ST. MARYS' SCHOOL RUNDA.
FORM 4 APRIL HOLIDAY ASSIGNMENT

231/ 1 - PHYSICS -Paper 1
(Theory)

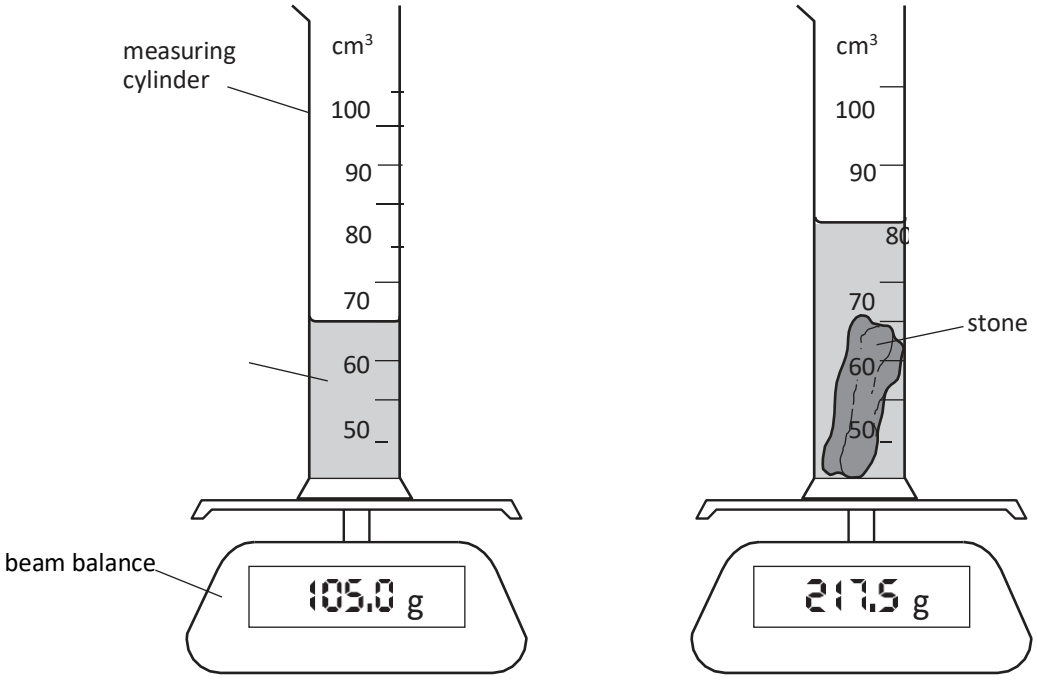
INSTRUCTIONS***: ATTEMPT ALL THE QUESTIONS WITH SUMMARY NOTES ON THE TOPIC THE QUESTION IS TESTING.***

Section A (25 marks)

Answer all Questions in this section

1. A measuring cylinder containing only water is placed on an electronic balance. A small, irregularly shaped stone is now completely immersed in the water.

The diagrams show the equipment before and after the stone is immersed



before the stone is immersed after the stone is immersed

calculate the density of the material of the stone? (2 marks)

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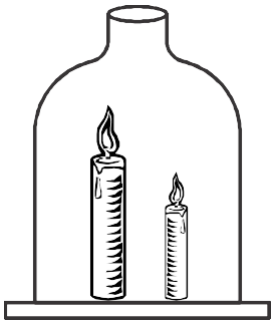
2. Two candles, a short and a long one were lit and then covered with a tall bell jar as shown below. State and explain which of the candles goes off first. (2 marks)



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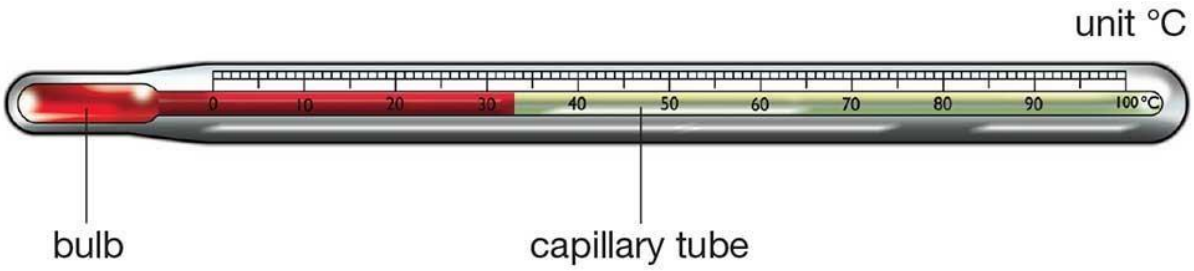
3. The diagram below shows a liquid in glass thermometer



State two ways of increasing the sensitivity of this thermometer (2 marks)

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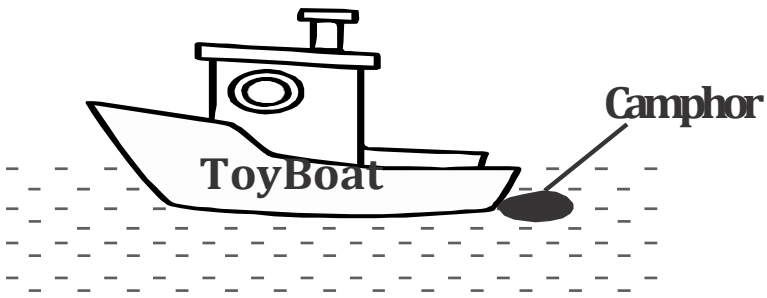
4. A toy boat was placed on the surface of water as shown below.



A piece of camphor was placed on one side of the boat as shown on the diagram. Show the direction of movement of the boat and explain. (2 marks)

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5. A crystal of potassium permanganate was carefully introduced at the bottom of water column held in a gas jar. Aftersometime, the whole volume of water was coloured. Explain this observation. (2 marks)

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6. Water flows steadily along a horizontal pipe at a volume rate of 8×10^{-3} m^3/s. if the area of cross-section of the pipe is 20 cm^2. Calculate the velocity of the fluid. (2 marks)

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7. (a) State the principle of moments (1 mark)

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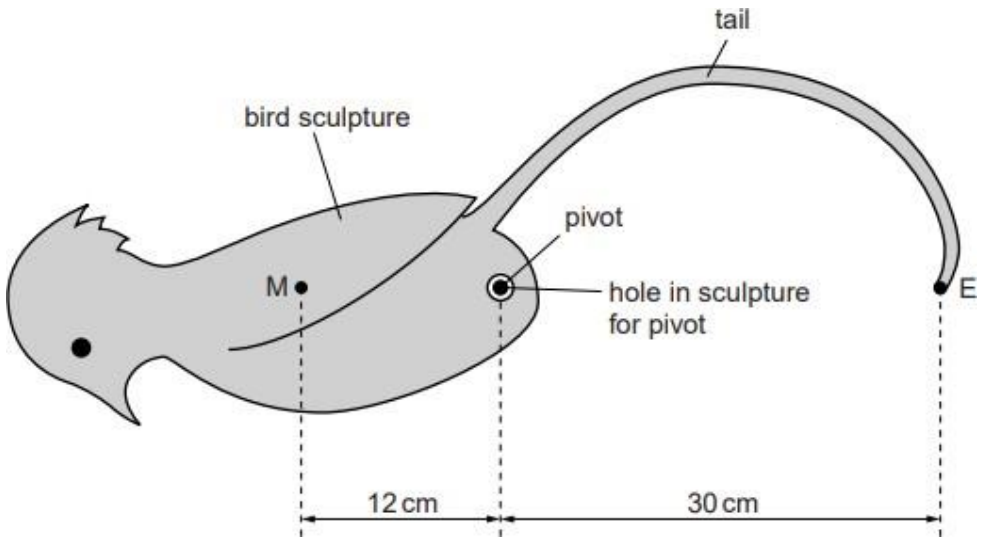
(b) the figure below shows a mobile bird sculpture that has been created by an artist.

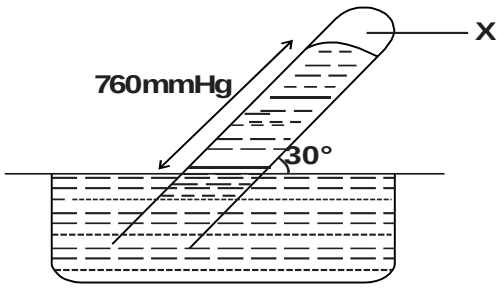


M is the center of gravity including its tail but not including the counter weight that will be added later. The mass of the bird and its tail is 1.5 kg. The bird sculpture is placed on a pivot . The artist then add the counter weight at the end **E** of the tail so that the bird remains stationary in that position shown above

Calculate the mass of Counter weight (2 marks)

(c) The centre of mass of the sculpture with counter weight is at the pivot. Calculate the upward force acting at the pivot (1 mark)

8. In the diagram below, find the pressure of the air in the tube X in the mmHg. The liquid shaded is mercury and the atmospheric pressure is 760mmHg. (3 marks)



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9. In an experiment to estimate the size of a molecule of olive oil, a drop of oil of volume 0.1 $2mm^3$ was placed on a clean water surface. The oil spread into a patch of area $6.0\times l0^4$ mm2. estimate the size of a molecule of olive oil (2 marks)

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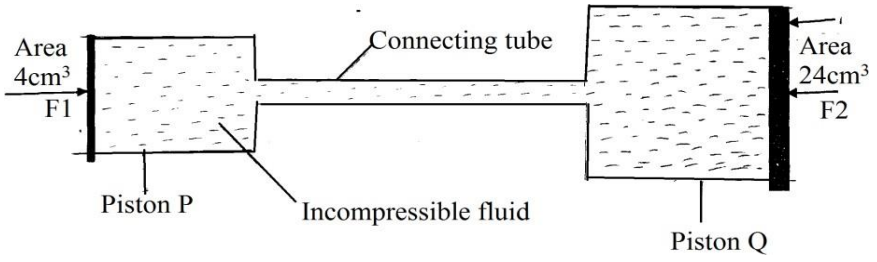
10. A body is projected vertically upwards from the top of a building with a velocity of 20m/s. Assuming that it lands at the base of the building, sketch the velocity time graph of the motion. (2 marks)

11. The figure 5 below shows two cylinders of different cross-sectional areas connected with a tube. The cylinders contains an incompressible fluid and are fitted with pistons P and Q as shown.

Fig 5.



Opposing forces Fl and F2 are applied to the pistons until they do not move. If the pressure on the smaller piston is $5Ncm^2$. Determine the force F2. (2 marks)

SECTION B (55 marks)

Answer all the questions in this section

11. a). State Archimedes principle (1mark)

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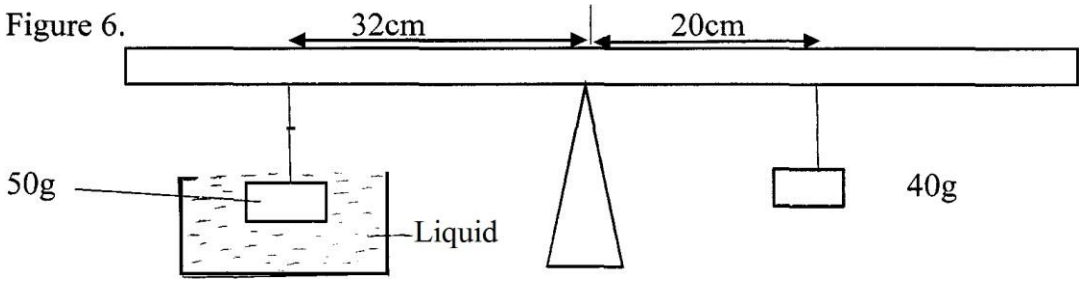
b). The figure 6 below shows a block of mass *50g* and density 2000kg/rn3 submerged in a certain liquid and

Figure 6.



suspended from a uniform horizontal been by means of a string. A mass of 40g suspended from the other end of the beam puts the system in equilibrium

a. i. determine the upthrust force acting on the block (3 marks)

b. ……

c. ……

d. ……

ii. calculate the density of the liquid (3 marks)

a. ……

b. ……

c. ……..,……

iii. calculate the new balance point of the 50g mass the 40g mass remains fixed) if the liquid was replaced with another whose density was 1 200kg/m^3 (3 marks)

a. ……

b. ……

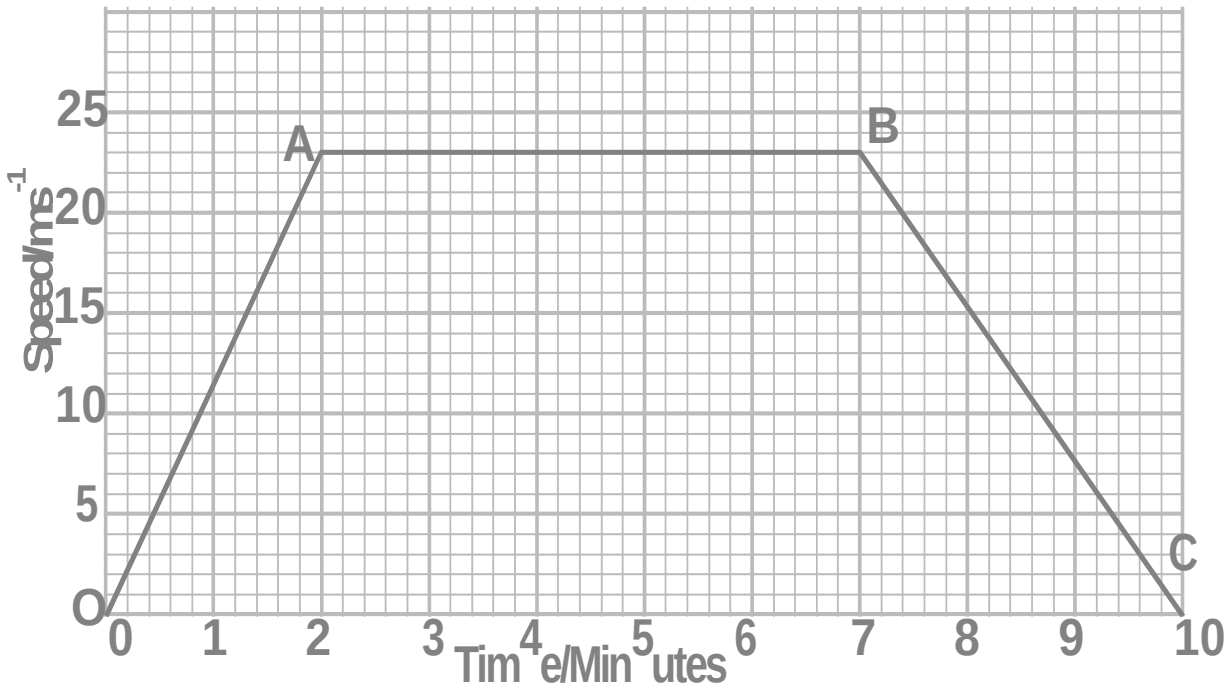
c. ……

iv. state and explain one application of Archimedes principle (1 mark)

a. ……

b. ……

12. The speed of a train, hauled by a locomotive varies as shown below as it travels between two stations along a straight horizontal track.



a) Use the graph to determine:

i) the maximum speed of the train. (1 mark)

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ii) The acceleration of the train during the first 2mins of the journey. (2 marks)

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iii) The time during which the train is slowing down. (2 marks)

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iv) The total distance, in metres, between the two stations. (3 marks)

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v) The average speed in ms^{-1} of the train. (3 marks)

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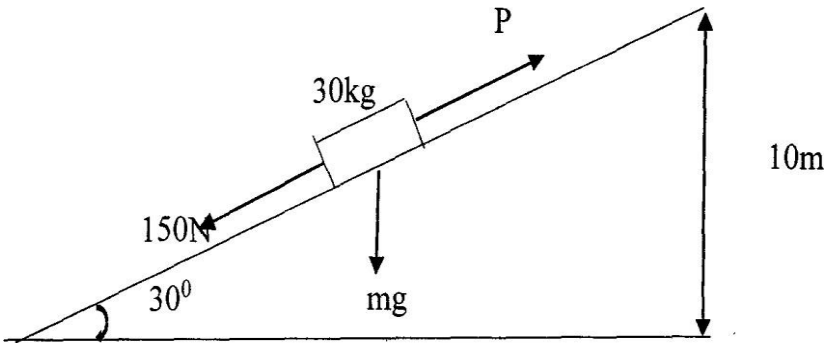
13. The figure below shows a block of mass 30kg being pushed up a slope by a force P at a constant speed. The frictional force on the block is 20N.



Determine

i. The value of P (2 marks)

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ii. The work done in moving the 30kg mass up the inclined plane. (2 marks)

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iii. On reaching the top of the slope, the block is left to run freely down the slope. Which one of the forces previously acting on the block would then act in the opposite direction (1 mark)

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iv. Determine the acceleration of the block down the slope (2 marks)

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v. State two factors that affect the final velocity of the block at the bottom of the inclined plane. (2 marks)

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vi. Determine the efficiency of the inclined plane (3 marks)

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14 (a) Define specific latent heat of fusion (1mark)

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(b) You are provided with the following apparatus:

- A filter funnel
- A thermometer
- A stop watch
- Ice at 0°C
- An immersion heater rated P watts
- A beaker
- A stand
- A boss and clamp and
- A weighing machine.

Describe an experiment to determine the specific latent heat of fusion of ice. Clearly state the measurements to be made. (4marks)

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(c) 200 g of ice at 0°C is added to 400g water in a well lagged calorimeter of mass 40g.The initial temperature of the water was 40°C. If the final temperature of the mixture is X°C,

(Specific latent of fusion of ice L = 3.36 x 10^5 Jkg^{-1}, specific heat capacity of water, c = 4200$Jkg^{-1}K^{-1}$, specific heat capacity of copper = 400 $Jkg^{-1}K^{-1}$.)

(i) Derive an expression for the amount of heat gained by ice to melt it and raise its temperature to X°C (2marks)

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(ii) Derive an expression for the amount of heat lost by the calorimeter and its content when their temperature falls to X°C. (2marks)

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(iii) Determine the value of X. (3marks)

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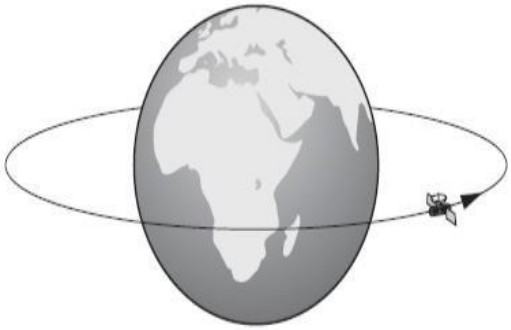
15. a) The diagram below shows a satellite orbiting the earth at a constant speed.



Explain why the satellite accelerates though it is moving with a constant speed (1mark)

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b) A string of negligible mass has a bucket tied at the end. The string is 60cm long and the bucket has a mass of 45000mg. The bucket is swung horizontally making 6 revolutions per second.

Calculate:

i) the angular velocity (2 marks)

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ii) the angular acceleration (3 marks)

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iii) the tension on the string (2 marks)

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iv) the linear velocity (2 marks)

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c) State a condition necessary for a body moving on a banked road not to skid. (1 mark)

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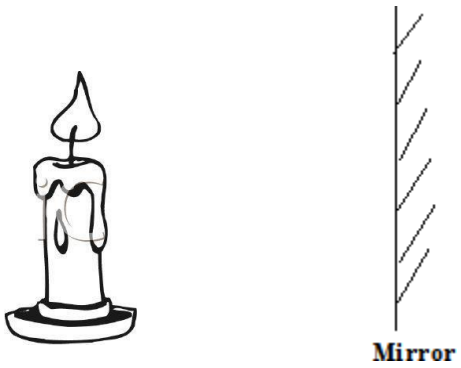
Physics –Paper- 2 (Theory)

TURN OVER

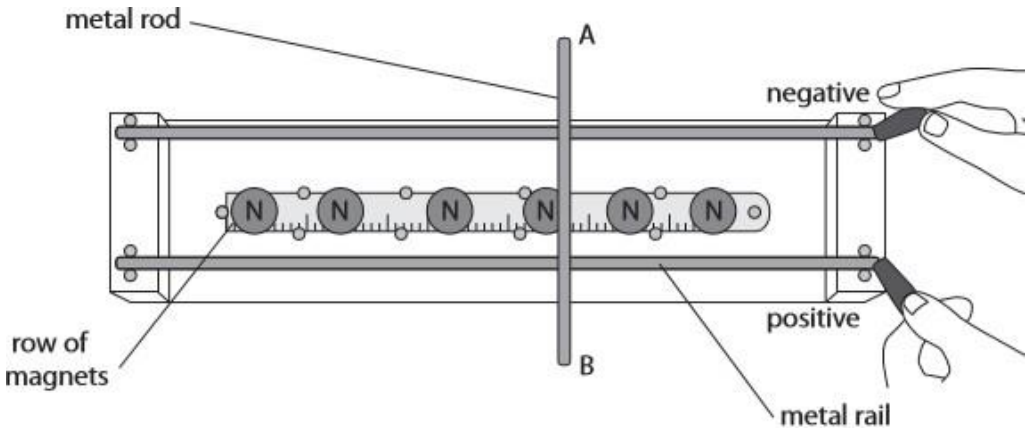
Section A (25 marks)
Answer all Questions in This section

1. Locate the position of the image of the object placed in front of a plane mirror sho **rks)**



2. Show the magnetic field pattern of the current carrying conductors shown below. **(2 marks)**

3. A student uses this apparatus to investigate what happens to a current-carrying conductor in a magnetic field. The student connects the two parallel horizontal metal rails to the positive and negative terminals of a power supply. The metal rod AB rests across the rails and is free to move.



Explain what happens to the metal rod AB. **(2 marks)**

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4. State two advantages of using a convex mirror as a driving mirror. (**2 marks)**

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5. State two factors that affects the resistivity of an electrical conductor. **(2 marks)**

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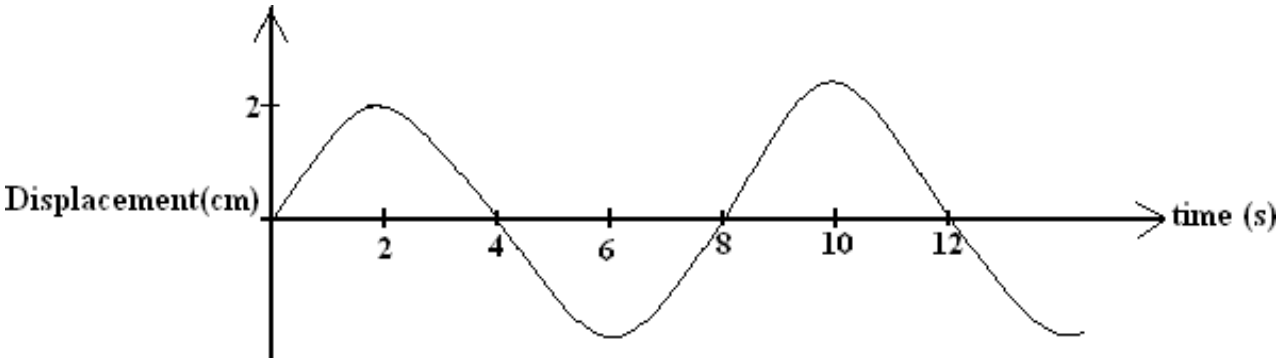
6. The figure below shows a wave in progress.

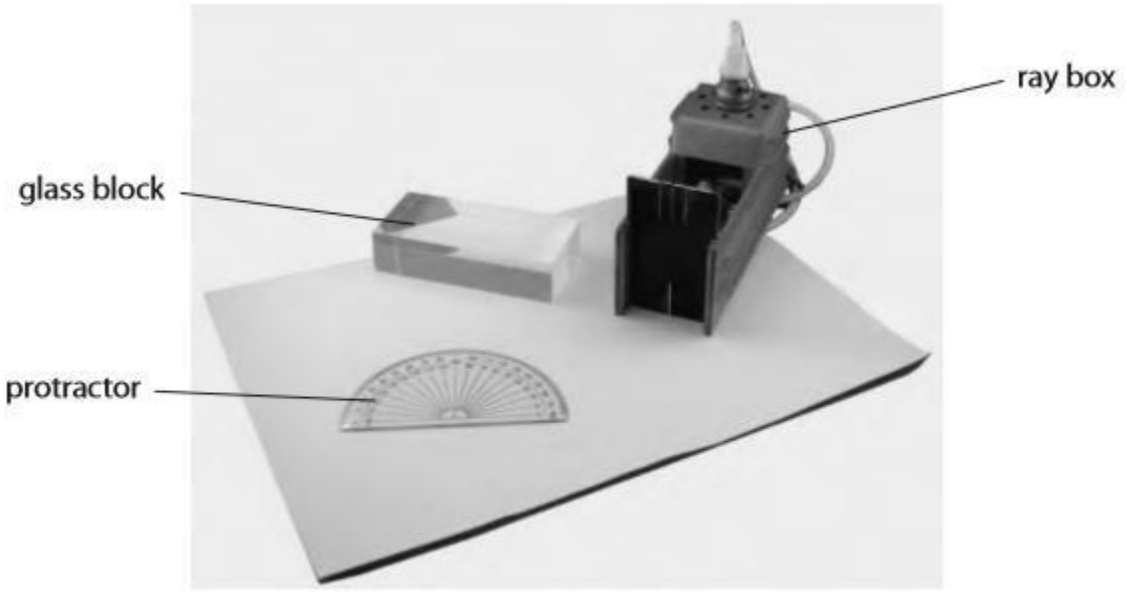


Determine the

a) Amplitude **(1 mark)**

b) Frequency **(2 marks)**

7. The photograph shows the apparatus the student has available.



Describe briefly how the student should carry out the experiment. **(4marks)**

You should include:

- What the student should measure
- How the measurements should be made
- How the student should use a graph to find the refractive index.

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8. A current ,I, flowing through a wire of resistance ,R, is increased by seven times. Determine the factor by which the rate of heat production was increased. **(3marks)**

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9. The wavelength of a radio wave is 1km. Determine its frequency if the speed in $3 \times 10^{8} ms^{-1}$ (**2marks)**

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10. State two uses of gold leaf electroscope. **(2marks)**

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11. Give a reason why soft iron is used as a core of the coil of an electric bell. **(1mark)**

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12. State two differences between pinhole camera and the human eye. **(2marks)**

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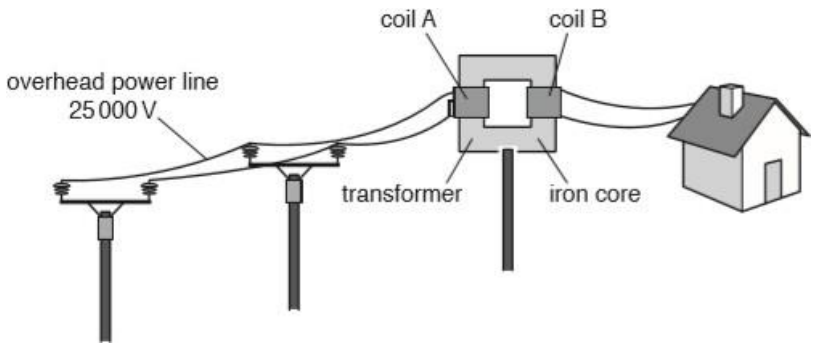
13. The figure below shows a transformer connecting an overhead 25 000 V electrical power line to a house.



(i) State whether coil A or coil B in the transformer has the larger number of turns **(1 mark)**

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(ii) Give a reason for your answer. **(1 mark)**

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SECTION B (55 MARKS)

Answer all the questions in this section

14. (a) Explain what is meant by the principle of superposition of two waves. **(2marks)**

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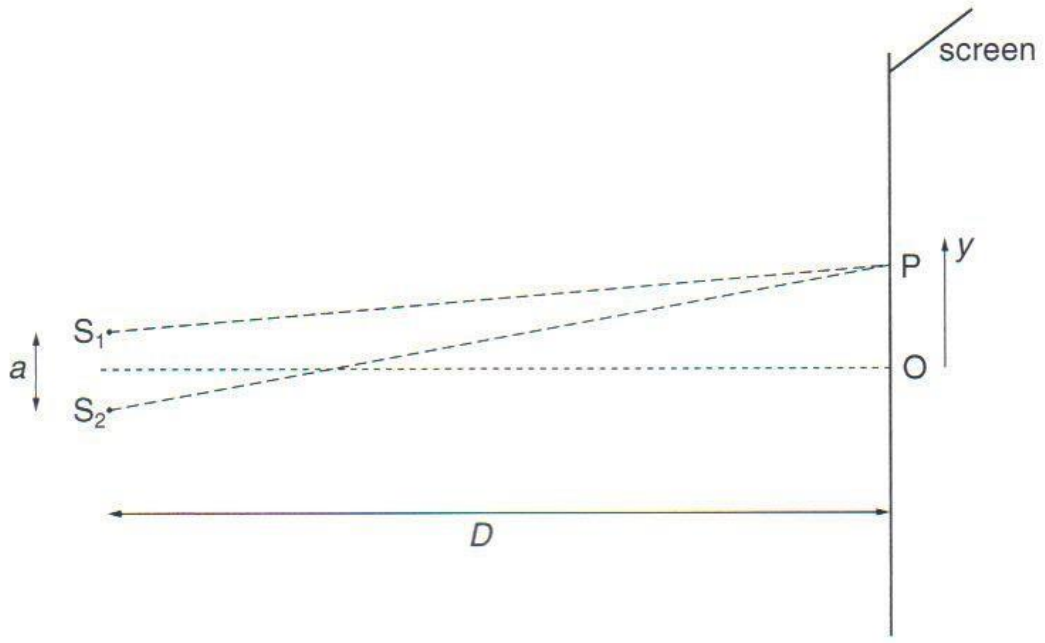
(b) In an experiment to try to produce an observable interference pattern, two monochromatic light sources, S_1 and S_2, are placed in front of a screen, as shown in Fig.1.



(i) In order to produce a clear interference pattern on the screen, the light sources must be *coherent*. State what is meant by *coherent.* **(1mark)**

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(ii) In Fig 1, the central point O is a point of maximum intensity. Point P is the position of **minimum** intensity nearest to O. State, in terms of the wavelength λ, the magnitude of the path difference S_1P and S_2P. **(2marks)**

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15. An X-ray tube is operated at 120Kv with a beam current of 0.5mA. Assuming its efficiency is 1%, calculate:

(i) The number of electrons hitting the target each second **(3marks)**

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(ii) The X-ray energy emitted each second **(2marks)**

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(iii) The heat energy dissipated **(2marks)**

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(iv) The minimum wavelength of the emitted X-radiation. (**2marks)**

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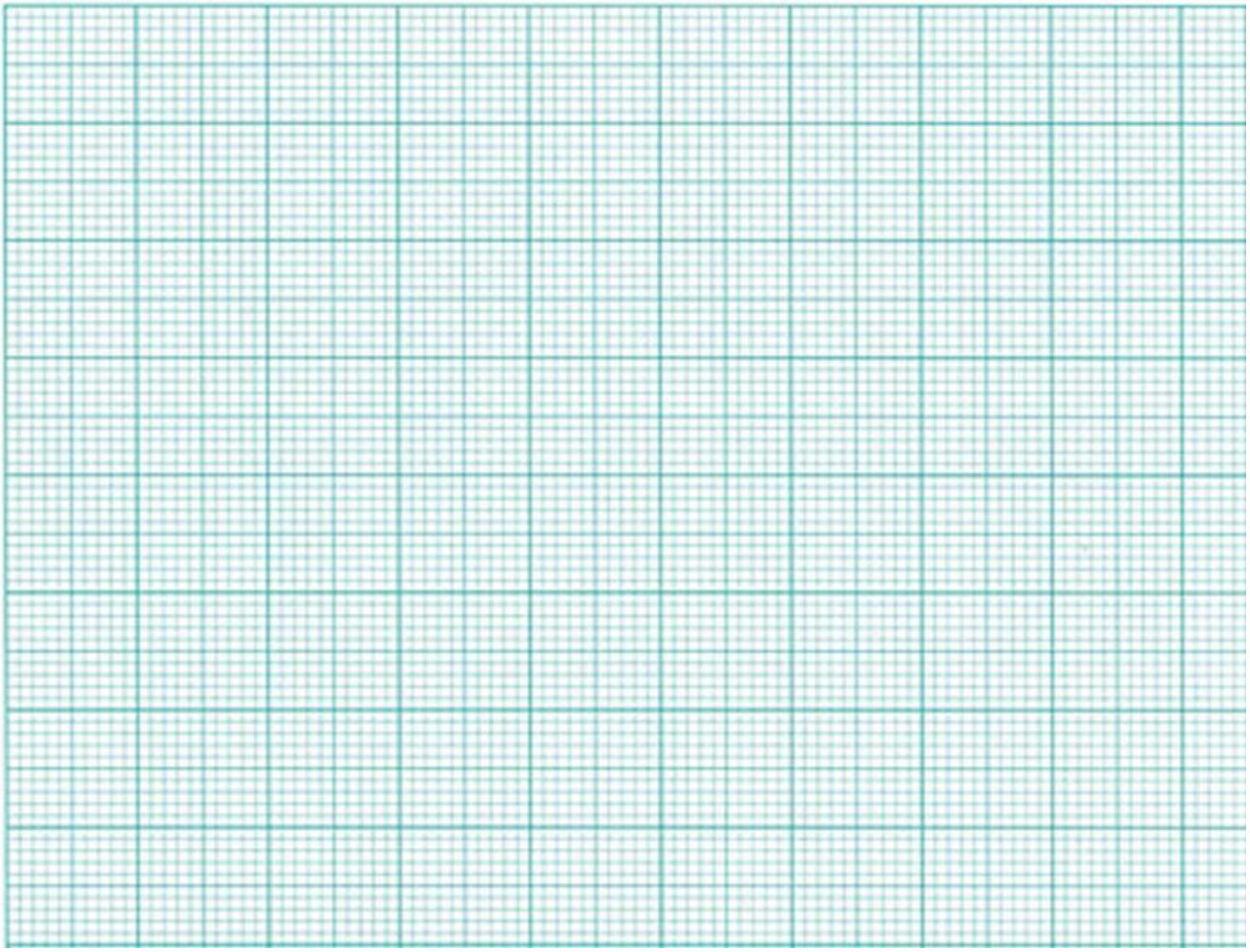
16. In an experiment to determine the range of beta particles in aluminium, different thickness of aluminium sheets were interposed between a small beta source and the window of a Geiger tube 20mm apart.

Thickness/mm	0	0.45	0.90	1.35	1.80	5.40	7.20
Count rate/s^{-1}	85.0	59.5	41.6	29.2	20.4	1.5	1.5

a) Plot a graph of count rate against thickness. **(5mks)**



b) Use your graph to determine the range of beta particles in aluminium . **(2marks)**

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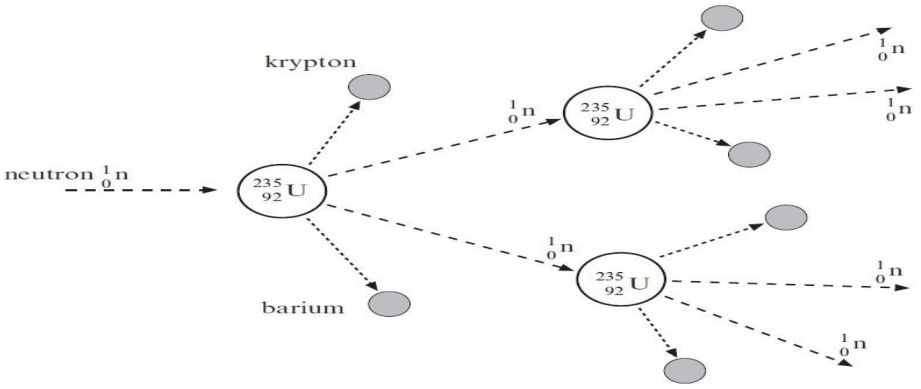
c) The diagram shows an uncontrolled nuclear fission reaction. When a **slow-moving** neutron strikes an atom of U, the atom splits. In this reaction two **fast moving** neutrons are produced together with the radioactive fission fragments of Ba (barium) and Kr (krypton).



I. What name is given to an uncontrolled fission reaction? **(1mark)**

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II. Complete the nuclear equation for this reaction**.** **(2marks)**

$$^{235}_{92}U + {}^{1}_{0}n \longrightarrow {}^{144}Ba + {}_{36}Kr + 2\,{}^{1}_{0}n$$

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III. In a nuclear reactor, the fission reaction is controlled using control rods of boron steel which readily absorb neutrons and a graphite moderator which improves the chances of uranium atoms splitting apart. State how the graphite moderator improves the possibility of fission of uranium.
(1mark)

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(i) Explain how the energy released from a nuclear reactor can be increased.
(2marks)

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(ii) Outline the advantages of producing electricity from nuclear fusion rather than nuclear fission in the future. **(2marks)**

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d) Explain what is meant by the half-life of a radioactive substance. **(1mark)**

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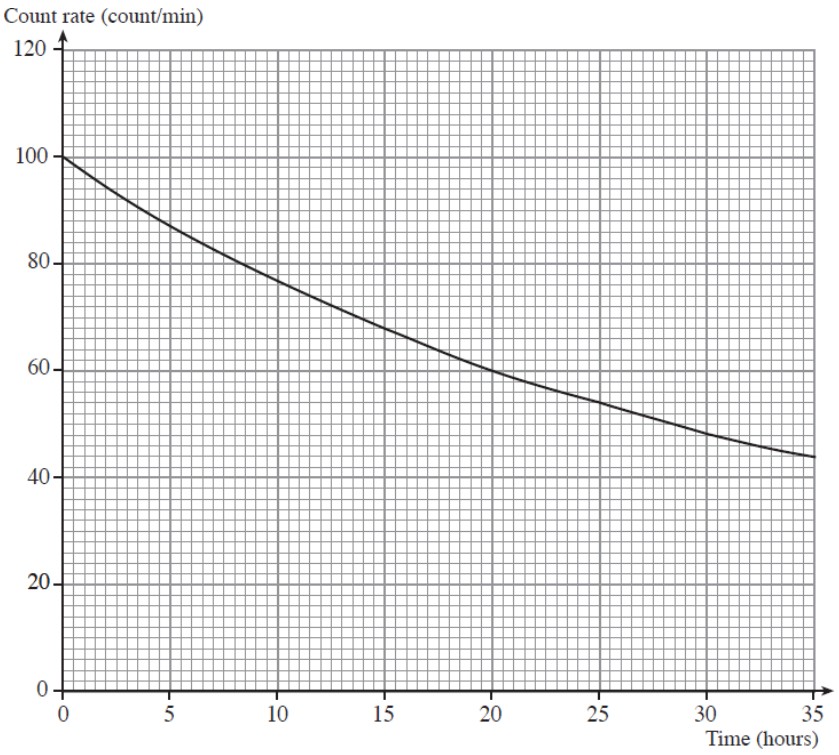
e) The count rate changed in the way shown in the graph below:



Use the graph to find a value for the half-life of the radioactive source. **(2marks)**

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17. A set of Christmas tree lights consists of 40 identical filament lamps connected in series across a supply of 240V.

(a) Define resistance. **(3marks)**

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(b) Each lamp when lit normally carries a current of 250mA. Calculate:

(i) The potential difference *V* across a lamp. **(3marks)**

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(ii) The resistance *R* of a lamp. **(3marks)**

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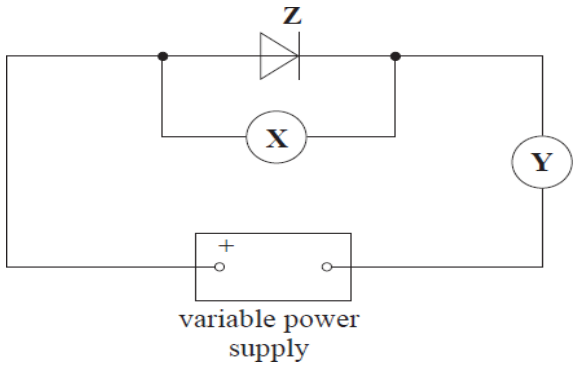
(c) The circuit shown is used to investigate how the current changes with voltage for component **Z**.



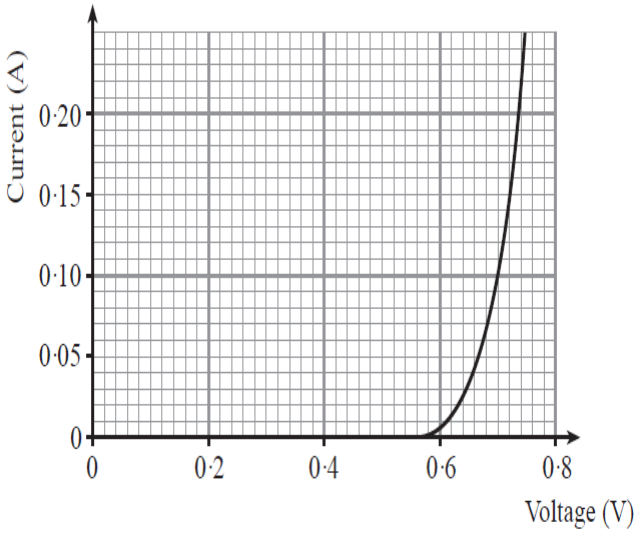
(a) Name the component: **(3mks)**

X ……

Y ……

Z ……

(b) The results from the investigation are shown on the graph.



(i) Describe **carefully** how the current through **Z** changes as the voltage is increased from 0·0 to 0·7V**.** **(2marks)**

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(ii) Write down in words an equation and use it to find the resistance of **Z** when the voltage is 0·7V. (**2marks)**

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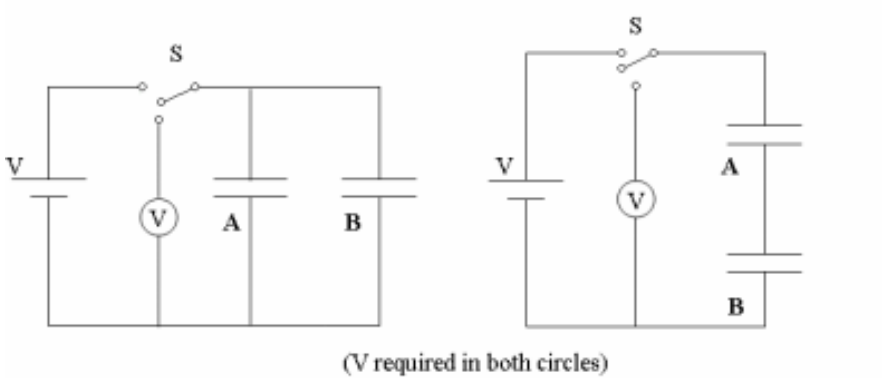
18. Figure below shows two capacitors, A of capacitance 2μF, and B of capacitance 4μF, connected in parallel. Fig. 2.2 shows them connected in series. A two-way switch S can connect the capacitors either to a d.c. supply, of e.m.f. 6V, or to a voltmeter.



(V required in both circles)

(a) Calculate the total capacitance of the capacitors

(i) When connected as in Fig. 2.1 (**2marks)**

(ii) When connected as in Fig. 2.2 **(2marks)**

(b) The switch in the circuit shown in Fig. 2.1 is then connected to the battery. Calculate

(i) The potential difference across capacitor **(2marks)**

(ii) The total charge stored on the capacitors. **(2marks)**

(c) The switch in the circuit shown in figure above is then connected to the battery. Calculate the total energy stored in the two capacitors. **(2marks)**