Fig. 9.1 shows a mobile phone (cell phone) being charged on a wireless charging plate.

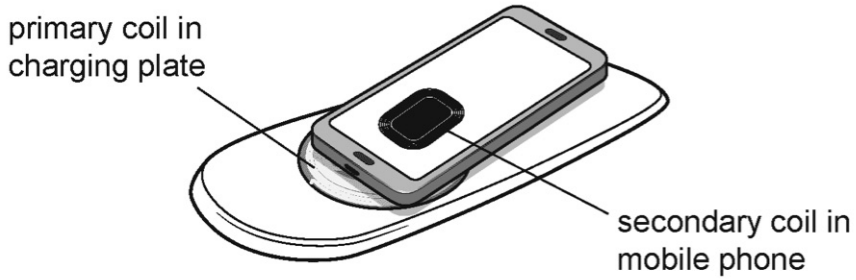

Fig. 9.1

(a) When the charging plate is switched on, there is an alternating current (a.c.) in the primary coil. A secondary coil is in the mobile phone.

Explain how a current is produced in the secondary coil.

.....

.....

..... [3]

(b) The maximum energy stored in the battery of the mobile phone is 0.012 kWh.

(i) Show that this maximum energy is 4.3×10^4 J.

[1]

(ii) The charging plate in Fig. 9.1 has a useful output power of 15 W.
The phone manufacturer claims that the battery can be charged to 50% capacity in less than 30 minutes.

Show that this claim is true.

[3]

Fig. 7.1 shows two charged metal plates. X marks the position of the centre of the space between the plates.

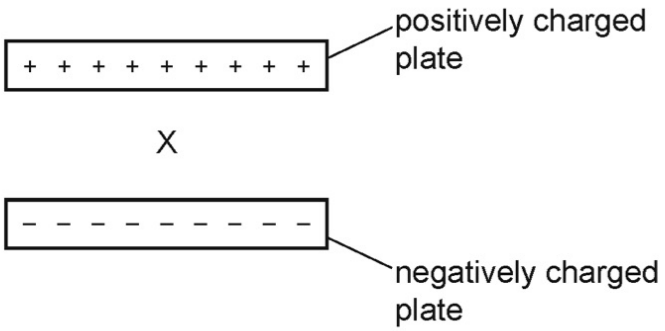

Fig. 7.1

(a) **(i)** On Fig. 7.1, draw at least **four** field lines to show the pattern and the direction of the electric field between the two charged plates. [2]

(ii) Describe the effect on a negatively charged particle placed at X.

.....

..... [1]

(b) During a thunderstorm, an electric field is set up between a cloud and the ground. Charges on the cloud and on the ground are shown in Fig. 7.2.

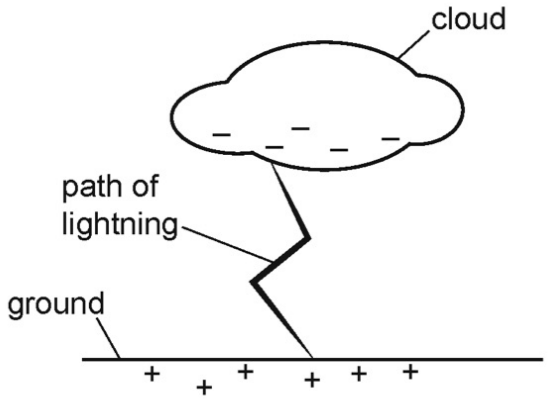

Fig. 7.2

The lightning shown in Fig. 7.2 discharges a current of 28000A for 0.0012s.

(i) Calculate the charge that flows from the cloud to the ground.

charge = ... [2]

(ii) The lightning transfers 1.2×10^8 J of energy.

Calculate the potential difference between the base of the cloud and the ground.

potential difference = ... [2]

(a) Radioactive isotopes that emit ionising radiation are used in hospitals.

(i) State and explain **two** safety precautions necessary for the use of these isotopes in medical procedures.

safety procedure 1 .....

explanation .....

.....

safety procedure 2 .....

explanation .....

.....

[2]

(ii) Give **two** reasons why alpha-emitters are **not** used as radioactive tracers inside the body.

1 .....

.....

2 .....

.....

[2]

(b) Sodium-24 is an isotope of sodium (Na) that has a proton number of 11 and a nucleon number of 24.

Sodium-24 decays by emission of a beta-particle to form an isotope of magnesium (Mg).

Use nuclide notation to write down the nuclide equation for this decay.

0247

(a) Fig. 8.1 shows a circuit. The circuit is designed to switch on a night light when the surroundings are dark.

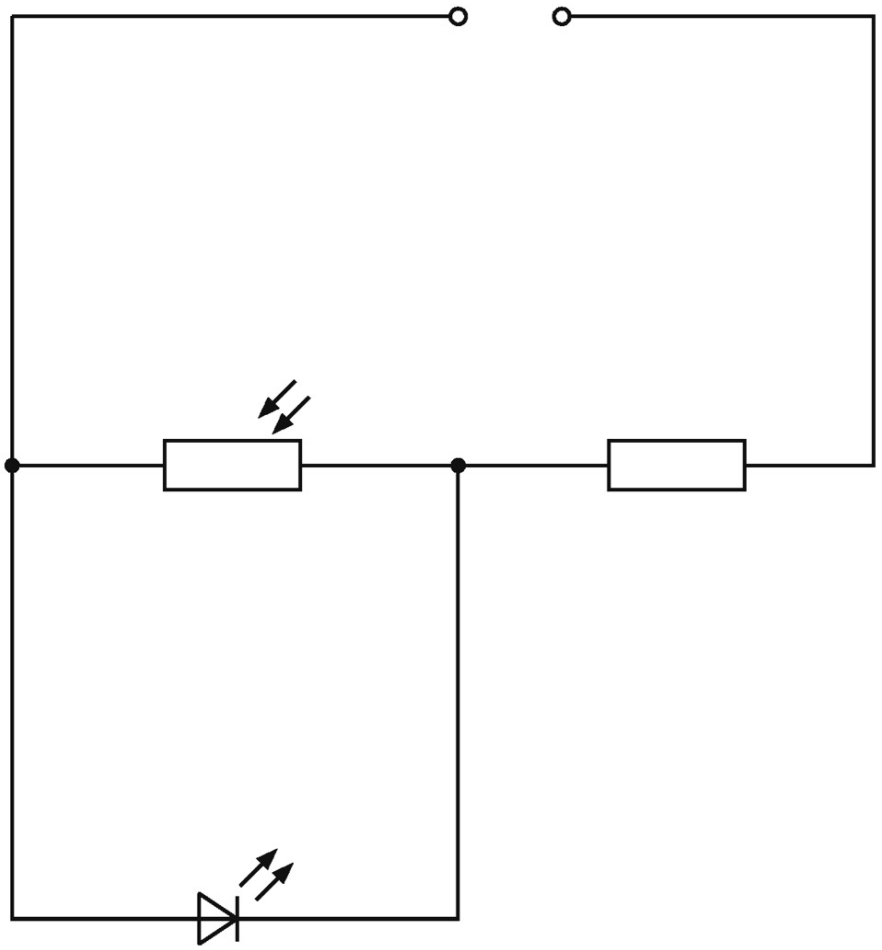

Fig. 8.1

(i) On Fig. 8.1, draw the circuit symbol for a voltmeter used to measure the potential difference (p.d.) across the light-dependent resistor (LDR). [1]

(ii) The surroundings change from light to dark.

1. State the effect of this change on the resistance of the LDR.

..... [1]

2. State and explain the effect of this change on the p.d. across the light-emitting diode (LED).

.....

.....

..... [2]

(b) Fig. 8.2 shows another circuit. Lamps A and B are identical filament lamps.

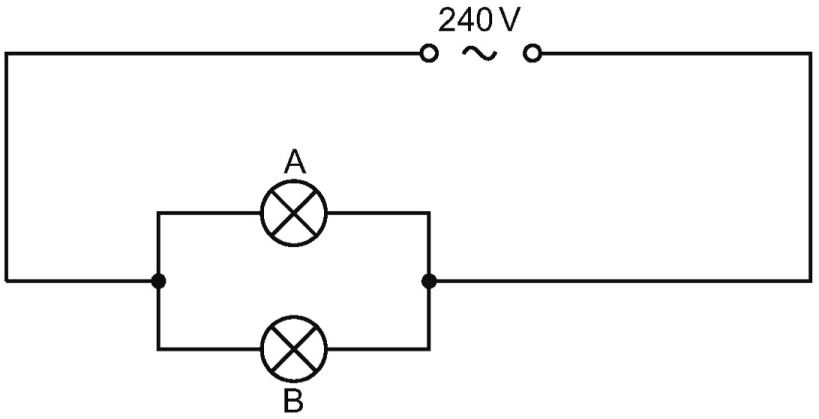

Fig. 8.2

The current supplied by the power supply is 0.50 A.

Calculate the resistance of lamp A.

resistance = ... [3]

(a) Fig. 7.1 shows three bars of steel, A, B and C.

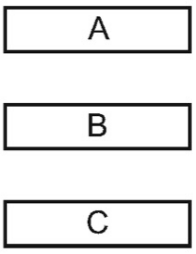

Fig. 7.1

A student is given the three pieces of steel. Two of the pieces are magnetised and one piece is unmagnetised.

Describe and explain how the student determines which piece is unmagnetised using only the three pieces of steel.

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Fig. 7.2 shows a circuit diagram of a step-down transformer.

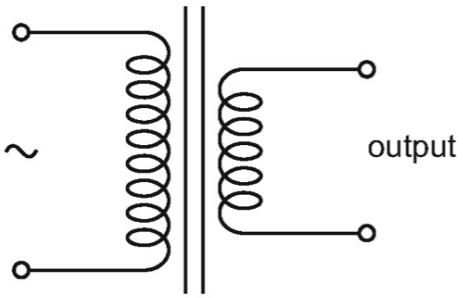

Fig. 7.2

(i) The mains voltage supplied to the transformer is 240 V. The output power of the transformer is 45 W. The transformer is 100% efficient.

Calculate the input current to the transformer.

input current = ... [3]

(ii) Draw a labelled diagram of a step-down transformer. On the labels, state a suitable material for each of the components.

[3]

Q31)

The isotope thallium-208 ($^{208}_{81}Tl$) is radioactive. It decays by β-decay.

(a) Thallium-208 decays to an isotope of lead (Pb).

(i) Complete the equation for this decay.

$$^{208}_{81}Tl \longrightarrow \overset{\cdots\cdots}{\cdots\cdots}Pb + \overset{\cdots\cdots}{\cdots\cdots}\beta$$

[3]

(ii) The β-emission of thallium-208 is accompanied by γ-emission from the nucleus.

Explain why this γ-emission does **not** affect the numbers in the equation in **(a)(i)**.

.....

..... [1]

(iii) Suggest **one** reason why a nucleus of thallium-208 is unstable.

.....

..... [1]

(b) A sample of thallium-208 is placed in a thick lead container. Fig. 8.1 shows a narrow beam of β-particles and γ-radiation emerging from a small hole in one side of the container.

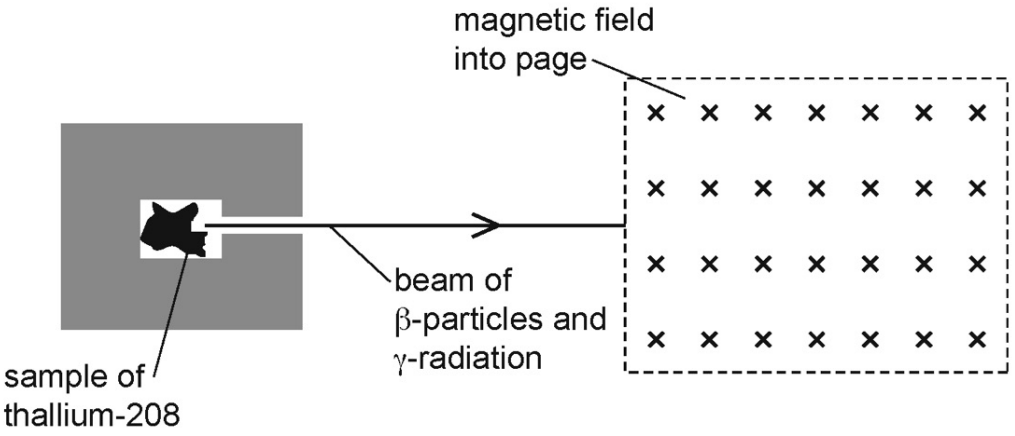

Fig. 8.1

The narrow beam enters a region where there is a magnetic field that is directed into the page.

On Fig. 8.1:

- draw a line **labelled** β to indicate the path of the β-particles in the magnetic field
- draw a line **labelled** γ to indicate the path of the γ-radiation in the magnetic field.

[3]

9321

The electromotive force (e.m.f.) of a battery is 7.5 V.

(a) Define the term electromotive force.

.....

.....

..... [2]

(b) The battery is connected in series with a variable resistor and a 30 Ω resistor. The battery is made using 1.5 V cells.

(i) Draw a circuit diagram that shows all the 1.5 V cells connected to produce an e.m.f. of 7.5 V, the variable resistor and the 30 Ω resistor.

[3]

(ii) The resistance of the variable resistor can be varied from 0 Ω to a maximum resistance of 150 Ω.

Using the axes in Fig. 7.1, draw a graph to show how the current in the circuit varies with the resistance of the variable resistor as it increases from 0 Ω to 150 Ω.

Determine and label the value of the maximum current on the *y*-axis.

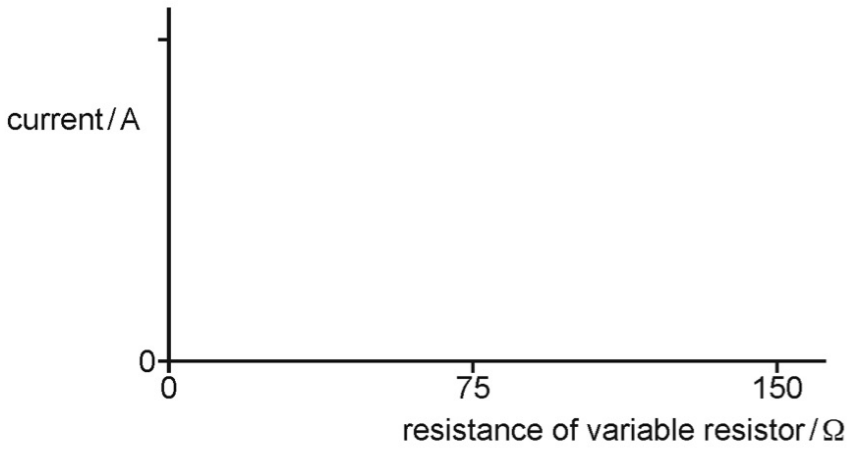

Fig. 7.1

[4]

Fig. 6.1 shows an isolated metal sphere suspended by an insulating thread from the ceiling.

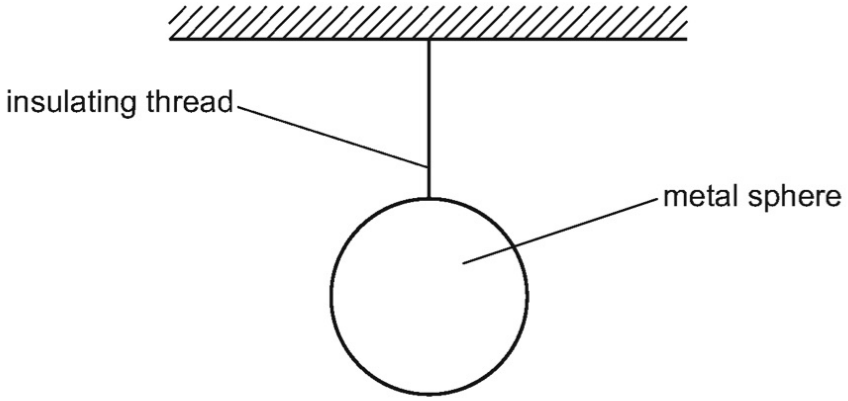

Fig. 6.1

The sphere is negatively charged.

(a) The charge on the sphere produces an electric field in the surroundings.

(i) State what is meant by 'electric field'.

.....

..... [1]

(ii) Draw on Fig. 6.1 to show the pattern and direction of the electric field produced by the charge on the sphere. Draw at least **four** lines. [3]

(b) The magnitude of the charge on the sphere is 3.5×10^{-10} C.

An earthed metal wire is touched against the surface of the sphere and the sphere is discharged.

(i) State what happens in the wire as the sphere is discharged.

.....

.....

..... [2]

(ii) It takes a time of 0.14 ns for the sphere to discharge completely.

Calculate the average current in the earthed wire as the sphere discharges.

average current = ... [3]

0834

(a) Fig. 8.1 shows the single turn coil of a simple direct current (d.c.) motor.

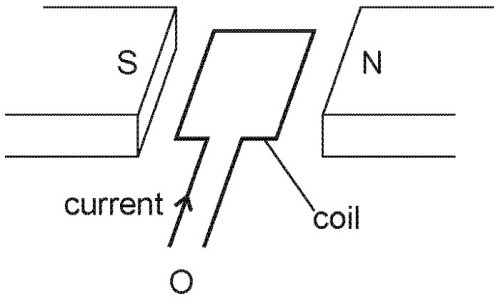

Fig. 8.1

(i) Explain the direction of the turning effect as seen by an observer at O.

.....

.....

..... [2]

(ii) The coil is replaced by an otherwise identical new coil with three turns and the same current in the coil.

State how the turning effect compares with the turning effect in **(i)**.

..... [1]

(iii) A third coil is identical to the coil in **(i)** except that its resistance is three times greater. The potential difference (p.d.) across the coil is the same as the p.d. in **(i)**.

State how the turning effect compares with the turning effect in **(i)**.

..... [1]

(b) Fig. 8.2 is a voltage–time graph showing the output of a simple alternating current (a.c.) generator at times t_0, t_1, t_2 and t_3.

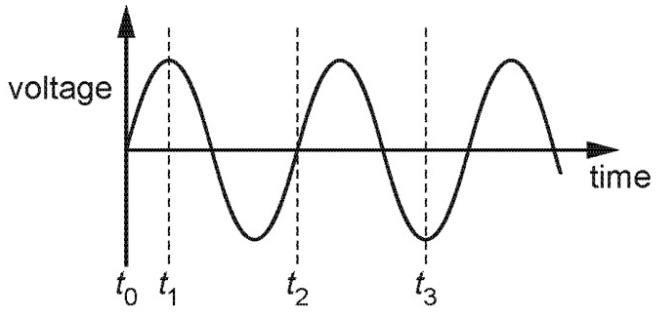

Fig. 8.2

Fig. 8.3 is an end view of the plane of the coil of the generator at time t_0. The coil is rotating clockwise.

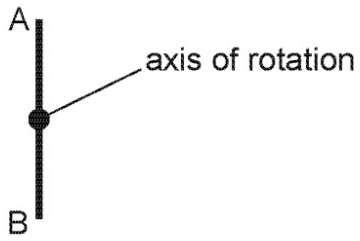

Fig. 8.3

(i) Draw an end view of the position of the plane of the coil at time t_1. Include the labels A and B.

[1]

(ii) Draw an end view of the position of the plane of the coil at time t_2. Include the labels A and B.

[1]

(938)

(a) On Fig. 6.1, sketch the current–voltage graph of a filament lamp and explain its shape.

Fig. 6.1

explanation .....

.....

[3]

(b) Fig. 6.2 shows an electric circuit.

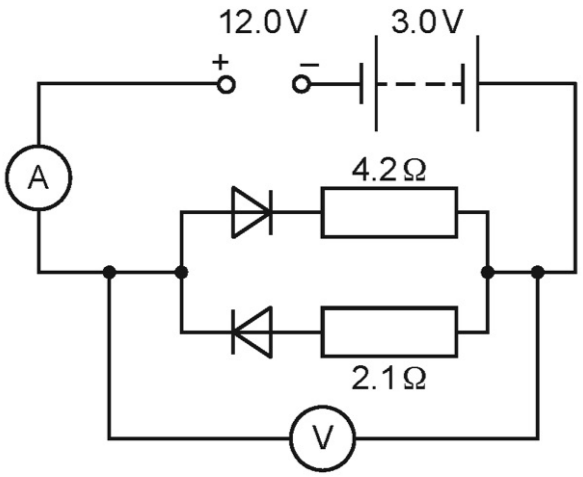

Fig. 6.2

(i) Calculate the reading on the voltmeter.

voltmeter reading = ... [2]

(ii) Calculate the current in the 4.2 Ω resistor.

current = ... [2]

(iii) Determine the current in the 2.1 Ω resistor.

current = ... [1]

(iv) Determine the reading on the ammeter.

ammeter reading = ... [1]

(v) Calculate the electrical power transferred in the 4.2 Ω resistor.

power = ... [2]

A student investigates the relationship between the diameter of a wire and the electrical resistance of the wire.

Plan an experiment which enables her to investigate how the diameter of a wire affects the resistance of the wire.

Resistance R is calculated from the equation $R = \frac{V}{I}$

where V is the potential difference (p.d.) across the wire and I is the current in the wire.

The apparatus available includes wires of different known diameters.

In your plan:

- list any additional apparatus needed
- complete Fig. 4.1 to show a circuit suitable for measuring the resistance of a wire
- explain briefly how to do the experiment, including the measurements to take so that the resistance can be determined
- state the key variables to keep constant
- draw a table, or tables, with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

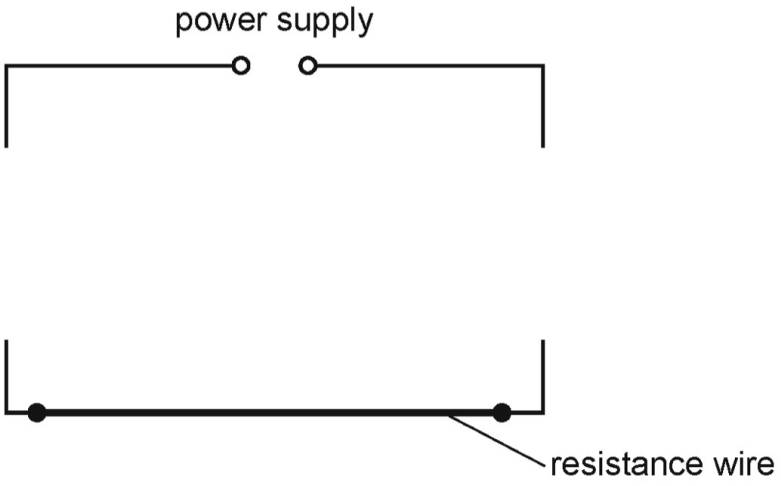

Fig. 4.1

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..... [7]

Q37)

A student investigates the resistance R of a diode using the circuit shown in Fig. 2.1.

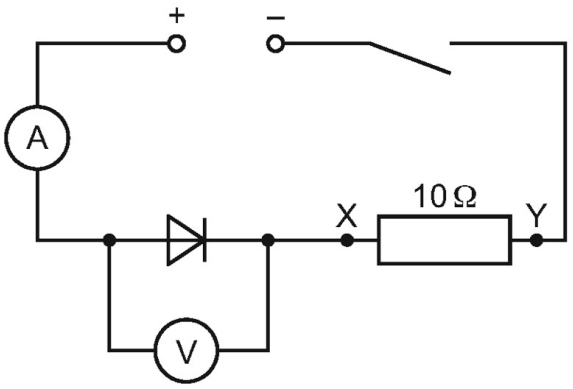

Fig. 2.1

(a) The student:

- closes the switch
- records the voltmeter reading V
- records the ammeter reading I
- opens the switch.

Fig. 2.2 shows the readings on the voltmeter and the ammeter.

Record the readings on the voltmeter and the ammeter in the first row of Table 2.1.

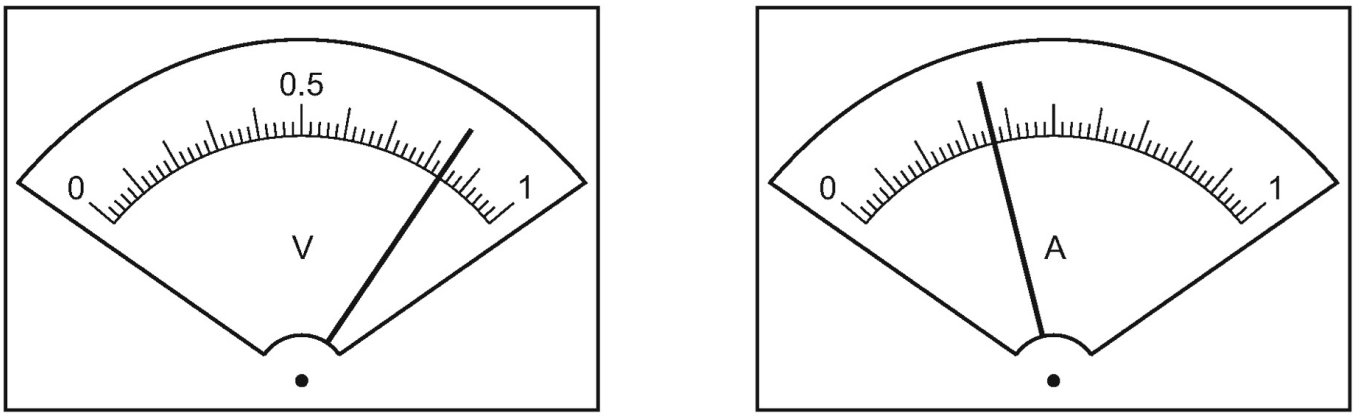

Fig. 2.2

Table 2.1

resistance between X and Y/Ω	V/V	I/A	R/Ω
10			
13	0.83	0.27	
20	0.81		4.5

[2]

(b) Calculate the resistance R of the diode using your meter readings from **(a)**.

Use the equation $R = \frac{V}{I}$.

Record your answer in the first row of Table 2.1 to an appropriate number of significant figures.

[2]

(c) The student:

- connects a 3Ω resistor in series with the 10Ω resistor between terminals X and Y, as shown in Fig. 2.3, and repeats the procedure in **(a)**

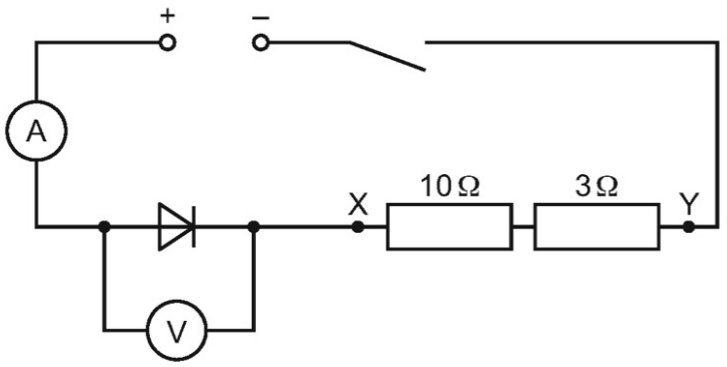

Fig. 2.3

- connects the 7Ω, 10Ω and 3Ω resistors in series between X and Y, as shown in Fig. 2.4, and repeats the procedure in **(a)**.

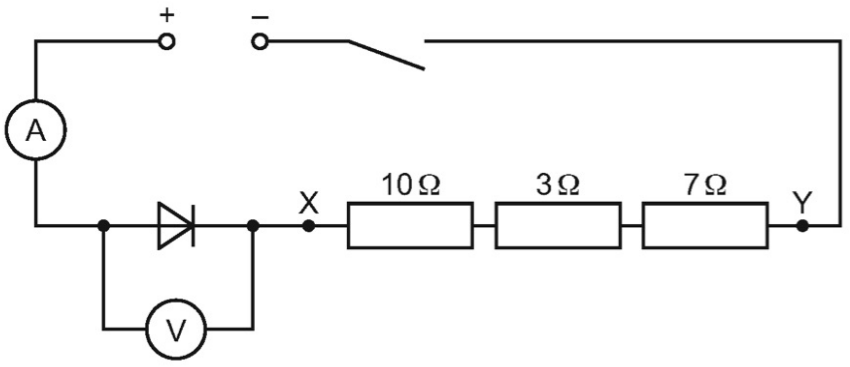

Fig. 2.4

Table 2.1 is incomplete.

Complete Table 2.1 by adding the missing values of R and I. [2]

(d) As the resistance between terminals X and Y is increased, the current in the circuit changes.

Use your results in Table 2.1 to state the relationship between the current in the circuit and:

(i) the potential difference (p.d.) V across the diode

.....

..... [1]

(ii) the resistance R of the diode.

.....

..... [1]

(e) A student attempts to set up the circuit shown in Fig. 2.1. The student finds that the ammeter does **not** give a reading when the circuit is complete. The ammeter is **not** broken.

Suggest what the student may have done incorrectly while setting up the circuit.

..... [1]

(f) Name a single device that can be used to control the current in the circuit instead of adding extra resistors in series.

Draw the electrical symbol for the device.

name of device .....

electrical symbol

[1]

Q38)

A student investigates the brightness of a lamp.

Plan an experiment to investigate how the intensity (brightness) of the light produced by the lamp is affected by the current in the lamp.

The apparatus available includes:

- a lamp and power supply
- a light meter which measures the intensity of light arriving at it
- an ammeter
- a variable resistor.

In your plan, you should:

- complete the circuit diagram in Fig. 4.1 to show the variable resistor connected to control the current in the lamp
- state the key variables to be kept constant
- explain briefly how to do the experiment
- draw a table with column headings, to show how to display the readings (you are **not** required to enter any readings in the table)
- explain how to use the readings to reach a conclusion.

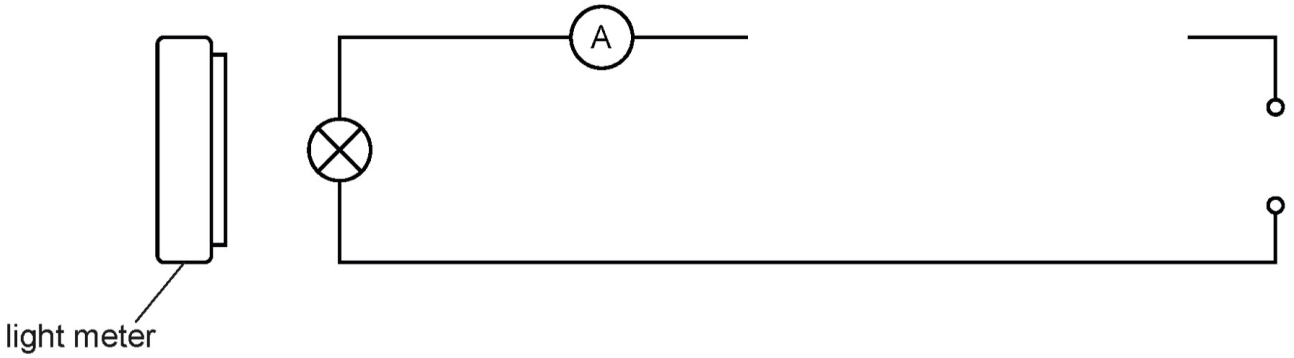

Fig. 4.1

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