Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER | CANDIDATE NUMBER

* 3 4 8 7 0 4 1 4 5 6 *

PHYSICS **5054/22**

Paper 2 Theory **May/June 2014**

1 hour 45 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.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

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.

This document consists of **15** printed pages and **1** blank page.

DC (HB (EL/SW)) 75077/2

CAMBRIDGE International Examinations

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Section A

Answer **all** the questions in this section. Answer in the spaces provided.

1 Fig. 1.1 shows a lorry accelerating in a straight line along a horizontal road.

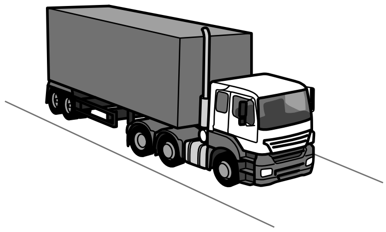

Fig. 1.1

(a) The driving force on the lorry in the forward direction is *D* and the total backward force on the lorry is *B*.

(i) State and explain whether *D* or *B* is the larger force.

....

.... [1]

(ii) Suggest one possible cause of the backward force *B*.

.... [1]

(b) The weight of the lorry is 300 000 N.

The gravitational field strength *g* is 10 N/kg.

(i) Calculate the mass of the lorry.

mass = ... [1]

(ii) The resultant force on the lorry is 15 000 N. Calculate the acceleration of the lorry.

acceleration = ... [2]

(c) Later, the lorry turns a corner at constant speed.

Explain why the lorry accelerates even though the speed is constant.

....

.... [1]

2 Fig. 2.1 shows part of a hydraulic jack used to lift the front of a car.

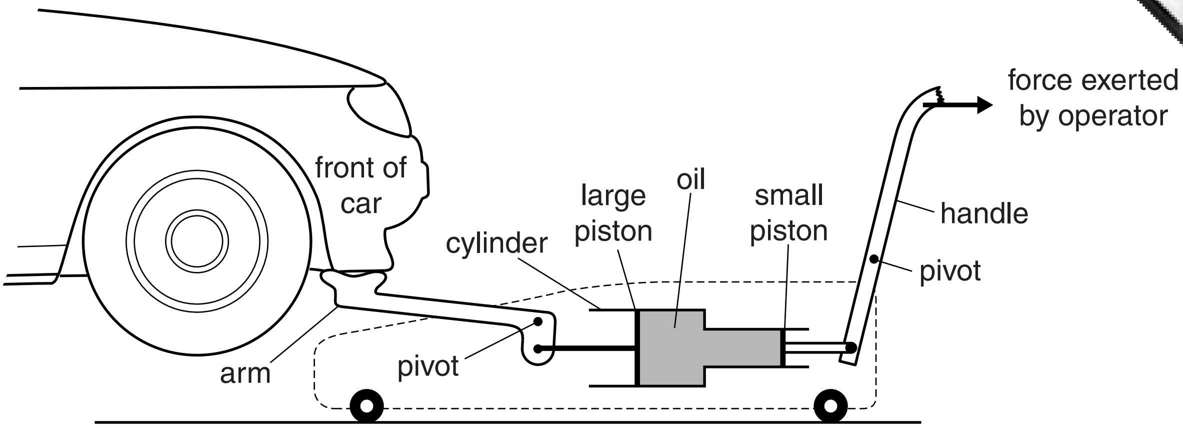

Fig. 2.1 (not to scale)

The operator pulls the handle and causes a force of 50 N to act on the small piston. The force exerted by the oil on the large piston increases by *F*. The large piston moves and rotates the arm about the pivot. This raises the front of the car.

The cross-sectional area of the small piston is 1.5 cm^2.
The cross-sectional area of the large piston is 5.0 cm^2.

(a) Calculate

(i) the pressure in the oil caused by the force on the small piston,

pressure = ... [2]

(ii) the value of *F*.

F = ... [1]

(b) Explain why the large piston moves through a shorter distance than the small piston.

....

....

.... [1]

(c) The efficiency of the jack is 75%. Explain what is meant by *efficiency*.

....

.... [2]

3 Most substances expand when they are heated.

(a) (i) State one example where expansion is useful.

.... [1]

(ii) State one example where expansion causes a problem.

.... [1]

(b) Explain, using ideas about molecules, why solids expand when heated.

....

....

....

....

.... [2]

(c) When equal volumes are heated through the same temperature rise, the expansions of solids, liquids and gases are different.

Complete each of the two sentences using one of these expressions:

much larger **slightly larger** **much smaller** **slightly smaller**

1. The expansion of a solid is .... than the expansion of a liquid.

2. The expansion of a gas is .... than the expansion of a liquid.

[2]

4 Fig. 4.1 shows part of a long rope used by a student to show a transverse wave.

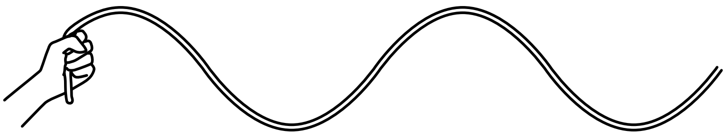

Fig. 4.1

(a) On Fig. 4.1,

(i) mark the direction of movement of the student's hand, [1]

(ii) mark and label the wavelength λ of the wave, [1]

(iii) mark and label the amplitude A of the wave. [1]

(b) Describe how the frequency of the wave is found using a stopwatch.

....

....

....

.... [2]

(c) Using the same rope, the student produces a wave of a longer wavelength than that shown in Fig. 4.1.

State how the student does this.

....

.... [1]

5 Visible light, radio waves, X-rays, gamma rays and microwaves are some of the comp... electromagnetic spectrum.

(a) State two other components of the electromagnetic spectrum.

1. ....

2. ....
[1]

(b) White light is a mixture of different colours.

Fig. 5.1 shows a ray of white light entering a glass prism.

The white light separates into a number of colours. Only the blue light and the red light are shown.

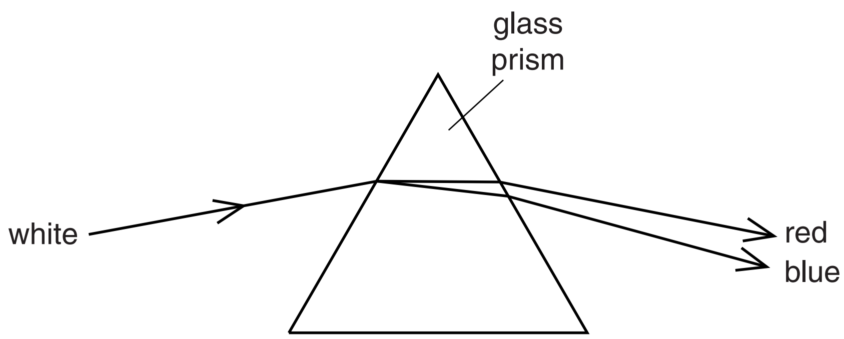

Fig. 5.1

Explain why the blue light and the red light separate as shown.

Use the term *refractive index* in your answer.

....

....

....

....

.... [3]

6 **(a)** A beam of parallel light strikes a converging lens of focal length 2.8 cm.

The width of the beam before it reaches the lens is 1.0 cm. The width changes on the other side of the lens.

State a distance from the lens where the width of the beam is

(i) less than 1.0 cm,

.... [1]

(ii) more than 1.0 cm.

.... [1]

(b) An object is placed 3.0 cm from a converging lens of focal length of 2.8 cm. Fig. 6.1 is an incomplete, full-scale ray diagram for this arrangement.

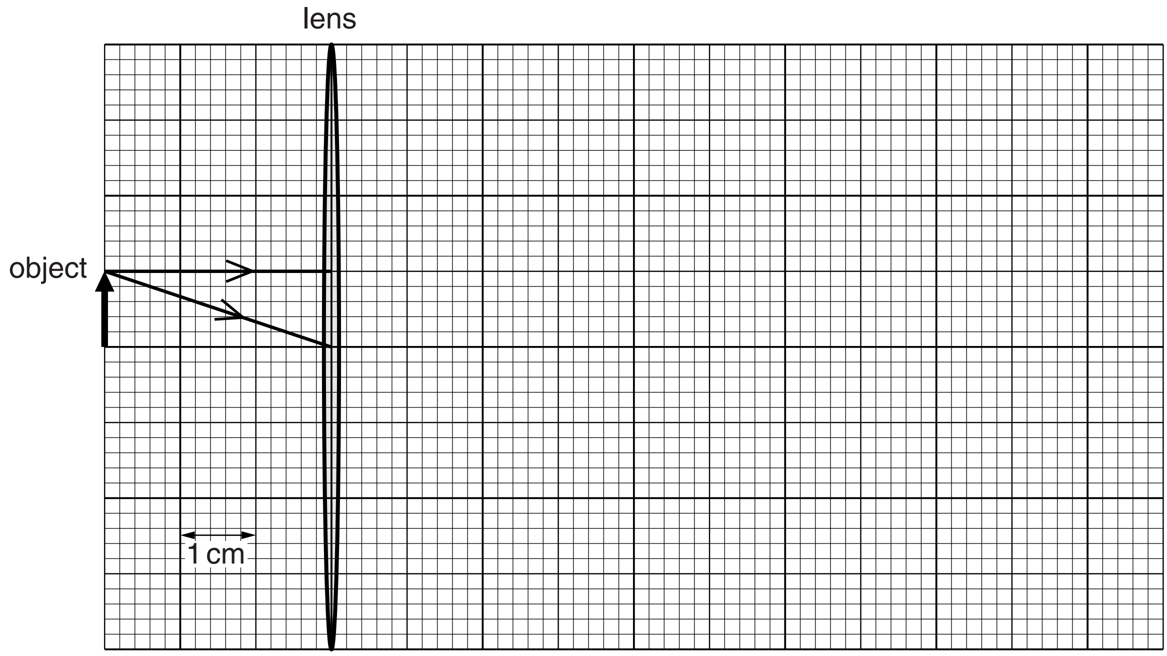

Fig. 6.1 (full scale)

(i) On Fig. 6.1, draw the paths of the two rays after they pass through the lens. [2]

(ii) Explain how your ray diagram shows that the image is more than 11 cm from the lens.

....

.... [1]

(iii) Underline **three** of the following words which describe the image.

diminished inverted magnified real upright virtual [1]

7 Fig. 7.1 shows a compass needle near a bar magnet. Magnetic poles are shown on the compass needle and on the magnet.

A finger stops the compass needle from turning.

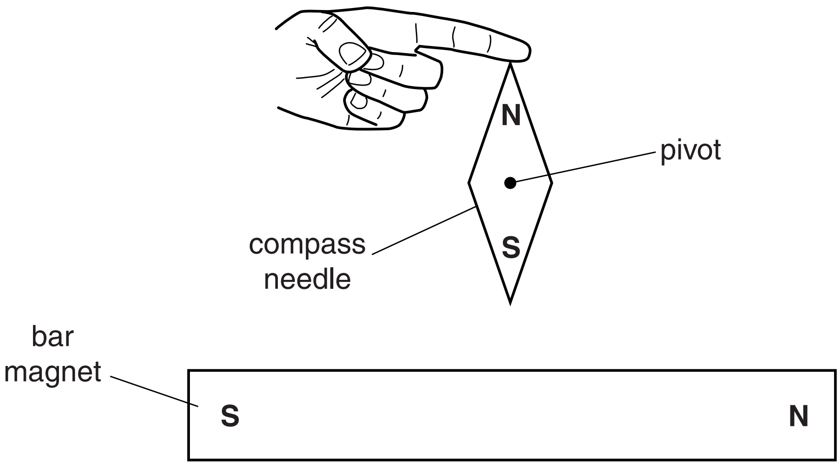

Fig. 7.1 (not to scale)

(a) **(i)** The magnet causes a force on the S-pole of the compass needle.

On Fig. 7.1, draw an arrow from the S-pole of the compass needle to show the direction of this force. [1]

(ii) Explain why the compass needle turns when the finger is removed.

....

.... [1]

(b) A small compass is used to plot the magnetic field lines of the magnet.

Describe how the compass is used to plot magnetic field lines on a piece of paper.

....

....

....

....

.... [3]

8 **(a)** An atom consists of electrons surrounding a nucleus made up of protons and ne

State which of these particles

(i) have an equal and opposite charge,

.... [1]

(ii) have almost equal mass.

.... [1]

(b) The nuclide notation for carbon-14 is $^{14}_{6}C$. Carbon-14 decays by beta emission to a stable isotope of nitrogen (N).

(i) Write numbers in the empty boxes below to show the nuclide notation for this isotope of nitrogen.

$$^{14}_{6}C \rightarrow {}^{\square}_{\square}N + \beta$$

[2]

(ii) The half-life of carbon-14 is 5700 years.

A sample of wood from a living tree contains 2.4×10^{12} atoms of carbon-14.

A similar sample of the same size is taken from an old piece of wood. It contains 6.0×10^{11} atoms of carbon-14.

Calculate the age of the old piece of wood.

age = ... [2]

Section B

Answer **two** questions from this section. Answer in the spaces provided.

9 A children's ride consists of a steel cable that runs between two posts of different heights, as shown in Fig. 9.1.

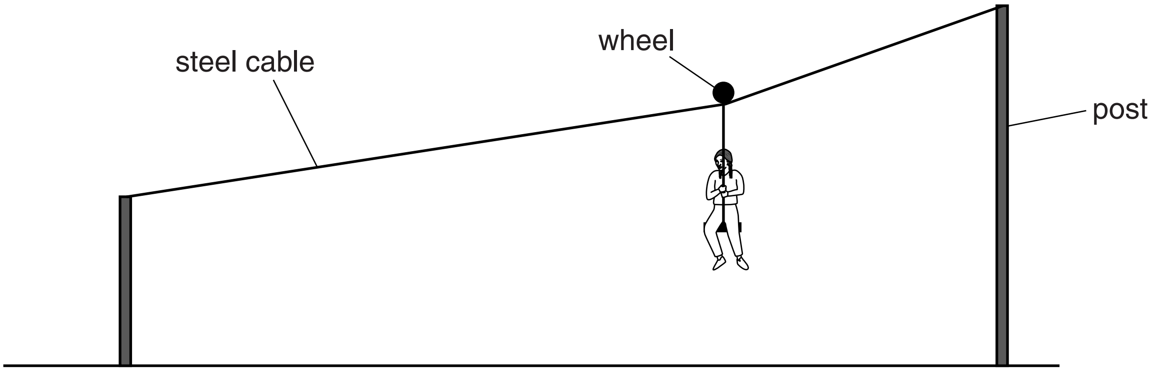

Fig. 9.1

A girl starts and finishes the ride at rest. Her horizontal motion can be taken as

- an initial uniform acceleration for 3.0 s, followed by
- a constant speed of 2.4 m/s for a further 5.0 s and
- a final uniform deceleration that lasts for 1.0 s.

(a) On Fig. 9.2, draw a speed-time graph of the horizontal motion.

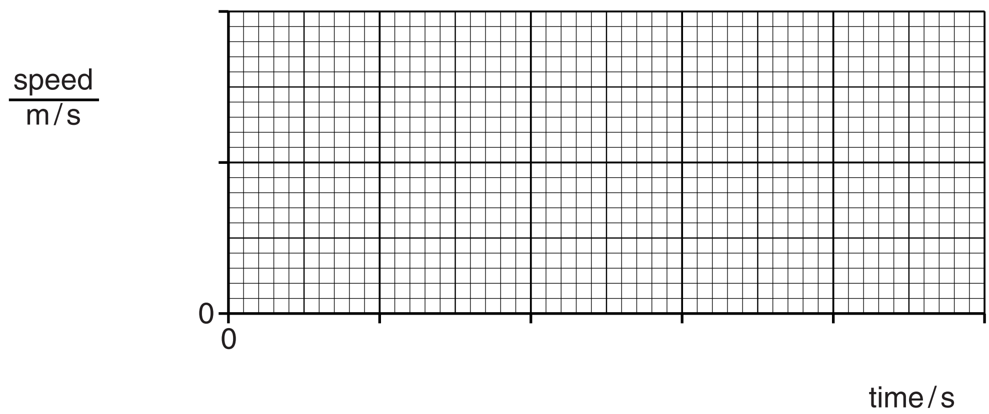

Fig. 9.2 [3]

(b) Explain what is meant by *uniform acceleration*.

....

....

.... [2]

(c) The final deceleration is larger in size than the initial acceleration.

Explain how the data shows this.

....

.... [1]

(d) Calculate the horizontal distance travelled by the girl in the first 8.0 s.

distance = ... [3]

(e) **(i)** The girl has a mass of 30 kg and falls a vertical distance of 1.6 m during the ride.

The gravitational field strength *g* is 10 N / kg.

Calculate the decrease in gravitational potential energy of the girl.

decrease in potential energy = ... [2]

(ii) The gain in kinetic energy of the girl is less than the decrease in her potential energy. Suggest one reason for this.

....

.... [1]

(f) A group of pupils make measurements to show that the girl's speed is constant during the middle section of the ride.

Suggest what measurements are made and how they show that the speed is constant.

....

....

....

....

....

.... [3]

10 Two metal saucepans contain the same mass of hot water at the same initial tempera
Pan A is white and pan B is black, but otherwise the two saucepans are identical.
Both saucepans are uncovered and cool under the same conditions.
The cooling curves for the two saucepans are shown in Fig. 10.1.

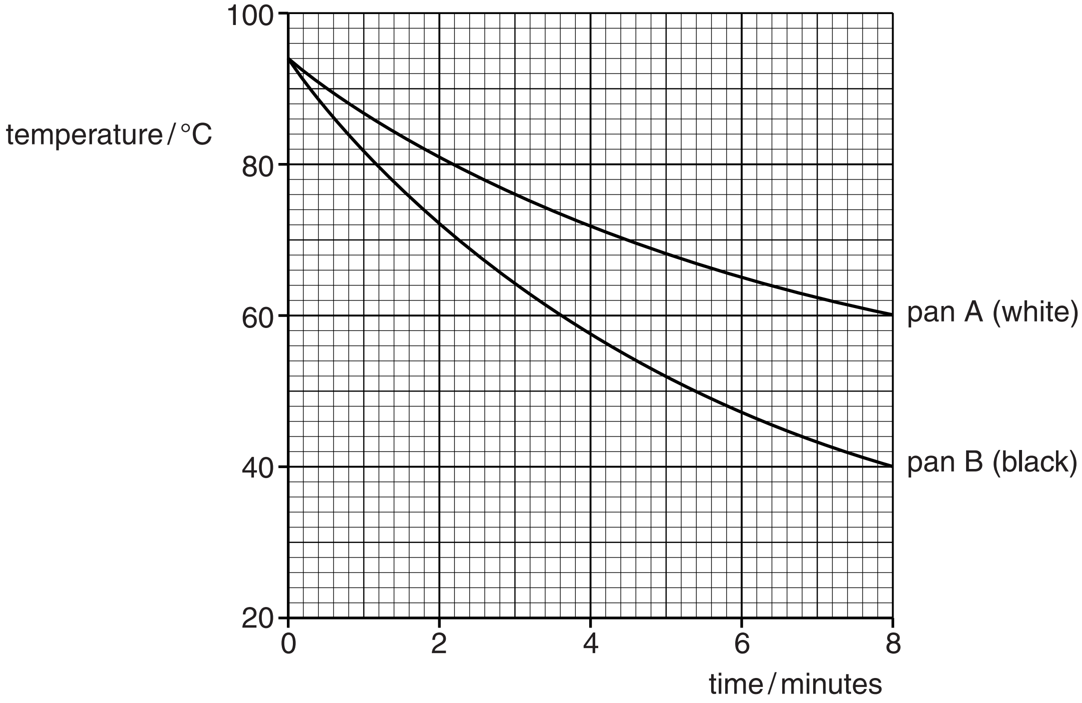

Fig. 10.1

(a) Describe how the water in a pan loses heat by

(i) conduction,

....

....

.... [2]

(ii) convection.

....

....

.... [2]

(b) (i) Explain why pan B cools faster than pan A.

....

.... [1]

(ii) Describe and explain how Fig. 10.1 is different when the pans are covered and the experiment is repeated.

....

....

.... [2]

(c) The specific heat capacity of water is 4200 J / (kg °C).

(i) Explain what is meant by *specific heat capacity*.

....

....

.... [2]

(ii) The specific heat capacity of water is very high. Suggest one disadvantage of this when water is used for cooking.

....

.... [1]

(iii) The water in pan A cools for 8 minutes, as shown in Fig. 10.1. During this time, the water loses an average of 9000 J of thermal energy per minute.

1. Calculate the mass of water in pan A.

mass = ... [3]

2. The mass of water in pan B is the same as that in pan A.

Calculate the thermal energy lost from the water in pan B during the 8 minutes.

loss of thermal energy = ... [2]

11 A student sets up the circuit shown in Fig. 11.1.

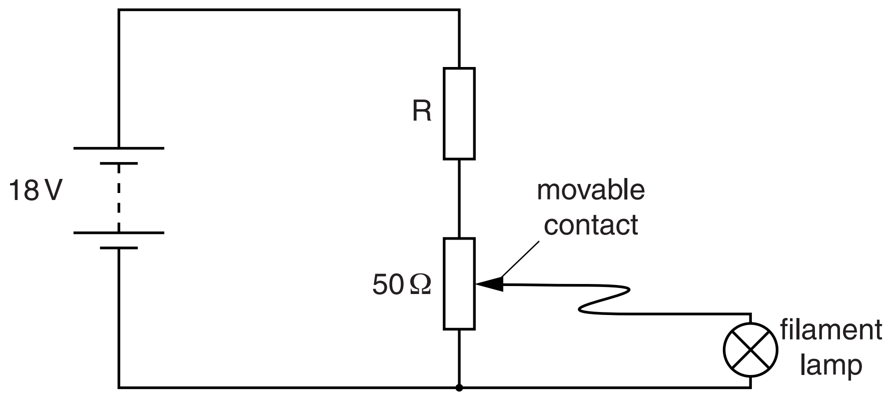

Fig. 11.1

R is a fixed resistor in the circuit. The filament lamp is marked 12 V, 0.25 A.

The circuit is used to produce a current/voltage graph for the filament lamp. The ammeter and voltmeter needed are not shown.

To obtain different readings, the student changes the position of the movable contact.

(a) On Fig. 11.1, draw the symbols for an ammeter and a voltmeter in the correct positions. [3]

(b) Explain why it is sensible to include the resistor R in this circuit.

....

....

.... [2]

(c) **(i)** On Fig. 11.2, sketch a current/voltage graph for the lamp.

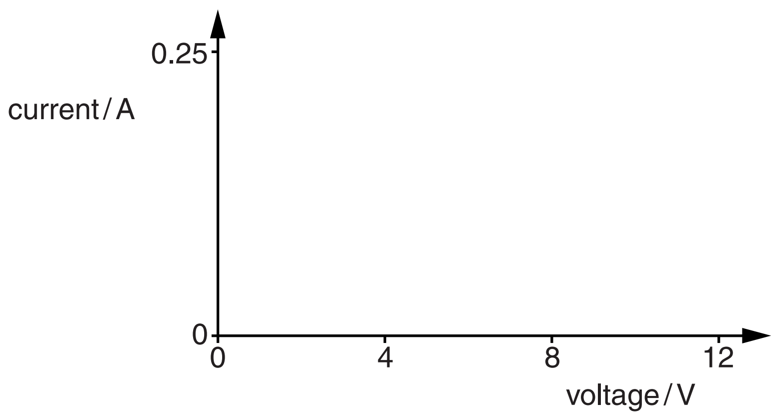

Fig. 11.2 [3]

(ii) State and explain how a current/voltage graph for a fixed resistor is diffe[illegible]e graph for a filament lamp.

....

....

.... [2]

(d) Fig. 11.3 shows the position of the movable contact when the voltage across the lamp is 12 V and the current in the lamp is 0.25 A.

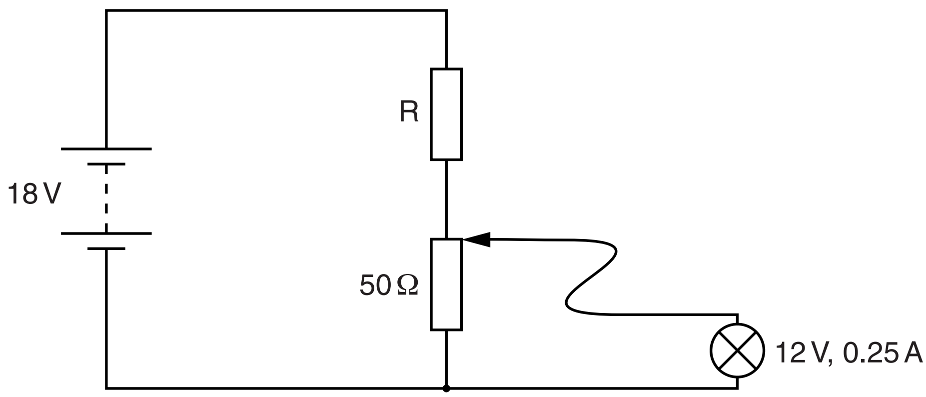

Fig. 11.3

Determine

(i) the current in the 50 Ω resistor,

current = ... [2]

(ii) the current in R,

current = ... [1]

(iii) the potential difference (p.d.) across R,

p.d. = ... [1]

(iv) the resistance of R.

resistance = ... [1]

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