REPUBLIC OF RWANDA

RWANDA EDUCATION BOARD

ORDINARY LEVEL NATIONAL EXAMINATIONS 2002/2003

SUBJECT   : PHYSICS I

DURATION   : 3 HOURS

INSTRUCTIONS:

This paper consists THREE sections A, B and C.

Attempt all questions in section A.   **(55 marks)**

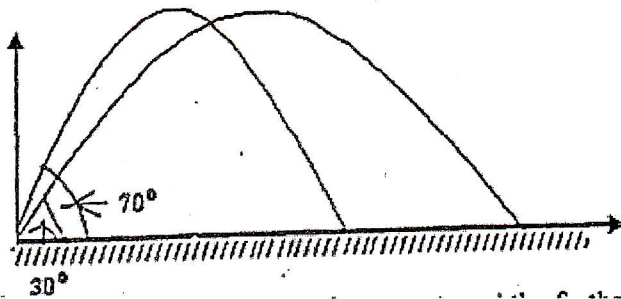Answer any three questions in section B.   **(30 marks)**

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

You may use a calculator and a mathematical instrument.

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 on 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 2a) above by which the air moves? **(1 mark)**

c) A piece of iron of mass 200g and specific heat capacity 460J/Kg 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)**
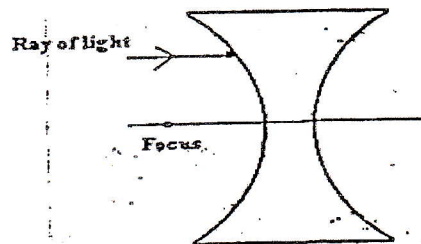
ii) Copy the diagram in your answer sheet book and complete the ray of light as it travels through the lens. **(1 mark)**

b) An object is placed 4cm in front of the above lens. A vertical image is produced 1cm 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)**
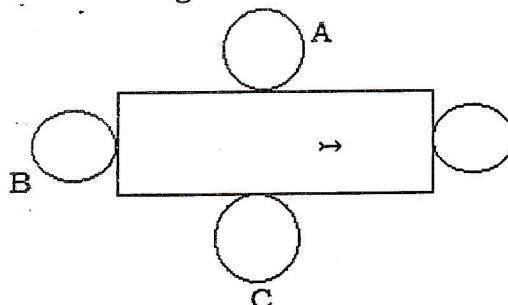
5. a) A boy raises a hammer and then hits the nail. State the energy changes which occur. **(2 marks)**

    b) The potential energy of a 5kg mass is 100J. Calculate how high the mass is from the ground. Take g = 10m/s². **(2 marks)**

6. Two light charged balls are suspended on nylon threads and the released. Immediately the balls come to rest with the threads making equal angles with the vertical as shown in the diagram below.
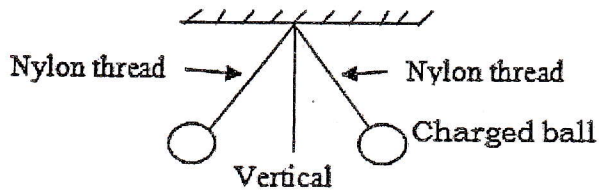
    a) What can you say about the charges on the ball? **(1 mark**

    b) What would happen to the balls if somebody touches one of the balls? **(1 mark)**

    c) A steady current of 2A flows passing a point, find the charges which pass the point 3 seconds. **(1.5 marks)**

7. a) Name the simple machine that can be used to lift small masses in a laboratory. **(1 mark)**

    b) State why the efficiency of the machine in 7a) is less than 100%. **(1 mark)**

    c) A machine lifts a mass of 150g through a vertical height of 8cm. 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 280cm³ and its mass is 336g. Calculate the density of the substance. **(1 mark)**

    c) State the differences between density and relative density of the 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)**
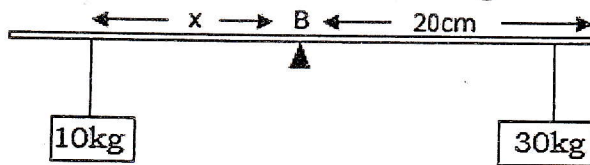
10. a) Name the unit that is the same as a watt. **(1 mark)**

    b) A person takes one minute 15 seconds to run a distance of 100m. Calculate the person's power if his weight is 600N. **(2 marks)**

11. The figure below shows forces E and F acting on a falling drop of water to the ground.
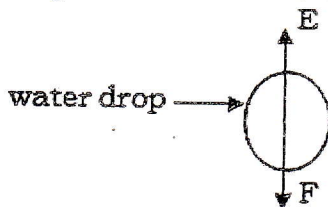
    a) Name force: i) E **(1.5 marks)**

                    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 spirit 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 a horizontal circle above his head as shown in the diagram below.
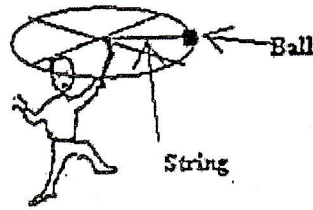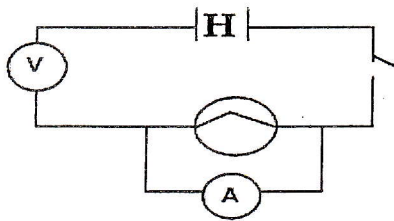

a) Name the force in the string pulling inwards on the ball. **(1 mark)**
b) What happens to the force in the string when the speed increases? **(1 mark)**
c) In which direction does the ball move when the string breaks? **(1 mark)**

14.

a) From the electric circuit above there are three mistakes. What are the 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. Answer only three questions.** **(30 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.
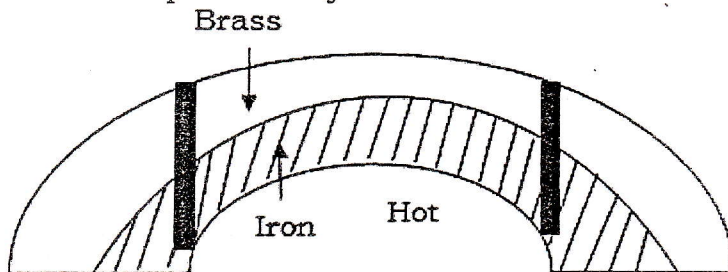
 i. Which of the two metals expands faster? **(1 mark)**
  ii. Draw the bimetallic strip when it has cooled down. **(1 mark)**

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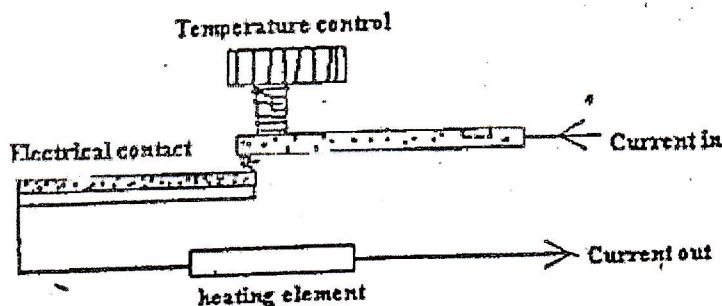
From the diagram above,

i) What is the use of the 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.
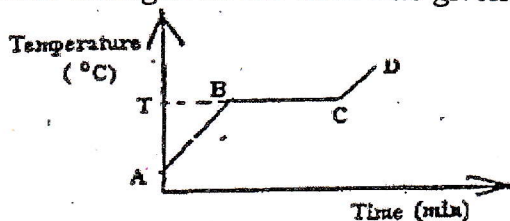
i. What does temperature A represent? (1 mark)

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 the substance called? (1 mark)

iv. What is the state of substance C to D? (1 mark)

16. a) Given a driving glass, a piece of paper and some water, draw well labeled diagrams to show that the air of the atmosphere exerts pressure in all directions. Give a brief explanation. (3 marks)

b) Below is a diagram of a simple lift pump. The piston is going down.
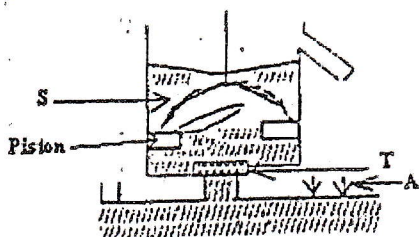
i) Name parts A, T and S. (1.5 marks)

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 20kg rests on a square surface measuring 0.2m. Calculate the pressure exerted by the mass on the surface. Take g = 10m/s². (2 marks)

17. a) What is meant by an a lunar eclipse? (1 mark)

b) With the help of a well labeled diagram, show how umbra and penumbra shadows form. (3 marks)

c) The figure below shows a simple camera.
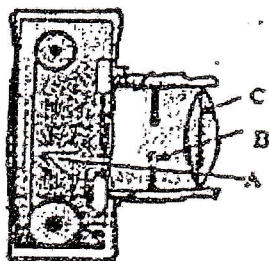
i) Name parts labeled A, B and C. (1.5 marks)

ii) What is the use of part B? (1.5 marks)

iii) Which part of the eye 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 water. State the relationship between the ray of light in air, the normal and the ray of light in water. (1.5 marks)

ii) Draw a diagram to show this relation in 17d (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 the distance on the Y-axis and time on X-axis. **(2 marks)**

   c) The initial velocity of a moving body is 10m/s. In 5 s time, the velocity of the body reaches 30m/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 a 45 minute's time? **(2 marks)**

19. a) State Ohm's law. **(2 marks)**

   b) Copy the simple circuit below and insert:
   i) a switch, S_1, to control current flow through lamp C. **(2 marks)**
   ii) a voltmeter to measure voltage lamp B. **(2 marks)**

1.5V
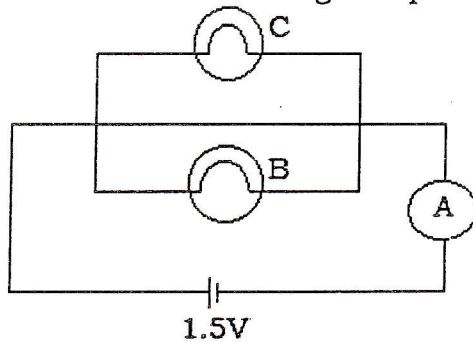
   c) Calculate the electric current flow recorded by the ammeter A in the circuit if resistance of lamp C is 2 Ohms and that of lamp B is 3 Ohms. **(2 marks)**
   d) Draw a simple electric bulb and describe briefly how it gives off light. **(4 marks)**

Section C: *Answer only one question.* **(/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 a wire and a bulb.

   a) With aid of a well labeled diagram, explain how an electric current is produced by a simple cell.

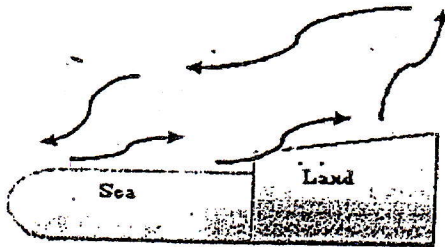   b) How do you show that the electric current is produced by the simple cell?

END

ANSWERS TO ORDINARY LEVEL PHYSICS PAPER 2002/2003

SECTION A:

1. a) The stone travels the farthest at an angle of 30°

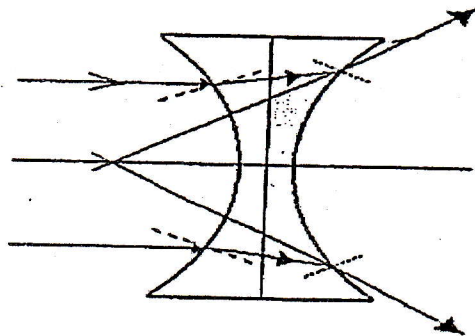   b) Because of the gravity force or weight or the earth attracts

   c) At angle 70°.

2. a)

   b) Convection

   c) Heat lost: $Q = 0.200 \times 460 \times (120 - 70) = 4600J$

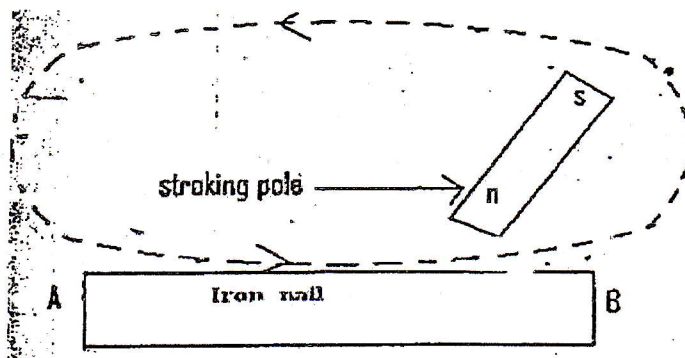3. a) i) Diverging lens

   ii)

   Incident ray travelling parallel to the principal axis will refract through the lens and diverge, never intersecting.
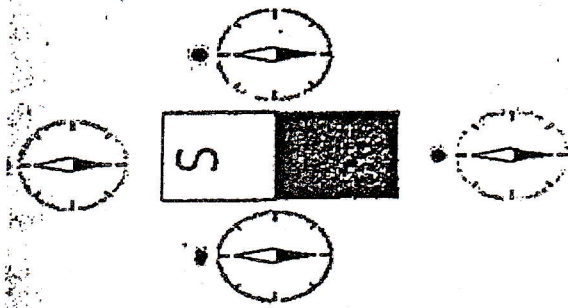
   b) i) Magnification: $Y = \dfrac{q}{p} = \dfrac{1}{4} = 0.25$

   ii) Height of object: $Y = \dfrac{h^1}{1.5} = 0.25 \Rightarrow h^1 = 0.04cm$

4. a)

b)

5. a) Potential energy in his muscles, kinetic energy, calorific energy, sound and light energy.

   b) $mgh \Rightarrow \dfrac{Q}{t} \Rightarrow$ it $= 2 \times 3 = 6C$

6. a) The charges of the same sign and the same amount of charges.

   b) If somebody touches one of the ball, it becomes discharged and the force of repulsion between the ball disappear and we will observe the attraction between the ball charged and non charged ball.

   c) Using $i = \dfrac{Q}{t} \Rightarrow Q = $ it $= 2 \times 3 = 16C$

7. a) Pulley, tongs

   b) Due to friction force

   c) $W = mgh = 0.150 \times 10 \times 0.08 = 0.12J$

8. a) Because it contains impurities (minerals)

   b) Density: $p = \dfrac{m}{v} = \dfrac{336 \times 10^{-3}}{280 \times 10^{-6}} = 1200 kg/m^3$

   c) Density is defined as the ratio of mass divided by volume while relative density of a substance is defined as the ratio of mass or weight of a given volume of the substance divided 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)
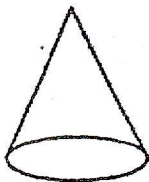
   c) Using principle of equilibrium: $10 \times g \times x = 30 \times g \times 20 \Rightarrow x = 60cm$.

10. a) Watt = Joule per second

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

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

    b) The 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 the drop absorbs heat and cools the body.

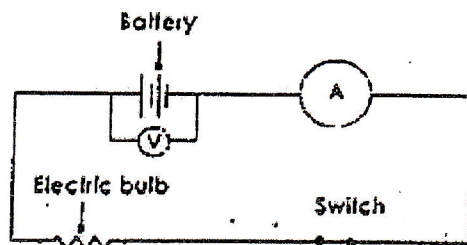   c) Fridge, freezer of refrigerator

13. a) centripetal force

    b) The force in the string increases its strength

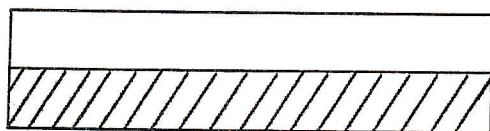   c) Tangent to the trajectory or horizontally.

14. a) The voltmeter is in series instead of being in parallel, the ammeter is in parallel instead of being 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 others.

SECTION B.

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 or water

Proof 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.
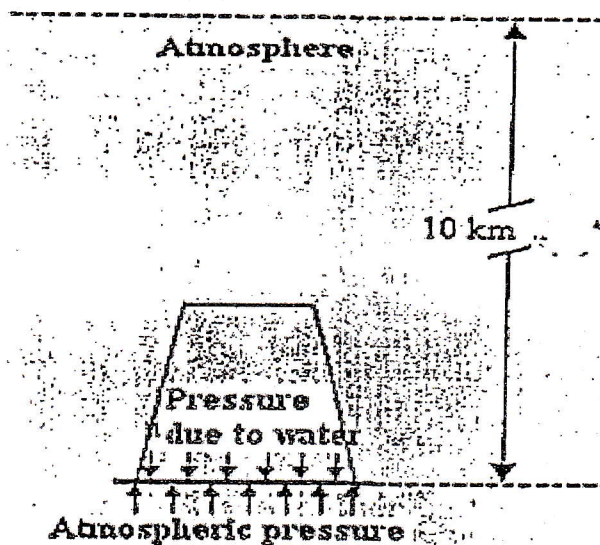

b) i) A: Air pressure or atmospheric pressure; T: Valve or cylinder valve cap; S: Valve piston.

ii) Water from the cylinder rises above the piston.

iii) The valve closes S, T valve opens, the water rises in the cylinder, and the water above the piston flows.

c) Pressure: $p = \dfrac{F}{A} = \dfrac{mg}{A} = \dfrac{20 \times 10}{0.2 \times 0.2} = 500\,Pa.$

17. a) A lunar eclipse occurs when the earth is between the sun and moon and its shadow darkens the moon.

b)
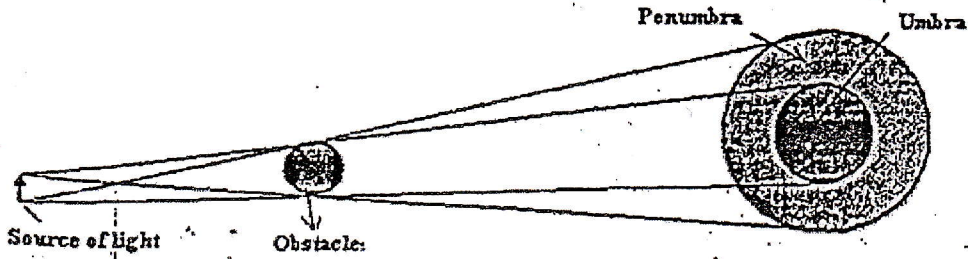
c) i) A: sensitive film or film; B: Diaphragm; C: objective or converging lens.

ii) B is used to adjust the light

iii) Retina

c) i) The incident ray, the refracted ray are on opposite sides of the normal at the point of incident and all three are in the same plane

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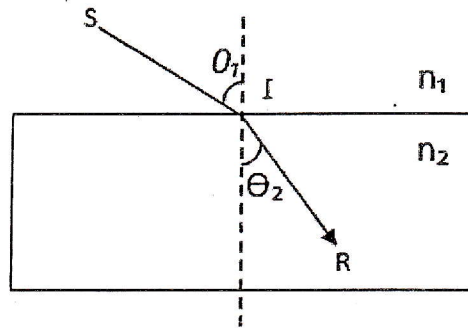
18. a) Uniform velocity: The velocity is independent of time or does not change or acceleration is zero.

b)
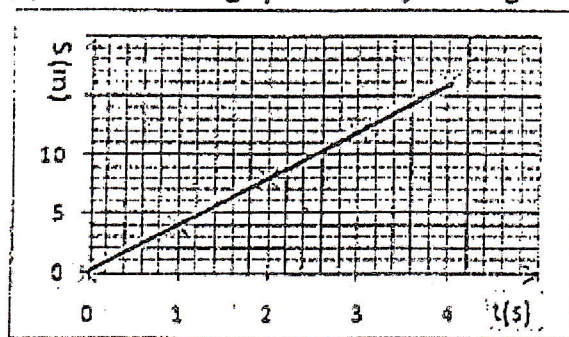
c) i) Acceleration: $a = \dfrac{\Delta v}{t} = \dfrac{30-10}{5} = 4\text{m/s}^2$

ii) Distance moved by the body: $S_1 = \dfrac{1}{2}at_1^2 + vt_1 = 4 \times 5^2 + 10\times5 = 100\text{m}$

iii) Distance moved by the body in $t_2 = (45\times60) - 5 = 2695\text{s}$; $S_2 = vt_2 = 30 \times 2695 = 80850\text{s}$

Total distance : $S = S_1 + S_2 = 80950\text{m}$.

19. a) Ohm's law states that the voltage (V) across a resistor is proportional to the current through it, where the constant of proportionality is the resistance (R): $\Delta V = IR$

b) i), ii)
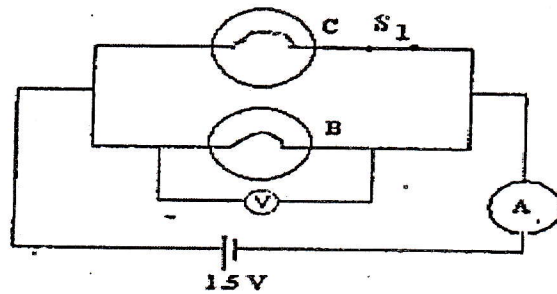
c) Equivalent resistance: $\frac{1}{R} = \frac{1}{Rc} + \frac{1}{Rb} \Leftrightarrow R = \frac{RcRb}{Rc+Rb} = \frac{2\times3}{2+3} = 1.2\Omega$; Electric current: $i = \frac{U}{R} = \frac{1.5}{1.2} = 1.25A$.

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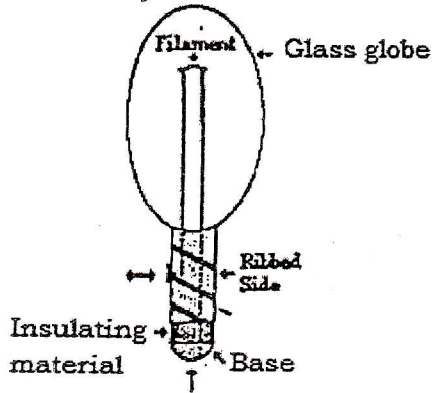
A light bulb is a relatively simple device consisting of a filament resting upon or somehow attached to two wires. The wires and the filament are conducting materials which allow charge to flow through them. Due to the joule effect, the filament produces light.

SECTION C:

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. They are set up so that the holes are in a 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 straight line the light is cut off.
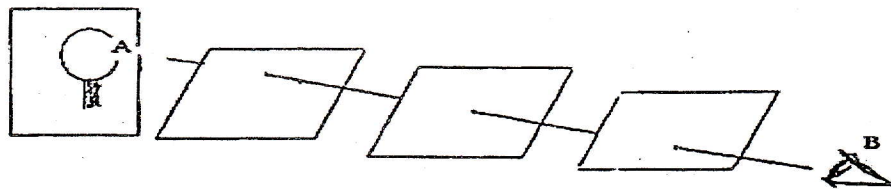
21. See question 21 (2000/2001)

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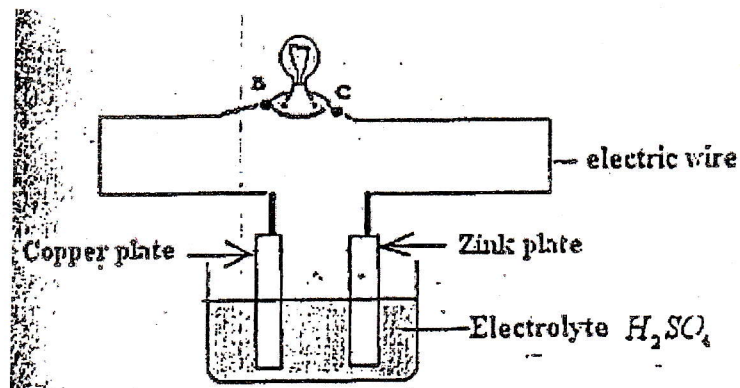
(b) The movement of electrons in the circuit causing electrical current in the lamp

END