1 **(a)** A cathode-ray oscilloscope makes use of the process known as thermionic emission.

Describe what happens during this process.

.....

.....

.....[1]

(b) In the space below, draw a **labelled** diagram of a cathode-ray oscilloscope.

Include in your diagram the tube, the cathode, the accelerating anode, the focusing anode and both X- and Y-plates. Do not attempt to show any external circuits.

[3]

(c) A cathode ray is a beam of electrons.

Suggest one way of controlling the number of electrons in the beam.

.....

.....[1]

(d) One cathode-ray tube has 5000 V between the accelerating anode and the cathode.

The beam of electrons carries a total charge of 0.0095 C in 5.0 s.

Calculate

(i) the current caused by the beam,

current = ...[2]

(ii) the energy transferred by the beam in 20 s.

energy = ...[2]

[Total: 9]

2 **(a)** What is meant by the *electromotive force* (e.m.f.) of an electric power supply?

.....

.....[2]

(b) When connected to a 240V supply, a desk lamp has a power rating of 60W.

Calculate

(i) the current in the lamp,

current = ...[2]

(ii) the resistance of the lamp's filament.

resistance = ...[2]

(c) A torch lamp is normally connected to a 3.0 V battery and carries a current of 0.25 A. The resistance of its filament is 12 Ω.

The desk lamp in **(b)** and the torch lamp are connected in series.

Students X and Y plan to connect the lamp combination to a 240 V supply.

Student X says that the filament of the torch lamp will melt and the circuit will no longer work.
Student Y says that both lamps will light up and stay on.

Show, with a suitable calculation, whether student X or student Y is correct.

.....

.....[2]

[Total: 8]

3 The graphs in Fig. 9.1 show the relation between the current *I* and the potential difference *V* for a resistor and a lamp.

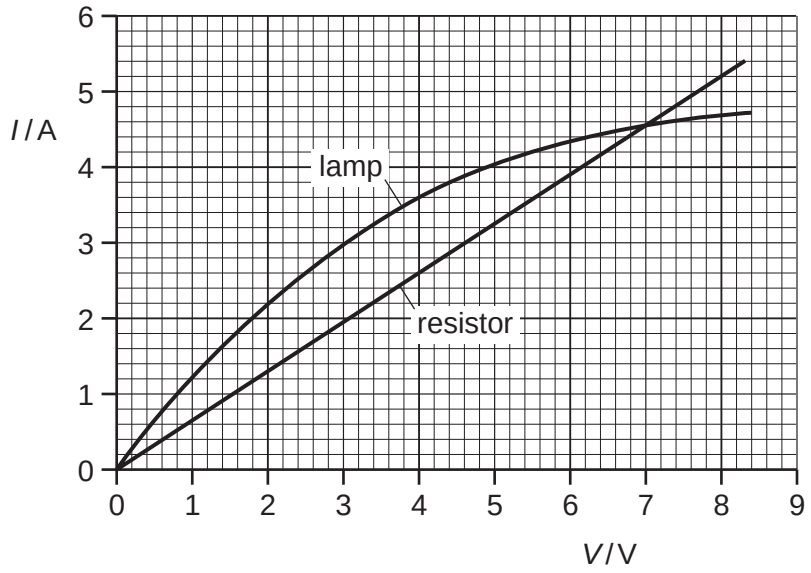

Fig. 9.1

(a) (i) Describe how, if at all, the resistance varies as the current increases in

1. the resistor, ...

2. the lamp. .....[2]

(ii) State the value of the potential difference when the resistor and the lamp have the same resistance.

potential difference = ...[1]

(b) The two components are connected **in parallel** to a supply of e.m.f. 4.0V. Calculate the total resistance of the circuit.

total resistance = ...[4]

[Total: 7]

4 **(a)** A coil of wire is connected into a circuit containing a variable resistor and a battery.

The variable resistor is adjusted until the potential difference across the coil is 1.8 V.

In this condition, the current in the circuit is 0.45 A.

Calculate

(i) the resistance of the coil,

resistance = ... [1]

(ii) the thermal energy released from this coil in 9 minutes.

energy released = ... [3]

(b) The coil in part **(a)** is replaced by one made of wire which has half the diameter of that in **(a)**.

When the potential difference across the coil is again adjusted to 1.8 V, the current is only 0.30 A.

Calculate how the length of wire in the second coil compares with the length of wire in the first coil.

length of wire in second coil is …… the length of wire in first coil [4]

[Total: 8]

5 **(a)** State the law of attraction and repulsion between electrostatic charges.

.....

.....

..... [2]

(b) Sometimes, when people have been riding in a car, they get an electric shock from the door handle as they get out of the car.

Suggest why this happens.

.....

.....

..... [2]

(c) A plastic rod is rubbed with a cloth and becomes positively charged. After charging, the rod is held close to the suspended table-tennis ball shown in Fig. 8.1. The table-tennis ball is covered with metal paint and is initially uncharged.

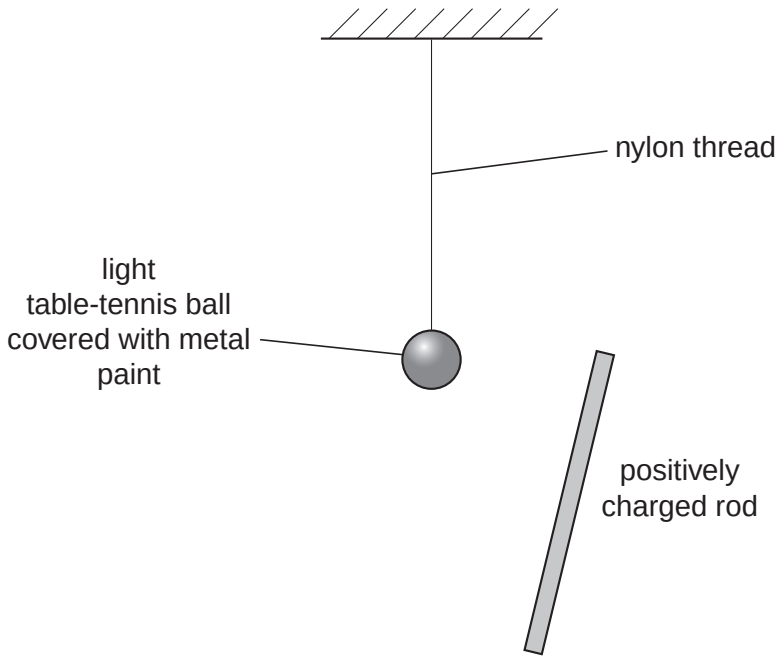

Fig. 8.1

(i) Describe what happens to the charges on the metal-painted table-tennis ball as the positively-charged rod is brought close to the ball.

.....

.....

..... [1]

(ii) The ball is attracted towards the charged rod.

Explain why this happens.

.....

.....

..... [2]

(iii) When it is a few centimetres away from the rod, the ball is briefly touched by a wire connected to earth.

In terms of the movement of charges, describe what happens to the charge on the ball.

.....

..... [2]

[Total: 9]