attracted by a magnet while sugar is not attracted by a magnet use a magnet to pick iron filings from the mixture by holding the magnet close to the mixture.*

11. *(a) Mechanical energy; chemical energy; electrical energy; heat energy and light energy*
    (b) Generators, solar, batteries, etc.

12. *(a) In parallel*
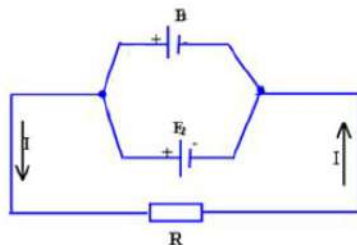
$$R_{eq} = r_{eq} + R = \frac{r_1 r_2}{r_1 + r_2} + R = \frac{2 \times 2}{2 + 2} + 1 = 2\Omega$$

$$I = \frac{E}{R_{eq}} = \frac{1.5}{2} = 0.75A$$

(b) In series
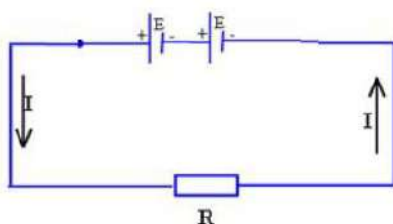
$$R_{eq} = r_{eq} + R = r_1 + r_2 + R = 2 + 2 + 1 = 5\Omega$$

$$I = \frac{E}{R_{eq}} = \frac{1.5}{5} = 0.6A$$

13. (a) According to **Archimedes' principle**, *"Any non-porous object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object. The volume of fluid displaced is equal to the volume of the portion of the object submerged."*
(b) (i) 8N, (ii) 6N (iii) 5N

14. *Heat travels through water by convection method. Heat is applied under the container of water. Water at the bottom becomes hot and its density reduces hence rises to the top of the container. The denser cold water at the top goes down to the bottom where it is also heated. This water also becomes hot and rises creating streams of warm water called convection currents.*
Or
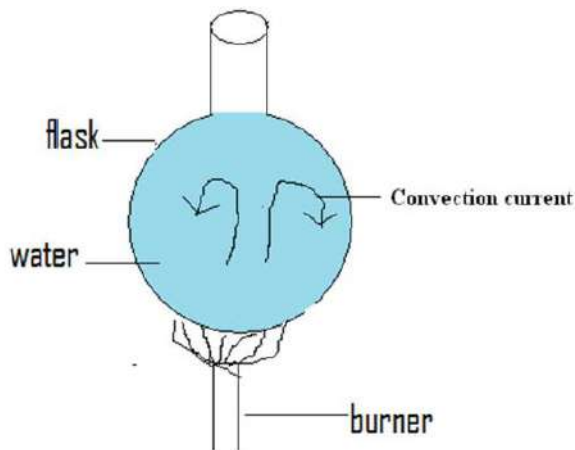
SECTION B: ANSWER ONLY THREE QUESTIONS

15. *(a) Specific heat capacity is the quantity of heat required to raise the temperature of 1 kg of a substance by 1°C or 1 K. Its unit: J/Kg°C or J/kg.K*

(b) Data m = 600g = 0.6 kg; $\Delta t = 100°C – 25°C = 75°C$; c = 900J / kg.K
Heat applied: $Q = mc\Delta t = 0.6 \times 900 \times 75 = 40\ 500\ J$
Heat capacity: $\mu = \frac{Q}{\Delta t} = mc = 0.6 \times 900 = 540\ J/K$

16. *(a) (i) Potential energy is the energy possessed by the body because of its position. E.g. a body above the earth's surface has potential energy stored in the form of gravitational potential energy. A spring wound up has a potential energy because of its strained condition.*
(ii) Kinetic energy is that energy possessed by the body because of its motion.
(b) Data: m = 80g = 0.08kg; $g = 10m/s^2$; h = 2m
Potential energy: P.E = mgh = 0.08 X 10 X 2 = 1.6 J
Kinetic energy = Potential energy at the ground
          i.e K.E = mgh = 0.08 X 10 X 2 = 1.6 J

17. (a) **A converging lens:** *Parallel incident rays to the lens meet at a Point.*
    A diverging lens: *Parallel incident rays to the lens diverge as they emerge out of the lens.*
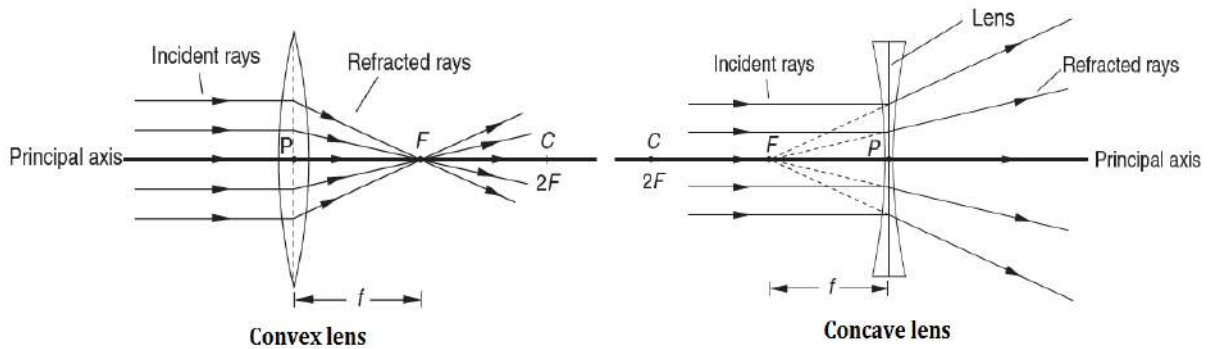
(b) *Focal point of a lens is a point where rays refracted by a lens meet. In convex lens the focal point is real and in concave lens is virtual.*
(c) *Image is beyond 2F, real, inverted and larger than object 2cm. see graph*

$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Rightarrow q=\frac{fp}{p-f}=\frac{6\times4}{6-4}=12cm$$

$$\gamma=-\frac{q}{p}=\frac{h'}{h} \Leftrightarrow h'=-\frac{qh}{p}=-\frac{12\times100}{6}=-200cm$$
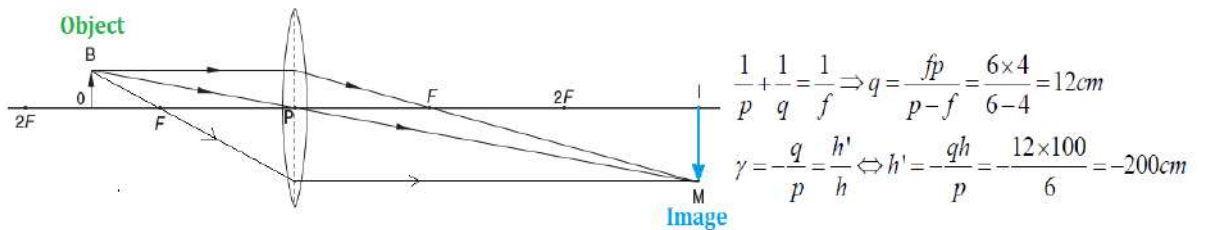
18. (a) *A barometer*
    (b) *Use a crashing can experience or any other experiment.*
    Inverting a glass of water
    Prove of existence of atmospheric pressure by inverting a glass of water covered by a sheet of paper when the glass was turned downwards, water remained inside. Atmospheric pressure keeps the paper into contact with the upturned glass, thus keeping the water in the glass.
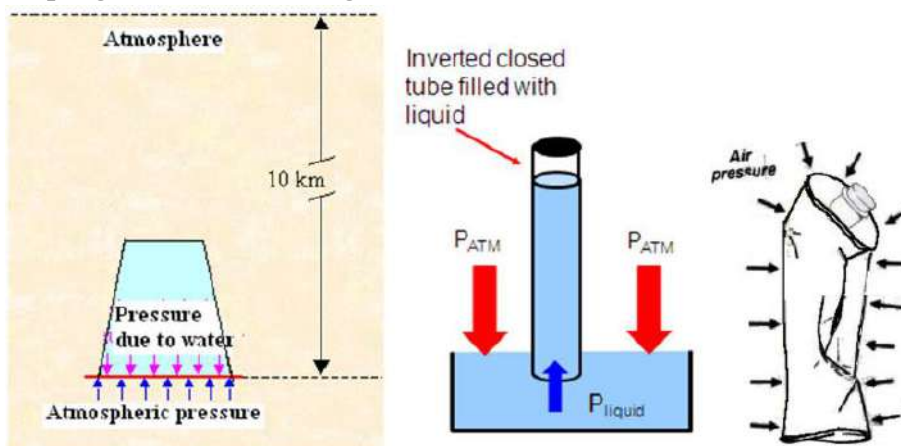
(c) *P = ρgh = 1 000 X 10 X 10 = 100 000 Pa*

19. (a) *Data: u = 72 km/h = 20 m/s; v = 0 m/s*

$$a = \frac{0-20}{5} = -4m/s^2$$

Average deceleration is $4m/s^2$

(b) *Force: F = ma = 1 500 X (-4) = - 600 N*

   Braking force is 6000 N

(c) $v^2 = u^2 + 2as \iff s = \frac{v^2-u^2}{2a} = \frac{0^2-20^2}{2\times4} = 50\ m$

   The distance travelled is 50 m.

SECTION C: ANSWER ONLY ONE QUESTION

20. (a) *Labelled electric diagram to determine the unknown resistor in circuit.*
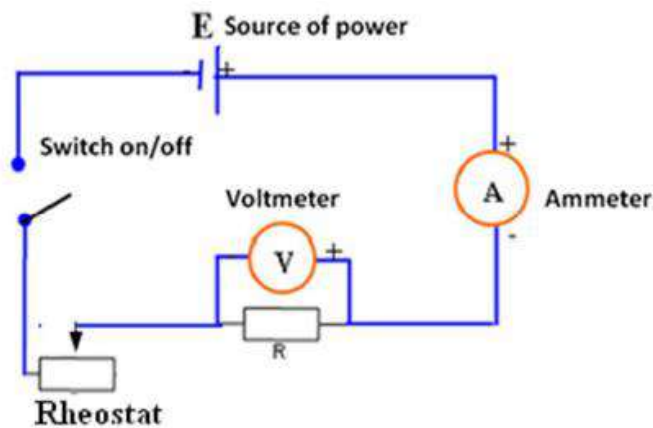
(b) (i) *The graph of V against I*
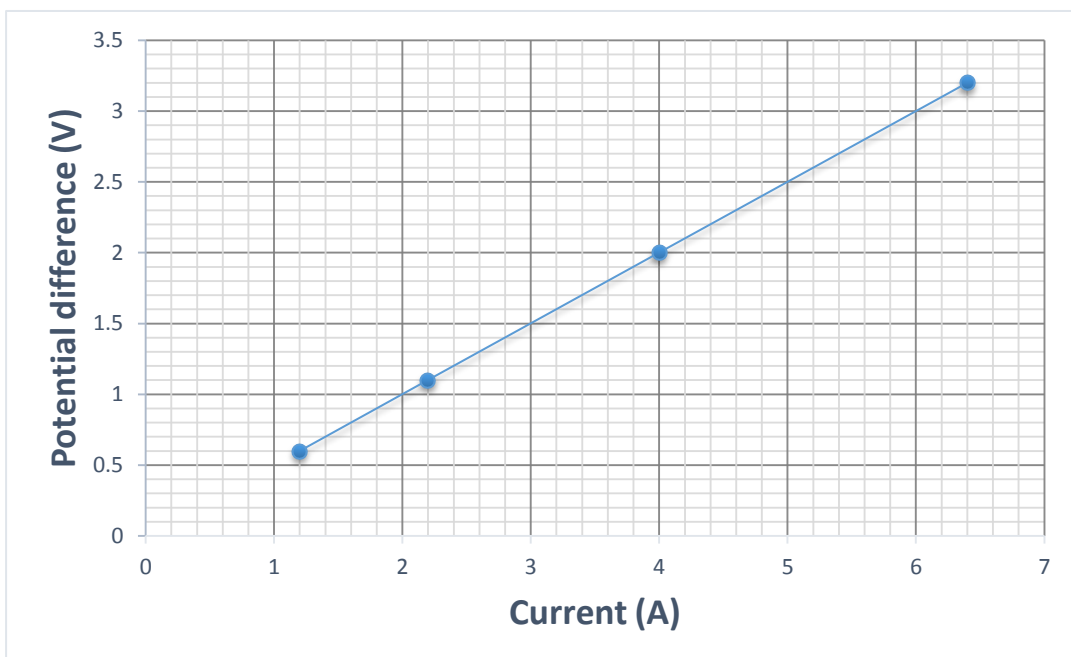
(ii) *Ohm's law*

(iii) *Increase in V:* ΔV = 6.4 - 1.0 = 5.4 V

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Increase in I: $\Delta I = 3.2 - 0.5 = 2.7\ A$

Resistance: $R = \frac{\Delta V}{\Delta I} = \frac{5.4\ V}{2.7\ A} = 2\ \Omega$

21. *(a) Graph of mass against volume*
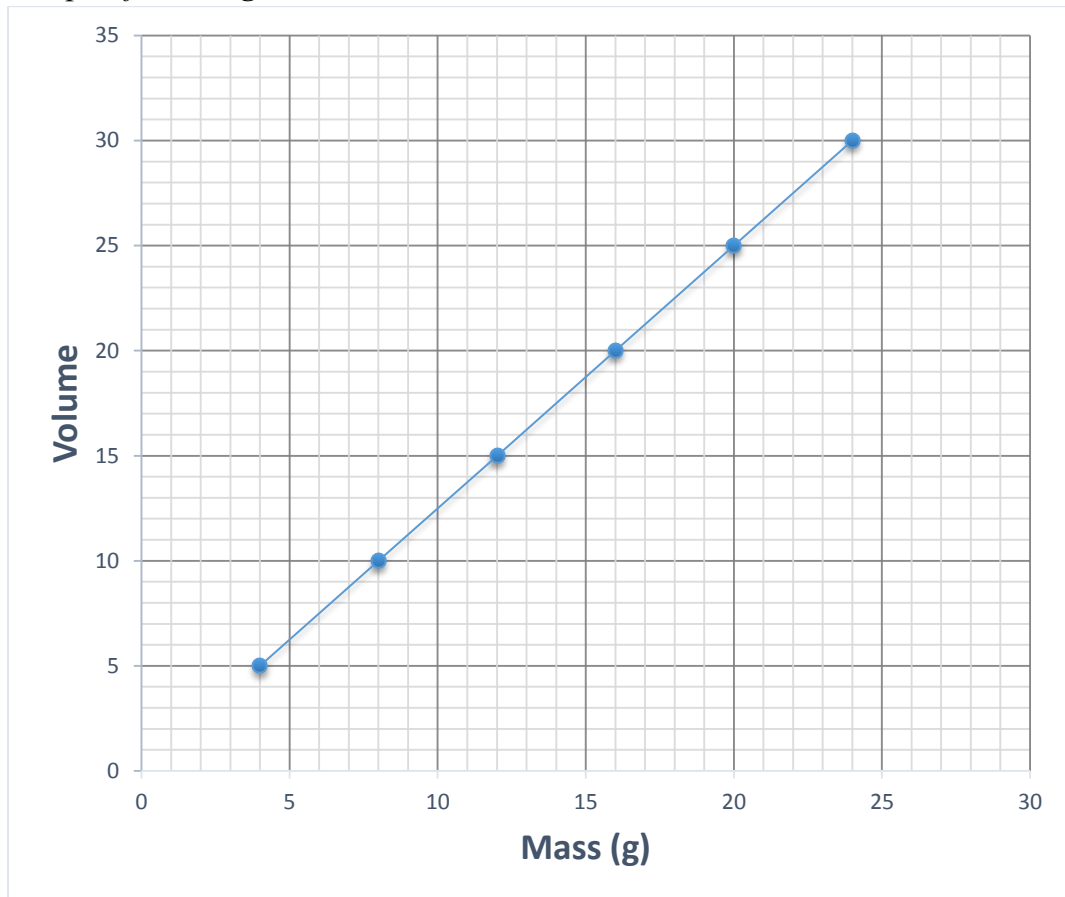
(b) The graph should not go through the origin. It is meaningless. Zero mass has zero volume and zero divided by zero is meaningless.

(c) Density of the liquid = increase mass over increase volume

$\rho = \frac{m}{V} = \frac{\Delta m}{\Delta V} = \frac{20\ g}{25\ cm^3} = 0.8\ g/cm^3$

Physics I
010
03 Nov. 2011 08.30 am – 11.30 am

ORDINARY LEVEL NATIONAL EXAMINATIONS 2011

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.   **(55 marks)**

Answer **THREE** questions in section B.   **(30 marks)**

Answer only **one** question in section C   **(15 marks)**

You may use a calculator and mathematical instruments.

SECTION A: Attempt all questions from this section. (55 marks)

1. (a) What is meant by the term resistivity? **(2 marks)**
   (b) Write an equation for resistivity. **(1 mark)**

2. State effects of electric current and give an example of each effect. **(4 marks)**

3. Draw a labelled diagram of a periscope and use light rays to explain how it functions. **(4 marks)**

4. What is the difference between a vector quantity and a scalar quantity? Give an example of each quantity. **(4 marks)**

5. (a) Sketch a distance-time graph showing
   (i) A motion of a body moving with uniform velocity. **(2 marks)**
   (ii) A body moving with non-uniform velocity. **(2 marks)**
   (b) A car starts from rest and is accelerated uniformly at the rate of $3m/s^2$ for 8 s. Find the distance travelled. **(2 marks)**

6. (a) Explain the term induced magnetism. **(2 marks)**
   (b) Mention one method of demagnetizing a magnet. **(1 mark)**

7. Why is a tall person more likely to fall down while climbing a mountain? **(4 marks)**

8. Identify the interchange of energy between potential energy and kinetic energy for a swinging pendulum bob. **(3 marks)**

9. (a) Friction is useful in our daily lives. Mention two examples to justify this statement. **(2 marks)**
   (b) What causes friction and how can it be prevented? **(2 marks)**

10. What do you understand by each of the following terms?
    (a) Angular velocity. **(1 mark)**
    (b) A period of swinging pendulum bob. **(1 mark)**
    (c) Frequency of a swing pendulum bob. **(1 mark)**

11. (a) State factors influencing pressure in a liquid at a point in a liquid in equilibrium. **(2 marks)**
    (b) With the aid of a diagram show that water finds its own level. **(2 marks)**

12. (a) A load 600 N is raised 0.3 m by a machine. If the effort applied is 200 N and it moves 1 m, find the efficiency of the machine. **(2 marks)**
    (b) Why is the efficiency of a machine not a hundred percent? **(2 marks)**

13. Why does an iron left outside at night feel colder than a piece of dry wood? **(4 marks)**

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14. In the electric circuit below, what will be the reading of the ammeter if S_2 is:
    (a) Open and S_1 closed? **(2 marks)**
    (b) Closed and S_1 closed? **(3 marks)**
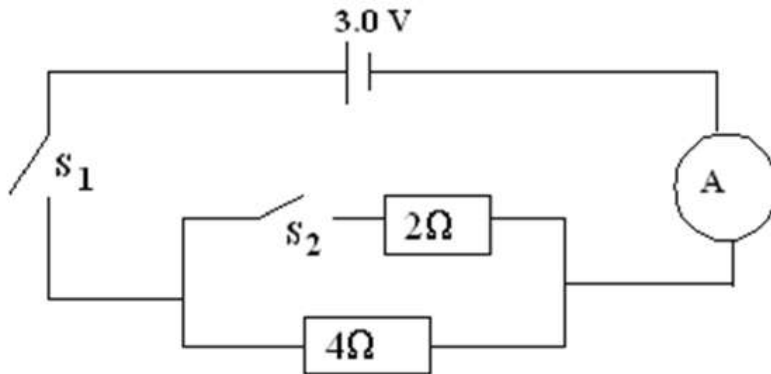
SECTION B: Attempt any THREE questions only. (30 marks)

15. (a) What is meant by the term real image as applied to optics. **(2 marks)**
    (b) Distinguish between a concave mirror and a convex mirror. Give one application of each type of mirror. **(3 marks)**
    (c) An object is placed vertically at the center of curvature of a concave mirror.
       (i) Use rays and draw a diagram to show how the image of this object is formed. **(3 marks)**
       (ii) State the characteristics of this image. **(2 marks)**

16. (a) What effect does increase in pressure have on the melting point of ice? **(2 marks)**
    (b) State two physical properties of water which change with temperature. **(2 marks)**
    (c) How much heat is needed to raise the temperature of a body with mass 4 kg by $8°C$? The specific heat capacity of the body is $300J/kg.K$ **(2 marks)**
    (d) Find the amount of heat required to melt 100 g of lead initially at $25°C$ if the melting point of lead is $327°C$. Specific heat capacity of lead is $140J/kg.K$. Specific latent heat of fusion of lead is $2.7 \times 10^5 \, J/kg.$ **(4 marks)**

17. (a) Describe how you would use a gold leaf electroscope to determine the sign of the charges on a given charged body. **(4 marks)**
    (b) Explain how an insulator gets charged. **(2 marks)**
    (c) Describe how a lightning conductor safeguards a tall building from being struck by lightning. **(4 marks)**

18. (a) What is inertia? **(2 marks)**
    (b) With aid of a diagram explain how you can demonstrate inertia effect. **(4 marks)**
    (c) State Newton's second law of motion. **(1 mark)**
    (d) A block of mass 5000 g is pulled from rest on a horizontal frictionless surface by a constant force F. If the block travels 8 m in 2 s, find:
       (i) Acceleration **(1.5 marks)**

(ii) Force F. **(1.5 marks)**

19. (a) Differentiate between primary cells and secondary cells. **(2 marks)**
    (b) What are the components of a simple direct current electric motor?
    (3 marks)
    (c) Explain the term back e.m.f (electromotive force) of battery? **(2 marks)**
    (d) What is the difference between a pratical d.c motor and a simple d.c motor? **(3 marks)**

SECTION C: Attempt only ONE question. **(15 marks)**

20. Describe how you can verify the law of refraction of light (SNELL'S LAW) using the following apparatus: rectangular glass block, optical pins, plain paper, drawing pins, a ruler and a protractor. Illustrate your methods with aid of a diagram and show how you come to the conclusion. **(15 marks)**

21. Describe how you can determine the density of an irregular stone using the following apparatus: Eureka can, water, a small irregular stone, a thread, beam balance, measuring cylinder and a beaker. State sources of errors and all precautions you take to avoid errors in your experiment.
    (15 marks)

MARKING SCHEME OF ORDINARY LEVEL PHYSICS
NATIONAL EXAMINATION 2011

Section A: Answer all questions

1. *(a) Resistivity is the ability of a conductor which opposes the flow of current in a resistor. Or it is numerically equal to the resistance of 1 m length of it of cross section area 1 m^2.*
   Or it is a constant characterizing the nature of an electric conductor
   Or it is a specific resistance of a material conductor.
   (b) $\rho = \dfrac{RA}{L}$

2. **Heat effect:** *electric iron, electric kettle, filament, immersion heater.*
   Light effect: *electric bulb, florescent tubes.*
   Magnetic effect: *electric motor, electric bell, loudspeaker*
   Chemical effect: *electrolysis during electroplating*
   Physical effect: *electrocution.*

3. *A simple periscope consists of a tube containing two plane mirrors, fixed parallel to and facing one another. Each makes an angle of 450 with the line joining them. Light from the object behind a tall obstacle is turned through 900 at each reflection and an observer is able to see over the top of an obstacle.*
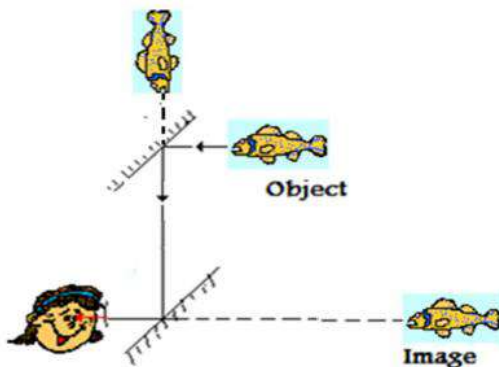
4. *A* **scalar quantity** *is defined by its magnitude only. It is non-directional in nature. Thus area is a scalar quantity because when stating an area we do not have to state the direction of the area. Other examples of scalars are: mass, length, time, density, volume, speed, etc. All quantities that have both the magnitude and direction of measurement are called* **vector quantities***. Examples of vectors are: weight, velocity, acceleration, etc.*

5. *(a)*
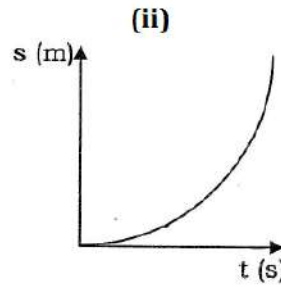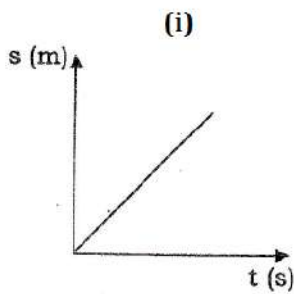
(b) $s = \frac{1}{2}at^2 + ut = \frac{1}{2} \times 3 \times 8^2 = 96\ m$

6. *(a) When a piece of unmagnetized steel or other ferromagnetic body is placed either near to or in contact with a pole of a magnet and then removed it is found to be magnetized i.e. it becomes a magnet itself. This is called induced magnetism. The material is said to have induced magnetism in it. Tests with a compass needle show that the induced pole nearest the magnet is of opposite sign to that of the inducing pole.*

   (b) Heating; Placing it inside a solenoid through which AC is flowing; Hammering the magnet when pointing E - W direction; Keeping like pole together for a long time.

7. *The center of gravity of a tall person is high and makes him to be unstable, hence he is therefore likely to fall down. Or the center of gravity of a tall person is high. A slight force would exert turning force out of the body of a tall person and hence fall down.*

8. *Simple pendulum*
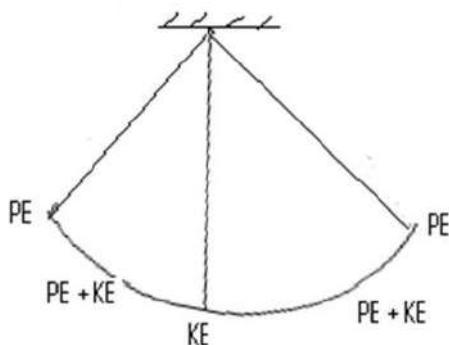
9. *(a) Friction is very important because it enables us to move, to write, to make fire.*
   (b) ***Causes of friction:*** *Rough surfaces*
   Prevention: *The moving machine parts are always oiled or greased. This helps one to slip more easily over the other. The liquid is usually oil, which we refer to*

as a lubricant (reduce friction by separating two contacting surfaces with an intermediate layer of softer material). And we call the effect lubrication.

10. *(a)* ***Angular velocity*** *describes rate of rotation. It is defined as the ratio of the angular displacement to the time interval:* $\omega = \frac{\Delta\theta}{\Delta t}$
Or angular coordinate per unit time
(b) The period T of an object revolving in a circle is the time required for one complete revolution.
(c) Frequency f is the number of revolutions per second. $f = \frac{1}{T} = \frac{\omega}{2\pi}$

11. *(a) Density and depth*
(b) Pascal's vases

12. *(a) Work done by loads:* $W_L = Ld_L = 600 \times 0.30 = 180\,J$
Work done by effort: $W_E = Ed_E = 200 \times 1 = 200\,J$
Efficiency: $\eta = \frac{W_L}{W_E} = \frac{180}{200} = 90\,\%.$
(b) Friction and weight of the moving part of the machine

13. *Iron is a good conductor of heat so heat will be conducted quickly from the hand to conductor of heat, so there is no conduction of heat from the hand to wood. Or iron is a good conductor of heat and it can also lose heat fast to the cold surrounding so at night the iron feels colder. Or dry wood is poor conductor of heat so wood cannot lose heat or gain it. So it does not feel cold as the iron.*

14. *(a)* $I = \frac{U}{R} = \frac{3}{4} = 0.75\,A$
(b) $\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{4} = \frac{3}{4} \implies R_e = \frac{4}{3}\,\Omega$

And hence $I = \frac{U}{R} = \frac{3\times3}{4} = 2.25\,A$

15. *(a) Real image is made from "real" light rays that converge at a real focal point. It can be projected onto a screen because light actually passes through the point where the image appears.*

    (b) If the mirror coating is in the inside of the spherical surface, then the mirror is called a **convex mirror** *(curves outwards). If the mirror coating is on the outside of the spherical surface, then the mirror is called a* **concave mirror** *(curves inward).*
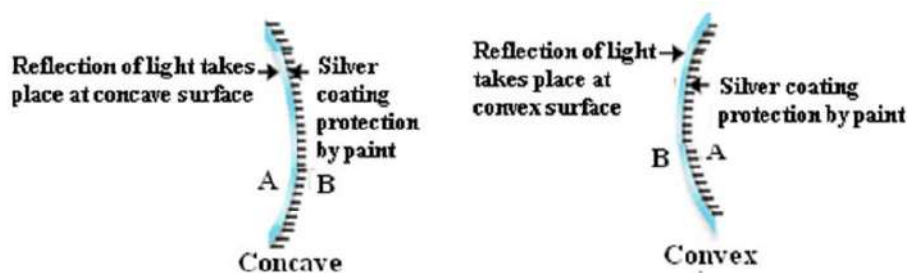
    Concave: terrestrial reflecting telescope; projectors, shaving mirrors, car head light, solar concentration. Convex: driving mirrors, security in shop (vigilant mirrors)

    (c) (i)
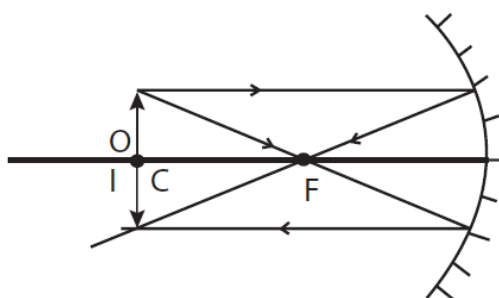
    (ii) **Nature of image:** *real, inverted, the same size as object, formed at the center of curvature.*

16. *(a) When the pressure increases, the melting point of ice decreases.*

    (b) Volume, density and change of state

    (c) Heat: $Q = mc\Delta T = 4 \times 300 \times 8 = 9\ 600\ J$

    (d) $Q = mc\Delta T + mL = 0.1 \times (327 – 25) \times 140 + 0.1 \times 27 \times 10^{5} = 31\ 228\ J$

17. *(a) Charge electroscope by transferring a known charge to the cap of electroscope, the gold leaf diverge. Bring the charged body near the cap of electroscope:*

    - *If the gold leaf diverges more the charge on the gold leaf is the same as that on the body.*

- *If the gold leaf decrease in divergence (collapse), the sign of the charge on the body is opposite to that on the gold leaf.*

(b) *Insulator is charged by rubbing. E.g. when an ebonite rod (polythene) is rubbed with fur it becomes negatively charged. When a glass rod is rubbed with silk (nyron) it becomes positively charged.*

(c) *A negatively charged cloud high above the tall building induced positively charge on the spikes and the negative charges (electrons) are repelled to the Earth through the copper strip to the ground.*

18. (a) *Inertia is the tendency of an object to resist to changes in its state of rest or motion in the absence of any net forces acting.*

(b) *Coin experiment*
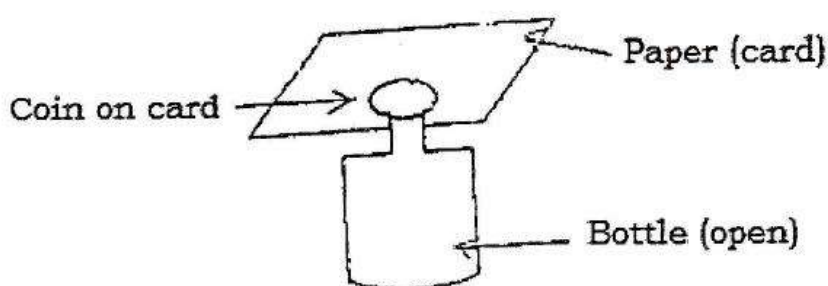
A small coin is placed on a card. The card and the coin are placed over the mouth of a bottle. The card is horizontally flicked away with a finger. The coin drops into the bottle.

(c) *The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object:* $a = \dfrac{F_{net}}{m}$

Or the rate change of momentum of a body is directly proportional to the force applied and it takes place in the direction in which the force acts.

(d) (i) $S = \frac{1}{2}at^2 + ut \leftrightarrow 8 = \frac{1}{2} \times a \times 2^2 + 0 \times 2 \leftrightarrow a = 4m/s^2$

(ii) $F = ma = 5 \times 4 = 20 \ N$

19. a)

Primary cell	Secondary cell
Cannot be rechargeable	can be rechargeable
High internal resistance	low internal resistance
Have short life	have long life
Have small e.m.f 1.5 V	have large e.m.f (2 V)
Use disposal batteries	use ordinary batteries
Irreversible chemical reaction generates electric current	reversible chemical reaction generators electric current

(b) Rectangular coil of wire, spindle, commutator, battery and rheostat, a U-shaped magnet.

(c) Bemf is the counter electromotive force that sets its self against the current that induces it. Or Bemf is the electromotive force that opposes to the applied voltage.

(d)

Practical DC motor	*Simple DC motor*
Several coils are wound in evenly spaced states in a soft iron cylinder	*One coil field pole which are stationary armature turns in the space between the N pole and S pole.*
Powerful and efficient	*Less powerful and less efficient.*

SECTION C: ANSWER ONLY ONE QUESTION

20. *Experiment to verify Snell's law*
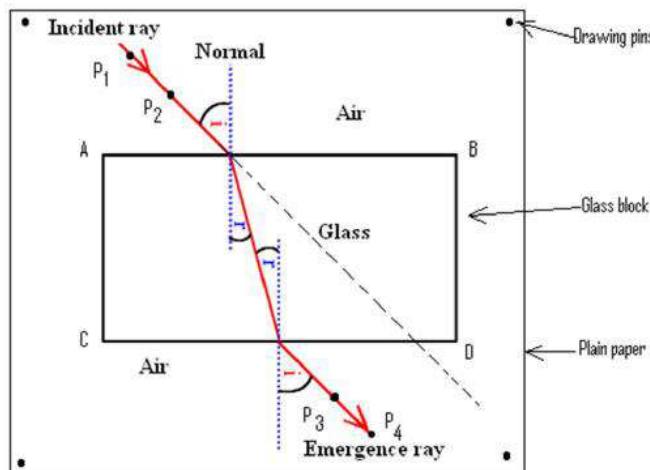
- *Place a soft board on a table or a plane surface*
- *Place a plain (white) paper on the soft board and fix it with drawing pins.*
- *Draw a straight line AB on the paper and place a glass block on the paper so that one edge is in contact with the ruler along line AB.*
- *The ruler is then transferred to the other edge of the glass block and line CD is drawn.*
- *Draw a normal through point O.*
- *Draw several oblique straight lines through point O at different angles of incidence from the normal. These lines represent incident rays.*
- *Fix pins P1 and P2 for apart on one of the incident rays.*
- *Looking through the other side CD of the glass block with the images of P1 and P2.*
- *Remove the pins and replace them with pencil crosses.*
- *Draw a line through P3 and P4 so that it touches the side CD at point P.*
- *Join points O and P with a straight line to form a refracted ray.*

- *Using a protractor, measure the angle of incidence I and the angle of refraction and record them in a table.*
- *Make five more angles of incidence and their corresponding angles of refraction.*

i	r	Sin i	Sin r	$\dfrac{\sin i}{\sin r}$

The ratio is found. This ratio $\dfrac{\sin i}{\sin r}$ is constant.

Conclusion: *for any given pair of media, the ratio of $\dfrac{\sin i}{\sin r}$ is a constant*

21. *Experiment to determine density of irregular stone*
- **Measure the mass** *of the stone using beam balance*
- *Take at least 3 measurements and find the average mass (m) of the stone.*
- **Measure the volume**
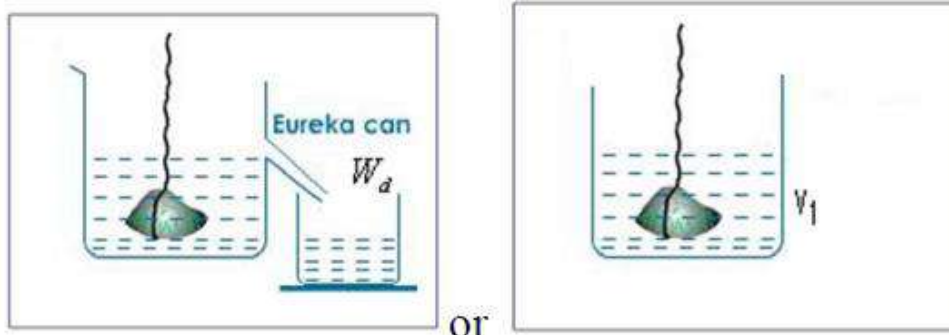
- *Pour some water into the Eureka can placed on a level surface until the water starts running out of the out let of the Eureka can and collect into beaker put under the outlet.*
- *Wait until the water stops running out of the outlet. Tie a stone with a tread.*
- *Place graduated measuring cylinder under the outlet of the Eureka can.*
- *Carefully lower the stone into the Eureka can.*
- *Wait again until all displaced water is collected in the measuring and stops dropping out of the outlet.*
- *Read the volume of the displaced water in the measuring cylinder.*
- *Repeat the experiment two more times and find the average volume (V). Or Pour some water in a measuring cylinder to get an initial volume V_1.*
- *Tie a stone with a tread.*
- *Slowly lower the stone into measuring cylinder until t is completely submerged.*
- *The water level in the measuring cylinder rises to the volume V_2.*
- *The volume of the stone: $V = V_2 - V_1$*

- *Repeat the above method at least two more times to find the average volume*
- *Calculate the density:* $\rho = \dfrac{m}{V}$

Sources of errors
- *The beam balance may be inaccurate.*
- *Wrong reading of the beam balance scale.*
- *Wrong reading of the volume of displaced water.*

Precaution
- *Avoid splashing water when lowering the stone into Eureka can.*
- *Avoid the parallax error when reading water volume and the mass of the stone.*
- *Avoid reading the volume of displaced water before the water stops dropping out of the outlet.*

Physics I

010

16th Nov. 2012 08.30 am – 11.30 am

REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD (REB)

P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2012

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

This paper consists of **three** sections **A**, **B** and **C**

Answer **ALL** questions in section A.　　　**(55 marks)**

Answer **THREE** questions in section B.　　**(30 marks)**

Answer only **one** question in section C　　**(15 marks)**

You may use a calculator and mathematical instruments.

Use only a blue pen and a pencil for drawing only.
No other ink is allowed.

SECTION A: Attempt all questions from this section. (55 marks)

1. State three characteristics of magnetic field lines. **(3 marks)**

2. Find the magnitude of force which produces a moment of 200 N m about a fulcrum at a distance of 5.0 m from the line of action of the force.
(3 marks)

3. Why is a stool made with outwards slanting legs? **(3 marks)**

4. Why is a convex mirror used as a side mirror on motor cars? **(3 marks)**

5. A man lifts a weight of 300 N trough a vertical height of 5 m in 10 s. Determine the man's power. **(3 marks)**

6. Explain, using the kinetic theory, why the pressure of air inside a car tyre increases on a hot day. **(4 marks)**

7. (a) Why is the density of rain water less than that of ocean water?
(2 marks)
(b) Calculate the density of a substance whose mass is 180 g and volume 200 cm^3. **(2 marks)**

8. (a) What is meant by the term force? **(2 marks)**
(b) A force of 80 N acts on a body and produces an acceleration of 2 m/s^2. What is the mass of the body? **(2 marks)**

9. (a) What happens to water when it is heated
    (i) From 0°C to 4°C$?$ **(1 mark)**
    (ii) From 4°C to 100°C$?$ **(1 mark)**
(b) At what temperature does water have maximum density? Explain your answer. **(2 marks)**

10. A battery of e.m.f 1.5 V and internal resistance, r, is connected in series with a 4 Ω resistor. The current in the circuit is 0.3 A. Sketch a diagram to show this connection and calculate the internal resistance, r, of the battery. **(4 marks)**

11. (a) State the principle of floatation. **(1 mark)**
(b) Why does a balloon full of a hydrogen gas rise when released?
(3 marks)

12. The table below shows speeds of a car accelerating on a straight road.

Time /s	0	1	2	3	4
Speed /ms^{-1}	0	6	12	18	24

(a) What is the acceleration of the car? **(1 mark)**
(b) Is the acceleration non-uniform? **(1 mark)**
(c) What distance does the car travel in 5 s? **(2 marks)**

13. (a) Why is water used to cool engines and radiators of vehicles? **(2 marks)**

(b) How much heat is needed to raise the temperature by $20°C$ of 4 kg of a substance of specific heat capacity $300 J / kg°C$? **(2 marks)**

14. (a) What is the coulomb? **(2 marks)**
    (b) The current through a conductor is 6 A. What is the charge which passes in 2 s? **(2 marks)**

15. With aid of a diagram explain why it is possible to drink fanta from a fanta bottle using a drinking straw? **(4 marks)**

SECTION B: Attempt any THREE questions. (30 marks)

16. (a) What is meant by specific latent heat of vaporization? **(2 marks)**
    (b) State two factors which affect the boiling point of water. **(2 marks)**
    (c) Calculate the heat required to convert 0.9 kg of water at $100°C$ to steam. Specific latent heat of vaporization of water = 2.26 X10⁶ J/kg. **(3 marks)**
    (d) What is the difference between boiling and evaporation? **(3 marks)**

17. (a) Differentiate a concave lens from a convex lens. **(3 marks)**
    (b) What is meant by principal axis of a lens? **(2 marks)**
    (c) An object is placed between the principal focus of a convex screen. Sketch a diagram to show the image formed and state characteristics of this image. **(5 marks)**

18. (a) Which property of transmission of pressure in liquids is used in hydraulic press and hydraulic car brakes? **(1 mark)**
    (b) What is the other unit of pressure that is the same as N / m^2. **(1 mark)**
    (c) Name the instrument that is used to measure the pressure of the atmosphere and which does not contain a liquid? **(1 mark)**
    (d) A hydraulic press has a large circular piston of radius 80 cm and a circular plunger of radius 10 cm. A force of 200 N is exerted by the plunger.
        (i) Find the force exerted on the piston. **(6 marks)**
        (ii) State one reason why the weight of the load just raised by the piston is less than the force obtained. **(1 mark)**

19. (a) What is the use of a fuse in an electric circuit? **(3 marks)**
    (b) Draw a diagram showing an electric circuit consisting of one battery of voltage 1.5 V, two parallel lamps and an ammeter to read the total current flow in the circuit. Calculate the current if the resistance of each lamp is 3 Ω. **(7 marks)**

20. (a) What is meant by dispersion of light? **(2 marks)**
    (b) Explain how a rainbow is formed. **(3 marks)**
    (c) The diagram below is a glass prism. A beam of white light strikes the face of a prism as shown. Copy the diagram below and show how the white light is split into its component colours. Label the colours. **(5 marks)**

light ray
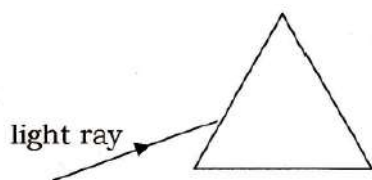
SECTION C: ATTEMPT ONLY ONE QUESTION. (15 MARKS)

21. A student carried out an experiment to determine the electrical resistance, R, of six lengths, L, of a wire. R is measured in ohms and L is measured in metres. Below are the results obtained.

L/M	5.0	6.0	7.0	8.0	9.0	10.0
R/Ω	2.0	2.4	2.8	3.2	3.8	4.0

(a) Plot the graph of R against L (plot R along y-axis and L along x-axis)
(9 marks)
(b) Determine the slope (gradient) of the graph. Show on the graph how you determine the slope. **(4 marks)**
(c) Use the results from (b) above to calculate resistivity of the wire, ρ , given that $\rho = R\frac{L}{A}$ and cross section area of the wire L = 0.50 mm².

(2 marks)

22. A student heated 5.0 kg of water in a copper calorimeter. The student recorded the time and corresponding temperature. The table below shows the results obtained.

Time/ minutes	4	5	6	7	8	9
Temperature /°C	36	40	45	49	54	57

(a) Plot a graph of temperature (along y-axis) against time (along x-axis).
(9 marks)
(b) From the graph, determine room temperature. **(1 mark)**
(c) Use the graph to determine the rate of temperature change. **(5 marks)**

MARKING OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2012

Section A: Answer all questions

1. *Lines of magnetic field (lines of force) start from the North Pole of a magnet and are directed to the South Pole. Lines of force can never cross one another. Close together where magnetic field is strong, far apart where magnetic field is weak and parallel where the field is uniform. Curve from N-pole and coverage to S-pole.*

2. $\mu = Fd \iff F = \frac{\mu}{d} = \frac{200}{5.0} = 40\ N$

3. *The legs increase the area of the base. Lower the centre of gravity and make the stool more stable.*

4. **Convex mirrors** *give a wider field of view than a plane mirror of the same size and it always gives an erect (but small) image, for these reasons it used as a car driving mirror.*

5. $P = \frac{Fd}{t} = \frac{300 \times 5}{10} = 150\ W$

6. *Molecules gain kinetic energy. Molecules have high speed. Increase the number of collision between molecules and car tyre. Increase force between the car tyre and pressure increase. Or when the temperature increases the volume of a car tyre being constant the air expands, the collision with the wall increases. The pressure force increases.*

7. *(a) The ocean water contains minerals or impurities which has greater density than density of rain water which is pure.*
   (b) $\rho = \frac{m}{V} = \frac{180 \times 10^{-3}}{200 \times 10^{-6}} = 900\ kg/m^3$

8. *(a) The word force generally denotes a push or a pull that makes objects stop or move more quickly or more slowly. Force are the way in which matter interact.*
   (b) $F = ma \iff m = \frac{F}{a} = \frac{80}{2} = 40\ kg$

9. *(a) (i) From 0ºC to 4ºC the water contract further, reaching its minimum volume at about 4ºC.*

(ii) From 4°C to 100°C the water expands in normal way i.e. increases in volume as temperature increases.
(b) If we heat ice at -10°C, it expands like any other solids until it reaches 0°C. After this it begins to melt while the temperature remains constant at 0°C. This melting is accompanied by a contraction in volume. Between 0°C and 4°C the water contract further, reaching its minimum volume at about 4°C. This means that has its minimum volume and maximum density at 4°C.

10.
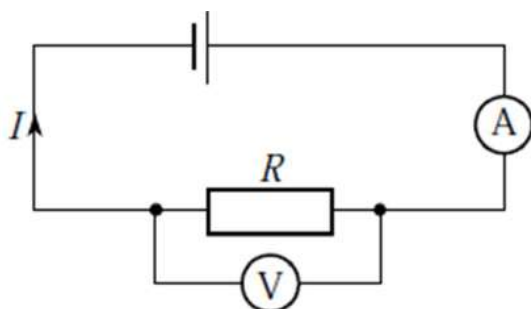
$$I = \frac{\varepsilon}{R+r} \Longleftrightarrow r = \frac{\varepsilon - RI}{I} = \frac{1.5 - 4 \times 0.3}{0.3} = 1 \, \Omega$$

11. *(a) For a floating object the mass of displaced fluid equals the mass of the object.*
    (b) Hydrogen gas is less dense than normal air. The weight of hydrogen balloon is less than that of air displaced (up thrust is greater than the weight of displaced air).

12. *(a)* $a = \frac{\Delta v}{\Delta t} = 6 \, m/s^2$
    (b) No, it is constant.
    (c) $S = \frac{1}{2} at^2 = \frac{1}{2} \times 6 \times 5^2 = 75 \, m$

13. *(a) The specific heat of water is the highest. It requires nearly 4200 Joules of heat energy to increase the temperature of 1 Kg of water by 1°C and so it takes more energy to heat water than most other substances.*
    (b) Q = mcΔt = 4 X 300 X 20 = 24 000 J.

14. *(a) The SI unit of electric charge is Coulomb; abbreviated C. C is equal in magnitude to the total charge of 6.23 X 10²³ electrons. The coulomb is the quantity of charge passing a point in a circuit when a steady current of 1 A flows for 1 s.*
    (b) Q = It = 2 X 6 = 12 C.

15. *When drinking using straw, you suck air in the straw into the lung the atmospheric pressure pushes the liquid from the container and forcing it to enter*

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

into the straw and lastly into the mouth. The air pressure in the straw decreases and the atmospheric pressure acting on the surface of water.
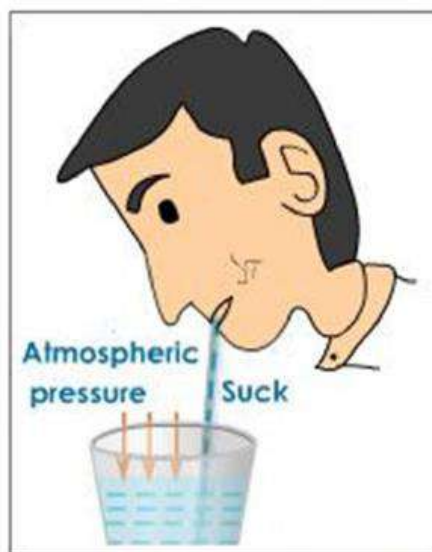
SECTION B: ANSWER ONLY THREE QUESTIONS

16. *(a) The amount of energy required to convert 1 kg of a substance from liquid to gas (or vice-versa) without a change in the external temperature is known as the **specific latent heat of vaporization (boiling)** for that substance.*
(b) Temperature and Pressure.
(c) $Q = mL_V = 0.9 \times 2.26 \times 10^6 = 2\ 334\ KJ$.
(d)

Boiling (Vaporization)	Evaporation
Occurs at the surface and inside the liquid	Occurs only at the surface
Occurs when the liquid attains its boiling point at the pressure	Takes at all temperature below the boiling point
Temperature does not change during boiling	Temperature may be change during evaporation

17. *(a)*

Convex lenses	Concave lenses
A lens is biconvex (or double convex, or just convex) if both surfaces are convex.	A lens with two concave surfaces is biconcave (or just concave).
That lenses are thicker in the middle than at edges.	That lenses are thinner in the middle than at edge.
The fact that a double convex lens is	The fact that a double concave lens is thinner across its middle is an

thicker in its middle is an indicator that it will converge rays of light which travel parallel to its principal axis.	indicator that it will diverge rays of light which travel parallel to its principal axis.
A double convex lens is a converging lens.	A double concave lens is a diverging lens.
The focal length of a convex lens is positive.	The focal length of a concave lens is negative.
The characteristics of the image depend on the position of the object: It can be real or virtual, erect or inverted, diminished or magnified.	For all positions of object, the image is virtual, erect and smaller than the object, and is situated between the object and lens.

(b) The **principal axis** of lens is the line passing through the centre of the optical centre of the lens. This line passes through principal focus.

(c) Non considered.

18. (a) Pascal's principle: Pressure in liquids is transmitted equally in all direction.

(b) Pa

(c) **Aneroid barometer (**Bourdon gauges**)**

(d) A hydraulic press has a large circular piston of radius 80 cm and a circular plunger of radius 10 cm. A force of 200 N is exerted by the plunger.

(i) $P = \frac{F_1}{F_1} = \frac{F_2}{F_2} \iff F_2 = \frac{F_1 A_2}{A_1} = \frac{200 \times 80^2}{10^2} = 12\ 800\ N$

(ii) A small force (thrust) applied at the end with a small area will produce a larger force at the end with the larger area.

19. (a) If the current flowing becomes dangerously high, the fuse comes hot and then it melts hence breaking or stopping the flow of electric current.

Or Fuse is for safety precaution and is designed to allow particular power or flow of electric current when flow is greater than the designed it breaks.

Or the fuse is used to protect electrical device and buildings against overflow of current.

(b) $I = \frac{\varepsilon}{R_e} = \frac{1.5}{\frac{3 \times 3}{2 \times 3}} = 1A$
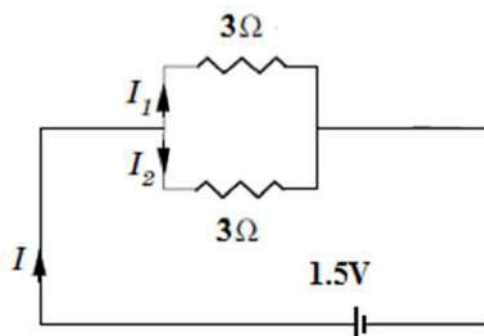
20. (a) **Dispersion** is separation of colours by glass (or other materials) due to their speed differences in glass. The variation of refractive index n with wavelength λ is called **dispersion.**

(b) Rainbows appear when the Sun is shining and it's raining at the same time. Light bends when it passes through water. Each colour bends a different amount. When white light enters a raindrop, the colours get separated. The white light splits into seven colours that you can see. These seven colours always appear in the same order: red, orange, yellow, green, blue, indigo, and violet.

(c)

White Light — Glass Prism — Red, Orange, Yellow, Green, Blue, Indigo, Violet
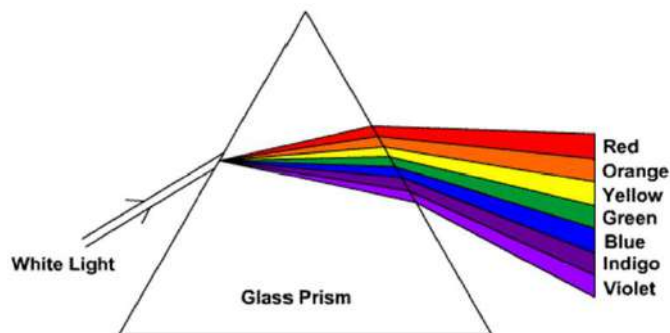
SECTION C: ATTEMPT ONLY ONE QUESTION.

21. (a)
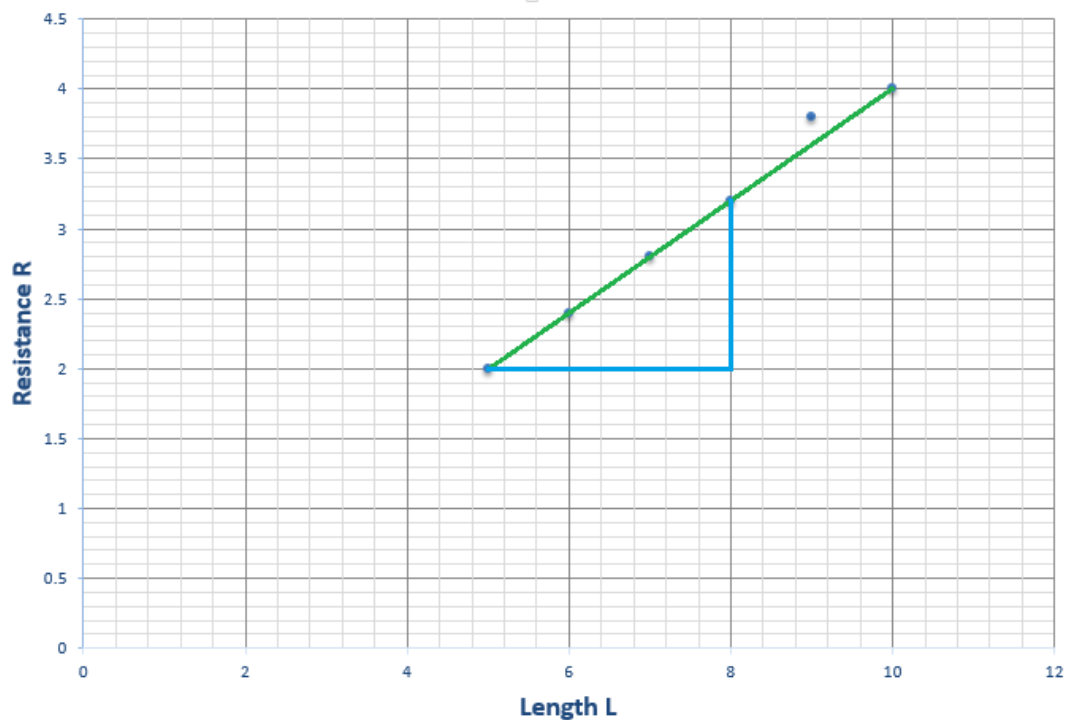
(b) The slope (gradient) of the graph is $S = \frac{\Delta R}{\Delta L} = \frac{3.2-2}{8-5} = \frac{1.2}{3} = 0.4\,\Omega/m$

(c) From $R = \varphi \frac{L}{A} \iff \varphi = \frac{R \times A}{L} = \frac{2 \times 0.50 \times 10^{-6}}{5} = 2 \times 10^{-7}$

22. (a)
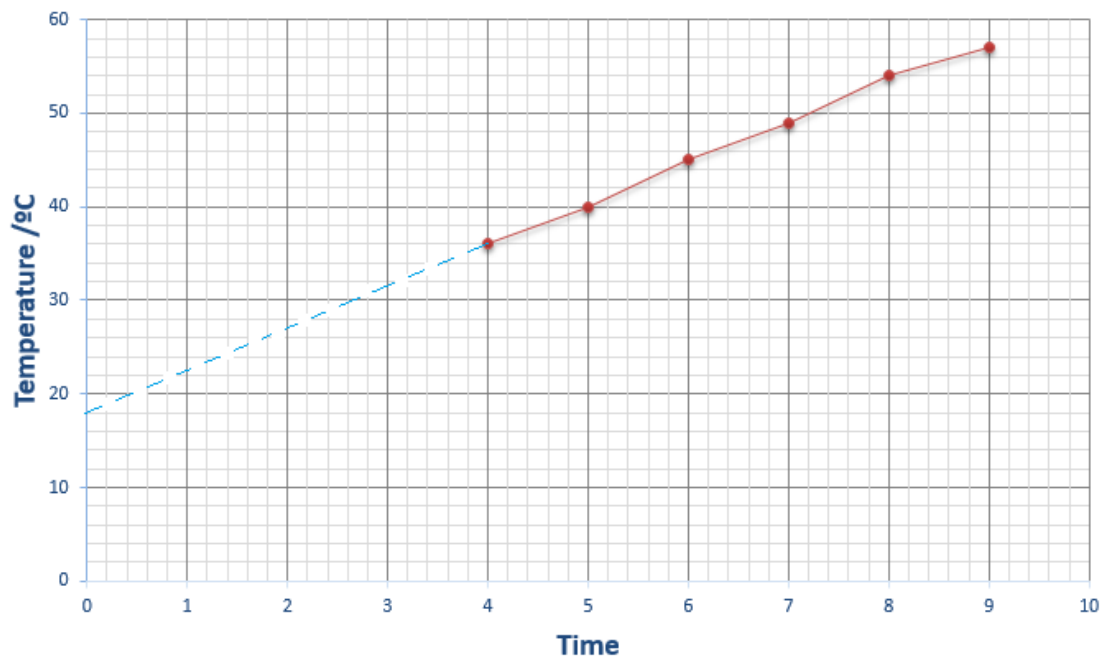
(b) From the graph, the room temperature is 18℃.

(c) The rate of temperature change is $= \dfrac{\Delta T}{\Delta t} = \dfrac{49-40}{7-5} = \dfrac{9}{2} = 4.5℃/min$

Physics I

011

01/11/2013   08.30 am – 11.30 am

REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD (REB)
P.O.BOX 3817 KIGALI

ORDINARY LEVEL NATIONAL EXAMINATIONS 2013

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Do not open this question paper until you are told to do so.

2. This paper consists of **three** sections **A**, **B** and **C**

    SECTION A: This section is compulsory   **(55 marks)**

    SECTION B: Attempt any **THREE** questions.   **(30 marks)**

    SECTION C: Attempt only **one** question.   **(15 marks)**

3. Calculators may be used.

4. Use only a blue pen and pencil.

SECTION A: Attempt all questions from this section. (55 marks)

1. a) What is the instrument used to measure the density of milk called?
(1 mark)
   b) The density of salt is 2.16 g/cm³. What is the volume of 216 g of salt?
(2 marks)

2. The diagram below shows a uniform metre rule balanced horizontally when a force of 6.0 N is hang at 0 cm mark. Calculate the weight of the metre rule. **(3 marks)**

0 cm mark   100cm mark

← 20 cm →

6.0 N
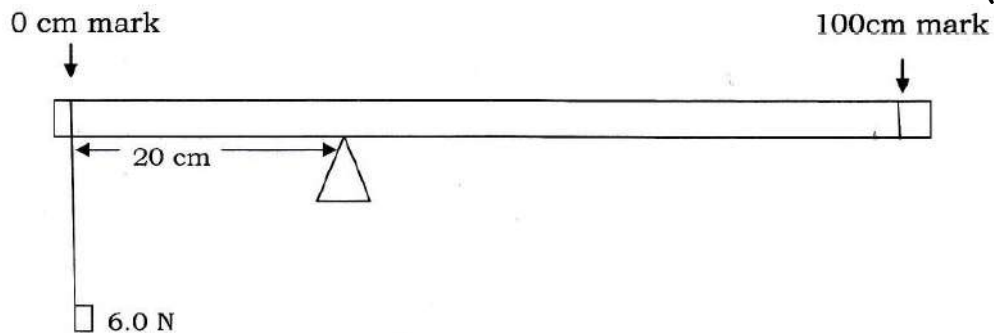
3. The figure below shows a velocity – time graph for a body moving with uniform acceleration.

Velocity (m/s)

40

30

20

10

1   2   3   4   5   Time (s)
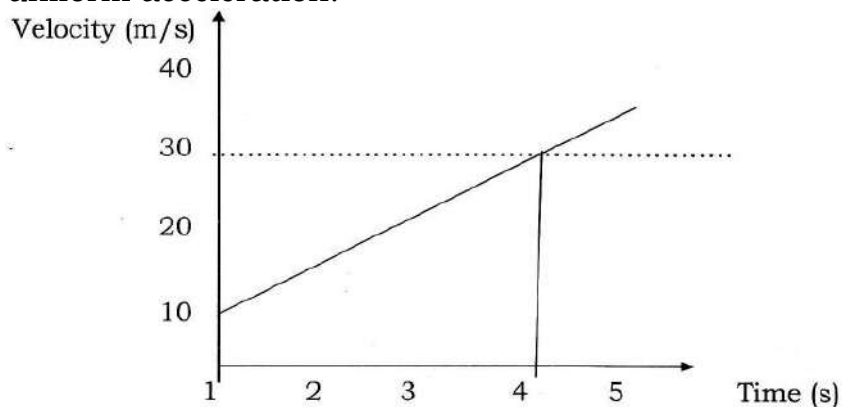
From the above graph:
a) What is the initial velocity? **(1 mark)**
b) What is the distance moved in 5 s? **(2 marks)**

4. The mass of rectangular block of dimensions 5 m X 1 m X 2 m is 50 kg. What is the minimum pressure that it can exert? Given that 1 kg exerts a force of 10 N. **(3 marks)**

5. a) Copy the diagram below and complete it to show the path of the ray of light traveling from water to air. Angle of incidence is greater than critical angle. **(2 marks)**

← Normal

Water Surface   Air
                                 Water

Light ray
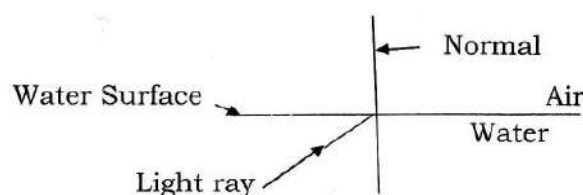
b) Why does the ray of light take the path you have shown? **(1 mark)**

6. a) What is a neutral point in a magnet field? **(2 marks)**
    b) State any two methods of making a magnet in laboratory. **(2 marks)**

7. a) What is meant by specific latent heat of vaporization? **(1 mark)**
    b) State two factors which affect the boiling point of water. **(2 marks)**
    c) What is the heat needed to change 0.8 kg of water at 100°C to steam? Specific latent heat of water = 2.26×10^6 J/kg. **(2 marks)**

8. a) What is the difference between energy and power? **(2 marks)**
    b) What is the power of a water pump which can lift 100 kg of water through a vertical height of 5 m in 10 s. Take g = 10 m/s². **(2 marks)**
    c) A ball is held 2 m above the ground and then released. List the energy changes which occur. **(1 mark)**

9. a) State two electrical charges. **(2 marks)**
    b) A positively charged rod AB is suspended horizontally at its midpoint. One end of a positively charged rod is brought just below end A. State what happens to the end A of the rod AB? **(1 mark)**
    c) A current of 3 A flows for 5 s, what charges passes? **(2 marks)**

10. Three cells are arranged in parallel and connect to a 2 ohms resistor.
    a) Draw a simple electric circuit to represent this arrangement. **(2 marks)**
    b) If each cell has a potential of 1.5 V, calculate the current in the circuit. **(2 marks)**
    c) If one cell is removed from the circuit, is there any change in the current in the circuit? **(1 mark)**

11. a) Name two types of curved mirrors. **(2 marks)**
    b) State two uses of a convex mirror. **(2 marks)**

12. A measuring cylinder is filled with a liquid.
    a) What does the pressure of the liquid at the bottom depend on? **(2 marks)**
    b) If the depth of the liquid is 0.3 m and the pressure it exerts at the bottom is 3000 Pa, find the density of the liquid. g = 10 m/s². **(2 marks)**

13. Give an example to justify that air of the atmosphere exerts force. **(4 marks)**

14. The diagram below shows a thermometer used to measure the temperature of human body.
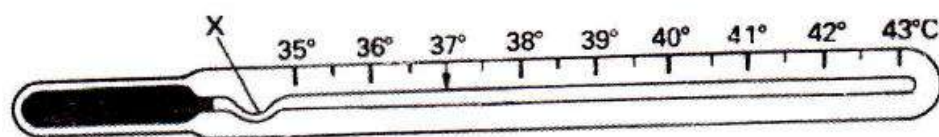
a) Name part X and state its function. **(2 marks)**

b) What happens when you place this thermometer under the tongue of a patient? **(1 mark)**
c) Why is the temperature range between 35°C – 43°C? **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS. (3O MARKS)

15. a) Name any two physical properties of matter which change with change of temperature. **(2 marks)**
b) Convert a temperature of 300 K to Celsius degrees, °C. **(2 marks)**
c) Explain what is meant by the term "unusual expansion of water". **(3 marks)**
d) Liquids expand when heated. The diagram below shows a flask full of water fitted with glass tube.
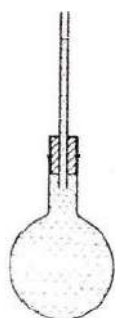
   i. What happens when the flask is heated? **(1 mark)**
   ii. What happens when you continue heating the water? **(1 mark)**
e) What effect does increase in pressure have on the melting point of ice? **(2 marks)**

16. a) What are pulleys? **(2 marks)**
b) State two reasons why the efficiency of pulleys is always less than 100%. **(2 marks)**
c) A pulley raises a load of sand of weight 3000 N using an effort of 600 N. what is the mechanical advantage of the system? **(2 marks)**
d) Efficiency of machine is 80 % and mechanical advantage is 4. Find the velocity ratio. **(2 marks)**
e) A pulley raises a load 4 cm when an effort used moves 12 cm. What is the velocity ratio? **(2 marks)**

17. a) What is a lens? **(2 marks)**
b) State the properties of images formed in a converging lens when the object is nearer the lens than the focal point. **(3 marks)**
c) Give any two applications of a converging lens. **(2 marks)**
d) What are the characteristics of the images in a diverging lens? **(3 marks)**

18. a) State Ohms' law. **(2 marks)**
b) What voltage is needed to drive a current of 2.5 A through a resistor of 2 Ω? **(2 marks)**
c) A voltmeter is connected in parallel in an electric circuit and an ammeter is connected in series in a circuit. Why? **(4 marks)**
d) i. What does the symbol below represent in an electric circuit? **(2 marks)**
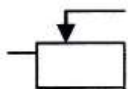
ii. State the function of the symbol in d)i. **(2 marks)**

19. a) Dry wood of weight 20 N floats on water. What is the weight of the liquid displaced by the wood? **(1 mark)**
b) State Archimedes' principle. **(2 marks)**
c) A body weights 24 N in air and when wholly immersed in water it weighs 12 N. What is the relative density of the body? **(2 marks)**
d) A ship is made of iron and some other materials but it does not sink into water. Why? **(3 marks)**
e) A balloon filled with some amount of a light gas when released, rises into air. At some point it stops rising and drifts sideways. Explain why the balloon rises and then stops rising. **(2 marks)**

SECTION C: ATTEMPT ONLY ONE QUESTION. (15 MARKS)

20. a) List eight basic laboratory rules which ensure safety of pupils and materials in the laboratory. **(8 marks)**
b) List any seven careers in which Physics is necessary. **(7 marks)**

21. List five important ways in which science is useful in each of cases below:
a) Industries **(5 marks)**
b) Work places **(5 marks)**
c) Our lives **(5 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2013

Section A: Answer all questions

1. a) **Lactometer:** *It is special type of hydrometer used for testing the purity of milk or to check richness of milk. It has a range of relative density 1.105 to 1.045. Or: hydrometer, densimeter, lactodensimeter*

   b) $\rho = \dfrac{m}{V} \iff V = \dfrac{m}{\rho} = \dfrac{216}{2.16} = 100 \; cm^3 = 10^{-4} \; m^3$

2. *Principle of moment: clockwise moment equals to anticlockwise moment*

   $6.0 \times 20 = (50 - 20)W \iff W = \dfrac{120}{30} = 4 \; N$

3. a) *Acceleration:* $a = \dfrac{30-10}{4-1} = \dfrac{20}{3} \; m/s^2$

   At t = 1: $10 = \dfrac{20}{3} + u \iff u = 10 - \dfrac{20}{3} = \dfrac{10}{3} \; m/s$

   b) *Distance moved in 5 s:*

   $S = \dfrac{1}{2}at^2 + ut = \dfrac{20}{2\times 3} \times 5^2 + \dfrac{20}{3} \times 5 = \dfrac{250+100}{3} = \dfrac{350}{3} \, m$

4. *The minimum pressure that it can exert:* $P = \dfrac{F}{A} = \dfrac{50\times 10}{5\times 2} = 50 \; Pa$

5. a) *Path of light ray*
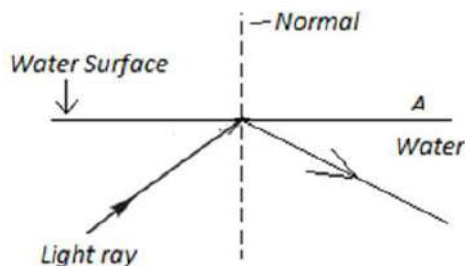
   b) *For all angles of incidence greater than the critical angle c the incident light undergoes what we describe as total internal refraction.*

6. a) *Neutral point is a point where the resultant magnetic field is zero.*
   b) *Induced magnetism, Magnetization by contact, Magnetization by electric current and Electromagnetic (Magnetism from Electricity), stroking method (contact method, single touch, double touch).*
   Or

Neutral point
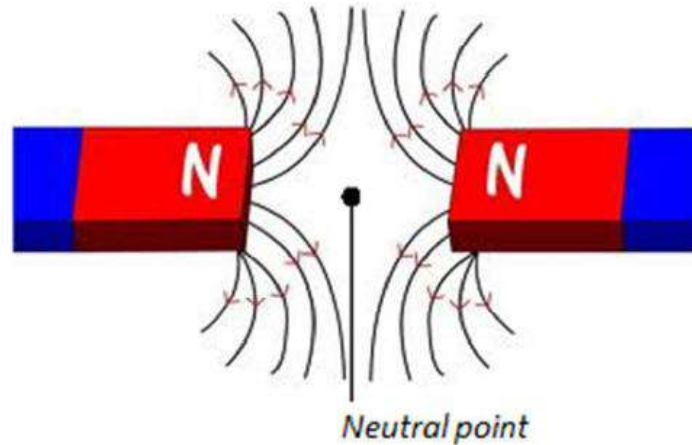
7. a) *The amount of energy required to convert 1 kg of a substance from liquid to gas (or vice versa) without a change in the external temperature at constant pressure is known as the* **specific latent heat of vaporization (boiling)** *for that substance.*

b) *Impurities and pressure*

c) *Heat required:* $Q = mL_c = 0.8 \times 2.26 \times 10^6 = 1\ 808\ KJ$

8. a) **Energy** *is the capacity to do work or transfer of heat energy, it has the unit of Joule while Power is the rate of which work is done or the rate at which energy is used. The rate of doing work is called as power or the rate at which work is done or energy is transferred is called as power:* $P = \dfrac{W}{t}$

The SI unit of power is the Watt (or J/s).

b) *The power of a water pump:* $P = \dfrac{W}{t} = \dfrac{100 \times 10 \times 5}{10} = 50\ W$

c) *Potential energy mechanical energy, kinetic energy, sound and heat energy.*

9. a) *Positive and negative charges.*

b) *It is repelled.*

c) *Charges:* $Q = It = 3\ X\ 5 = 15\ C$

10. a) *Three cells are arranged in parallel and connect to a 2 Ω resistor.*
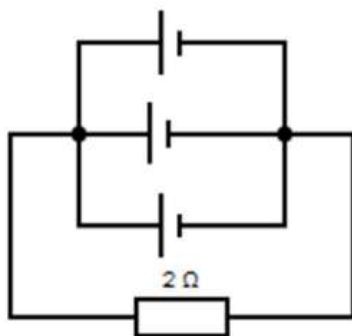
b) *Current in the circuit* $I = \dfrac{1.5}{2} = 0.75\ A$

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

c) No change for the current in the circuit since the emf remains 1.5 V

11. *a) Convex and concave curved mirrors.*

*b) **Concave mirrors** are used as make-up and as shaving mirrors in order to get an enlarged (magnified) erect image of the face. They are used as dentists 'mirrors to focus light on the tooth being examination. The largest telescope uses concave mirrors to collect light from distant stars. They are used in solar heating devices to concentrate solar radiations. They are used as reflectors in the headlights of a car because a small lamp at their focus, give a parallel reflected beam. This is only strictly true if the mirror has a parabolic shape. **Convex mirrors** give a wider field of view than a plane mirror of the same size. For this reason and because it always gives an erect (but small) image, it used as a car driving mirror. However it does give the driver a false idea of distance. They are also used as Vigilance mirrors in large shops and supermarkets and as reflectors in the street lamps.*

12. *a) Density of liquid and depth (height). Although the pressure changes with the weather.*

b) $P = \rho g h \iff Density: \rho = \dfrac{P}{gh} = \dfrac{3\,000}{10 \times 0.3} = 1\,000\ kg/m^3$

13. *You can use invented glass (glass can), drinking straw, siphon, crushing can, syringe, etc.*

Crushing can experiment

Take an empty plastic gallon milk jug with a screw top. Fill it about a quarter of the way full with very hot water. Cap it tightly and let it stand for about an hour. What did you expect to happen? What did happen? The excess atmospheric pressure outside the can causes it to collapse inward. This plastic bottle was closed at approximately 2,000 m altitude, and then brought back to sea level. It was crushed by air pressure.

Collapsing Can Experiment

The effect of the enormous atmospheric pressure can be demonstrated by removing air from a can using a vacuum pump. The can collapses as the air pressure inside the can becomes less than the atmospheric pressure outside.

Inverting a glass of water
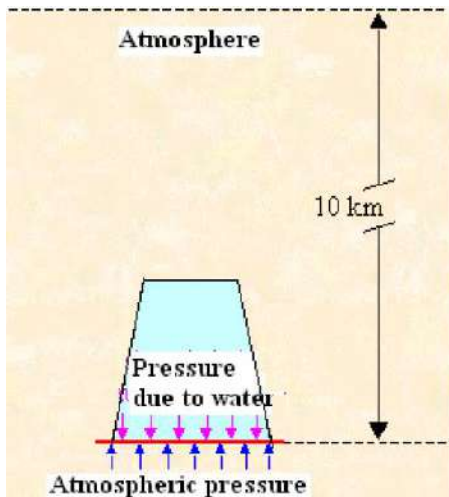
Prove of existence of atmospheric pressure by inverting a glass of water covered by a sheet of paper. When the glass was turned downwards, water remained inside. Atmospheric pressure keeps the paper into contact with the upturned glass, thus keeping the water in the glass.

Drinking straws, syringe and rubber suckers
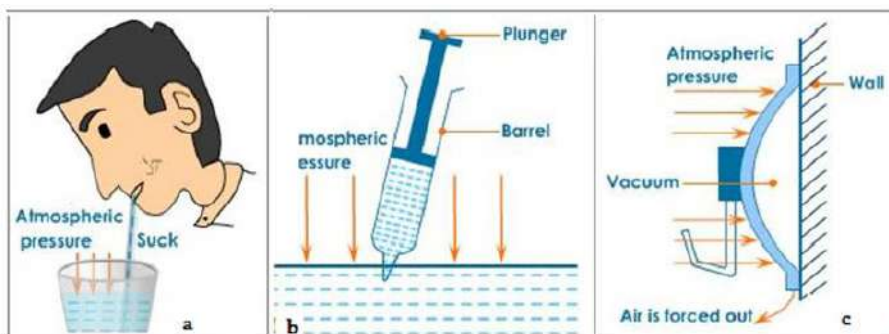
When drinking using straw, you suck air in the straw into the lung the atmospheric pressure pushes the liquid from the container and forcing it to enter into the straw and lastly into the mouth. The air pressure in the straw decreases and the atmospheric pressure acting on the surface of water. In the same way, atmospheric pressure forces a liquid to move into a syringe when its plunger is withdrawn. Rubber suckers are used for installing hooks in the kitchen and bathroom. The air between the rubber sucker and the wall is first forced out so that the atmospheric pressure pressing on it can hold it firmly against the wall.

The can collapses as the air pressure inside the can becomes less than the atmospheric pressure outside

14. *a) K: constriction or narrow part. It prevents mercury from flowing back to the bulb.*
b) The mercury expands on small change of temperature.
c) The normal temperature of healthy person is 37ºC below 35ºC or above 42ºC a person is died. Or a person temperature scale ranges between 35ºC – 42ºC out of this range a person is died. Or because it is the temperature range of human being interval.

SECTION B: ANSWER ONLY THREE QUESTIONS

15. *a) Change of state, change of size, change of resistance (electrical property, intermolecular force, density.*
b) 300 K = 300 - 273 = 27ºC .
c) If we heat ice at -10ºC, it expends like any other solids until it reaches 0ºC. After this it begins to melt while the temperature remains constant at 0ºC. This melting is accompanied by a contraction in volume. Between 0ºC and 4 0C the water contract further, reaching its minimum volume at about 4ºC. This means that has its minimum volume and maximum density at 4ºC. Beyond 4ºC, the water expands in normal way i.e. increases in volume as temperature increases. As the temperature of a ponds or Lake Falls, the water contracts, becomes denser and sinks. A circulation is thus set up until all the water reaches its maximum density at 4ºC. If further cooling occurs any water below will stay at 4ºC the top owing to its lighter density. In due course, ice forms on the top of the water, and after this the lower layers of water at 4ºC can lose heat only by conduction. Only very shallow water is thus liable to freeze solid. In deeper water there will always be water beneath the ice in which fish and other creatures can live.
d) i) the level of water in the tube drops (falls) because the glass flask expands.
ii) The water in the tube rises.
e) Increased pressure lowers the melting points of water and reducing the pressure lowers the boiling point of water.

16. *a) A pulley is a simple machine that uses grooved wheels and a rope to raise, lower or move a load. A pulley is a machine consisting of a fixed grooved wheel, sometimes in a block, around which a rope or chain can be run. A simple pulley serves only to change the direction of the applied force (i.e. applied effort).*
b) Mass of pulley, friction force between two moving parts.

c) $MA = \frac{L}{E} = \frac{3000}{600} = 5$

d) $VR = \frac{MA}{\eta} = \frac{4}{0.80} = 5$

e) $VR = \frac{D_E}{D_L} = \frac{12}{4} = 3$

17. a) A lens is an optical device with perfect or approximate axial symmetry which produces converging or diverging light rays due to refraction is known as a **lens**. A lens is a transparent medium (usually glass) bounded by two curved surfaces (generally spherical, cylindrical, or plane surfaces).

b) The image is **behind the object, virtual, erect and larger than object**.

c) **Magnifying glass** and **objective or eyepiece of optical instruments**.

d) For all positions of object, the image is virtual, erect and smaller than the object, and is situated between the object and lens.

18. a) The electric potential difference between two points on a circuit (V) is equivalent to the product of the electric current between those two points (I) and the total resistance of all electrical devices present between those two points (R).

b) $U = RI = 2 X 2.5 = 5 V$

c) Ammeter should therefore have a low resistance compared with that of the rest of the circuit, so that they do not introduce unwanted resistance. An ideal voltmeter has infinite resistance so that no current passes through it and so disturb the circuit as little as possible.

d) i. Potential divider

   ii. In order to have variable voltage.

19. a) For a floating object the weight of displaced liquid equals the weight of the object.ie the weight of the liquid displaced by the wood is 20 N.

b) "Any non-porous object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object

$B = W_f = m_f g = \rho_f g V_{displaced}$.

c) Relative density: $RD = \frac{24}{24-12} = 2$

d) The density of a bar of iron greater that of water so it sinks in water. The boat has an iron hallow form that makes the average density of the whole is less than the density of water, where it floats.

e) The gas inside the balloon is less dense than the weight of balloon, thus the balloon rises until when the upthrust equals the weight of balloon acting downwards the balloon stops rising and floats.

SECTION C: THIS QUESTION IS COMPULSORY

20. a) **Basic laboratory safety rules**

   1. Never run in the laboratory and follow all directions exactly as given.

   2. Consider the safety of your fellow students. The laboratory is a place for serious work.

   3. Any accident or injury must be reported to the teacher at once.

   4. Do not work in laboratory without supervision. Always work safely!

   5. Perform only those experiments assigned by the teacher.

   6. No equipment should be used until proper instructions are received from the teacher and you have proven your proficiency.

   7. Never touch materials or apparatus on the demonstration table.

   8. Learn at once the location and operation of the fire extinguishers and other first aid materials.

   9. No laboratory equipment may be taken from the laboratory or classroom unless so directed by the teacher.

   10. Never force glass tubings, thermometers or any breakable materials in or out of rubber stoppers and tubings; instead, apply a lubricant. Glycerin is recommended rather than water as a lubricant.

   11. Solid waste, broken glass and other laboratory waste should be placed in their specific containers. The waste paper baskets are for paper only.

   12. Do not touch any electrical device which has just been used. Most electrical devices are hot after use and serious burns may result if caution is not exercised before the hot object is touched.

   13. Do not tastes, eat, or drink any laboratory materials unless instructed. Regard all reagents as poisonous.

   14. Always wear shoes, eye protection and suitable protective gloves (Latex)

   15. Always add acid to water but not water to acid.

   b) Electrical engineering, civil engineering, laboratory, astronomy, geology, surveying, education, medicine, military, sport, arts, etc.

21. *Industries, work places and our daily lives:*

   - Manufacturing of beer, soap, salt, etc.

   - Most of the equipment used in Modern Agriculture and for predicting weather in Meteorology are based on Physics principles.

   - Tools for research in a subject like History are based on Physics. For example, radioactivity is used in determining the age of fossils in a process called carbon dating.

   - The development of telephone, telegraph and telex enables us to transmit messages instantly.

- The development of radio and television satellites has revolutionized the means of communication.

- Advances in electronics (computers, calculators and lasers) have greatly enriched the society.

- Generation of power from nuclear reactors is based on the phenomenon of controlled nuclear chain reaction.

- Digital electronics is widely used in modern technological developments.

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Physics I

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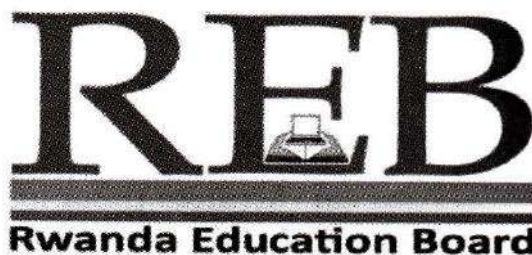
ORDINARY LEVEL NATIONAL EXAMINATIONS, 2014

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    SECTION C: Attempt only **one** question.   **(15 marks)**

3. Calculators may be used.

4. **Use only blue or black pen and pencil.**

SECTION A: Attempt all questions from this section. (55 marks)

1. The following are quantities common in Physics: mass, weight, density, force, velocity and speed. Which quantities are:
   (a) Vectors? **(1.5 marks)**
   (b) Scalars? **(1.5 marks)**

2. Why is the density of sea water not the same as the density of distilled water? **(3 marks)**

3. Explain why solids have a fixed shape? Use the kinetic nature of molecules in solids to explain your answer. **(3 marks)**

4. Why is the sharp edge of a knife thin? **(3 marks)**

5. (a) What is the unit of power? **(1 mark)**
   (b) A man lifts 50 kg of sugar through a vertical distance of 1.5 m. Calculates the work done. Take $g = 10 \ N / kg$. **(2 marks)**

6. (a) What is the difference between displacement and distance? **(2 marks)**
   (b) A car has a velocity of 60 km/h. How far does it travel in 20 minutes? **(2 marks)**

7. (a) Explain why water has maximum density at about $4°C$. **(2 marks)**
   (b) Give two reasons to explain why mercury is a good liquid for use in a thermometer. **(2 marks)**

8. (a) Explain why a pencil that is partly immersed in a liquid, appears bent at the surface. **(2 marks)**
   (b) The figure bellow shows a ray of light travelling towards the face of a plane mirror. Copy the diagram and complete its path after leaving the surface of the mirror. Label your diagram. **(2 marks)**

9. (a) What factors does conduction of heat in solids depend on? **(2 marks)**
   (b) Although the earth absorbs a lot of heat from the sun during the day, its temperature does not continue to rise every day. Explain this phenomenon. **(2 marks)**

10. Explain each of the following:
    (a) Experiments on electrostatics do not work well on humid days. **(2 marks)**

(b) An uncharged metal rod causes the leaf of a charged electroscope to collapse. **(2 marks)**

11. A 1.5 V cell has an internal resistance of 0.25 Ω. It is connected in series with a 0.35 Ω resistor, what current flows? **(4 marks)**

12. (a) Which of the following materials are strongly attracted by a magnet: wood, iron, glass and nickel? **(1 mark)**
(b) Explain why two steel pins hang from the end of a vertical bar magnet do not hang vertically. **(3 marks)**
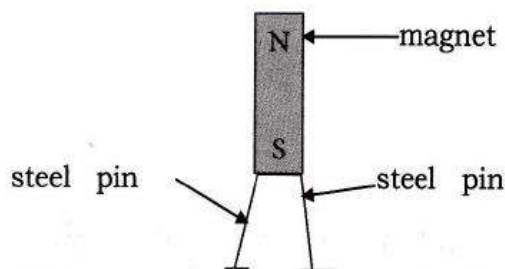
13. (a) Explain why, when a stone is thrown upwards it rises and then falls to the ground again. **(3 marks)**
(b) A student of mass 60 kg runs with a velocity of 2 m/s. Calculate the kinetic energy. **(1 mark)**

14. (a) Explain why, in house electric lamps are connected in parallel. **(2 marks)**
(b) A circuit consists of 6.0 Ω and 3.0 Ω in parallel arrangement and a p.d of 12 V is connected across the whole circuit. Calculate the current in the circuit. **(2 marks)**

15. (a) Explain why in a pin-hole camera, the size of the hole must not be too large. **(1 mark)**
(b) State properties of an image formed in a pin-hole camera. **(3 marks)**

SECTION B: ATTEMPT ANY THREE QUESTIONS. **(3O marks)**

16. (a) Give an example of
    (i) a luminous object. **(1 mark)**
    (ii) a non-luminous object **(2 marks)**
(b) Why are translucent glasses used in toilet windows? **(2 marks)**
(c) What is the difference between the principal focus of a converging lens and the principal focus of a diverging lens? Illustrate your answer using diagrams of these lenses. **(5 marks)**
(d) Give an application of a diverging lens. **(2 marks)**

17. (a) Why do corrugated iron sheet roofs make cracking noises as a day gets hotter and as the day gets colder? **(3 marks)**
(b) Why are immersion heaters placed at the bottom of hot water tanks? **(3 marks)**

(c) Why does milk in a bottle keep cool when the bottle stands in water in a porous pot in dry weather days? **(2 marks)**

(d) How much heat is needed to raise the temperature by $10°C$ of 5 kg of a substance of specific heat capacity $300J/kg.°C$? **(2 marks)**

18. (a) State any two effects of an electric current. **(2 marks)**

(b) Why does a voltmeter have a high resistance while an ammeter has a low a low resistance? **(2 marks)**

(c)
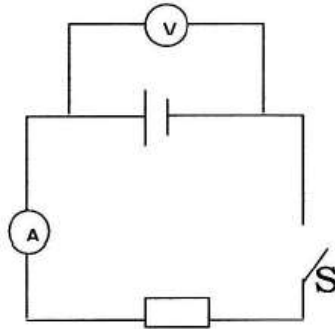
The voltmeter, V and the ammeter, A readings in the circuit above when switch S is open are 3.0 V and 0.0 A and when the switch is closed are 2.4 V and 2.0 A. Calculate the internal resistance of the cell. **(3 marks)**

(d) The diagram below shows a lamp, a battery, a switch and a copper wire.
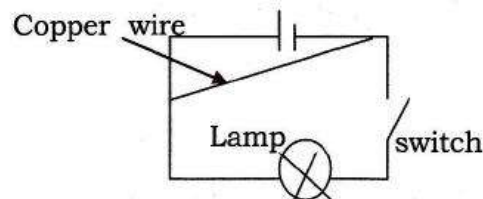
(i) When the switch is on, the lap does not give light. Explain why.

(2 marks)

(ii) What is this effect called? **(1 mark)**

19. (a) Calculate the pressure exerted on a level ground by a man whose mass is 70 kg and the area of his both feet is 250 cm^2. Give the answer in Pascal (Pa). Take $g = 10 N/kg$. **(2 marks)**

(b) Explain why water is not suitable as a barometer liquid. **(3 marks)**

(c) Explain how it is possible to drink a fanta drink using a straw.

(3 marks)

(d) Why is an aneroid barometer better for measuring pressure at various altitudes? **(2 marks)**

20. (a) What is meant by term **inertia** of a body? **(2 marks)**

(b) What is the relation between force F, mass m and the acceleration produced by a moving body? **(1 mark)**

(c) The force in a rope pulling a body is 100 N. the mass of the body is 40 kg and the frictional force is 20 N.

(i) Find the resultant force. **(1 mark)**

(ii) Calculate the acceleration **(2 marks)**

(d) State Newton's third law. **(2 marks)**
(e) Why does one feel pain when he/she boxes or hits a hard surface with a fist? **(2 marks)**

SECTION C: ATTEMPT ONLY ONE QUESTION. (15 marks)

21. Describe an experiment you can carry out to determine the density of a very small piece of dry wood which has irregular shape. The piece of wood does not sink into water. **(15 marks)**

22. (a) With aid of a labelled diagram describe an experiment to show how the heat radiated from a hot object depends on the nature of the surface.
(12 marks)
(b) State three applications of this effect. **(3 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2014

Section A: Answer all questions

1. *(a) Vector quantities: weight, force, velocity*
   (b) Scalar quantities: mass, density, speed.

2. *Distilled water has no impurities whereas sea water has many salts, minerals and other substances dissolved in it which density is greater than the density of dissolved water.*

3. *Molecules of solids are: very close together, tightly held together by intermolecular forces and vibrating in a fixed position.*

4. *The sharp edge of a knife has a very small area because a force applied on small area produces a greater pressure and facilities to cut easily.*

5. *(a) The unit of power is W = J/s*
   (b) W = Fd = 50 X 10 X 15 = 750 J

6. *(a)* **Distance** *is a scalar quantity, describing the length of the path between two points along which the particle has travelled while* **Displacement** *is a vector describing the difference in position between two points. Displacement is defined as distance moved in specified direction. When considering the motion of a particle over time,* **distance** *is the length of the particle's path;* **displacement** *is the change from its initial position to its final position.*

   (b) $d = vt = \left(\frac{60 \times 1000}{3600}\right)(20 \times 600) = 20\,000\ m = 20\ km$

7. *(a) If we heat ice at -10ºC, it expends like any other solids until it reaches 0ºC. After this it begins to melt while the temperature remains constant at 0ºC. This melting is accompanied by a contraction in volume. Between 0ºC and 4ºC the water contract further, reaching its minimum volume at about 4ºC. This means*

that has its minimum volume and maximum density at 4ºC. Beyond 4ºC, the water expands in normal way i.e. increases in volume as temperature increases.

(b) Mercury is a good thermometric liquid for the following reasons:

- *It is easily seen, because it is opaque and silvery.*
- *It does not wet glass which contains it. No mercury remains on the sides of the tube when the mercury level falls and expands regularly.*
- *It is good conductor of heat and soon reaches the same temperature as its surroundings.*
- *It has a high boiling point (357ºC); and therefore can measure temperatures beyond this.*
- *It has small specific heat capacity, so it takes only a little heat from hot objects.*
- *It does not vaporize and distil on to the upper part of the bore.*

8. *Because rays from pencil under water (more denser) change the direction when they enter air (less dense) from the surface of water, ie. They are refracted because the speed of light is faster in air than in water.*

Apparent position of pencil

Actual position of pencil

(b)

Normal   Reflected ray

Incident ray i r   Mirror
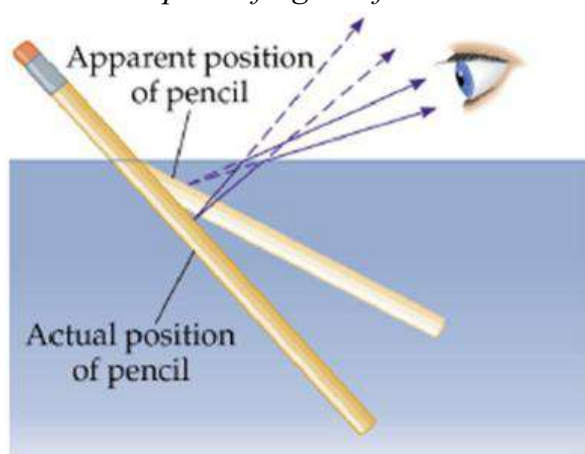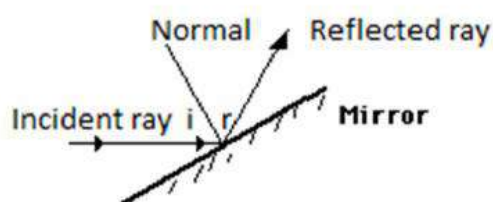
9. *(a) The conduction of heat in solids depends on cross sectional area, length, nature of materials and temperature difference between two points.*

(b) Heat energy is radiate outwards from the earth surface. Or this because part of the heat energy absorbed by the earth during the day goes into atmosphere in form of radiation. Or during the day the earth is heated by the sun and its

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

temperature rises higher than the se water temperature. Air over the earth gets hot and expands and rises while cooler air flows to the earth hence the earth cools.

10. *(a) A humid day contains water and conducts charges. A body cannot be charged while it is in a conducting surroundings. The charges pass to the earth through the humid day.*
(b) When metal rod is brought near or in contact the cap of a charged electroscope, the leaf collapses because unlike charges attract the cap of electroscope with a positive/negative charges from metal rod hence the leaf collapses.

11. $I = \dfrac{\varepsilon}{R+r} = \dfrac{1.5}{0.15+0.35} = 2.5\ A$

12. *(a) Iron and Nickel*
(b) The bar magnet magnetizes the ends of steel pins and pins acquire the same poles. The pins heads have similar poles hence they repel (like poles repel and unlike poles attract).

13. *(a) A stone is thrown upwards, it rises and then falls to the ground because at the beginning it has a velocity and that velocity decreases because of gravity then at maximum height the velocity becomes zero and the stone falls to the ground.*
(b) $K = \frac{1}{2}mv^2 = \frac{1}{2} \times 50 \times 2^2 = 120\ J$

14. *(a) In order to reduce the total resistance, to have the same voltage across the terminals of the lamps, to allow lamps to work independently.*
(b) $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} \iff R_{eq} = \dfrac{R_1 R_2}{R_1 + R_2} = \dfrac{6 \times 3}{6+3} = 2\ \Omega$

$I = \dfrac{\varepsilon}{R_{eq}} = \dfrac{12}{2} = 6\ A$

15. *(a) According to the size of pinhole, the image may be slightly or blurred (confused image). A blurred image results if the hole is made much larger than a pinhole. The hole must not be too small. When it is too small, the image is blurred because of diffraction. Diffraction is the bending or spreading of light rays (wave) behind an object.*
(b) The image is upside down or inverted image; Image is real (it can be formed on the screen), Image is reversed (left to right); Image is less bright (The clarity of image will depend on the position of the object and on dimensions of the

pierced pinhole); Image has a different size to the lamp object (Enlarged image is larger than actual object while Reduced image is smaller than object).

SECTION B: ANSWER ONLY THREE QUESTIONS

16. *(a) i)* **Luminous sources** *: the sun, electric lamps, firefly (Luciola Lusitanica) and candles.*
ii) **Non-luminous source:** *A book, a room and the moon.*
(b) Translucent glasses are used in toilet window because they allow certain light to pass through but we cannot see through them.
(c)

Converging lens   **Diverging lens**
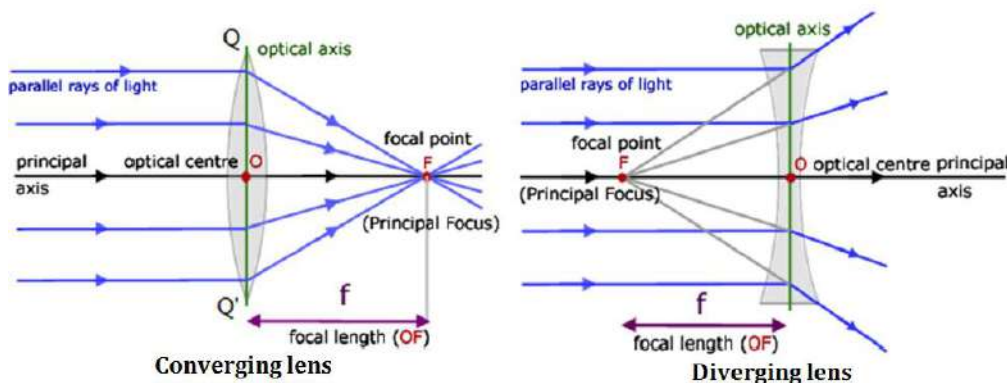
(d) Diverging lens is used to correct myopia (short sightedness); they used as eyepiece to Galilean telescope.

17. *(a) When the day gets hot the iron sheets gain heat and expand. And on colder day, the iron sheet loose heat and contract.*
(b) Water is not a good conductor of heat. Heat in water is transmitted by convection current; water at the bottom of a hot water tank gets less denser than cold water at the top of a tank hence rises. The cold water at the top more dense goes down to the bottom where I also get heated and rises. This process goes until all water is hot or boils. Or water is not a good conductor of heat. Heater is immersed in water at the bottom of water tank to facilitate the convection in all the quantity of water.
(c) A porous pot loses heat by evaporation on its outside surface in day weather. As the evaporation takes place the water in the pot loses heat and becomes cold. This process is known as cooling by evaporation when a bottle stands in a porous pot containing water it cools down because water and porous pot are both bad conductor of heat. Or the porous pot and water are both poor conductor of heat. So the heat energy from outside does not reach the milk bottles the heat energy from outside evaporates the water from the outer surface of the porous pot so the milk inside the bottle remains cools.
(d) $Q = mc\Delta T = 5 \times 300 \times 10 = 15\,000\,J$

18. (a) Electric current effects: light effect; heat effect; chemical effect; magnetic effect.

(b) A voltmeter has a higher resistance to avoid reducing the strength of current in the circuit since it connect in parallel. Or a voltmeter has a high resistance in order to avoid the reduction of current through element across which it is connected in it. An ammeter has a low resistance because I measures the strength of the current in circuit. It offers no resistance to the flow of current since connect in series.

(c) $r = \frac{\varepsilon - V}{I} = \frac{3 - 2.4}{2} = 0.3\ \Omega$

(d) i) All circuit flows through the copper wire because the wire has a low resistance. The lamp has a high resistance and electron do not like to do heavy work by overcoming resistance in the lamp.

   ii) This effect is called short circuit.

19. (a) $P = \frac{F}{A} = \frac{mg}{A} = \frac{70 \times 10}{250 \times 10^{-4}} = 28\ 000\ Pa$

(b) Water is not a suitable as a barometer liquid because its density is low; it would require over 10 m long tube; it is not easy to see; its colour is not suitable; it is not easy to carry and liquid can spill.

(c) When sucking using a straw, the air in the straw is removed and creates a vacuum in the straw. The air of the atmosphere exerts pressure on the fanta in the bottle. The force push fanta in the straw to replace the air which has been sucked hence drinking goes on.
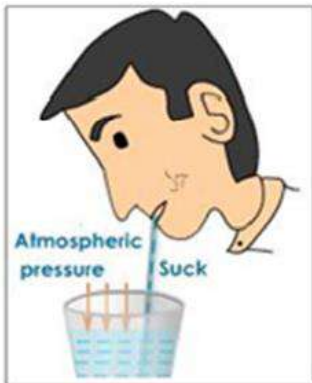
(d) As aneroid barometer is better for measuring pressure at various altitude because it is compact and it is portable

20. (a) The Inertia is the tendency of an object to resist changes in its state of rest or motion in the absence of any net forces acting. Inertia is the tendency of an object to resist changes in its velocity. Inertia is tendency of an object to resist accelerations. The inertia is the reluctance for a body to move when it is at rest or stop when it is in motion.

(b) F = ma

(c) (i) $F_{net} = F - F_{fr} = 100 - 20 = 80\ N$

(ii) $a = \frac{F_{net}}{m} = \frac{F-F_{fr}}{m} = \frac{100-20}{40} = 2\ m/s^2$

(d) To all active force acting to a mass there is an equal and opposite reactive force which reacts. Or action and reaction forces are equal and opposites.

(e) Because the first provides an action force on hard surface and the hard surface provides an equal and opposite force which makes him/her feel pain.

SECTION C: ATTEMPT ONLY ONE QUESTION

21. *To find the mass of dry wood: Weigh the dry wood on beam balance and record the reading mass "m" in kg. Reweigh the wood three times and find the average mass.*

   To find the volume of the wood:

   - Pour water in measuring cylinder and record volume V_1 without object.

   - Tie a stone (sinker) on a thread and lower it carefully into the water and record the volume of water with stone V_2.

   - Tie the wood (floating object) to the stone with a thread.

   - Lower slowly the wood and stone tied together into water.

   - Record the volume V_3 (water, stone and wood).

   - Calculate the volume of the wood: $V = V_3 - V_2$
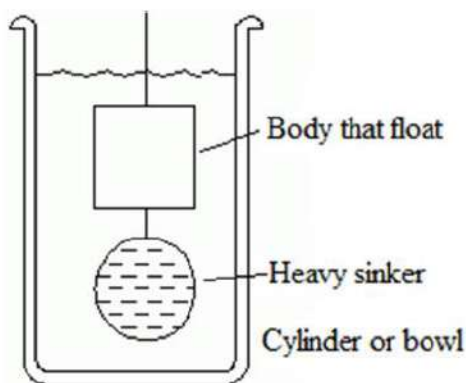
   Or using Eureka can

   - Pour water in eureka can until water runs out.

   - Wait until all water has stopped running out.

   - Place an empty beaker under the outlet of eureka can.

   - Tie a stone on a thread and lower it in eureka can.

   - Wait until all water has stopped running out of outlet.

   - Determine the volume water in beaker which is equal to the volume of stone and denote it as V_1.

   - Tie the wood and stone in the same thread.

   - Lower them in eureka can and wait until all water has stopped running out.

- *Determine the volume of water in measuring cylinder which is equal to the volume of the stone and the wood and denote it as V_2.*
- *Determine the volume of dry wood by: $V_2 - V_1$.*
- *The density of dry wood by using: $\rho = \dfrac{m}{v}$*

22. *(a) Experiment to show how the heat radiated from a hot object depends on the nature of the surface*
   - *Take two sheets of iron plates polish one sheets and paint black the second.*
   - *Fill a cork on the reverse side of each plate using wax.*
   - *Set up the plates vertically a short distance apart black surface facing and polished surface.*
   - *Insert a burning burner at equal distance between the two sheets*
   - *Both plates are heated equally by the burner.*
   - *After a certain time the wax on the black painted plate melts before the cork falls down.*
   - *The cork on the polished surface remains cool and wax will melt later.*
   - *This shows that a polished surface is a good reflector of heat, while a black surface is a good absorber of heat.*
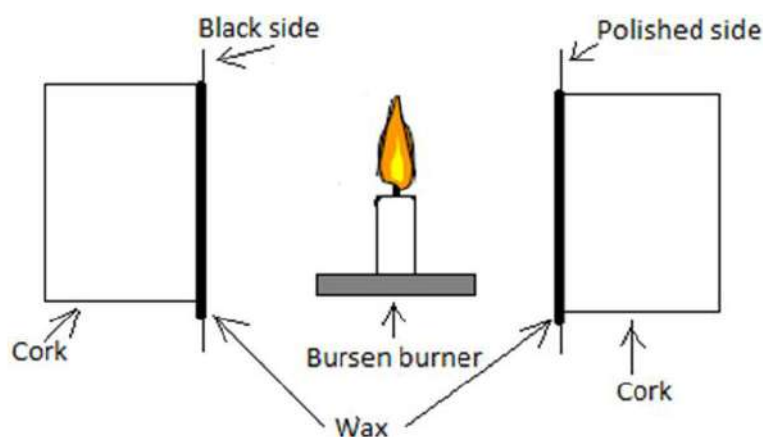
   Or with two tin cans and hot water
   - *Take two tins with lids*
   - *One painted black and the other white*
   - *Fit bungs holding thermometers into a hole in each tin*
   - *Stand both tins on a bad conductor (wood or paper)*

- Pour a known volume of hot water into one tin
- Fit the lid so that the thermometer bulb is in the water. Note the time taken for the temperature to fall 10ºC (e.g. from 70°C to 60ºC)
- Now pour exactly the same volume of hot water in the 2nd tin. Note the time taken for its temperature to fall by the same 10ºC.
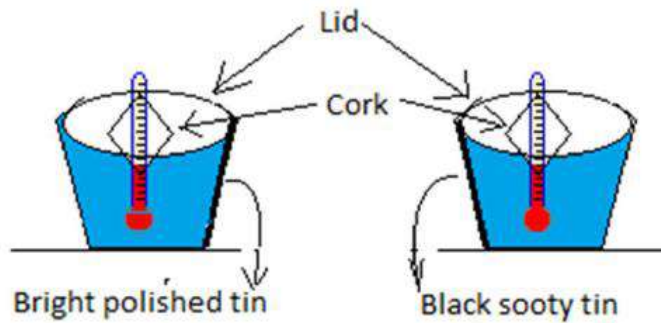
Conclusion: *the black tin use small time to fall 10ºC. The black surface is better radiator than the polished (white) surface.*

Application: *aluminium roofs reflect energy; vacuum flask; black bodies helps to absorb in solar heating.*

Physics I

011

13/11/2015 08.30 AM – 11.30 AM

Rwanda Education Board
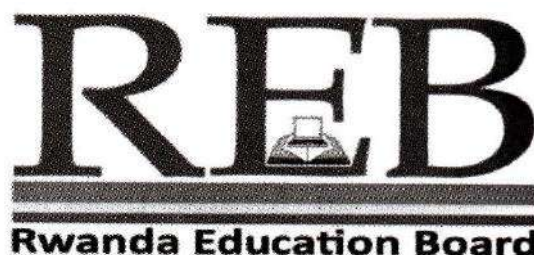
ORDINARY LEVEL NATIONAL EXAMINATIONS, 2015

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form, and **<u>DO NOT</u>** write your names and index number on additional answer sheets of paper if provided.

2. Do not open this paper until you are told to do so.

3. This paper consists of **three** sections **A**, **B** and **C**

- Answer **ALL** questions in section A.   **(55 marks)**
- Answer **THREE** questions in section B.   **(30 marks)**
- Answer only **one** question in section C   **(15 marks)**

4. Use only a **blue** or **black** pen.

5. Calculators and mathematical instruments may be used.

SECTION A: Attempt all questions from this section. (55 marks)

1. A piece of steel has a volume of 12 cm³ and mass of 96 g. find the density of the steel. Express the answer in kg/m³. **(3 marks)**

2. What is the difference between distance and displacement? **(3 marks)**

3. (a) What is meant by the term acceleration of a moving body? **(1 mark)**
   (b) The velocity of a car slows down uniformly from 98 km/h to 48 km/h in 10 s. calculate the deceleration of the car. **(2 marks)**

4. Explain why standing passengers in a fast moving bus continue to move forward when the bus stops suddenly. **(3 marks)**

5. (a) Which quantity has the same unit as energy? **(1 mark)**
   (b) An engine with a force of 5000 N pulls a car 100 m. Find the work done by the engine. **(2 marks)**

6. (a) What is meant by mechanical advantage of a machine? **(1 mark)**
   (b) What does the mechanical advantage of a machine depend on? **(1 mark)**
   (b) Write the equation relating mechanical advantage, velocity ratio and efficiency of a machine. **(1 mark)**
   (c) What are pulleys used for? **(1 mark)**

7. (a) Why is it painful to carry a heavy parcel by a thin string? **(2 marks)**
   (b) A block of metal produces an average pressure of 1000 N/m² when resting on a flat surface of area 0.5 m². Find the force exerted by the block. **(2 marks)**

8. (a) Define the term specific latent heat of a substance. **(2 marks)**
   (b) 17600 J is given up when 8 g of steam at 100°C condenses to 8 g of water at 0°C. Find the specific latent heat. **(2 marks)**

9. (a) Give an example of self-luminous object. **(1 mark)**
   (b) Define the term a light ray. **(1 mark)**
   (c) A beam of light rays may be parallel, diverging or converging. Which type of beam of rays is produced by headlamps of a car at night? **(1 mark)**
   (d) State any one property of light. **(1 mark)**

10. (a) State the laws of reflection of light at a plane surface. **(2 marks)**
    (b) What is a simple periscope made of? **(1 mark)**
    (c) What is the use of a simple periscope? **(1 mark)**

11. (a) Why are plastic materials used to cover copper wires carrying electricity? **(2 marks)**
    (b) The current I passing a section of a wire is 4 coulombs per second. Calculate the quantity of charge passing the section of the wire. **(2 marks)**

12. (a) Define the following terms:
　　　(i) Potential energy. **(1 mark)**
　　　(ii) Kinetic energy **(1 mark)**
　　(b) A car of mass 1000 kg runs at a speed of 20 m/s. Calculate the kinetic energy of the car. **(2 marks)**

13. (a) What is the disadvantage of primary cells? **(1 mark)**
　　(b) What is the advantage of secondary cells? **(1 mark)**
　　(c) Where are secondary cells used? **(2 marks)**

14. (a) State any two methods of making magnets. **(2 marks)**
　　(b) How can a magnet be demagnetized? **(2 marks)**

15. (a) What is a magnetic field? **(1 mark)**
　　(b) Why are magnetic fields vectors? **(2 marks)**
　　(c) Between two like poles of a bar magnet there is point called neutral point. What is this neutral point? **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS. (3O MARKS)

16. (a) State laws of refraction of light? **(2 marks)**
　　(b) Why does a ray of light travelling from air through a glass block bend towards the normal at the point where it enters the glass block? **(2 marks)**
　　(c) When white light passes through a triangular glass prism it is refracted and different colours are produced.
　　　(i) Why is the white light split into many colours? **(1 mark)**
　　　(ii) Which colour is refracted most? **(1 mark)**
　　　(iii)Which colour is refracted least? **(1 mark)**
　　　(iv) Name the colours in order starting with the least refracted to the most refracted. **(1 mark)**
　　(d) Which lens causes a beam of white light parallel to the principal axis:
　　　(i) To converge to a real focus? **(1 mark)**
　　　(ii) To diverge from a virtual focus? **(1 mark)**

17. (a) What is meant by the term centre of gravity of a body? **(2 marks)**
　　(b) Mention the equilibrium states of a body. **(3 marks)**
　　(c) Why is a tall person more likely to topple (fall down) when climbing a mountain than a short person? **(2 marks)**
　　(d) A uniform meter rule is balanced at the 40 cm mark when a load of 3 N is hung at 10 cm mark. Find the mass of the meter rule. (Take g = 10 N/kg). **(3 marks)**

18. (a) Explain the meaning of the following terms:
　　　(i) Temperature of a substance. **(1 mark)**
　　　(ii) Heat of a substance. **(1 mark)**
　　　(iii)The lower fixed point on Celsius scale of temperature. **(1 mark)**
　　(b) Mercury and alcohol are used in thermometers.
　　　(i) State two properties of these liquids which make them suitable for use in thermometers. **(2 marks)**

(ii) Why s alcohol thermometer more suitable for measuring low temperatures? **(2 marks)**

(c) Convert 30°C to Kelvin scale of temperature. **(2 marks)**

(d) Why does a clinical thermometer have a constriction above its bulb? **(1 mark)**

19. (a) Explain the meaning of the following terms:
    (i) A good conductor of electricity. **(1 mark)**
    (ii) A bad conductor of electricity. **(1 mark)**

(b) Which of the following has more resistance to the flow of electric current: A long thin good conductor wire of electricity, and a short thick good conductor wire? Explain your answer. **(3 marks)**

(c)Three resistors of 2 Ohms, 4 Ohms, 6 Ohms are first connected in series and then disconnected and again connected in parallel. Determine the resistance:
    (i) In series **(1 mark)**
    (ii) In parallel. **(2 marks)**

(d) What are the advantages of connecting resistors in parallel in a simple electric circuit? **(2 marks)**

20. (a) Describe the structure of a simple mercury barometer. **(4 marks)**

(b) A height of the mercury column in a barometer is found to be 67.0 cm at a certain place. What would be the height of a water barometer at the same place? Density of mercury is 1.36×10^4 kg/m^3 and density of water is 1.0×10^3 kg/m^3. **(3 marks)**

(c) A man blows into one end of a U-tube containing water until the levels differ by 40.0 cm. If the atmospheric pressure is 1.01×10^5 N/m^2 and the density of water is 1000 kg/m^3, calculate his lung pressure. **(3 marks)**

SECTION C: ATTEMPT ONLY ONE QUESTION. **(15 marks)**

21. The table below shows the velocity of a moving body and the time taken by the body.

Time /s	Velocity /m.s^{-1}
0	0
1	2
2	4
3	6
4	8
5	10

(a) Plot the graph of velocity along vertical axis and time along horizontal axis using the data given in the above table. **(10 marks)**

(b) Determine the slope of the graph. Show on the graph how you find the slope. **(3 marks)**

(c) What does the slop represent? **(1 mark)**

(d) From the graph determine the velocity of the body when time is 2.5 s. **(1 mark)**

22. In an experiment to measure the unknown resistance by the ammeter-voltmeter method, a student obtained the following results.

Voltmeter reading /V	Ammeter reading /A
2.0	1.0
3.0	1.5
4.0	2.0
5.0	2.5
6.0	3.0
7.0	3.5

(a) Plot the graph of potential difference, V (y-axis) against current, I (x-axis) **(10 marks)**
(b) Determine the slope of the graph. Show on the graph how you find the slope. **(3 marks)**
(c) State the relationship between the resistance, potential difference and current. **(2 marks)**

MARKING OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2015

Section A: Answer all questions

1. $Density = \frac{mass}{volume} = \frac{96 \times 10^{-3}}{12 \times 10^{-6}} = 8 \times 10^3 \ kg/m^3$

2. *Distance is a scalar quantity describing length covered by a moving body while displacement is a vector quantity describing distance covered in specific direction.*

3. *(a) Acceleration is the rate of change of velocity.*
    (b) $u = 98 \frac{km}{h} = \frac{98\ 000\ m}{3\ 600\ s} = 27.2\ m/s$

    $v = 48 \frac{km}{h} = \frac{48\ 000\ m}{3\ 600\ s} = 13.3\ m/s$

    $Deceleration = \frac{u-v}{t} = \frac{27.2-13.3}{10} = 1.39\ m/s^2$

4. *Passengers continue to move in order to resist any change of state of motion due to the inertia according to Newton's 1st law of motion.*

5. *(a) Work*
    (b) W = Fd = 5 000 X 100 = 500 000 J

6. *(a) Mechanical advantage is the ration of load to the effort. It is a measure of factors of the effort to overcome the load.* $MA = \frac{L}{E}$
    (b) The MA depends on load and effort
    (c) $\eta = \frac{MA}{VR}$
    (d) Pulleys are used for lifting heavy load.

7. *(a) The weight of the parcel is spread over small area of the string in contact with the hand. So a large force per unit area (pressure) is produced on the flesh and thus the hard feel pain.*
   *(b)* $P = \frac{F}{A} \Longleftrightarrow F = P \times A = 1000 \times 0.5 = 500\ N$

8. *(a) Specific latent heat is the amount of heat required to change unit mass of substance from one state to another state at constant temperature.* $L = \frac{Q}{m}$

(b) $Q = mL + mc\Delta T \iff L = \frac{Q - mc\Delta T}{m} = \frac{17600 - 0.008 \times 4200 \times 100}{0.008} = 178000\,J/Kg$

9. *(a) The sun, stars, glow warm….*
   (b) A light ray is a direction or path along which light energy travels. It is a very thin line of light.
   (c) Diverging or parallel
   (d) In homogenous, transparent and isotropy medium, light travels in straight line.

10. *(a) The incident ray, reflected ray and the normal at point of incidence all lie in the same plane. The angle of incidence is equal to the angle of reflection.*
    (b) A simple periscope is made of a long tube and two plane mirrors fixed at 45°, parallel and facing each other.
    (c) A simple periscope is used to see objects hidden from direct view.

11. *(a) Plastics do not conduct electricity, so it is used for safety rea6bns to avoid electrification (short-circuit) OR Plastic is a bad conductor of electricity (insulator) so it protects us from electrocution.*
    (b) Not considered.

12. *(a) (i) Potential energy is energy possessed by a body because of its position.*
    * P.E = mgh (m = mass, g = gravity, h = height)*
    (ii) Kinetic energy is the energy possessed by a body because of its motion.
     $KE = \frac{1}{2}mV^2$
    (b) $KE = \frac{1}{2}mV^2 = \frac{1}{2} \times 100 \times 20^2 = 200\,000\,J$

13. *(a) Primary cell can't be recharged, high internal resistance, less emf, irreversible chemical reaction.*
    (b) Secondary cell can be recharged, low internal resistance, high emf, and reversible chemical reaction.
    (c) Camera, telephone, radio, car…

14. *(a) Magnetization by electric current, by induction, by contact or stroking*
    (b) Demagnetization by hammering the magnet when they are pointing east-west at 90° to the Earth's magnetic field direction, electric current, heating, or by bad keeping.

15. *(a) A region in which a magnetic force may be detected.*
    (b) They are oriented from North Pole to South Pole around a bar magnet.

(c) The neutral point is a point between two like poles of magnets where the magnetic net force is zero.

neutral point
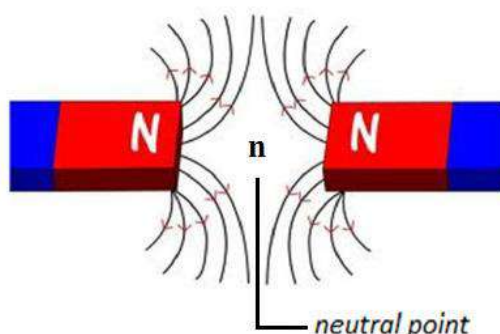
SECTION B: ANSWER ONLY THREE QUESTIONS

16. *(a) The incident ray, refracted ray and the normal at point of incidence all lie in the same plane The ratio of the sine of the angle of incident to the angle of refraction is constant equal to the index of refraction:*
    (b) A ray of light travelling from air to the glass bends towards the normal the speed of right in air is greater than the speed of right in glass block. Or the refractive index of air is less than that of glass block.
    (c) (i) White light splits into different colours when passing through a glass prism because it is composed of many colours and each colour has its own speed. Or each colour has its own refractive index of refraction.
    *(ii) the **most refracted** colour is **violet**.*
    *(iii) The **least refracted** colour is **red**.*
    *(iv) From the least to the most refracted colours we have**: red, Orange, yellow, green, blue, and violet.***
    (d) (i) converging lens.
        (ii) Diverging lens

17. *(a) The centre of gravity of a body is a point where all the weight of a body is concentrated. It is the point of application of resultant force due to earth's attraction (weight).*
    (b) Equilibrium state of a body: stable, unstable, neutral.
    (c) When climbing a mountain a tall person is likely to fall down than a short person because the centre of gravity of a tall person is a higher than that of a short person which makes him/her be unstable.
    (d) Clockwise moment = anticlockwise moment

$$m_1 d_1 = m_2 d_2 \Longleftrightarrow m_1 = \frac{m_2 d_2}{d_1} = \frac{0.3 \times 0.3}{0.1} = 0.9 \, kg$$

18. *(a) (i) Temperature is the degree of hotness or coldness*

(ii) Heat of substance is the internal energy of a body contains. Heat is the form of energy that is transferred from one body to another due to a temperature difference.

(iii) The lower fixed point on Celsius scale is the melting point of pure ice (it is freezing point of pure water) which is 0ºC.

(b) Mercury and alcohol are used in thermometer because they:

- *Are a good conductor of heat, not vaporize easily and distil.*
- *Have a low specific heat capacity and have clear colours (easily seen) opaque.*
- *Have a high boiling point and a lower freezing point.*
- *Have a high coefficient of cubical expansibility.*
- *Are sensitive to the change of temperature.*
- *Do not wet glass.*

(ii) Alcohol thermometer is suitable for measuring the low temperature because:

- *Alcohol does not solidify easily. Its freezing point is -115ºC and boils at 78ºC. It is therefore essential to use alcohol thermometers in places such as northern Canada and Russia, where winter temperatures of – 40ºC are not uncommon.*
- *It expands more (about six times more than mercury). Alcohol is more sensitive to temperature changes and can be used to measure small temperature margins.*
- *Alcohol is not a poisonous substance and it is cheaper than mercury*

(c) 30ºC = (273 + 30) K = 303 K

(d) Because it prevents mercury from flowing back to the bulb.

19. *(a) (i) A good conductor is a material which allow the flow of current easily or a material which has low resistance or a material which has free electrons.*

(ii) A bad conductor is a material which has high resistance or which does not allow the flow of current or which electrons do not move.

(b) Along thin wire because the resistance of the wire increases with the length and strangle the passage of electron in small section. Or a long a thin wire the resistance is directly proportional to the length of the wire and inversely proportional to the cross sectional area. $R = \varphi \frac{L}{A}$

(c) (i) $R = R_1 + R_2 + R_3 = 2 + 4 + 6 = 12 \, \Omega$

(ii) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} \Longleftrightarrow R = \frac{12}{11} = 1.09 \, \Omega$

(d) When one resistor is removed the current continue to flow or resistor work independently. The net resistor in parallel is less than that of in series. In parallel the resistor have the same voltage.

20. (a) A dish containing mercury. A meter ruler to measure the level of mercury containing in the tube. A 1 m thick glass tube closed at one end fills mercury and inverted in the dish.
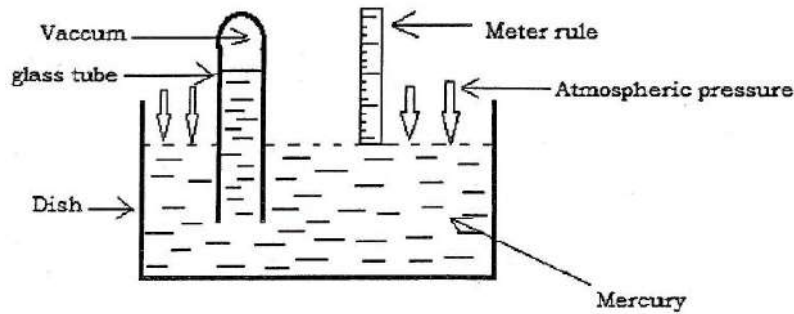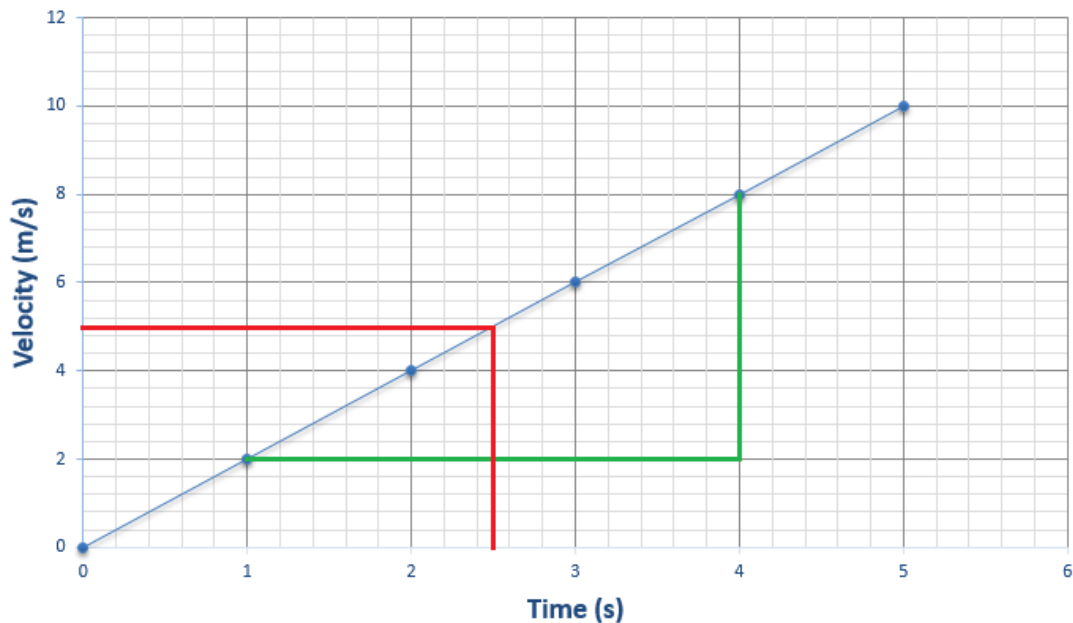

(b) $\rho_{Hg}gh_{Hg} = \rho_w gh_w \iff h_w = \frac{\rho_{Hg}h_{Hg}}{\rho_w} = \frac{1.36\times10^4\times0.67}{10^3} = 9.112m$

(c) $P_{lung} = P_{atm} + \rho gh_w = 1.01 \times 10^5 + 1000 \times 10 \times 0.4 = 105000\ Pa$
$$= 1.05 \times 10^5\ Pa$$

SECTION C: ATTEMPT ONLY ONE QUESTION

21. (a)

(c) The slope: $a = \frac{\Delta v}{\Delta t} = \frac{8-2}{4-1} = \frac{6}{3} = 2\frac{m}{s}$

(c) The slope represents acceleration

(d) If $t = 2.5\ s$ then $v = 5\ m/s$

22. (a)
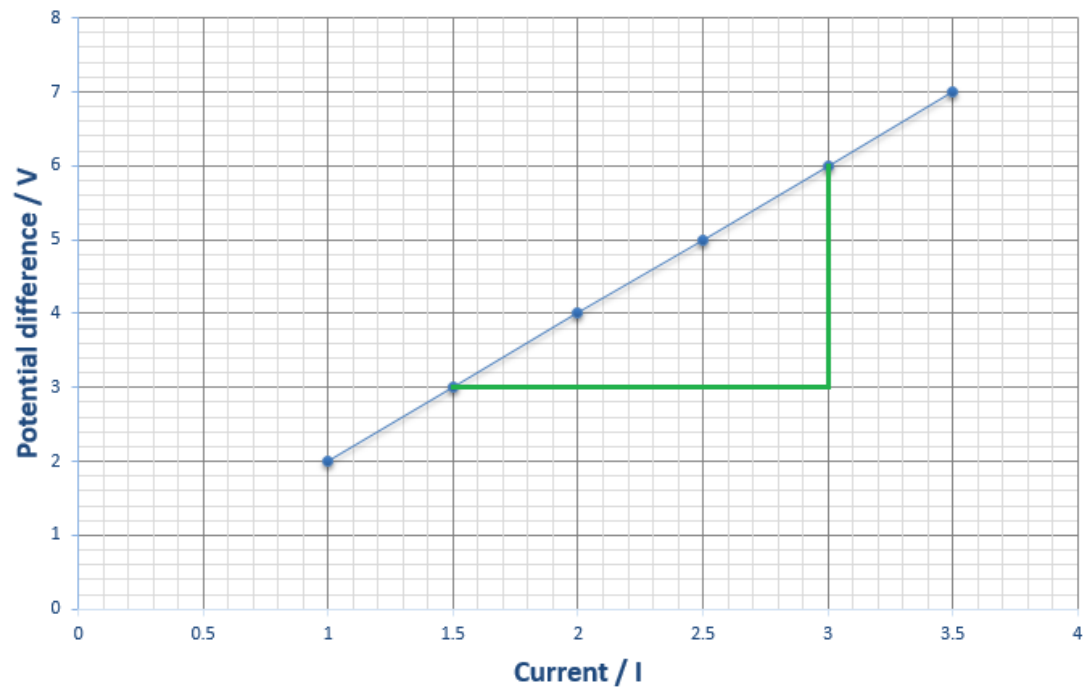
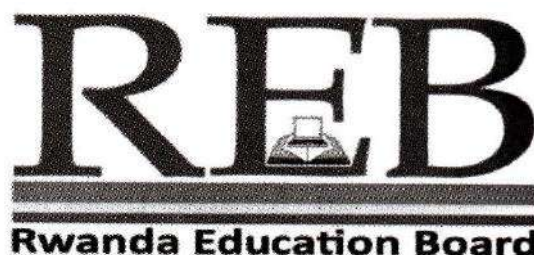*(b) The slope:* $a = \dfrac{\Delta U}{\Delta I} = \dfrac{6-3}{3-1.5} = \dfrac{3}{1.5} = 2 \ \Omega$

(c) Resistance $= \dfrac{Potential\ difference}{Current}$

$R = \dfrac{U}{I}\ or\ U = RI$

Compiled by HUNGURIMANA Dieudonné, 0788473140, ENDP KARUBANDA, HUYE

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2016

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.

2. Do not open this paper until you are told to do so.

3. This paper consists of **three** sections **A**, **B** and **C**

   - Answer **ALL** questions in section A.   **(55 marks)**
   - Answer **THREE** questions in section B.   **(30 marks)**
   - Answer only **one** question in section C   **(15 marks)**

4. Calculators and mathematical instruments may be used.

5. Use only a **blue or black pen and pencil.**

SECTION A: Attempt all questions from this section. (55 marks)

1. Which instrument would you use to measure each of the following quantities?
   a) The mass of a stone. **(1 mark)**
   b) The diameter of 100Frw coin. **(1 mark)**
   c) The weight of a stone. **(1 mark)**
   d) The volume of water. **(1 mark)**

2. For each of the statements below, indicate TRUE if it is correct and FALSE if it is wrong.
   a) Density of water is less than the density of ice .... **(1 mark)**
   b) The density of ice is less than the density of water because when water freezes it expands (volume increases) while its mass remains the same .... **(1 mark)**
   c) The density of ice is greater than the density of water because ice is a solid. .... **(1 mark)**

3. a) What is the difference between speed and velocity of a moving body? **(2 marks)**
   b) How far will a cyclist travel in 2 hours if his velocity is 8 m/s? **(2 marks)**

4. a) Give one example in which friction is a disadvantage. **(2 marks)**
   b) Explain why wheels turn on ball bearings. **(2 marks)**

5. a) When a stone is thrown up, it goes up for a while and then falls down. What causes the stone to fall down? **(1 mark)**
   b) A stone is thrown vertically upwards with initial velocity of 20 m/s. How high does the stone rise in air? Take $g = -10$ m/s^2. **(3 marks)**

6. a) A boy standing on the ground exerts a force equal to his weight on that ground. If the boy's weight is 600 N and the area of his shoes in contact with the ground is 120 cm^2. Calculate the pressure he exerts on the ground. **(2 marks)**
   b) If the boy in 6 (a) lies flat on the ground, what effects does this position have on the pressure on the ground? Explain your answer. **(2 marks)**

7. a) Convert 20°C to Kelvin scale. **(1 mark)**
   b) What causes convection currents to rise when a liquid is heated? **(2 marks)**
   c) What is meant by "heat transfer by radiation method"? **(1 mark)**

8. Copy the diagram below and show the path of the ray of light after reflection from the plane mirror. Name the reflected ray, the angle of incidence and the angle of reflection.

Incident ray

Mirror
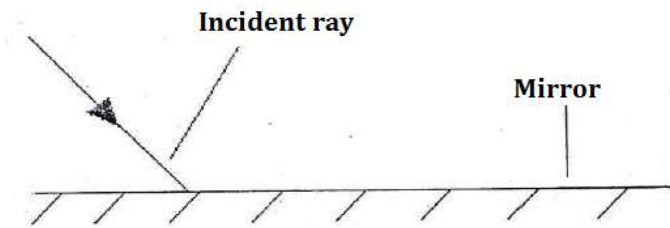
9. The table below shows how charged objects affect each other when they are brought close to each other. Copy the table and complete it. **(4 marks)**

Charge on object A	Charge on object B	Force
Positive		Repel
Positive	Negative	
	Positive	Attract
Negative		Repel

10. a) When is an object in equilibrium state? **(1 mark)**
    b) State the condition for a body to be in a neutral equilibrium. **(2 marks)**
    c) A uniform meter rule is pivoted at 50 cm mark. A force of 150 N placed at 70 cm mark balances a force F placed at 20 cm. Find force F. **(1 mark)**

11. a) State the law of floatation. **(2 marks)**
    b) A ship may travel from the sea into a river. Explain why the ship will sink deeper in the river than in the sea. **(2 marks)**

12. Below are examples of changes of matter. For each change; state whether it is a physical change or a chemical change.
    a) Thermal expansion due to heating
    b) Burning a piece of wood.
    c) Dissolving sugar in hot water.
    d) Reaction between sodium and water.

13. The figures below are simple electric circuits. The lamp figure is normally bright.

Figure 1 — Lamp
Figure 2 — Lamp
Figure 3 — Lamp
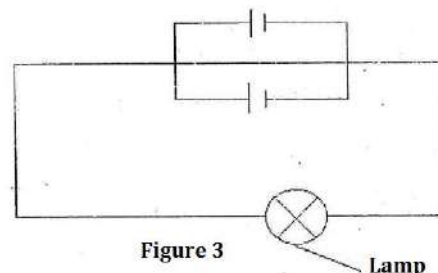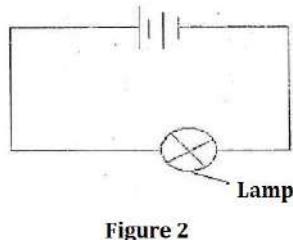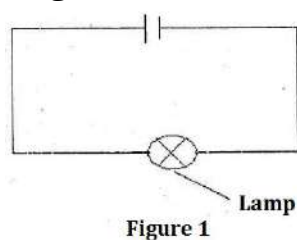
a) Use the words ''normal bright'', ''brighter than normal'', ''dimmer than normal bright'' to describe the brightness of lamps in Figures 2 and Figure 3. (All three lamps are identical). **(2 marks)**
    b) Identify the arrangement of cells in:
    (i) Figure 2. **(1 mark)**
    (ii) Figure 3. **(1 mark)**

14. a) What is the difference between a convex lens and a concave lens?

    (2 marks)

    b) Which lens would you use to correct:
    (i) Long sight eye defect? **(1 mark)**
    (ii) Short sight eye defect? **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS   (30 MARKS)

15. a) Copy Figure 4 below and complete it to show the path of the incident ray through the water from the air. Does the ray remain straight as it travels through water? Explain your answer.
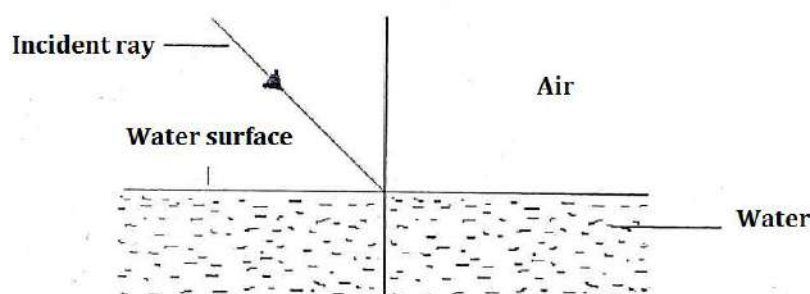

Figure 4

    b) What is meant by the " dispersion of white light"?
    c) Copy the diagram below of a ray of light passing through a prism and complete it.
    Show the angle of deviation.

    d) Explain how a rainbow is formed.

16. a) What is meant by "specific latent heat of fusion of a substance"?

    (2 marks)

    b) How much heat will change 10g of ice water at 0°C to liquid water at 0°C? Specific latent heat of fusion of ice = 340 J/g.   **(2 marks)**
    c) i) At what temperature does evaporation occur?   **(1 mark)**
       ii) What causes the evaporation to happen rapidly?   **(3 marks)**
    d) Explain how our bodies keep temperature constant after a vigorous exercise?   **(2 marks)**

17. a) State the effects of the electric current which show its existence.

    (3 marks)

    b) The opposition of a conductor to current flow is called resistance.
       i) What effects does increasing temperature of the filament of an electric lamp have on the resistance of the filament?   **(1 mark)**
       ii) Which has more resistance, a thin conductor wire and a thick conductor wire?   **(1 mark)**
    c) Define the term 'electromotive force of a cell'.   **(2 marks)**

d) The electromotive force of two dry cells is 3.0 V. The internal resistance of each cell is 0.3 Ω. A resistor of 0.4 Ω is connected in series to the two cells which are arranged in series.
Calculate the current. (See diagram below).   **(3 marks)**
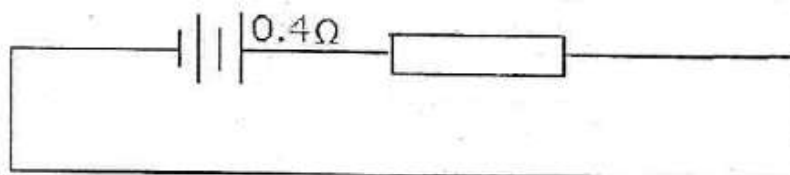
18. a) What is meant by a "magnetic material"? Give an example of a magnetic material.   **(2 marks)**
b) State any two methods of magnetizing a steel bar.   **(2 marks)**
c) The diagrams below are bar magnets.

S	N

N	S

Copy the diagrams and show magnetic lines of force around. Show the neutral point on the diagrams.   **(2 marks)**
d) Why is it bad to heat or hammer a bar magnet?   **(2 marks)**
e) How is a magnet used to show geographical direction on Earth?
                                                           (2 marks)

19. a) What is meant by a body with a uniform acceleration?   **(2 marks)**
b) A car travelling at 10 m/s accelerates uniformly for 5s and reaches a velocity of 20 m/s. Calculate the acceleration?   **(3 marks)**
c) A bus driver, travelling at 25 m/s, applies his brakes and stops with uniform retardation in 2.0 s.
(i) What is meant by uniform retardation?   **(2 marks)**
(ii) Calculate the retardation.   **(3 marks)**

SECTION C: Attempt only one question   (15 MARKS)

20. In an experiment to determine the rate of change of temperature of water when the supply of heat was constant, the following results were obtained.

Time / minutes	Temperature /°C
1	33
3	55
5	75
7	95
8	95
9	95

a) On a graph paper, plot a graph of temperature (along y - axis) against time (along x – axis).   **(10 marks)**
b) Using your graph; find:
 i) The room temperature where the experiment was conducted. **(1 mark)**
 ii) The boiling temperature of water.   **(1 mark)**

iii) The slope (gradient) of the graph, then state the rate of change of temperature of water. **(3 marks)**

21. In an experiment to determine the density of steel, a number of pieces of iron with different masses were used. The volume and the mass of each piece of steel were measured. The table below shows the results obtained.

Volume / cm³	Mass /g
2	16
3	25
4	32
5	38
6	48
7	56

a) Plot a graph of mass (along y – axis) against volume (along x – axis).
(10 marks)

b) Determine the slope of the graph and show how you determine the slope. **(3 marks)**

c) Determine the density of the steel. **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS
NATIONAL EXAMINATION 2016

Section A: Answer all questions

1. a) *Bean balance / electronic balance*
   b) *Vernier callipers / micrometer*
   c) *Newton spring balance / Newton meter*
   d) *Measuring cylinder / graduated cylinder.*

2. a) *False*
   b) *True*
   c) *False*

3. a)

Speed	*Velocity*
Distance covered in a unit of time	*Distance covered in a unit of time in a specific direction.*
It is a scalar quantity	*It is a vector quantity.*
It has magnitude only	*It has both magnitude and direction*

   b) *Distance travelled = speed X time = 8 m/s X 2 X 60 X 60 =*
   57 600 m = 57.6 km

4. a) *It causes unwanted noise*
   It causes wear and tear.
   It causes unwanted heat
   Reduction of efficiency of a machine.
   b) *Ball bearings reduce friction between wheels and axles.*
   Wheels turn easily (or increase efficiency)

5. a) *Force of gravity*
   b) *u = 20 m/s; V = 0 m/s; g= 10 m/s² and t = t (s)*
   V = u + gt; 0 = 20 m/s + (10 m/s²)t
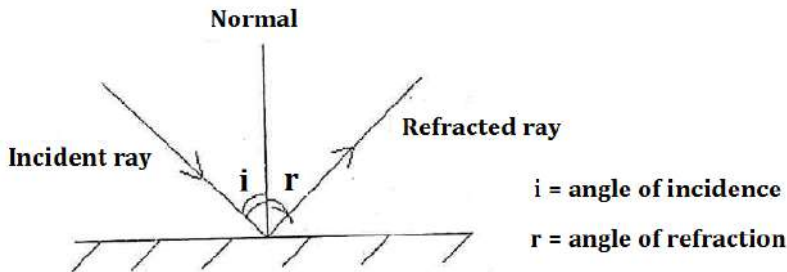 $$t = \frac{20 \, m/s}{10 \, m/s} = 2 \, s$$

   $$h = -\frac{1}{2}gt^2 + ut = -\frac{1}{2} \times 10 \times 2^2 + 20 \times 2 = -20 + 40 = 20 \, m$$

6. a) $P = \frac{F}{A} = \frac{600 \, N}{120 \times 10^{-4} m^2} = 5 \times 10^{-4} \frac{N}{m^2} \, Or \, 5 \times 10^{-4} \, Pa$

   b) *The area in contact with the boy's body increases and hence the pressure decreases.*

7. a) $20°C = (273 + 20) = 293 K$

   b) When a liquid is heated, it expands and becomes less dense and rises upwards.

   c) Radiation is flow of heat from one place to another by means of electromagnetic waves.

8.

9.

Charge on object A	Charge on object B	Force
Positive	**Positive**	Repel
Positive	Negative	**Attract**
Negative	Positive	Attract
Negative	**Negative**	Repel

10. a) Equilibrium is the state of body where the sum of moments tending to turn the body clockwise round any point is equal to the sum of the moments tending to turn it anticlockwise.

    b) A body in a neutral equilibrium returns in its initial position after being displaced slightly.

    c)
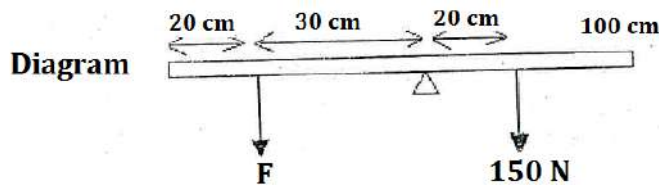
   $F \times 30\ cm = 20\ cm \times 150\ N$

   $30 F = 3000$

   $F = 100\ N$

11. a) It states that a floating body displaces its own weight of fluid in which it floats.

    b) Sea water is denser than river water so the volume of sea water displaced by the ship is less than the river water displaced. So the ship sinks deeper into the river water.

12. a) Physical change

    b) Chemical change

c) Physical change
d) Chemical change

13. a) Figure 2: brighter than normal
    Figure 3: normal bright
    b) i) Figure 2: cells are in series
       Figure 3: cells are in parallel
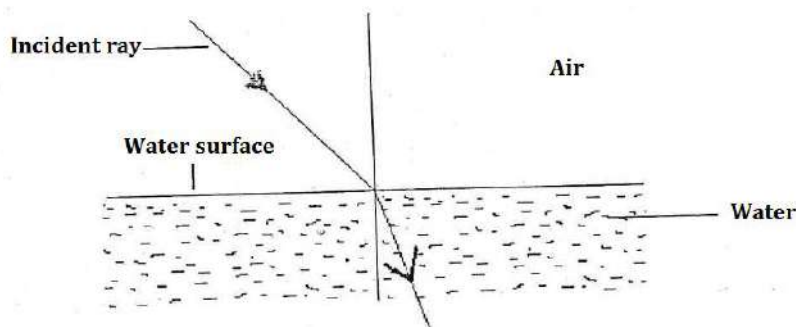
14. a)

Convex lens	Concave lens
Thinner at the edges and thicker in the middle	Thinner in the middle and thicker at the edges.
Can give a real and virtual image	Gives only virtual image
Positive focal distance	Negative focal distance.

b) i) Convex lens or converging lens
   ii) Concave lens or diverging lens.
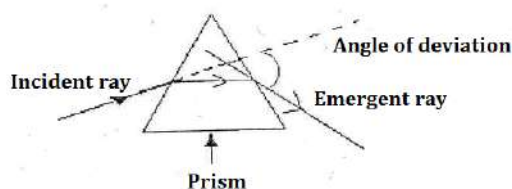
SECTION B: ANSWER ONLY THREE QUESTIONS

15. a)

 The incident ray bends as it enters water. Its speed reduces as it enters water, hence the direction of the ray changes. The refracted ray bends towards the normal.
b) Dispersion of white light is the splitting of white light into different colours which make up the white light.
c)

d) When it is about to rain or raining, sunlight falls on the rain drops. Light is refracted hence splitting up into different colours which form the rainbow.
16. a) It is the quantity of heat needed to change a unit mass from solid to liquid without change in temperature.

b) Latent heat of fusion needed = m X L = 10g X 340 J/g = 3 400 J.
c) i) At any temperature
   ii) - At higher temperature of the liquid: the higher the temperature, the greater the rate of evaporation.
   - *Area of exposed surface: evaporation increases as the rate of water surface increases.*
   - *The rate of removal of vapour: on a windy day, evaporation is faster.*
   - *Nature of the liquid.*
   - *Decrease in atmospheric pressure.*
   - *Dryness of air in contact with liquid.*

17. *a) Heating effect, chemical effect, lighting effect, magnetic effect, physiological effect.*
   b) i) The resistance of the filament increases when its temperature increases.
      ii) A thin conductor wire.
   c) The e.m.f. of a cell is the potential difference at its terminals when it is not connected to any resistance or apparatus.
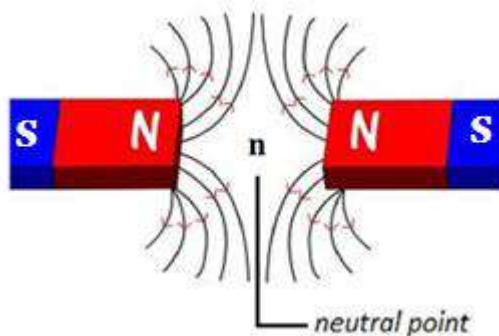   *d) Total resistance = 0.4 X 2 Ω + 0.4 Ω =1.0 Ω*
      Total voltage = 3 V
      $$Current\ I = \frac{E}{R_t} = \frac{3\ V}{1.0\ \Omega} = 3\ A$$

18. *a) A magnetic material is a substance which can be magnetized or attracted by a magnet. E.g. Iron, cobalt, nickel.*
   b) Induction, electrical method
   c)

neutral point

   d) The magnet is demagnetized or it loses its magnetic properties.
   e) The bar magnet is suspended on a string when it comes to rest, the north magnetic pole points to the north geographical pole of Earth.

19. *a) A uniform acceleration is the constant rate of change of increasing velocity of a moving body.*
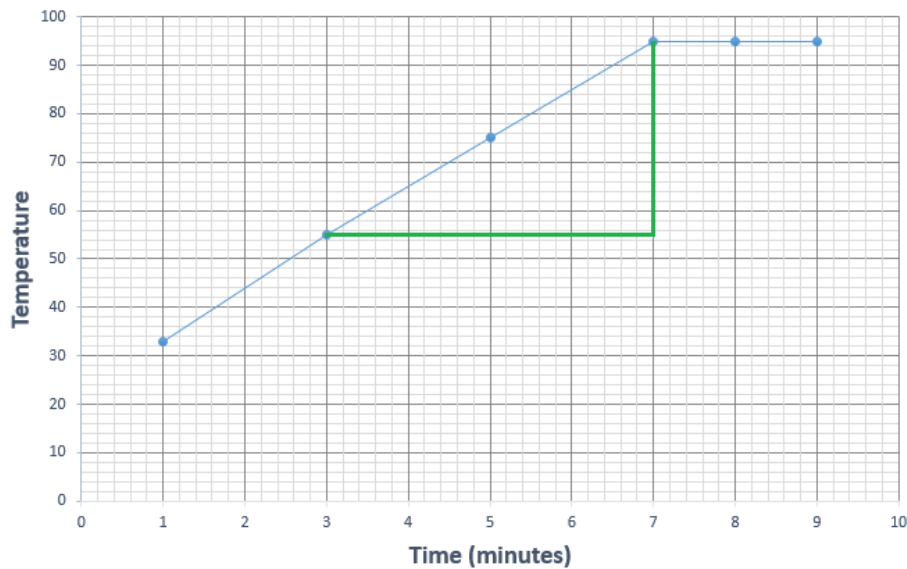   *b) u = 10 m/s; V = 20 m/s; t = 5 s*

$$a = \frac{V-u}{t} = \frac{20-10}{5} = 2m/s^2$$

c) i) Retardation is the constant rate of change of decreasing velocity of a moving body.

ii) $a = \frac{V-u}{t} = \frac{(0-25)m/s}{20s} = -1.24m/s^2$

SECTION C: ATTEMPT ONLY ONE QUESTION

20. (a)

b) i) The room temperature where the experiment was conducted is 25ºC.

ii) The boiling temperature of water is 95ºC.

iii) The slope or gradient of the graph: $S = \frac{\Delta T}{\Delta t} = \frac{95-55}{7-3} = \frac{40}{4} = 10\frac{ºC}{min}$

21. a)
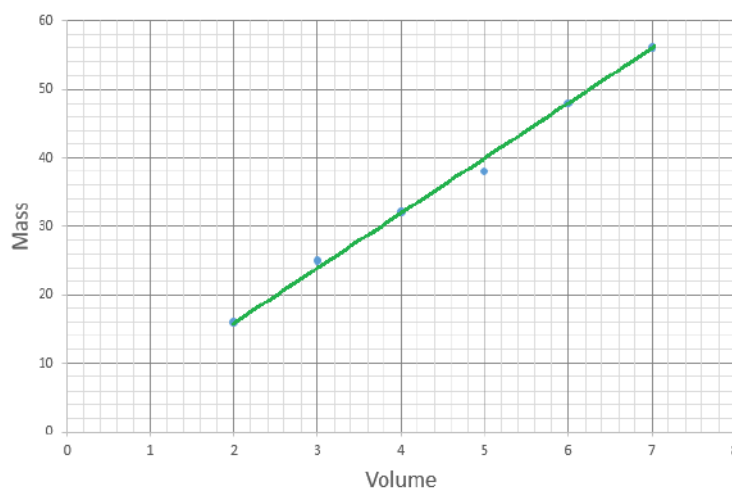
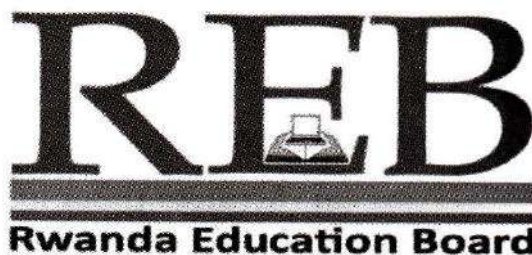*(b) The slope:* $S = \frac{\Delta m}{\Delta V} = \frac{48-16}{6-2} = \frac{32}{4} = 8 \; g/cm^3$

(c) Density of the steel $= \frac{Mass}{Volume} = \frac{16 \; g}{2 \; cm^3} = 8 \; g/cm^3$

| Physics I
011
23/11/2017 08.30 AM – 11.30 AM | **REB**
Rwanda Education Board |

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2017

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.

2. Do not open this paper until you are told to do so.

3. This paper consists of **three** sections **A**, **B** and **C**

- Answer **ALL** questions in section A.   **(55 marks)**
- Answer **THREE** questions in section B.   **(30 marks)**
- Answer only **one** question in section C   **(15 marks)**

4. Calculators and mathematical instruments may be used.

5. Use only a **blue** or **black pen** for answering and a **pencil** for drawing.

SECTION A: Attempt all questions from this section. (55 marks)

1. a) The mass of fresh milk at 20°C is 103.5g and its volume is 100cm³. Calculate the density of fresh milk. **(2 marks)**
    b) Why is it useful to know the density of fresh milk? **(1 mark)**

2. a) What is the difference between distance and displacement of a moving body? **(2 marks)**
    b) A car starts from town A and travels 40 km eastwards to town B northwards from town B to town C. What is the displacement of the car from town A to town C? **(2 marks)**

3. a) Define the term " deceleration" of a moving body. **(1 mark)**
    b) A car slows down from 72 km/h with a uniform deceleration of 2m/s². How long will it take to reach 18 km/h? **(3 marks)**

4. A student with a mass of 40 kg is running with a velocity of 2 m/s.
    a) Calculate the kinetic energy of the student. **(2 marks)**
    b) What would be the kinetic energy of the student if the velocity was doubled? **(2 marks)**

5. a) Define the term "center of gravity of a body." **(2 marks)**
    b) A uniform meter rule is balanced by the mass of 24 g at 100 cm mark while the pivot is at 65 cm mark. Calculate the mass of the meter rule. **(2 marks)**

    0cm   **100cm**

   ← —————65cm—————→ △

    24g
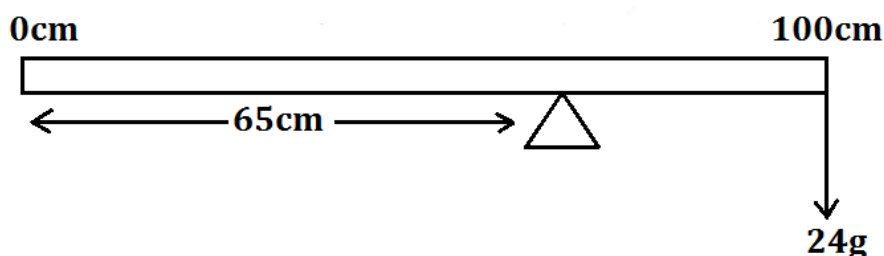
6. Two strings at right angle to each other support an object O of weight W. If the forces in the strings are 12 N and 5 N; calculate the weight W of the object. **(4 marks)**

7. a) State "Archimedes' Principle." **(2 marks)**
    b) What is meant by the term "upthrust?" **(2 marks)**

8. a) What is meant by the term "viscosity?" **(2 marks)**
    b) What effect does soap have on the surface tension of water? **(2 marks)**

9. a) What is meant by the term "temperature" of a substance? **(2 marks)**
    b) State two applications of temperature. **(2 marks)**

10. Read each statement below and write "TRUE" if it is correct or "FALSE" if it is wrong.
    a) Luminous objects radiate light. **(1 mark)**
    b) Shadows and eclipses are due to the rectilinear propagation of light.

(1 mark)

c) Beams of light are parallel and divergent only. **(1 mark)**

d) The image formed in a pinhole camera is erect (upright). **(1 mark)**

11. a) State Ohm's law. **(2 marks)**

b) Explain why:

(i) The ammeter measuring the current is placed in series in a circuit. **(1 mark)**

(ii) The voltmeter measuring the potential difference is placed in parallel with the circuit. **(1 mark)**

12. Read each statement below and write "TRUE" if it is correct or "FALSE" if it is wrong.

a) Like electric charges repel and unlike charges attract. **(1 mark)**

b) An example of a conductor of electricity is a human body. **(1 mark)**

c) Insulators of electricity allow charges to flow through them. **(1 mark)**

d) A pointed charged conductor has a low density charge at the point. **(1 mark)**

13. a) Use the domain theory of magnesium to explain the magnetic behaviour of iron. **(2 marks)**

b) State the difference between the magnetic properties of iron and steel. **(2 marks)**

14. List the energy changes which occur in each of these cases below:

a) A match stick is struck. **(1 mark)**

b) An electric lamp is switched on. **(1 mark)**

c) Dry cells in a torch when the torch is switched on. **(1 mark)**

d) A telephone ear piece when two people are talking on telephones. **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS (30 MARKS)

15. a) State "heat effects." **(2 marks)**

b) Explain why the cooling unit (freezer) inside a refrigerator is placed near the top but an electric immersion heater in water tank should be near the bottom of vessel being used to heat the water. **(2 marks)**

c) A clinical thermometer needs to be an accurate maximum thermometer. Briefly explain how two basic requirements are achieved. **(2 marks)**

16. a) Draw a convergent lens and show how it refracts an incident parallel beam of light. **(2 marks)**

b) Define the term "focal length" of a lens. **(1 mark)**

c) What does the power of a lens depend on? **(1 mark)**

d) Copy the diagram below and use rays to show how the image of the object is formed in a convergent lens. State the properties of the image. **(5 marks)**

Converging lens

Object

P   F   F'
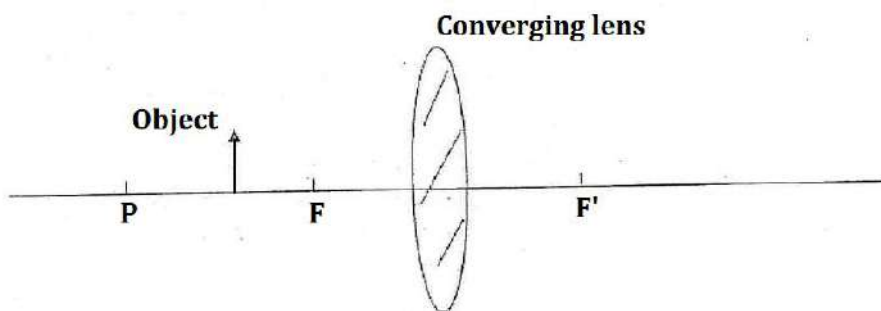
e) State one application of a converging lens. **(1 mark)**

17. a) State any two effects of the electric current. **(2 marks)**
    b) What is a **Coulomb**? **(1 mark)**
    c) A steady current of 4A flows for 5 seconds. Find the total charge passing any point in the circuit. **(1 mark)**
    d) What effect does increase in temperature have on the resistance of the filament of a torch bulb? **(1 mark)**
    e) A student is given a 12V lamp and decides to measure the resistance of the lamp filament using the voltmeter-ammeter method. The student decides to apply various voltages to the lamp and to measure the current in each case.
       (i) Draw a circuit diagram and show clearly, where the voltmeter and ammeter are placed in the circuit. **(2 marks)**
       (ii) Two of the student's results are:

Voltmeter reading / V	Ammeter reading / A
2.0	1.0
12	2.0

       Calculate the resistance of the lamp filament in each case. **(2 marks)**
       (iii) Explain why the resistance of the lamp filament is different in the two cases. **(1 mark)**

18. a) Explain why two steel needles hanging from the N pole of a magnet are not parallel. **(2 marks)**
    b) A bar magnet is heated. State the effect of its (the bar magnet) magnetic properties. How does the domain theory of magnesium explain this effect? **(2 marks)**
    c) What is a place where there is no magnetic field called? **(2 marks)**
    d) The North Pole N of a compass needle points to geographical north. Since like poles repel each other, how do you explain this fact? **(4 marks)**

19. a) What is the difference between force and pressure? **(3 marks)**
    b) State the principle of transmission of pressure in fluids. **(2 marks)**
    c) With the aid of two labelled diagrams, describe and explain the action of a "crushing can experiment." **(5 marks)**

SECTION C: THIS QUESTION IS COMPULSORY (15 marks)

20. In an experiment to determine the acceleration due to gravity **g** of a falling ball-bearing; the following results were obtained:

Time, t/s	t^2/s^2	Distance, h/m
1		5
2		20
3	9	45
4		80
5		125

a) Copy the above table and complete the missing values of **t^2**.   **(2 marks)**
b) Plot the graph of distance h against time **t^2**.   **(9 marks)**
c) Find the slope, **S** of the graph showing clearly how you get your answer.
(3 marks)
d) State the acceleration of gravity **g**.   **(1 mark)**

21. In an experiment to determine the specific heat capacity of a substance **c**, the following results were obtained.

Temperature, t/°C	Quantity of heat, Q/J
5	200
10	400
15	600
20	800
25	1000
30	1200

a) Plot the graph of quantity of heat **Q** against temperature, **t**.   **(9 marks)**
b) From the graph, find the gradient **S** of the graph showing clearly how you get your answer.   **(3 marks)**
c) Use the formula **S = mc** to determine the specific heat of substance **c**. Take mass **m**, of the substance to be 20g.   **(3 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2017

Section A: Answer all questions

1. a) The density of fresh milk at $20°C$ $\rho = \frac{m}{V} = \frac{103.5\ g}{100\ cm^3} = 1.035\ g/cm^3$

   b) The density of milk shows that it is pure milk (milk that is not mixed with other substances such as water…). The density of milk ranges between $1027\ kg/m^3$ and $1033\ kg/m^3$.

2. a) Displacement is the distance moved in a specific direction while distance is the length travelled in any direction.

   b) Displacement of the car from Town A to $C = \sqrt{(30^2 + 40^2)} = 50\ km$

3. a) Deceleration is the rate of decrease of velocity with time.

   b) $u = 72\ km/h;\ v = 18\ km/h = 4\ m/s$ and $a = -2\ m/s^2$

   From the formula; $v = u + at$

   $t = \frac{v-u}{a} = \frac{5-20}{-2} = 7.4\ s$

4. a) Kinetic energy of the student $= \frac{1}{2}mV^2 = \frac{1}{2} \times 40 \times 2^2 = 80\ J$

   b) The kinetic energy of the student would increase four times

   $$KE = \frac{1}{2}mV^2 = \frac{1}{2} \times 40 \times (2 \times 2)^2 = 320\ J$$

5. a) The center of gravity of a body is the point through which its total weight acts. The centre of gravity is defined as the point of application of the resultant force due to the earth's attraction on it. The center of gravity is a geometric property of any object.

   b) Let the mass of the meter rule be m, then

   $m \times (65 - 50) = 24 \times (100 - 65)$

   So $m = \frac{24 \times 35}{15} = 56\ g$

6. The weight W of the object $= \sqrt{(12^2 + 5^2)} = 13\ N$

7. a) Any non-porous object that is completely or partially submerged in a fluid at rest is acted on by an upward (or buoyant) force. The magnitude of this force is equal to the weight of the fluid displaced by the object.

   $B = W_f = m_f g = P_f g\ V_{displaced}$

b) The upthrust is the upward force that a liquid or gas exerts on a body immersed in it.

The buoyant force or upward force acts in the direction opposite to the force of gravity, so it makes an object feel lighter. When an object is immersed in a liquid, it appears to weigh less than when it is in air. This shows that fluid pushes the immersed object upwards thus reducing the reading on the spring balance. All liquids and gases push upwards any object immersed in them and this upward push is called upthrust.

8. *a) Viscosity is the resistance of a liquid to flow.*
    *The friction created as one liquid molecule flows over another is called **viscosity**. Viscosity has the effect of slowing down the flow of the liquid. As the temperature rises, viscosity decreases and a product such as calking will flow more easily. E.g. water flow easily and have low viscosity. Oil has high viscosity.*
    b) Soaps and detergents lower the surface tension of water. This is desirable for washing and cleaning since the high surface tension of pure water prevents it from penetrating easily between the fibers of material and into tiny crevices. Substances that reduce the surface tension of a liquid are called surfactants.

9. *a) Temperature is the degree of hotness or coldness of a body. It is also defined the average kinetic energy of the molecules of a substance.*
    b) Temperature of a person provides an indicator of good health or illness. The refrigerator units in cargo ships must provide a suitable low temperature. Central heating supplies in houses must provide a steady temperature for rooms /cold or hot weather.

10. *a) True*
    b) True
    c) False
    d) False

11. *a) Ohm's law states that the voltage (V) across a resistor is proportional to the current (I) through it where the constant of proportionality is the resistance (R): V = IR.*
    b) (i) Ammeter should have a low resistance compared with that of the rest of the circuit, so that they do not introduce unwanted resistance.
    (ii) An ideal voltmeter has infinite resistance so that no current passes through it and so disturb the circuit as little as possible.

12. *a) True*

b) True

c) False

d) False

13. *a) When the iron is not magnetized, the domains are randomly arranged so that their fields cancel out. In a magnetized piece of iron, the domains have all been aligned in the same direction so that their effects add together to make a strong magnetic field.*

*b) Induced magnetism can be used to form a magnetic chain. If the iron chain is removed by pulling the top clip away from the magnet, the chain collapses, showing that magnetism induced in **iron** is **temporary**. When the same is done with the steel chain [steel is **strong alloy of iron and carbon** 1.5 % along with small amounts of other elements such as manganese, chromium (Cr) and/or nickel (Ni)], it does not collapse: magnetism induced in **steel** is **permanent**.*
*Magnetic materials like iron which magnetize easily but do not keep their magnetism are said to be **sof**t. Those like steel, cobalt, and nickel which are harder to magnetize than iron but stay magnetized, are **hard**.*

14. *a) Mechanical energy---Heat energy---Light energy*
    b) Electrical Energy---Heat energy and light energy
    c) Chemical energy----Electrical energy-----light energy
    d) Electrical energy---- sound energy

**SECTION B: Attempt any THREE questions in this section**

15. *a) The effects of heat: increases the volume (expansion), increase the temperature, change the physical state of body, change chemical state (combustion), increase the internal energy.*
    b) When the water at the bottom is heated, it expands, becomes less and rises to surface as the cold water at the surface moves down to replace the hot water. Hot liquids and gases expand and rise while the cooler liquid or gas falls.
    c) A clinical thermometer is a fairly accurate thermometer because the liquid used is mercury which expands uniformly and is a good conductor of heat. The volume of the mercury in the bulb is small so the mercury reaches the temperature to be measured. The stem has a narrow bore and is capable of measuring small changes in temperature which makes it makes it more sensitive. The clinical thermometer is a maximum thermometer because it has a constriction just above the bulb. When the thermometer is used, the force of expansion pushes the mercury past the constriction until it reaches the maximum temperature on

removal. The mercury cannot pass the constriction unless it is shaken. It therefore remains, indicating maximum temperature. The reset the thermometer, the mercury must be shaken vigorously to make it pass the constriction.
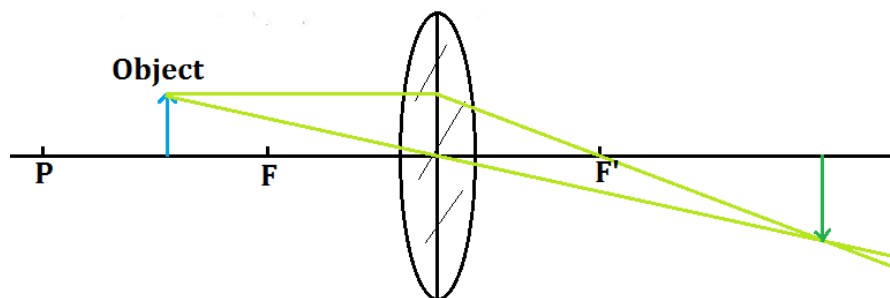
16. a)

Parallel rays
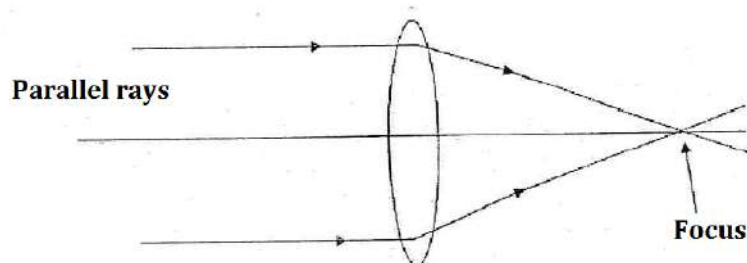
Focus

b) The focal length of a lens is the distance from the principle focus to the middle of the lens.

c) The power of a lens depends on its focal length. A short focal length lens has a higher power than a long focal length.

d)

Object

P   F   F'

e) It is used in cameras and microscopes.

17. a) *Magnetic effect, heat effect, light effect, chemical effect*

b) A coulomb is a charge passing in a circuit when a steady current of 1 Ampere flows for 1 second.

c) Q = It = 4A X 5s = 20 C

*d) The resistance of the filament of the torch bulb increases.*

e) i) Diagram

Ammeter

A

Battery   Lamp   V   Voltmeter
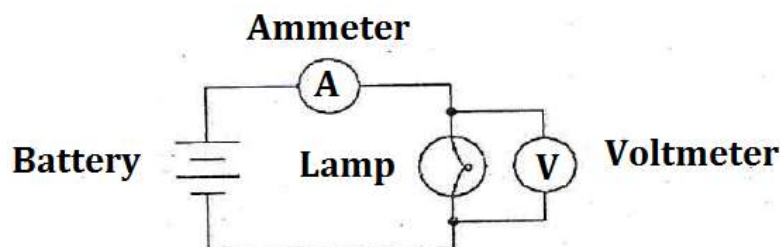
ii) $R_1 = \frac{2.0\,V}{1.0\,A} = 2\,\Omega$ $R_2 = \frac{12.0\,V}{2.0\,A} = 6\,\Omega$

iii) When the filament is hot, its resistance increases.

18. a) The two needles repel because their ends are both North poles (like poles of a magnet repel).

b) When the bar magnet is heated, it loses magnetism. A magnet is made up of many tiny regions called domains. Each domain behaves like a magnet. In a magnet, the domains are aligned in the same direction so that their effects add together to make a strong magnetic field. Heating a magnet gives the domains energy so that they can turn back to their original random arrangement and the magnetism is lost.

c) Neutral point.

d) The Earth behaves like a giant magnet. The geographic N pole of the Earth is the South magnetic pole. This is a south seeking pole because it attracts the N pole of a magnet. Near the geographic South Pole is the North magnetic pole.

19. a) Force is that which changes a body's state of rest or of uniform motion in a straight line. The unit of force is Newton i.e. the force needed to five a mass of one kilogram an acceleration of one meter per second squared. Pressure is the force acting normally per unit area. The unit of pressure is Newton per meter squared (N/m^2). 1 N/m^2 is the same as 1 Pascal (1 Pa).

b) When the fluid is completely enclosed in a vessel and a pressure is applied to it at any part of its surface, then the pressure is transmitted equally throughout the whole of the enclosed fluid.

c) Water is poured into a metal can and then heated while its mouth open. Water is allowed to boil for some time driving out all the air in the can. The steam above the water in the metal can drives out all the air in the can. The can is then tightly fitted in the mouth of the can and then the flame is removed. Cold water is then poured over the can. This causes the steam inside the can to condense producing water and water vapour at very low pressure. The outside atmospheric pressure on the can causes the can to collapse inwards hence demonstrating large forces which can be produced by atmospheric pressure.
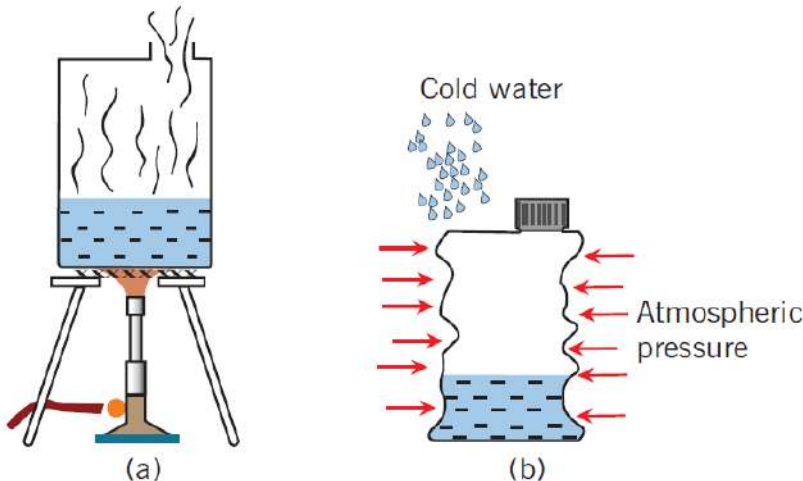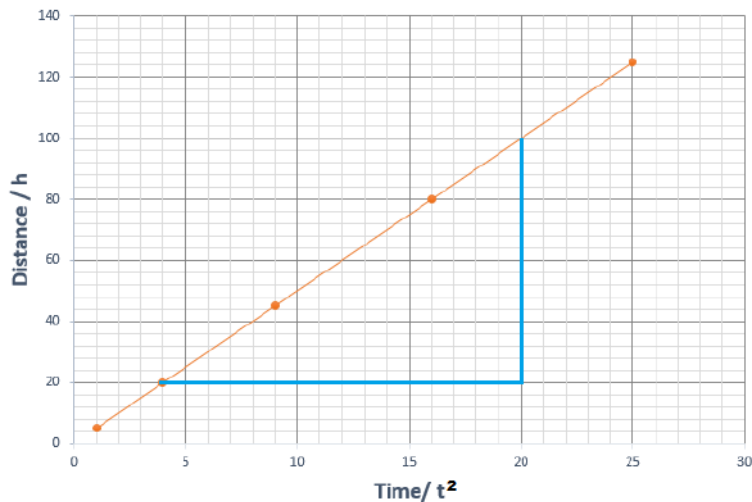
SECTION C: ATTEMPT ONLY ONE QUESTION

20. a)

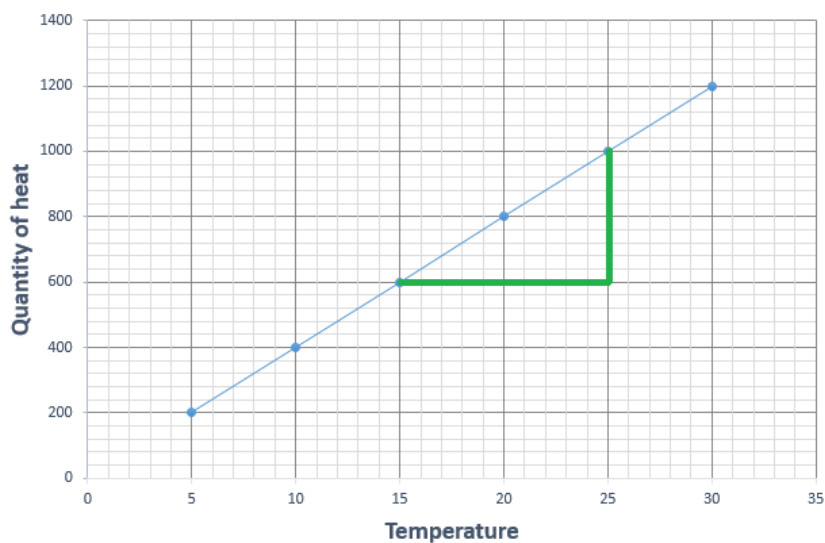| Time, t/s	t²/s²	Distance, h/m
1	**1**	5
2	**4**	20
3	9	45
4	**16**	80
5	**25**	125

b)

c) The slope: $S = \dfrac{\Delta h}{\Delta t^2} = \dfrac{100-20}{20-4} = \dfrac{80}{16} = 5 \, m/s^2$

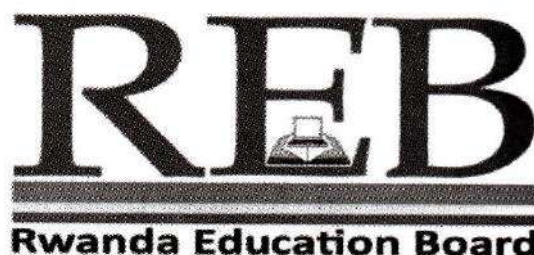*d) From* $h = \dfrac{1}{2}gt^2 \iff g = \dfrac{2h}{t^2} = 2 \times 5 \dfrac{m}{s^2} = 10 \, m/s^2$

21. a)

b) The slope: $S = \dfrac{\Delta Q}{\Delta t} = \dfrac{1000-600}{25-15} = \dfrac{400}{10} = 40 \, J/ºC$

c) $S = mc; \; c = \dfrac{S}{m} = \dfrac{40 \, J/ºC}{20 \, g} = 2 \, J/gºC$

PHYSICS I

011

22/11/2018 08.30 AM – 11.30 AM

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2018

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.

2. Do not open this paper until you are told to do so.

3. This paper consists of **three** sections **A**, **B** and **C**

   - Answer **ALL** questions in section A.   **(55 marks)**
   - Answer **THREE** questions in section B.   **(30 marks)**
   - Answer only **one** question in section C   **(15 marks)**

4. Silent non-programmable calculators may be used.

5. You do not need the periodic Table.

6. Use only a **blue** or **black pen** for answering and a **pencil** for drawing.

SECTION A: Attempt all questions from this section. (55 marks)

1. Identify 3 renewable energy sources that are actually used in Rwanda.
   (3 marks)

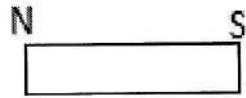2. (a)Copy and draw the magnetic field lines of force around the bar magnet below (figure 1). **(2 marks)**

   N   S

   Figure 1

   (b) Suppose that the bar magnet is divided into two parts as shown below (figures 2 and 3).
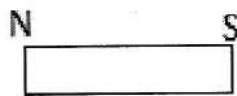
   Bar magnet before its division

   N   S

   Figure 2

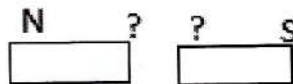   Bar magnet after the division

   N   ?   ?   S

   Figure 3

   Copy and name the missing magnetic poles as shown in figure 3. **(1 mark)**
   (c) Propose one method that you can use to demagnetize a magnet.
   (1 mark)

3. (a) (i) Use of electricity in homes can be dangerous. Explain how a fire breakout due to an electric fault can be prevented. **(1 mark)**
   (ii) Suggest a reason for power losses that might occur in electrical power transmission lines. **(1 mark)**
   (iii) Determine the role of a transformer in electrical power transmission.
   (1 mark)
   (b) Give two advantages of alternating current over direct current.
   (2 marks)

4. (a) Explain how the potential energy can be used to do work. **(2 marks)**
   (b) What energy transformations do take place when a battery operated radio is in use? **(2 marks)**

5. For each of the following statements; indicate whether the statement is true or false.
   (a)Pressure decreases when the surface area over which a force is applied decreases. **(1 mark)**
   (b) A fluid applies pressure perpendicular to all sides of an object in contact with the fluid. **(1 mark)**
   (c) If the weight of an object that is submerged in a fluid is 10N and the buoyant force on it is 20 N. The object will sink initially then remain underwater/submerged. **(1 mark)**

(d) A and B are non-miscible liquids and have densities of 0.75 g/ml and 1 .14 g /ml respectively. When both liquids are poured into a container, B floats on the top of A. **(1 mark)**
(e) Buoyant force is the weight of the mass of water displaced by an immersed object. **(1 mark)**

6. (a) How can induced current be produced? **(2 marks)**
(b) Suggest two ways that may be used to increase the induced current in a coil. **(2 marks)**

7. How does a diode work as a rectifier? **(3 marks)**

8. (a) Is a wheelbarrow 4 simple or compound machine? Explain. **(2 marks)**
(b) The mechanical advantage of a simple machine is 4. Explain what this means. **(1 mark)**

9. (a)Kelvin temperature scale is the best scale for measuring temperature. It is more commonly used in industry and sciences. Explain the reason behind. **(1 mark)**
(b) Why does
    (i) A liquid have a definite volume but not a fixed shape? **(1 mark)**
    (ii) A gas have no fixed shape and volume? **(1 mark)**
    (iii) A solid have fixed shape and definite volume? **(1 mark)**

10. Predict what will happen when the pressure and the temperature of a fixed amount of an ideal gas decrease simultaneously. Justifications are required. **(3 marks)**

11. Pascal's principle states that when a change in pressure is applied to an enclosed fluid at rest, it is transmitted undiminished to all portions of the fluid and to the walls of its container.
(a) Specify the fundamental characteristics of the mentioned fluid. **(1 mark)**
(b) How is Pascal's principle used in everyday life? **(2 marks)**

12. A certain object weighs 294.3 N at the earth's surface. Determine the mass of the object in kilograms then in centigrams. Take g = 9.81 m/s^2. **(3 marks)**

13. A force of 400 N is applied to a 40 kg object moving on a horizontal surface of which the friction force is 200 N.
(a) Find the net force acting on this body. **(1 mark)**
(b) Find the acceleration of the moving object. **(2 marks)**

14. (a) Determine the quantity of heat needed to raise the temperature of 1000 g of water from 20°C to 100°C. The specific heat capacity of water is 4 200 J.kg^{-1}.K^{-1}. **(2marks)**
(b) What will happen to the temperature of this quantity of water at 100°C if the heating continues? Explain your answer. **(2marks)**

15. (a) The small distance between two positive charged particles Q_1 and Q_2 placed in free space is d.
(i) Draw the electric field lines of force between Q_1 and Q_2.   **(1 mark)**
(ii) Name any one factor that affects the magnitude of Coulomb's force between Q_1 and Q_2.   **(1 mark)**
(b) A point p is at 100 cm from a positive point charge Q = 2nC placed in vacuum. Calculate the electric potential due to Q at p. The permittivity of free space ε_o = 8.85 x 12^{-12} F/m.   **(2 marks)**

SECTION B: ATTEMPT ANY THREE QUESTIONS (30 Marks)

16. (a) Describe an experiment to find the centre of mass of an irregular lamina like the diagram below (Figure 5).   **(3 marks)**

Figure 5

(b) Copy and label with a dot the centre of gravity of each of the following objects (figures 6, 7, 8, 9). Use the diagram to show how this centre of mass is obtained.

(i)   **(1mark)**

Rectangular lamina (figure 6)

(ii)   **(1mark)**

Circular object (figure 7)

(iii)   **(1mark)**

Cylindrical object (figure 8)

(iv)   **(1mark)**

Rectangular parallelepiped object (figure 9)

(c) Use the terms unstable equilibrium, stable equilibrium and neutral equilibrium to complete the following statements. Respect the order of the question when answering it and don't copy the entire statement.

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(i)..... ....occurs when a simple object is placed in such a position that any slight disturbance would not change the level of its centre of mass.

(1 mark)

(ii).... ...occurs when a simple object is placed in such a position that any slight disturbance effort would raise its centre of mass.   **(1 mark)**

(iii)... ....occurs when a simple object is placed in such a position that any slight disturbance effort would lower its centre of mass.   **(1 mark)**

17. Study the following velocity-time graph of a 5 kg moving body (figure 10) and answer the questions that follow:
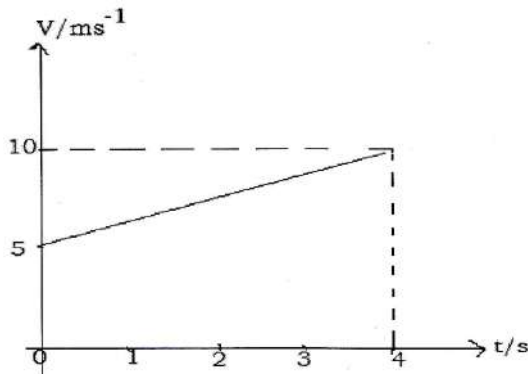
Figure 10

(a) Is this motion rectilinear motion with constant acceleration or uniform rectilinear motion?   **(1 mark)**

(b) From the graph, determine the initial velocity of the body. (1 mark)

(c) Find the slope of the graph. This is the acceleration of the moving body.

(3 marks)

(d) Use the result obtained from 17 (c) and plot the acceleration-time Graph.   **(3 marks)**

(e) Determine the distance covered/travelled from the given Velocity - time graph.   **(3 marks)**

18. The diagram below (figure 11) shows an arrow 1cm long placed at 6 cm in front of a concave mirror.
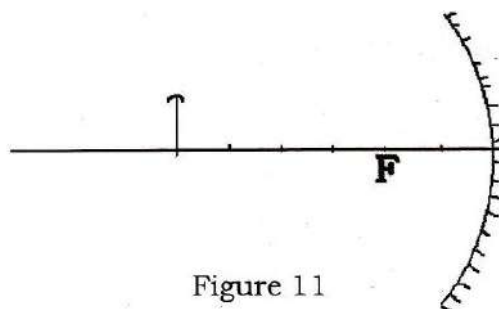

Figure 11
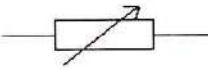
The focal length of this concave mirror is 2 cm.

(a) Draw a ray diagram on the graph paper provided at the end of your answer booklet to illustrate the image formation of the arrow.   **(3marks)**
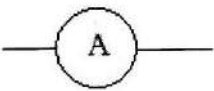
(b) From your graph, describe the characteristics (position, size, nature, direction) of the image obtained.   **(2marks)**
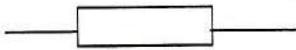
(c) Use calculations to determine the position, the size, the direction and the nature of the image of the above arrow.   **(3 marks)**

(d) Do your mathematical answers and the description above match the image formed by your ray diagram? Justify your answer. **(2 marks)**

19. (a) Identify the common electrical symbols below (figures 12, 13, L4l

(i) Figure 12 **(1mark)**

(ii) Figure 13 **(1mark)**

(iii) Figure 14 **(1mark)**

(b) You are provided with 2 resistors, 3 dry cells, a voltmeter, a switch, and sufficient number of connecting wires. Use all the given electrical components to design a circuit satisfying the condition below:
Two resistors are connected in series such that when the switch is closed; the current flows through the circuit. All the 3 dry cells are in series and the voltmeter measures the potential difference across all connected resistors. **(4marks)**

(d) The internal resistance of the dry cell in the following diagram (Figure 15) is negligible and its electromotive force, E = 4 V. The resistance R = 10 Ω.
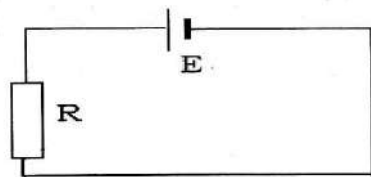

Figure 15

(i) Find the potential difference across the 10 Ω resistor. **(1 mark)**
(ii)Calculate the current passing through the circuit. **(2 marks)**

20. Describe the environmental factors that affect the growth rate of a plant and explain how they do so. N.B: These environmental factors can include both physical and chemical factors. **(10 marks)**

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SECTION C: THIS SECTION IS COMPULSORY   (15 Marks)

21. Answer this question on the graph paper provided at the end of your answer booklet. A group of students carried out an experiment to investigate how the electric current flowing through a constant resistor increases when the voltage applied to its ends increases gradually. The following table shows the results obtained

| Voltage U/V	1.0	3.0	5.0	7.0	9.0	11.0
Current I/mA	1.0	2.9	5.0	6.9	9.0	11.0

(a) Plot a graph of voltage (along y-axis) against current (along x-axis). Draw the best fit straight line.   **(8 marks)**
(b) From your graph, determine the slope/gradient of the graph. **(2 marks)**
(c) What does the result obtained in 21.b represent?   **(1 mark)**
(d) Predict the value of the current if the voltage reaches 16 V. Support your answer with evidence.   **(2 marks)**
(e) Explain why some values of the current do not obey the law of proportionality between current and voltage.   **(2 marks)**

MARKING SCHEME OF ORDINARY LEVEL PHYSICS
NATIONAL EXAMINATION 2018

SECTION A: Answer all questions

1. *Sunlight energy / solar energy; Hydropower / water energy; Geothermal energy; Wind energy; Biogas.*

2. *(a)*
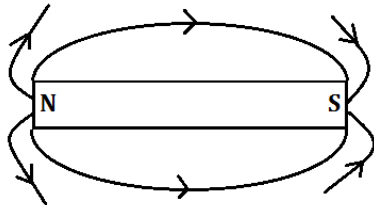
(b)

(c) Demagnetization by hammering the magnets when they are pointing east-west at 90° to the Earth's magnetic field direction; by electric current; by, heating, or by bad keeping.

3. *(a) (i) Do not overload the electrical sockets to prevent sparks that may lead to fire.*
   Always switch off the electrical appliances when not in use.
   Get electrical wiring checked by a qualified electrician.
   Using the circuit breakers.
   Use of a fuse.
   Use of automatic voltage stabilizer.
   Making open wires insulated…
   (ii) Magnetic losses in a transformer.
   Dielectric losses.
   Loss caused by contact resistance.
   Joule's heating effect.
   (iii) Turn low voltage electricity in power line to high voltage electricity while dropping the current.
   To change high voltage electricity in power line or
   To step up voltage electricity.
   To step down voltage electricity.
   (b) AC can be transmitted for a long distance.
   AC is easy to generate than DC.
   AC generators have higher efficiency than DC.
   AC can easily be converted into DC.
   AC can be stepped up / down but DC cannot.

4. (a) P.E. does work when it is transformed into KE. Or when a body released from a certain height / point, it falls down and do work.

(b) Chemical energy $\rightarrow$ Electrical Energy $\rightarrow$ Sound energy

5. (a) False
(b) True
(c) False
(d) False
(e) False

6. (a) Changing the magnetic field through a conducting coil of wire induces an electromotive force which in turn causes the induced current to flow.
(b) Increase the number of turns of the coil.
   Increase the strength of the magnetic field.
   Increase the speed of relative motion between coil and magnet.

7. By allowing current to pass in only one direction so that it can convert AC to DC.

8. (a) Compound machine because it consists of more than one simple machine namely lever, wheel and axle and inclined plane.
It can be a simple machine because it is in the second class of lever.
(b) The output force is 4 times the effort.
   $$MA = \frac{L}{E} \Longleftrightarrow L = 4E$$

9. (a) Because of lack of negative numbers.
   It does not depend on the properties of matter.
(b) (i) The particles of the liquid are very close enough, the attractive forces confine the shape of the container, they can slide about each other.
(ii) The separation between gas particles is very large compared to their size such that there are very weak attractive or repulsive forces between molecules and they are separated from each other and move randomly in space.
(iii) Solid's particles are packed very close together and are not free to move.

10. $\frac{PV}{T} = C^{te}, V = C^{te}$ $\frac{T}{P} \nearrow$
    If T and P decreases simultaneously at the same rate, any change is observed to the volume.
    If T decreases more and P decreases less, the volume increases.
    If T decreases less and P decreases more, the volume increases.

11. (a) Incompressibility
(b) Hydraulic press
   Hydraulic brakes.

Hydraulic lift pump.
Water towers.

12. $Mass\ (m) = \frac{Weight}{Gravity} = \frac{294.3}{9.81} = 30\ kg = 30 \times 10^5\ cg = 3 \times 10^6\ cg$

13. *(a) Net force = 400 N – 200 N = 200 N*
    b) Acceleration $a = \frac{F}{m} = \frac{200}{40} = 5\ m/s^2$

14. *(a) Q = mcΔT*
    $Q = mc(\theta_2 - \theta_1)$
    Q = 1 X 4 200 X (100 – 20) = 336 000 J
    (b) Temperature will not change. Heat gained goes to change the state of water from liquid to gas.

15. *(a) (i)*
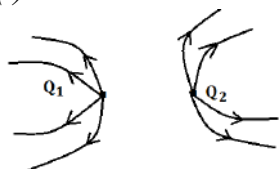
(ii) Distance between the separation of charges.
    Charges of two charge bodies.
    Permittivity of the medium.
    (b) Electric potential $= k\frac{Q}{d}$ *where* $k = \frac{1}{4\pi\varepsilon_0}$

$Electric\ potential = \frac{1\times2\times10^{-9}}{4\pi\times8.85\times10^{-12}} = 17.9\ V \cong 18\ V$

$Or\ Electric\ potential = \frac{1\times2\times10^{-9}}{4\pi\times8.85\times12^{-12}} = 1.6 \times 10^{21}\ V$

Section B: Answer only 3 questions

16. *(a) Make a hole on one edge of the body.*
    Suspend by hanging the mass attached on the thread to stand.
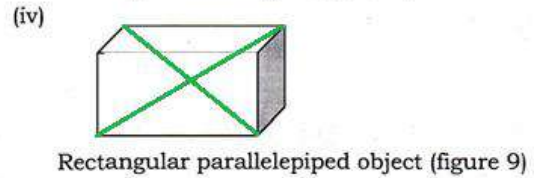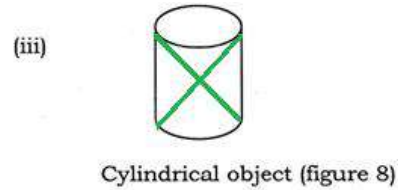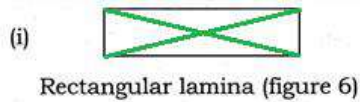   *Trace the vertical line.*
    Make a hole on the other side of the edge of the body.
    Suspend it by hanging the mass again on the stand.
    Trace the second vertical line.
   *The intersection of the two lines gives the center of gravity.*
    (b)

(i) Rectangular lamina (figure 6)

(iii) Cylindrical object (figure 8)

(iv)

(ii) Circular object (figure 7)

Rectangular parallelepiped object (figure 9)

(c) (i) Neutral equilibrium
(ii) Stable equilibrium
(iii) Unstable equilibrium

17. (a) Rectilinear motion with constant acceleration.
(b) Initial velocity (u) = 5 m/s.
(c) $a = \frac{\Delta v}{\Delta t} = \frac{10-5}{4-0} = 1.25 \, m/s^2$
(d)
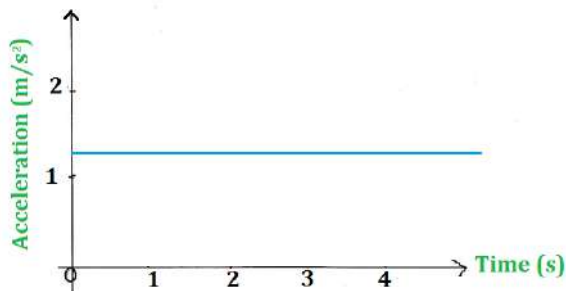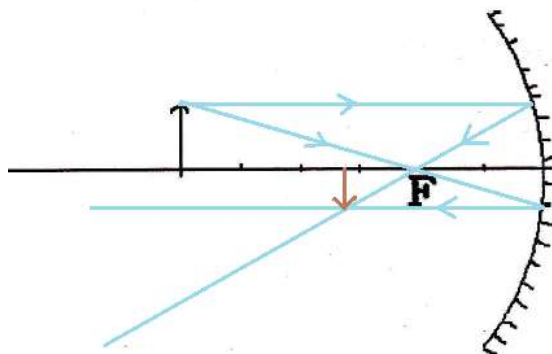

(e) Distance travelled
$$x = \frac{1}{2}at^2 + ut = \frac{1}{2} \times 1.25 \times 4^2 + 4 \times 5 = 10 + 20 = 30 \, m$$

18. (a)

(b) The image is: inverted, smaller than the object, real and located between the focus and the center of curvature.
(c) $\frac{1}{f} = \frac{1}{u} + \frac{1}{v} \Leftrightarrow v = \frac{fu}{u-f} = \frac{2 \times 6}{6-2} = \frac{12}{4} = 3 \, cm$
The image is real because it is positive.

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$$m = \frac{i}{O} = -\frac{v}{u} \Leftrightarrow i = \frac{vO}{u} = \frac{-3 \times 1}{6} = -0.5 \ cm$$

The image is inverted because i is negative.

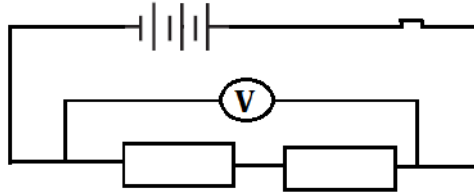*(d) Yes, the result in 18 (b) and 18 (c) are the same.*

19. *(a) (i) Rheostat or variable resistance*

   *(ii) Ammeter*

    (iii) Resistor

(b)

(c) (i) 4 V

   (ii) $I = \frac{U}{R} = \frac{4 \ V}{10 \ \Omega} = 0.4 \ A$

20.

	Factors	*Explanations*
1	*Sunlight*	*Used in the process of photosynthesis.*
2	*Water*	*Used in photosynthesis; in temperature regulation during transpiration…*
3	*Carbon dioxide*	*Used in the process of photosynthesis.*
4	*Oxygen*	*Used during respiration to produce the energy.*
5	*Temperature*	*Transpiration, photosynthesis*
6	*Mineral nutrients from the soil*	*Used by plants to manufacture different organic substances.*
7	*Space*	*Some plants need a large space to reduce competition with others.*
8	*Wind*	*For pollination and seed dispersal*

21. (a)
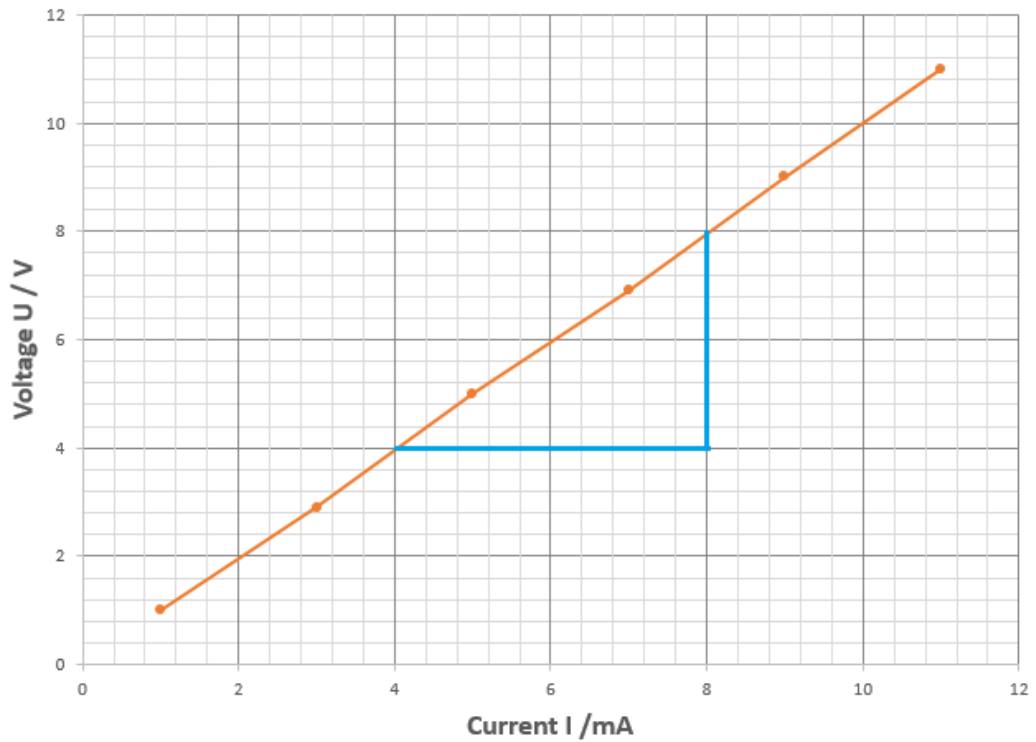
(b) The slope: $S = \frac{\Delta U}{\Delta I} = \frac{8-4}{8-4} = \frac{4}{4} = 1 \; V/mA$
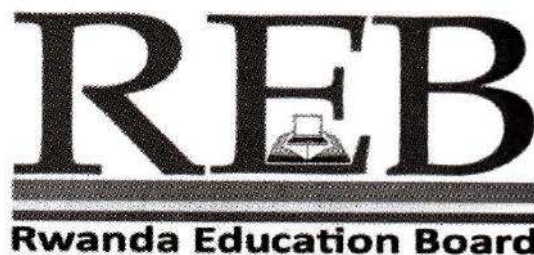
(c) Resistance of the resistor.

(d) $I = \frac{U}{R} = \frac{16}{1000} = 0.016 \; A = 16 \; mA$

(e) Systematic error.

Physics I

011

14/11/2019 08.30 AM – 11.30 AM

Rwanda Education Board

ORDINARY LEVEL NATIONAL EXAMINATIONS, 2019

SUBJECT: PHYSICS I

DURATION: 3 HOURS

INSTRUCTIONS:

1. Write your names and index number on the answer booklet as they appear on your registration form, and **DO NOT** write your names and index number on additional answer sheets of paper if provided.

2. Do not open this paper until you are told to do so.

3. This paper consists of **three** sections **A**, **B** and **C**

   - Answer **ALL** questions in section A.   **(55 marks)**
   - Answer **THREE** questions in section B.   **(30 marks)**
   - Answer only **one** question in section C   **(15 marks)**

4. Silent non-programmable calculators may be used.

5. You do not need the periodic Table.

6. Use only a **blue** or **black pen** for answering and a **pencil** for drawing.

SECTION A: Attempt all questions from this section. **(55 marks)**

1. For each of the statements below, indicate **true** if it is correct and **false** if it is wrong.
   a) According to the kinetic theory of matter, when a gas is heated, it cannot expand. **(1 mark)**
   b) The freezing point of water is equal to the melting point of ice in the same atmospheric conditions. **(1 mark)**
   c) Temperature and heat have the same units. **(1 mark)**
   d) Thermal equilibrium means the condition under which two or more substances in physical contact with each other exchange no heat energy and thus they are at the same temperature. **(1 mark)**

2. Explain the process of hydrological cycle (water cycle). **(4 marks)**

3. a) Select a derived physical quantity among the following: time, mass, acceleration and length. **(1 mark)**
   b) A piece of rock with a volume of 15 cm³ has a mass of 45 g.
      (i) Express its volume in m³. **(1 mark)**
      (ii) What is its mass in kg? **(1 mark)**

4. A RLC series circuit consists of an inductor, a resistor, a capacitor and an alternating current generator. Complete each of the following statements with the correct term from the words bank: increases, decreases or remains constant.
   Write only the answer in our answer booklet without copying the Statement.
   a) If the frequency of alternating current of a generator decreases, the reactance offered by the capacitor to an alternating current.................
   (1 mark)
   b) If the frequency of alternating current of a generator decreases, the reactance offered by the inductor to an alternating current.................
   (1 mark)
   c) The resistance offered by a resistor to an alternating current ....
   When the frequency of alternating current of a generator decreases.
   (1 mark)

5. a) What will happen to an object at rest if a force is acted upon it? **(1 mark)**
   b) Why do you need to wear a seatbelt in a moving car? **(2 marks)**
   c) Why does the moon orbit around the Earth? **(1 mark)**

6. a) A positively charged rod is brought close to one end of a neutral metallic plate without touching it.
      (i) What does a neutral metallic plate mean in this context? **(1 mark)**
      (ii) What type of charge appears on the closest side of the plate? **(1 mark)**
      (iii) Name the method of charging bodies used in this case. **(1 mark)**
   b) The electric force between two charged bodies is given by:
      $F = \frac{1}{4\pi\varepsilon} \frac{QQ'}{r^2}$. What does r mean in this relation? **(1 mark)**

7. You are provided with three electric components namely: one ordinary diode, one resistor, one dry cell and connecting wires. Use the symbols of these elements to draw a complete electric circuit such that the ordinary diode is forward biased. **(3 marks)**

8. a) What type of renewable energy comes from trapping heat generated inside the Earth? **(1 mark)**
   b) Why is the use of renewable energy advantageous to people? **(2 marks)**

9. Why are convex mirrors used as rear/back view mirrors of vehicles? **(3 marks)**

10. a) What do you understand by the term 'Pascal's principle'? **(1 mark)**
    b) Give any two applications of Pascal's principle in everyday life? **(2 marks)**

11. The volume of 600 ml of air assumed to be an ideal gas is at 27°C.
    a) Convert 27°C and 67°C into Kelvin? **(2 marks)**
    b) What is its volume at 67°C? **(2 marks)**
    (Assume that the pressure of the air is kept constant).

12. A simple machine requires 1000 J of work (work input) to raise a load of 500 N through a vertical distance of 1.5 m. Find:
    a) The work output (work done by the force of 500 N). **(2 marks)**
    b) The efficiency of the machine in %. **(2 marks)**

13. Suppose a high resistance voltmeter reads 1.5 V when connected across a dry cell on open circuit. It reads 1.2 V when the same battery is supplying a current of 0.30 A through the circuit when connected to a resistor of resistance R. Determine:
    a) The electromotive force of the battery. **(2 marks)**
    b) Resistance (R). **(3 marks)**

14. A 1000 kg car starts from rest and accelerates uniformly to a speed of 72 km/h during 50 seconds.
    a) Express the car's speed in m/s? **(1 mark)**
    b) Show that its acceleration is 0.4 m/s^2. **(2 marks)**
    c) Prove that the linear momentum of the car moving with a speed of 72 km/h is 20 000 kgm/s. **(2 marks)**

15. A charge $Q = 1 \times 10^{-11}$ acts as a positive point charge to create an electric field at a distance of 0.05m away.
    a) Draw the electric field line created by Q at a distance of 0.05 m away. **(1 mark)**
    b) Determine the electric field strength created by Q at a distance of 0.05 m. (Coulomb's law constant $k = 9 \times 10^9$ Nm^2/C^2) **(2 marks)**

SECTION B: Attempt only three questions   **(30 marks)**

16. The diagram below (figure 1) shows an object 2 cm tall placed at 6 cm away from a convex lens (converging lens) of focal length 3 cm.
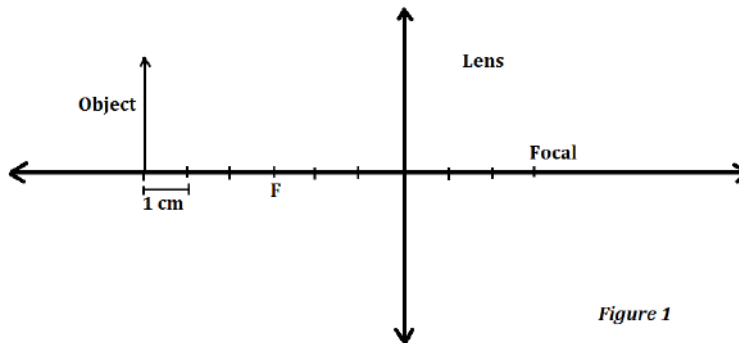

Figure 1

a) Copy the diagram and draw a ray diagram to scale (use the graph paper provided at the end of your answer booklet) to illustrate the image of the object.   **(3 marks)**
b) From the graph (don't use calculations), determine the:
  (i) Image position.   **(1 mark)**
  (ii) Size of the image.   **(1 mark)**
  (iii) Properties of the image obtained.   **(2 marks)**
c) Give names of two optical instruments that use convex lenses.   **(3 marks)**

17. In addition to your knowledge and skills, use the concepts of state of equilibrium in relation to the position of center of gravity to answer the following sub questions.
a) Explain the following types of static equilibrium:
  (i) Neutral equilibrium.   **(1 mark)**
  (ii) Stable equilibrium.   **(1 mark)**
  (iii) Unstable equilibrium.   **(1 mark)**
b) The diagram below (figure 2) shows three solid blocks (made of the same wood) A, B and C with their cross sectional areas resting on a horizontal table.   **(4 marks)**
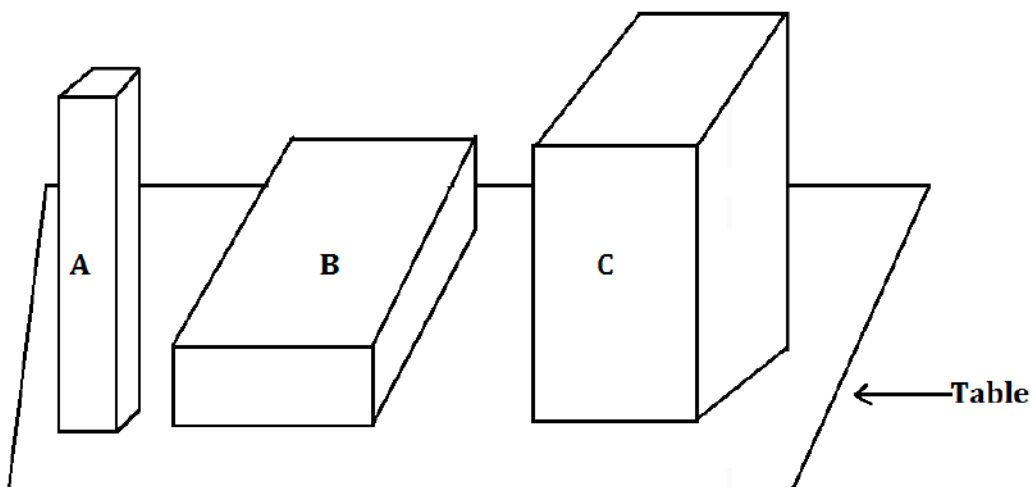

Figure 2

List the blocks in order from the least stable and justify your answer.

c) Observe the following diagrams (figure 3) and specify the type of equilibrium for each spherical object (ball) A, B and C. **(3 marks)**
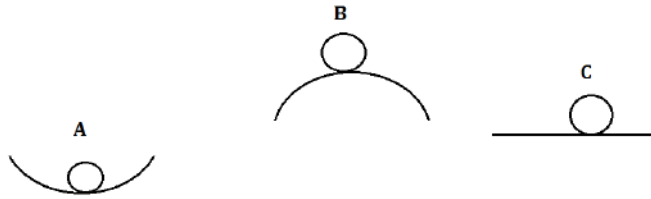

Figure 3

18. a) How can you tell that an object submerged into water will sink or float on water? **(3 marks)**
b) A student uses the following apparatus (figure 4) to demonstrate pressure difference in water. The apparatus is hollow and has three short tubes at different depths. The student completely fills the apparatus with water. Water comes out through all the three side tubes.
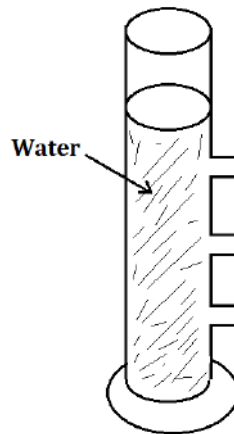

Figure 4

(i) Copy the diagram and draw the path followed by the water you would expect to see from each side tube. **(3 marks)**
(ii) Describe the pattern of the paths of water from the side tubes shown in your diagram. **(2 marks)**
(iii)Why does an object feel a buoyant force when it is submerged in a liquid? **(2 marks)**

19. a) Differentiate between heat capacity and specific heat capacity of a substance. **(2 marks)**
b) Describe how the following modes of heat transfer takes place.
(i) Conduction of heat. **(1 mark)**
(ii) Convection of heat. **(1 mark)**
(iii) Radiation of heat. **(1 mark)**
(c) The vacuum flask shown (figure 5) has five labelled features, each one designed to reduce heat transfer.
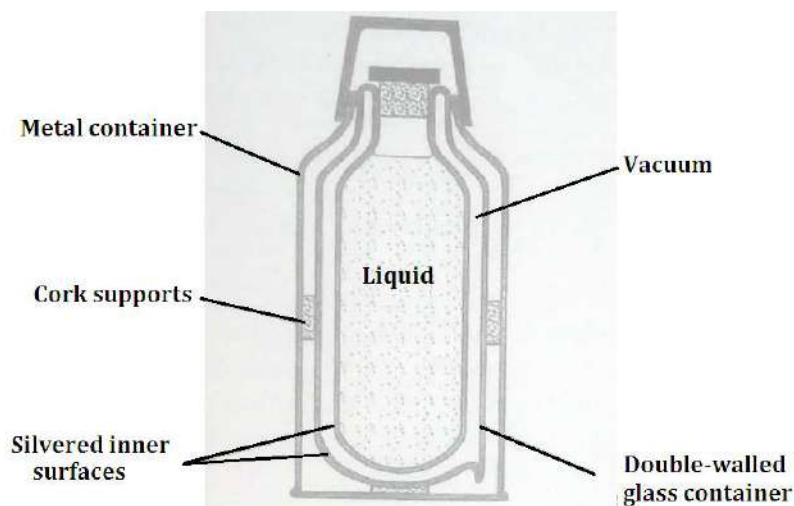Analyze figure 5 shown above and answer the sub questions below.

Figure 5

(i) Which labelled feature of the vacuum flask reduces heat transfer by both conduction and convection? **(1 mark)**

(ii) Explain how this feature of the vacuum flask reduces heat transfer by both conduction and convection. **(1 mark)**

(iii) Which labelled feature of the vacuum flask reduces heat transfer by radiation? **(1 mark)**

(iv) Explain how this feature of the vacuum flask reduces heat transfer by radiation. **(1 mark)**

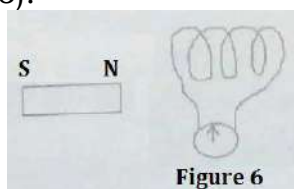20. a) A coil of wire is connected to a sensitive galvanometer as shows in the diagram below (figure 6).

Figure 6

(i) What is observed on the zero center of the galvanometer when the bar magnet is stationary in the coil? **(1 mark)**

(ii) What is observed on the center zero galvanometer when the bar magnet is moved towards the coil? **(1 mark)**

(iii) What is observed on the center zero galvanometer when the bar magnet is moved away the coil? **(1 mark)**

(iv) What is the cause of the observed results made when the magnet is moving towards the coil or when it is moving away from the coil? **(1 mark)**

b) Suggest two ways that may be used to increase the induced electromotive force in a coil. **(2 marks)**

c) A transformer is a device based on the principle of electromagnetic induction. **(1 mark)**

(a) Name one electric device that uses a transformer. **(1 mark)**

(ii) The input coil of a transformer has 200 turns of a wire and is connected to a 230 V alternating current supply. What is the voltage across the output coil when it has 600 turns? **(2 marks)**

(iii) What is the benefit of using transformers in the transmission of electrical power? **(1 mark)**

21. A student carried an experiment in order to determine the electromotive force, E, of a dry cell.
The results were as follows:

| Resistance, R/Ω	Current, I/A	$\dfrac{1}{current}, \dfrac{1}{I}/A^{-1}$
2	0.385	
4	0.250	
6	0.200	
8	0.150	
10	0.125	
12	0.100	

a) Copy and complete the table above including only R and 1/A. Round off to one decimal place for example 2.1 or 3.0

b) Plot a graph of 1/A (vertical axis) against R (on horizontal axis) and draw the best fit straight line.

c) Determine the slope S

d) Determine the value of E given that $E = \dfrac{1}{S}$ and interpret your results.

MARKING SCHEME OF ORDINARY LEVEL PHYSICS NATIONAL EXAMINATION 2019

SECTION A: Answer all questions

1. (a) False
   (b) True
   (c) False
   (d) True

2. Hydrological cycle is a constant movement of water above and below the Earth's surface. It begins by evapotranspiration. Water vaporizes into the atmosphere from vegetation, soil, lake, rivers and oceans.

   As water vapour rises, it condenses to form clouds that return water to the land through precipitation, rain, snow or water vapour condenses to form clouds which result in precipitation when conditions are suitable.

   Precipitation falls to the surface and infiltrates the soil or flows to the ocean as runoff; surface water (eg. Lakes, oceans, streams etc…) evaporates returning to the atmosphere, while plants return water to the atmosphere by transpiration.

   Note that the processes that make up the water cycle are **condensation**, **precipitation**, **infiltration**, **runoff** and **evapotranspiration**.
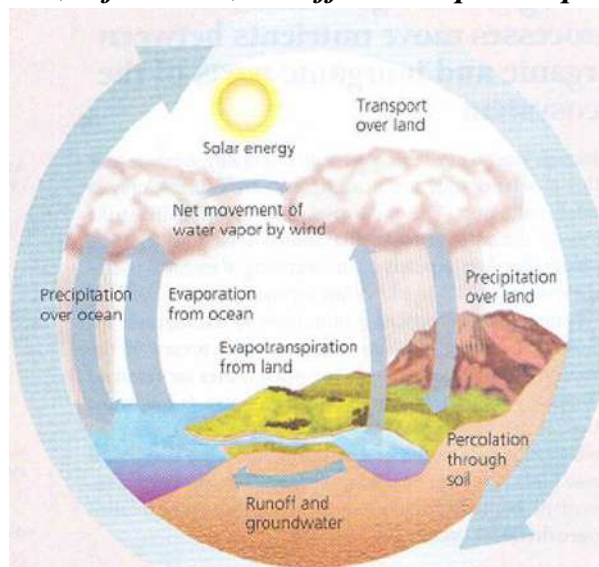
3. (a) Acceleration
   (b) (i) $V = 15 \times 10^{-6} \ m^3$
       (ii) $m = 45 \times 10^{-3} \ kg = 0.045 \ kg$

4. (a) Increases
   (b) Decreases
   (c) Remains constant.

5. *(a) It will either: move, change shape or remains at rest.*
(b) We wear a seatbelt in a moving car to avoid injuries due to inertia or when a car is in motion, our body is also in motion. If a driver applies the brakes due to inertia of body, our body is pushed forward and the seatbelt stops it.
*(c) The change of the direction of the velocity of the moon when it is orbiting around the Earth is due to the **universal gravitational attraction, centripetal force that the Earth exerts on the moon**.*

6. *(a) (i) Neutral metal plate is a plate with no net electric charge,*
   Or the number of protons equals to the number of electrons.
   (ii) Negative charge
   (iii) Charging by induction.
   (b) r is the distance between the two charges.

7. *Complete circuit with the three elements*
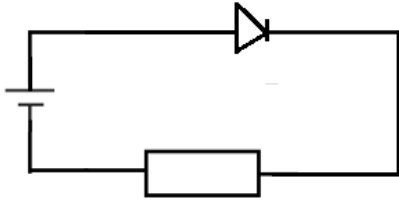
8. *(a)Geothermal energy.*
   (b) Cheaper
   Produce less pollution.
   It can last forever; reduction of greenhouse gas emission provides clean air and water…

9. *A convex mirror produces always a virtual image, erect / upright and smaller than the object.*
   Or it has a wider field of view with virtual, erect / upright and smaller image.

10. *(a) Pascal's principle states that when a change in pressure is applied to an enclosed fluid at rest, it is transmitted equally to all portions of the fluid and to the walls of its container.*
    (b) Hydraulic jack
    Hydraulic press
    Hydraulic brakes
    Water towers
    Hydraulic lift pump…

11. *(a) 27ºC= (27 + 273)K = 300 K*
    67ºC= (67 + 273)K = 340 K
    (b) The new volume is given by

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \iff V_2 = \frac{V_1 \times T_2}{T_1} = \frac{600 \ ml \times 340}{300} = 680 \ ml = 0.68 \ l$$

12. (a) Work output = F X d = 500 X 1.5 = 750 J

(b) $\varepsilon = \frac{Work\ output}{Work\ input} \times 100\ \% = \frac{750}{1000} \times 100\ \% = 75\ \%$

13. (a) The terminal potential difference of a dry cell in open circuit equals the e.m.f. then E = 1.5 V.

(b) V = RI
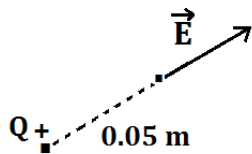
$$R = \frac{V}{I} = \frac{1.2\ V}{0.30\ A} = 4\ \Omega$$

14. (a) $v = 72\ km/h = \frac{72\ 000\ m}{3\ 600\ s} = 20\ m/s$

(b) The acceleration $a = \frac{\Delta v}{\Delta t} = \frac{20\ m}{50\ s^2} = 0.4\ m/s^2$

(c) The linear momentum $(\vec{P}) = m\vec{V} = 1000 \times \frac{20kgm}{s} = 20\ 000 kgm/s$
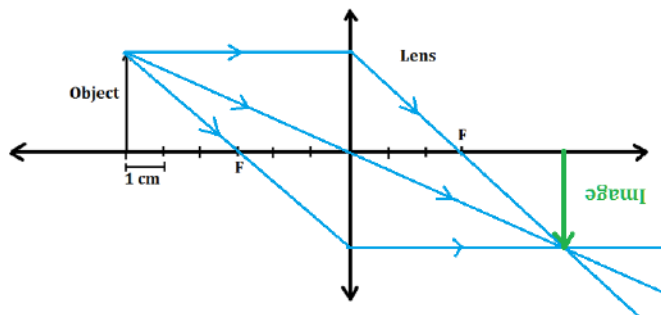
Or P = F X t = mat = 1000 X 0.4 X 50 Ns = 20 000 Ns = 20 000 kgm/s.

15. (a)

(b) The electric field strength $(E) = k\frac{Q}{d^2} = \frac{\frac{9 \times 10^9 \times 10^{-11}}{(0.05)^2} N}{C} = 36\ N/C$
Covalent bonding with a giant structure.

Section B: Answer only 3 questions

16. (a)

(b) (i) Image position = 6 cm
(ii) Size of the image = 2 cm
(iii) The image is **real, inverted**, **same size** as the object and is formed at 2 F.

(c) Compound microscope, telescope, eye glasses and magnifying lenses.

17. *(a) (i) Neutral equilibrium is a state of equilibrium which occurs when a simple object is placed in such position such that any slight disturbance effort would not change the level of its center of gravity.*
(ii) Stable equilibrium is a kind of equilibrium that occurs when a simple object placed in such position that any slight disturbance effort would raise its center of gravity.
(iii) Unstable equilibrium is a type of equilibrium that occurs when a simple object is placed in such position that any slight disturbance effort would lower its center of gravity.
  (b) List of blocks in order from the least stable to the most stable.
    1. A   2.C   3. B
    Reason: *The lower is the center of gravity, the more stable the object.*
            Or the greater the mass of the body and the greater the base of support, the greater will be its stability.
    (c) A: Stable equilibrium
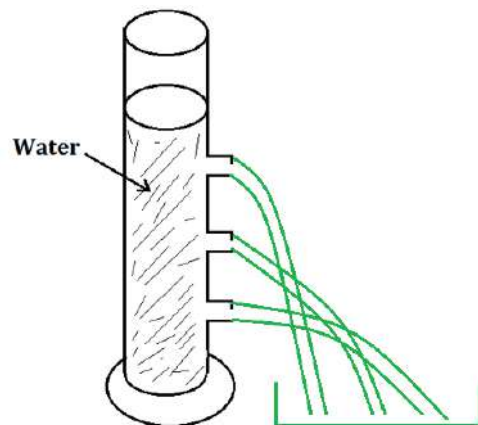   *B: Unstable equilibrium*
        C: Neutral equilibrium

18. *(a) If the density of the object is greater than the density of the water, the object will sink.*
Or if the density of the object is lower than the density of the water, the object will float on water.
Or if the upthrust due to water is greater than the weight of the object, it will float on water.
(b) (i)

(ii) The path of the water from the short tubes are parabolic and the horizontal ranges are different.
(c) Because the deeper under water, the higher the pressure.
  This is due to the difference between the pressure exerted on the top side of the object and the pressure on the bottom.

19. (a)

Specific heat capacity	Heat capacity
The specific heat capacity of a material is the energy needed to raise one unit mass of that material of one degree Celsius and it is constant for a given substance.	Heat capacity of a material is the amount of heat energy needed for a substance's temperature to raise by one Celsius and depends on the mass of the substance.
Its unit is J/kg K or J/kg °C	Its unit is J/kg or J/kg
$$c = \frac{Q}{m\Delta T}$$	$$ca = \frac{Q}{\Delta T}$$

(b) (i) Conduction of heat is a process in which heat is transferred from the hotter part to the colder part in the solid body from one molecule to another molecule as a result of the vibratory motion of the molecules.

   (ii) Convection of heat is a process of heat transfer in the liquid and gas from a region of high temperature to a region of low temperature due to actual movement of molecules or due to mass transfer.

   (iii) Radiation of heat is a process in which heat is transferred from one body to another without involving the molecules or the medium.

(c) (i) Vacuum

   (ii) Vacuum is a lack of atoms without atoms you examinate conduction and convection of heat.

   (iii) Silvered inner surfaces.

   (iv) It reflects the radiation (infrared) towards the liquid.

20. (a) (i) Nothing

   No deflecting in the galvanometer i.e the needle of the galvanometer is at the center or zero position.

   (ii) Deflection of galvanometer's needle in one direction.

   Electromotive force is induced in the coil due to the increase of the magnetic flux through the coil.

   (iii) Deflection of the galvanometer's needle in another direction.

   Electromotive force is induced in the coil due to the decrease of the magnetic flux through the coil.

   (iv) Change in magnetic field strength or change in the magnetic flux.

(b) $$\varepsilon = -N\frac{\Delta\phi}{\Delta t}$$

Increase the number of turns of wire in coil.

Increase the strength of the magnetic field

By using a strong magnet

Increase the rate of the change of magnetic flux.

(c) (i) Radio receiver, cell phone charger, regulated DC power supply, air conditioning....

(ii) The voltage across the output coil is given by

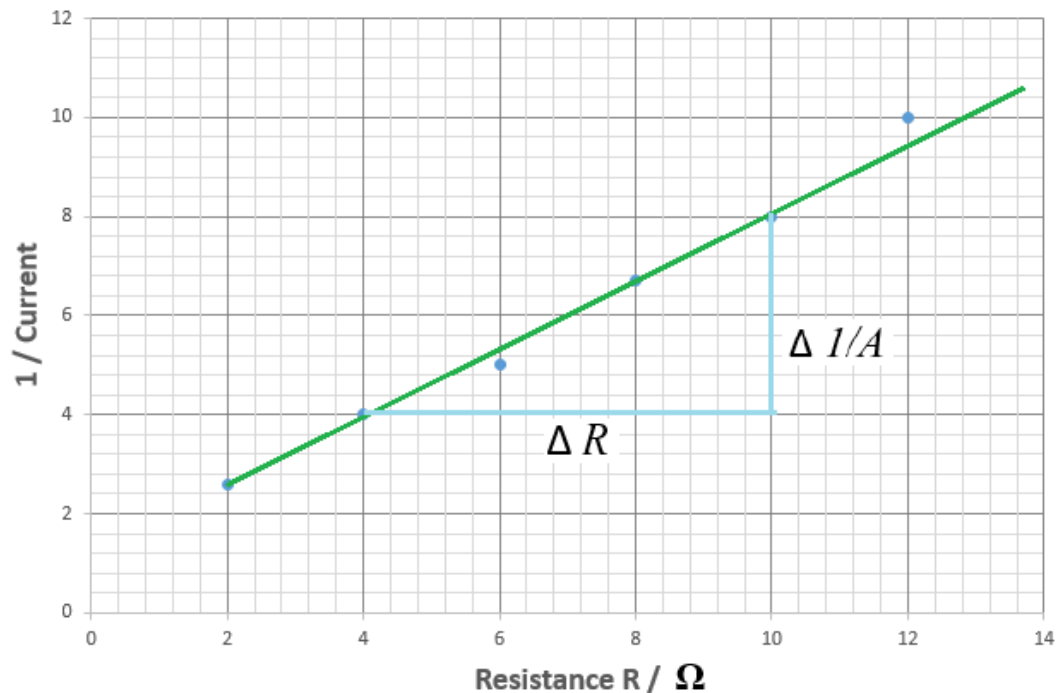$$\frac{E_S}{E_p} = \frac{N_S}{N_p} \Longleftrightarrow E_S = 230 \times \frac{600}{200} = 690\ V$$

(iii) To step-up and down the voltage / current.

SECTION C: This question is compulsory

21. (a)

Resistance, R/Ω	Current, I/A	$\frac{1}{current}, \frac{1}{I} /A^{-1}$
2	0.385	**2.6**
4	0.250	**4.0**
6	0.200	**5.0**
8	0.150	**6.7**
10	0.125	**8.0**
12	0.100	**10.0**

(b)

(c) Slope $S = \frac{\Delta 1/A}{\Delta R} = \frac{8-4}{10-4} = \frac{4}{6} = 0.667\ A^{-1}.\Omega^{-1}$

(d) $E = \frac{1}{S} = \frac{1}{0.667} = 1.5\ A\ \Omega$

$E = 1.5\ V$

This result is reasonable because a new dry cell has an e.m.f of 1.5 V.

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