Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8981335679

PHYSICS **0625/31**

Paper 3 Extended **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
Take the weight of 1 kg to be 10 N (i.e. acceleration of free fall = 10 m/s^2).

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **18** printed pages and **2** blank pages.

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1 **(a)** Figs. 1.1 and 1.2 show speed-time graphs for two objects, each moving in a straight line.

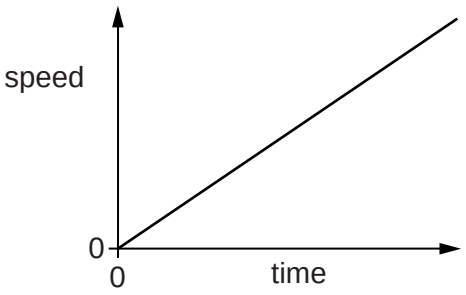


Fig. 1.1

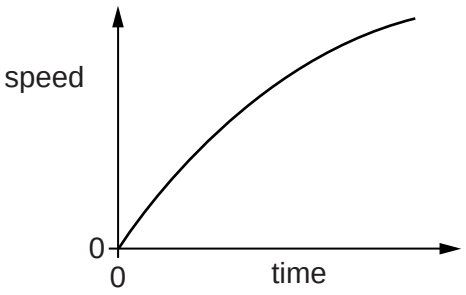


Fig. 1.2

(i) Describe the motion of the object shown by the graph in Fig. 1.1.

.....

.....

(ii) Describe the motion of the object shown by the graph in Fig. 1.2.

.....

.....

[3]

(b) On a day with no wind, a large object is dropped from a tall building. The object experiences air resistance during its fall to the ground.

State and explain, in terms of the forces acting, how the acceleration of the object varies during its fall.

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 7]

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[Turn over

2 A large stone block is to be part of a harbour wall. The block is supported beneath the surface of the sea by a cable from a crane. Fig. 2.1 shows the block with its top face a distance *h* beneath the surface of the sea.

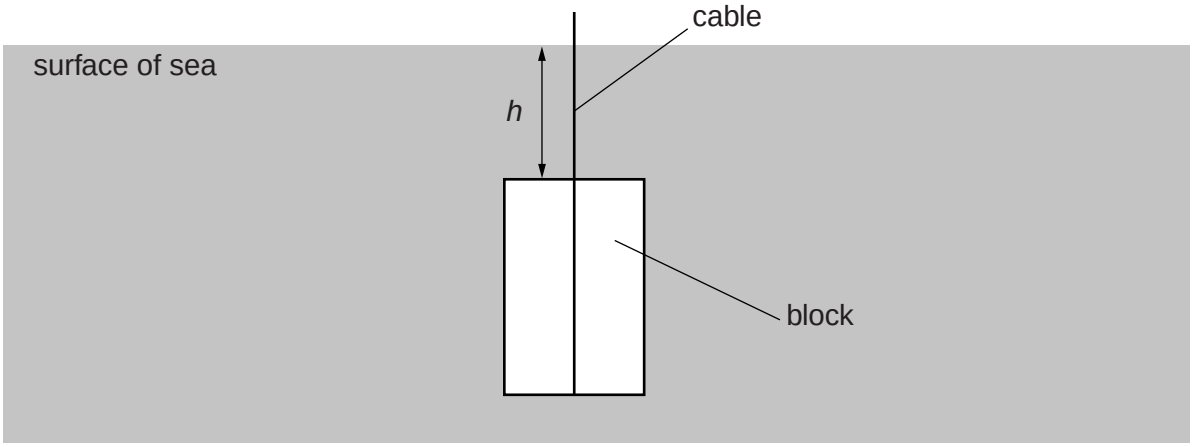


Fig. 2.1

The force acting downwards on the top face of the block, due to the atmosphere and the depth *h* of water, is 3.5×10^4 N.

(a) The top face of the block has an area of $0.25\,m^2$.

(i) Calculate the pressure on the top face of the block.

pressure = ... [2]

(ii) The atmospheric pressure is 1.0×10^5 Pa.

Calculate the pressure on the top face of the block due to the depth *h* of water.

pressure = ... [1]

(iii) The density of sea water is $1020\,kg/m^3$.

Calculate the depth *h*.

h = ... [2]

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(b) Suggest two reasons why the tension force in the cable is not 3.5×10^4 N.

1. .....

2. .....
[2]

(c) The block is lowered so that it rests on the sea-bed.

State what happens to the tension force in the cable.

..... [1]

[Total: 8]

3 Fig. 3.1 shows an early water-powered device used to raise a heavy load. The heavy load rests on piston B.

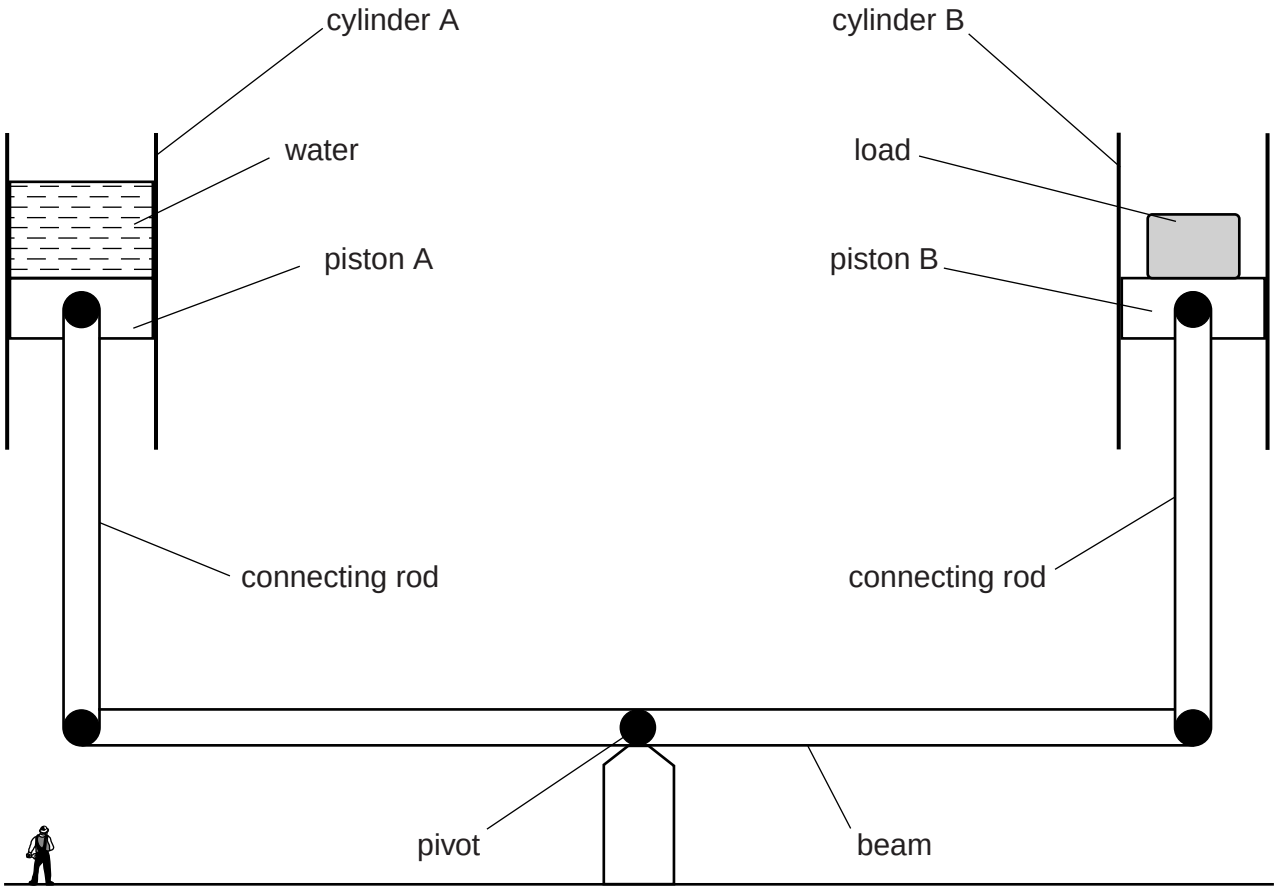


Fig. 3.1 (not to scale)

Initially, a large weight of water in cylinder A pushes piston A down. This causes the left-hand end of the beam to move down and the right-hand end of the beam to move up. Piston B rises, lifting the heavy load.

(a) The weight of water in cylinder A is 80 kN.

Calculate the mass of water in cylinder A.

mass = ... [2]

(b) The density of water is 1000 kg / m^3.

Calculate the volume of water in cylinder A.

volume = ... [2]

(c) Piston A moves down a distance of 4.0 m.

Calculate the gravitational potential energy lost by the water.

loss of gravitational potential energy = ... [2]

(d) The heavy load lifted by piston B gains 96 kJ of gravitational potential energy.

Calculate the efficiency of the device.

efficiency = ... [2]

[Total: 8]

4 **(a)** **(i)** State two ways in which the molecular structure of a liquid is different from the molecular structure of a solid.

1. .....

.....

2. .....

.....
[2]

(ii) Explain, in terms of energy, the process which takes place as a solid at its melting point changes into a liquid at the same temperature.

.....

.....

..... [1]

(b) During a severe snowstorm, a layer of snow (ice crystals) forms on the body of an animal in a field. The snow and the surrounding air are at 0 °C. The snow begins to melt.

(i) The mass of snow that falls on the animal is 1.65 kg. The specific latent heat of fusion of snow is 330 000 J / kg.

Calculate the thermal energy needed to melt this snow.

thermal energy = ... [2]

(ii) The animal derives energy from its food to maintain its body temperature.

State the energy change that takes place.

..... [1]

[Total: 6]

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5 **(a)** State what is meant by the *specific heat capacity* of a substance.

.....

.....

..... [2]

(b) A student carries out an experiment to find the specific heat capacity of aluminium. He uses an electric heater and a thermometer, inserted into separate holes in an aluminium block.

The following data are obtained.

mass of aluminium block = 2.0 kg
power of heating element = 420 W
time of heating = 95 s
initial temperature of block = 19.5 °C
final temperature of block = 40.5 °C

Calculate the value of the specific heat capacity of aluminium given by this experiment.

specific heat capacity = ... [4]

(c) In the experiment in **(b)**, no attempt is made to prevent loss of thermal energy from the surfaces of the block.

Suggest two actions the student could take to reduce the loss of thermal energy from the surfaces of the block.

1. .....

2. .....
[2]

[Total: 8]

6 A water wave in a tank travels from a region where the speed of the wave is faster into a region where it is slower.

Fig. 6.1 is a one-quarter scale diagram that shows the wavefronts in the region where the speed is faster.

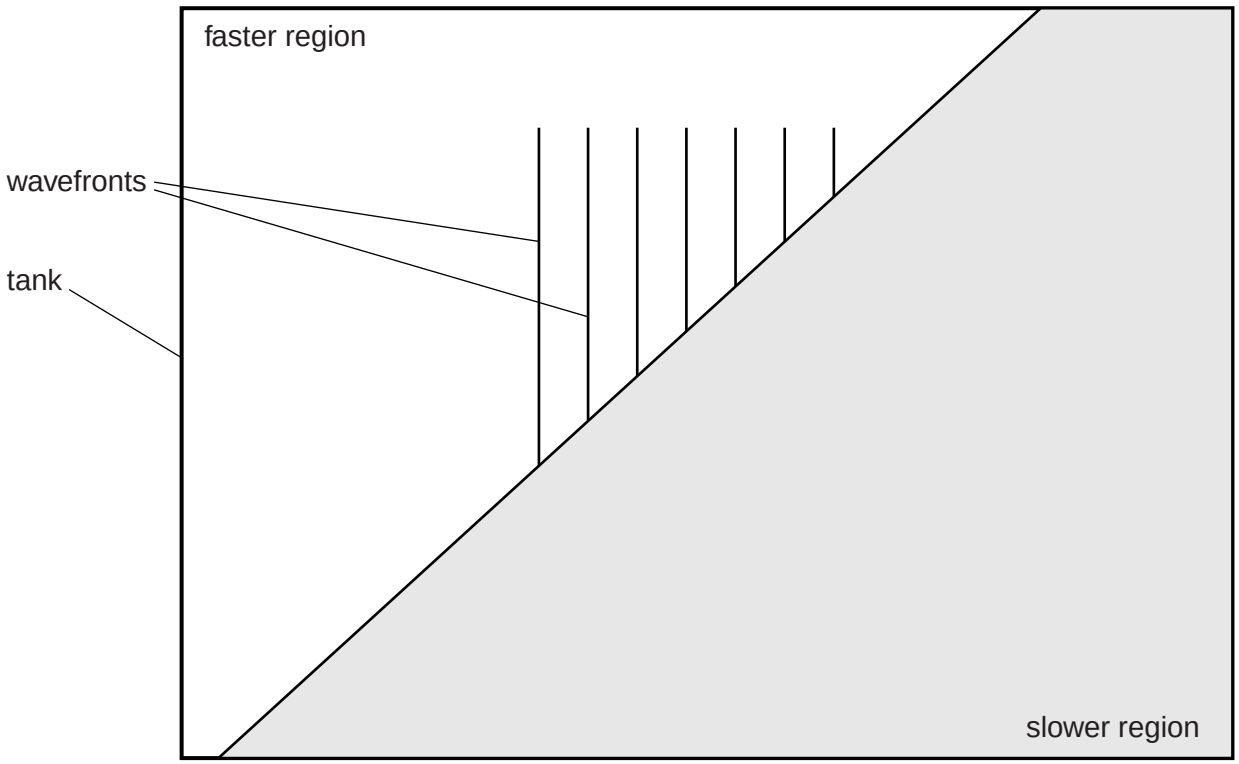


Fig. 6.1 (scale: 1.0 cm represents 4.0 cm)

(a) (i) Take measurements from the scale diagram in Fig. 6.1 to determine the wavelength of the water wave as it travels in the faster region.

wavelength = ... [2]

(ii) The speed of the wave in the faster region is 0.39 m / s.

Calculate the frequency of the wave.

frequency = ... [2]

(b) On Fig. 6.1, draw lines that indicate the positions of the wavefronts of the water wave in the slower region. [2]

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(c) State what happens to the frequency of the water wave as it passes into the slower region.

.....

..... [1]

[Total: 7]

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7 **(a)** Fig. 7.1 represents an object O placed in front of a converging lens.

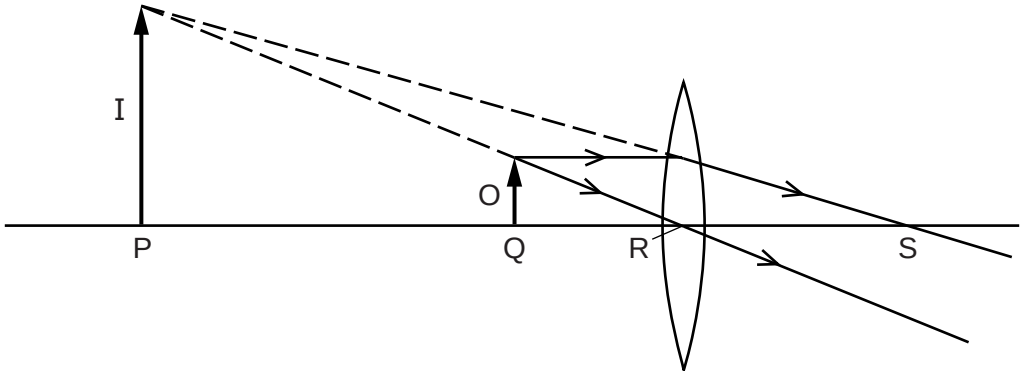


Fig. 7.1

(i) State a full description of the image I.

..... [2]

(ii) Using the letters on Fig. 7.1, identify the focal length of the lens.

..... [1]

(iii) On Fig. 7.1, draw an eye suitably placed to view the image I. [1]

(b) Fig. 7.2 shows an object O placed to the left of a converging lens. A principal focus of the lens is at the position marked F.

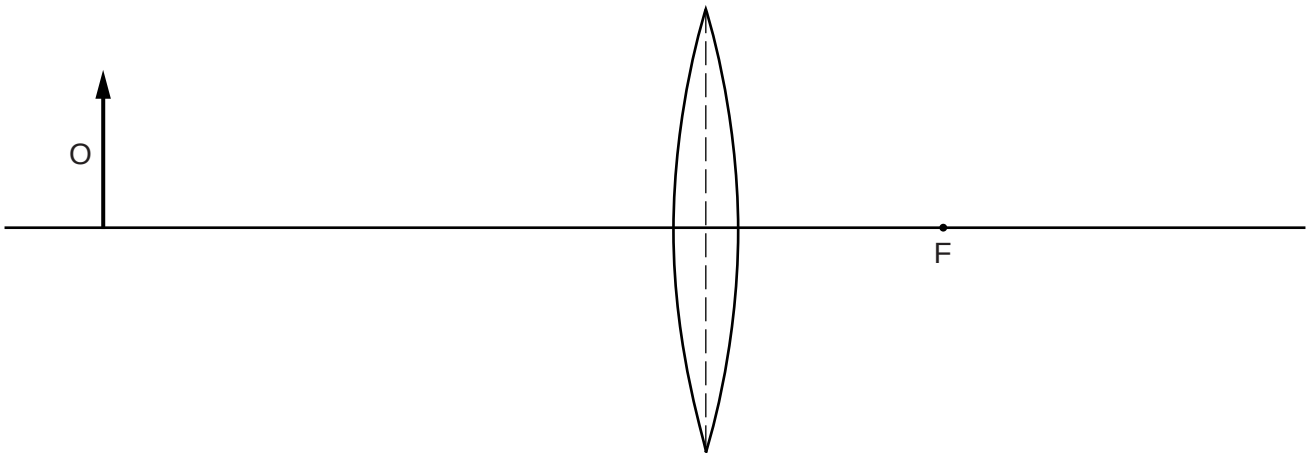


Fig. 7.2

(i) On Fig. 7.2, draw two rays to locate the image of object O. Draw the image.

(ii) On Fig. 7.2, draw one other ray from the upper tip of O to the image.

[4]

[Total: 8]

8 **(a)** Fig. 8.1 shows a bar magnet suspended by a spring over a coil. The coil is connected to a sensitive centre-zero millivoltmeter.

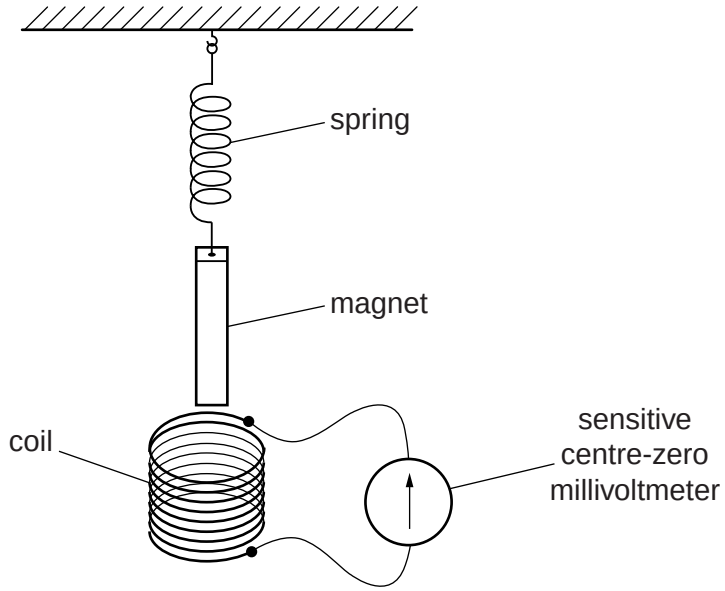


Fig. 8.1

(i) The lower end of the magnet is pushed down into the upper end of the coil and held at rest.

During the movement, an e.m.f. is induced in the coil. The meter shows a deflection to the right and then returns to zero.

Explain why this e.m.f. is induced.

.....

..... [1]

(ii) State what happens to the needle of the meter when

1. the magnet is released from rest and is pulled up by the spring,

..... [1]

2. the magnet continues to oscillate up and down, moving in and out of the coil with each oscillation.

..... [1]

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(b) Fig. 8.2 shows a transformer.

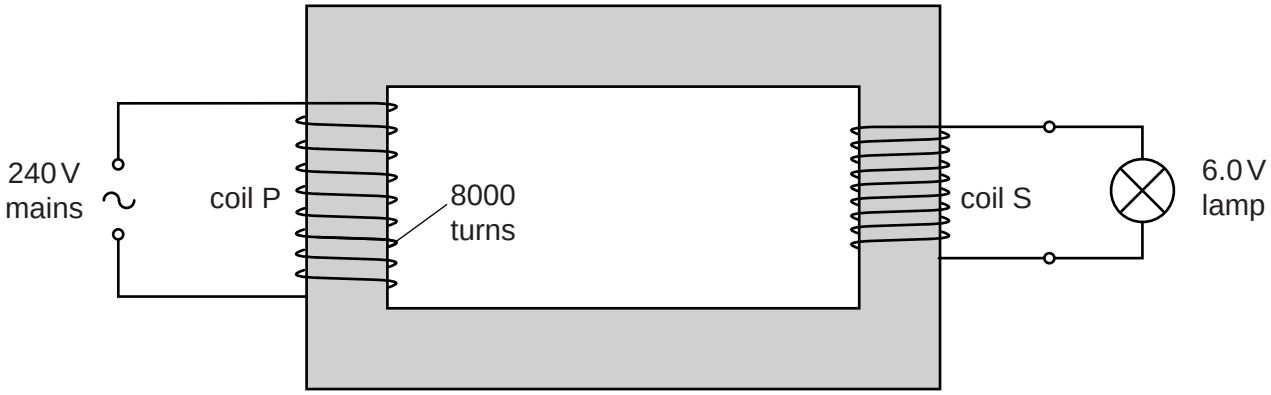


Fig. 8.2

The primary coil P, connected to the 240V mains supply, has 8000 turns. The secondary coil S supplies 6.0V to a lamp.

(i) Calculate the number of turns in the secondary coil.

number of turns = ... [2]

(ii) **1.** The current in the primary coil is 0.050 A.

Calculate the power input to the transformer.

power = ... [1]

2. 90% of the power input to the transformer is transferred to the lamp.

Calculate the current in the lamp.

current = ... [2]

[Total: 8]

9 In Fig. 9.1, a 12 V battery supplies a current I to a circuit. The circuit contains a thermistor and a 1000 Ω resistor in parallel, with a 500 Ω resistor in series.

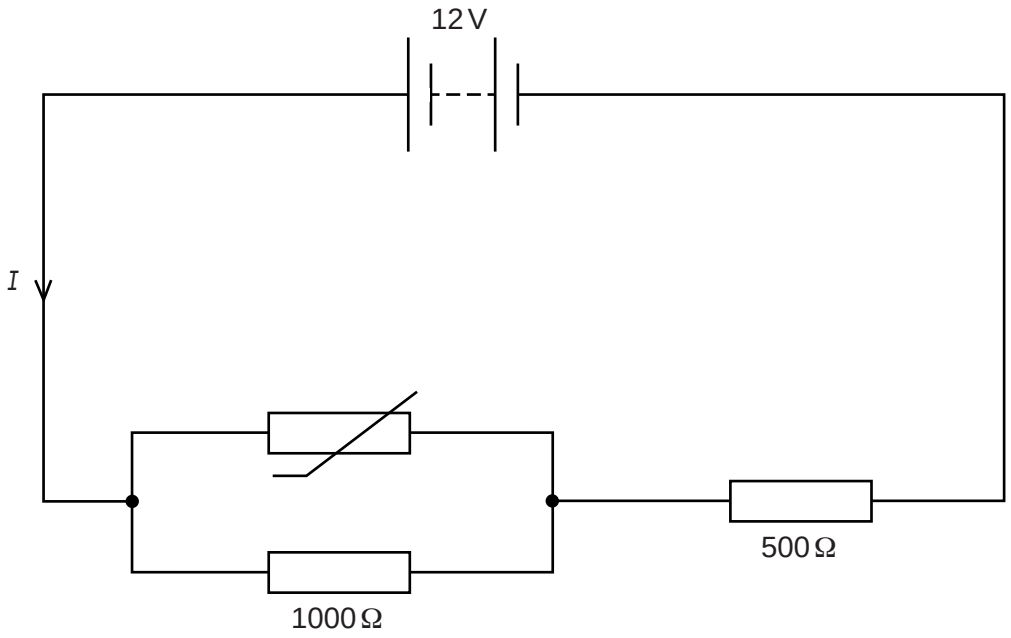


Fig. 9.1

(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.

Calculate

(i) the combined resistance of the thermistor and the 1000 Ω resistor,

resistance = ... [2]

(ii) the current I,

current = ... [1]

(iii) the potential difference across the 500 Ω resistor.

potential difference = ... [2]

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(b) The temperature of the thermistor is increased so that its resistance decreases.

State the effect of this change in resistance on the current through the 500 Ω resistor. Explain your answer.

.....

.....

..... [2]

[Total: 7]

10 Fig. 10.1 shows two parallel conducting plates connected to a very high voltage supply.

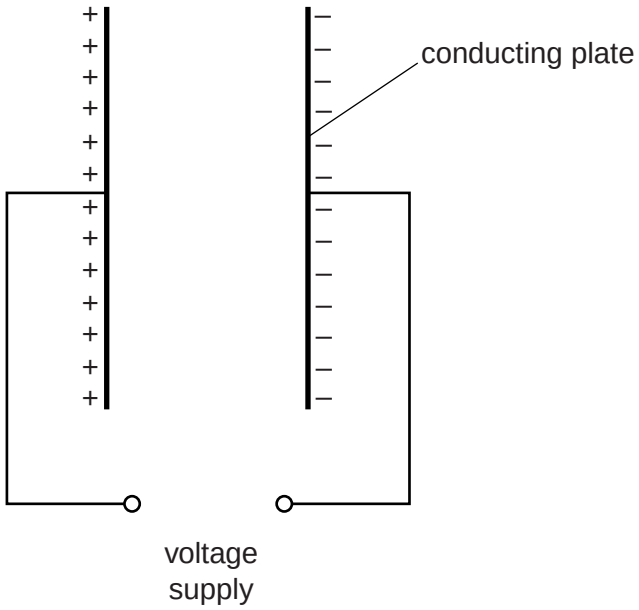


Fig. 10.1

The left-hand plate is positively charged and the right-hand plate is negatively charged.

(a) On Fig. 10.1, draw the electric field pattern produced between the charged plates. Use arrows to show the direction of the field. [2]

(b) A light, conducting ball is suspended by an insulating string. Fig. 10.2 shows the ball in the middle of the gap between the plates.

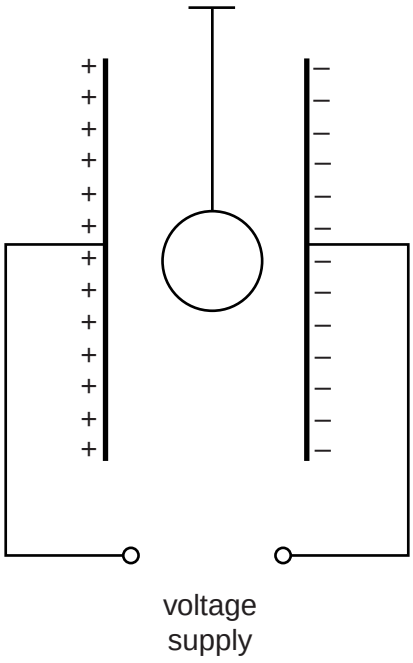


Fig. 10.2

On Fig. 10.2, show the distribution of charge on the ball. [2]

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(c) The ball is displaced to the left and then oscillates backwards and forwards between the two plates.

The ball touches a plate once every 0.05 s. Every time it touches a plate, a charge of 2.8×10^{-8} C (0.000 000 028 C) is transferred.

Calculate the average current produced by the repeated transfer of charge.

current = ... [2]

[Total: 6]

Question 11 is on the next page.

11 **(a)** State the nature of γ-rays.

.....

..... [1]

(b) A beam of α-particles and β-particles passes, in a vacuum, between the poles of a strong magnet.

Compare the deflections of the paths of the two types of particle.

.....

.....

..... [2]

(c) A beam of β-particles passes, in a vacuum, through the electric field between a pair of oppositely charged metal plates.

Describe the path of the particles.

.....

.....

..... [2]

(d) The nuclear equation shows the decay of an isotope of polonium.

$$^{A}_{Z}\text{Po} \rightarrow {}^{206}_{82}\text{Pb} + {}^{4}_{2}\text{X}$$

(i) State the nature of X.

.....

..... [1]

(ii) Calculate the values of A and Z.

A = ... Z = ... [1]

[Total: 7]

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