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10: Atomic physics – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
12	2016	June	31
12	2016	March	32
12	2016	November	31

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

12 Two radioactive sources are used by a teacher. One source emits only alpha particles and the other source emits only beta particles.

(a) Suggest how the sources can be identified.

....

....

....

....

....[2]

(b) The teacher also has a source that emits gamma rays.

State **two** ways in which gamma rays are different from alpha particles.

1. ....

2. ....

[2]

(c) State an effect of ionising radiation on living things.

....[1]

[Total: 5]

12 Three types of ionising radiation are alpha, beta and gamma.

(a) Draw **one** straight line from each type of radiation to a property of that radiation.

type of radiation	property of radiation
	has a negative charge
alpha α	has a long half-life
beta β	is stopped by paper
gamma γ	is electromagnetic radiation

[3]

(b) Polonium-210 has the nuclide notation $^{210}_{84}Po$.

For one neutral atom of polonium-210,

(i) determine the number of protons, ...[1]

(ii) determine the number of neutrons. ....[1]

(c) Fig. 12.1 shows a decay curve for polonium-210.

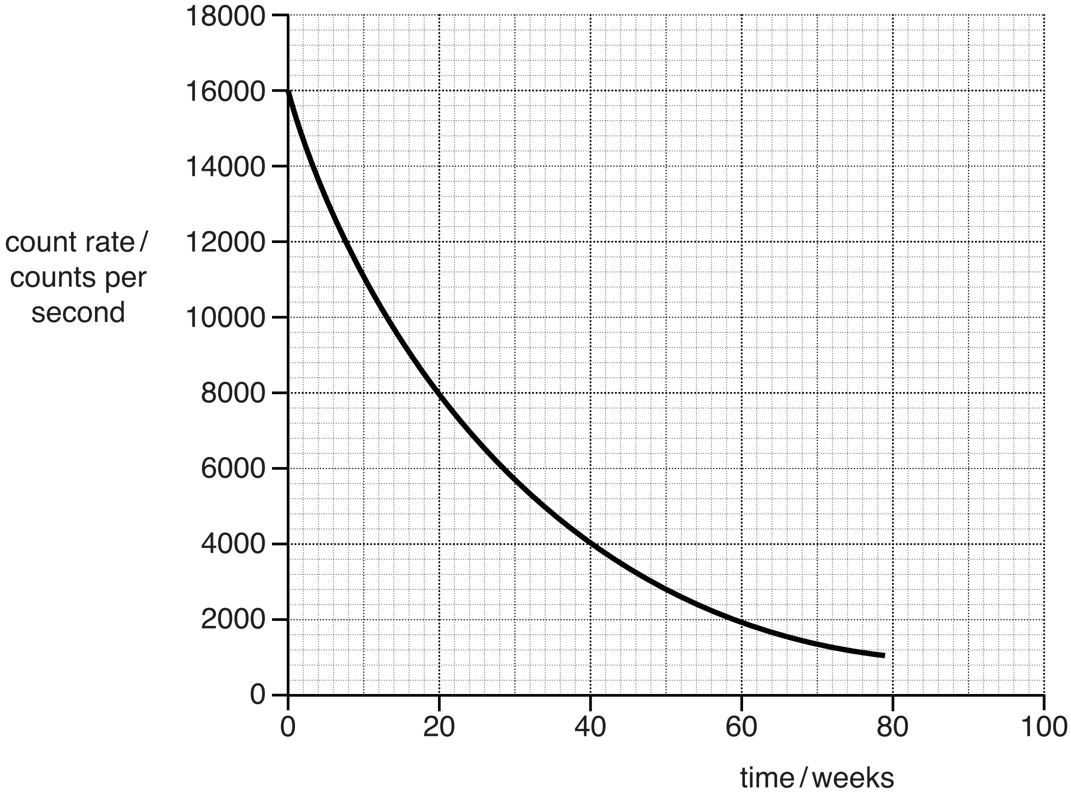

Fig. 12.1

Use the graph to determine the half-life of polonium-210.

half-life = ... weeks [2]

[Total: 7]

12 Caesium-137 is formed in nuclear reactors.

The nucleus of caesium-137 can be represented as

$$^{137}_{55}\mathrm{Cs}$$

(a) Complete Table 12.1 by stating the two types of particle in a nucleus of caesium-137, and the number of each particle present.

Table 12.1

type of particle	number of particles

[4]

(b) Caesium has more than one isotope.

Explain what is meant by the term *isotope*.

....

....

....[2]

[Total: 6]

Question	Answer	Mark
12 (a)	idea of paper between source and detector **OR** measuring range (in air) **OR** pass through an electric or magnetic field alpha stopped by paper **OR** larger range in air for beta **OR** identify deflection when in field	B1 B1
12 (b)	any two from: gamma travel at the speed of light gamma rays have no charge gamma rays have no mass gamma is a wave OR part of the electromagnetic spectrum gamma less ionising greater penetration not deflected by electric or magnetic fields	B2
12 (c)	damages cells / tissues / DNA **OR** causes (cell) mutations **OR** radiation sickness	B1
		Total: 5
12 (a)	line from alpha to stopped by paper line from beta to negative charge line from gamma to e.m. radiation	B1 B1 B1
12 (b) (i)	84	B1
12 (b) (ii)	126	B1
12 (c)	evidence of line from 8000 or idea of halving e.g. 8000 and 4000 20 ± 1.0 (weeks)	C1 A1
		Total: 7
12 (a)	(type of particle) / (number of particles) PROTON / 52 NEUTRON / 82	B2 B2
12 (b)	(nucleus has) same number of protons different number of neutrons	B1 B1
		Total: 6

Notes about the mark scheme are available separately.

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2: Electricity 1 – Topic questions Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
10	2016	June	31
11	2016	March	32
8	2016	November	31

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10 A student makes the circuit shown in Fig. 10.1 using a 12V battery.

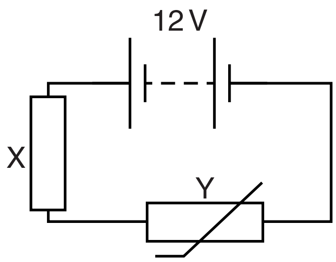

Fig. 10.1

(a) Complete the sentences about the circuit. Use words from the box.

fixed resistor	lamp	light-dependent resistor	parallel	series	thermistor

(i) Components X and Y are connected in ....[1]

(ii) The component Y is a ....[1]

(b) Fig. 10.2 shows how the resistance of Y varies with temperature.

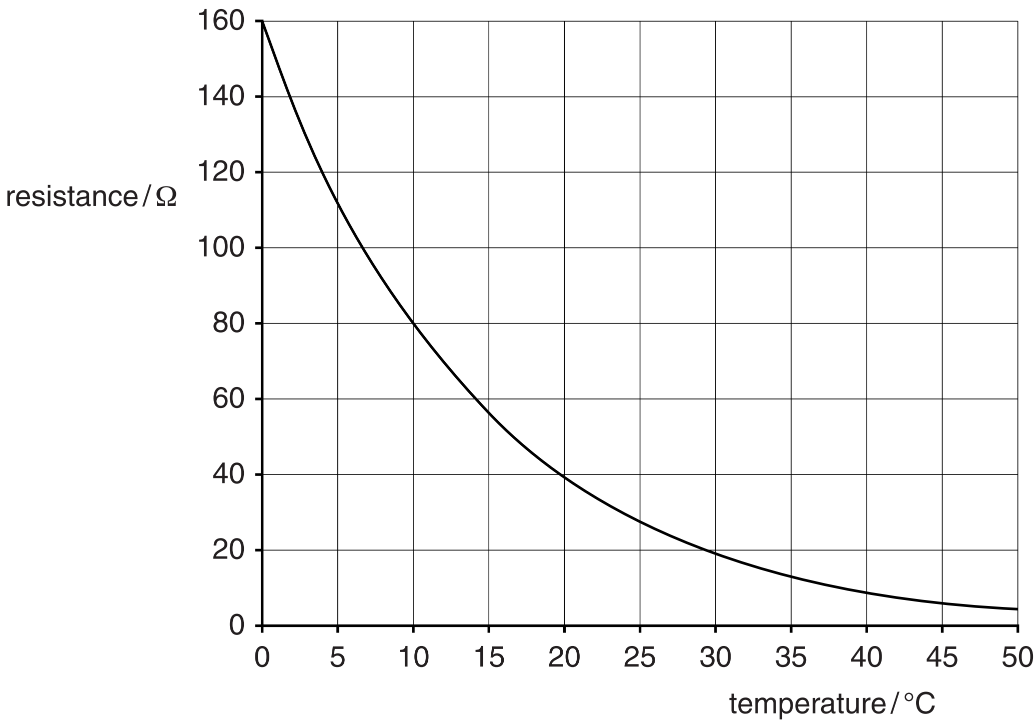

Fig. 10.2

(i) Describe how the resistance of Y varies with temperature.

....

....

....[2]

(ii) The temperature of Y is 10 °C. The resistance of X is 20 Ω.

Calculate the combined resistance of Y and X.

resistance = ... Ω [3]

(iii) Calculate the current in the circuit.

current = ... A [3]

[Total: 10]

11 **(a)** A student changes the current in a filament lamp. She measures the current and the potential difference (p.d.) across the lamp.

Fig. 11.1 is an incomplete circuit diagram.

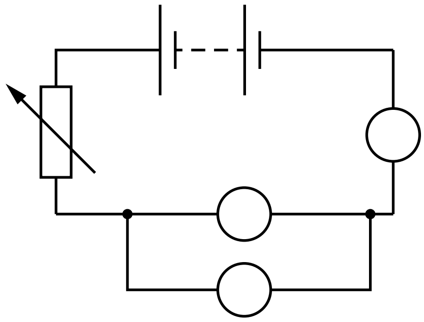

Fig. 11.1

(i) On Fig. 11.1, complete the unfinished circuit symbols. [3]

(ii) One pair of readings for the lamp is shown in the table.

p.d./V	current/A
6.0	1.2

Calculate the resistance of the filament in the lamp for these readings.

resistance of filament = ... Ω [3]

(iii) After many hours of use, the filament wire in a lamp becomes thinner.

State the effect, if any, on the resistance of the lamp.

....[1]

(b)(i) Complete the circuit in Fig. 11.2 to show a battery connected to three lamps arranged in parallel.

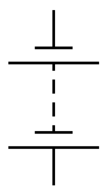

Fig. 11.2

[2]

(ii) Describe **two** advantages of connecting these lamps in parallel with the battery.

....

....[2]

[Total: 11]

8 A student measures the resistance of a sample of wire.

She plans to use the circuit shown in Fig. 8.1.

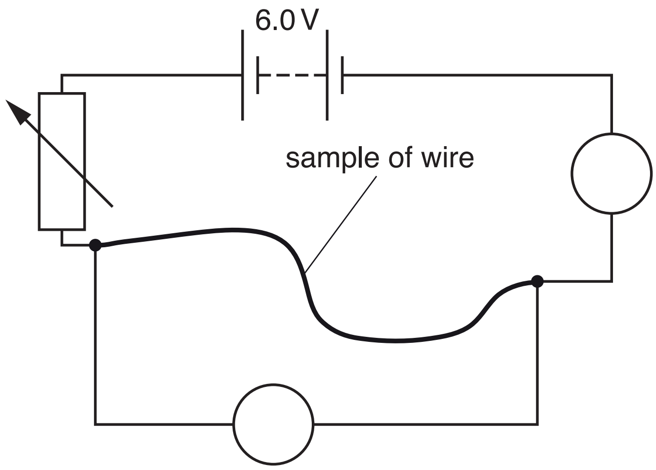

Fig. 8.1

Two circuit symbols are incomplete.

(a) Complete the symbols for the two meters on Fig. 8.1. [2]

(b) The current in the wire is 0.20 A. The potential difference across the wire is 6.0 V.

Calculate the resistance of the wire.

resistance = ... Ω [3]

(c) The student tests a thinner wire. It is the same length as the wire in **(b)** and is made of the same material. The potential difference across the wire is 6.0 V.

Explain how the current in this thinner wire compares with that in the first wire.

....

....

....[2]

[Total: 7]

Question	Answer	Mark
10 (a) (i)	<u>series</u>	B1
10 (a) (ii)	<u>thermistor</u>	B1
10 (b) (i)	resistance decreases as temp increases B1 at decreasing rate OR not proportional OR not linear	B1 B1
10 (b) (ii)	resistance of Y = 80 Ω Rt = R1 + R2 in any form 100(Ω)	C1 C1 A1
10 (b) (iii)	V = *I R* in any form 12 ÷ 100 **OR** 12 ÷ candidates **(b)(ii)** 0.12 (A) **OR** ECF from **(b)(ii)**	C1 C1 A1
		Total: 10
11 (a) (i)	ammeter correct symbol in series with lamp voltmeter correct symbol in parallel with lamp lamp correct symbol	B1 B1 B1
11 (a) (ii)	R = V / *I* in any form 6 ÷ 1.2 5 (Ω)	C1 C1 A1
11 (a) (iii)	(resistance) increases	B1
11 (b) (i)	3 lamp symbols drawn (lamps connected) in parallel with battery	B1 B1
11 (b) (ii)	any two from: • lamps all have 6 V or full voltage (across them) • if one (lamp) breaks, others continue to operate / little / no effect on others • lamps can be switched on and off independently	B2
		Total: 11
8 (a)	A in circle in series with wire V in circle in parallel with wire	B1 B1
8 (b)	V = I R **OR** (R =) *V* / I 6.0 / 0.2 30 (Ω)	C1 C1 A1
8 (c)	current is smaller (in 2nd wire) (as) resistance is greater (in 2nd wire)	B1 B1
		Total: 7

Notes about the mark scheme are available separately.

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6: Electricity 2 – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
5	2016	June	32
11	2016	March	32
8	2016	November	33

The mark scheme for each question is provided at the end of the document.

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5 Fig. 5.1 shows two circuits, A and B.

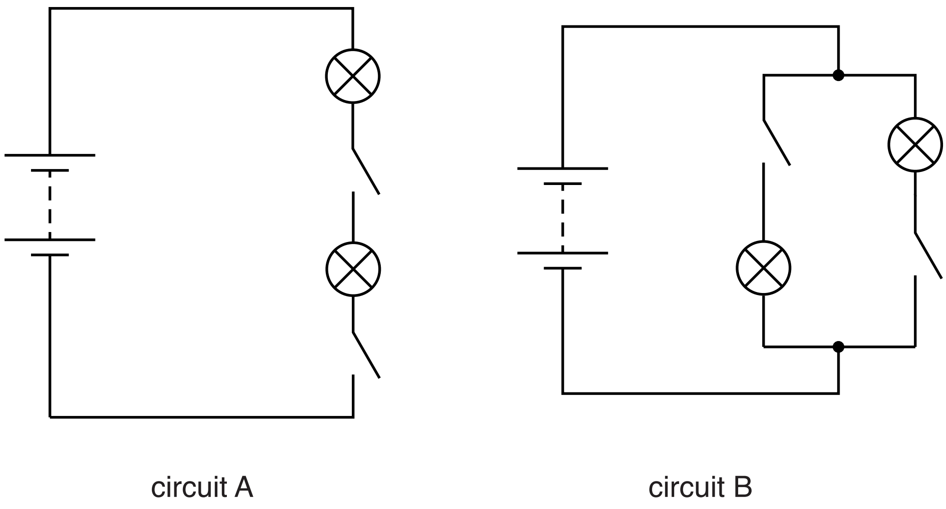

Fig. 5.1

Both circuits contain a 6V power supply and two 6V lamps.

(a) State **two** advantages of circuit B compared to circuit A.

....

....

....

.... [2]

(b) Fig. 5.2 shows the energy input and outputs, in one second, for one electric lamp.

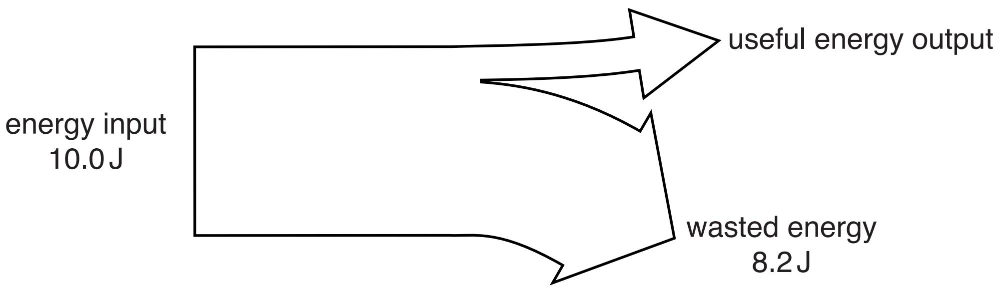

Fig. 5.2

(i) Calculate the useful energy output, in one second, of the lamp.

useful energy output = ... J [1]

(ii) In the space below draw a labelled diagram, similar to Fig. 5.2, for a more efficient lamp.

[1]

(c) Electricity can be generated using wind turbines.

Fig. 5.3 shows two wind turbines.

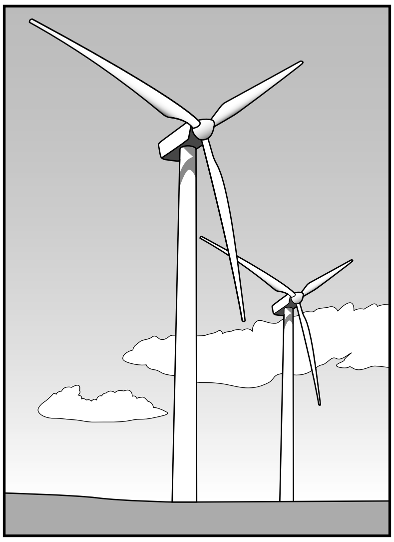

Fig. 5.3

State **two** advantages and **two** disadvantages of using wind turbines, rather than fossil fuels, to generate electricity.

advantages ....

....

....

....

disadvantages ....

....

....

....

[4]

[Total: 8]

11 (a) A student changes the current in a filament lamp. She measures the current and the potential difference (p.d.) across the lamp.

Fig. 11.1 is an incomplete circuit diagram.

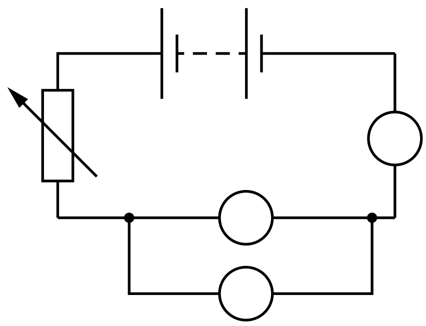

Fig. 11.1

(i) On Fig. 11.1, complete the unfinished circuit symbols. [3]

(ii) One pair of readings for the lamp is shown in the table.

p.d./V	current/A
6.0	1.2

Calculate the resistance of the filament in the lamp for these readings.

resistance of filament = ... Ω [3]

(iii) After many hours of use, the filament wire in a lamp becomes thinner.

State the effect, if any, on the resistance of the lamp.

....[1]

(b)(i) Complete the circuit in Fig. 11.2 to show a battery connected to three lamps arranged in parallel.

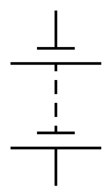

Fig. 11.2

[2]

(ii) Describe **two** advantages of connecting these lamps in parallel with the battery.

....

....[2]

[Total: 11]

8 Fig. 8.1 shows two uncharged (neutral) plastic spheres. Each sphere is suspended by an insulating thread.

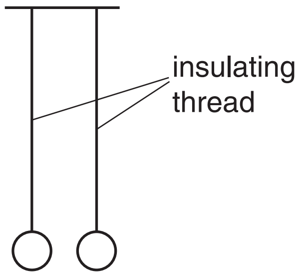

Fig. 8.1

(a) Suggest a material for the insulating threads.

.... [1]

(b) The spheres can be given a charge.

Three different experiments are carried out using the arrangements shown in Fig. 8.2.

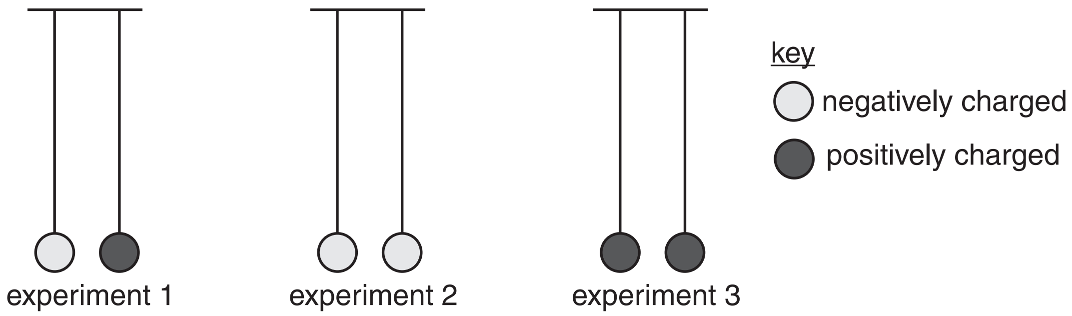

Fig. 8.2

For each experiment, describe the force, if any, between the spheres.

experiment 1 ....

experiment 2 ....

experiment 3 ....
[3]

(c) State and explain how one of the plastic spheres can be given a positive charge.

....

....

.... [2]

[Total: 6]

Question	Answer	Mark
5 (a)	any **two** from: lamps all have 6 V or full voltage (across them) OR lamps are brighter if one (lamp) breaks, little / no effect on other lamps can be switched on and off independently	B2
5 (b) (i)	10 – 8.2 OR 1.8 (J)	B1
5 (b) (ii)	diagram indicating smaller proportion of energy wasted (e.g. greater useful energy output OR smaller wasted energy output OR smaller energy input for same output)	B1
5 (c)	any **two** advantages from: • renewable (energy source) • does not contribute to global warming • does not contribute to atmospheric pollution • conserves fossil fuel reserves any **two** disadvantages from: • not a reliable supply of electricity • large area of land needed (for a wind farm) • unsightly • threat to birds • large number needed to replace one power station • infrastructure more expensive (per MW) than fossil fuel power stations • needs a suitable (windy) location	B2 B2
		Total: 8
11 (a) (i)	ammeter correct symbol in series with lamp voltmeter correct symbol in parallel with lamp lamp correct symbol	B1 B1 B1
11 (a) (ii)	R = *V* / *I* in any form C1 6 ÷ 1.2 C1 5 (Ω)	C1 C1 A1
11 (a) (iii)	(resistance) increases	B1
11 (b) (i)	3 lamp symbols drawn (lamps connected) in parallel with battery	B1 B1
11 (b) (ii)	any two from: • lamps all have 6 V or full voltage (across them) • if one (lamp) breaks, others continue to operate / little / no effect on others • lamps can be switched on and off independently	B2
		Total: 11

Question	Answer	Mark
8 (a)	any named insulator, e.g. cotton, string etc.	B1
8 (b)	1 = attract 2 = repel 3 = repel	B1 B1 B1
8 (c)	(sphere) is rubbed with a cloth electrons move off (sphere) owtte	B1 B1
		Total: 6

Notes about the mark scheme are available separately.

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5: Electromagnetism – Topic questions Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
11	2016	June	31
10	2016	March	32
9	2016	November	31

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11 (a) Put a ring around the names of the metals which are attracted to magnets.

aluminium copper iron mercury magnesium steel tin

[2]

(b) Fig. 11.1 and Fig. 11.2 show magnetic field patterns for bar magnets.

On each diagram, correctly label the poles. Write **N** or **S**.

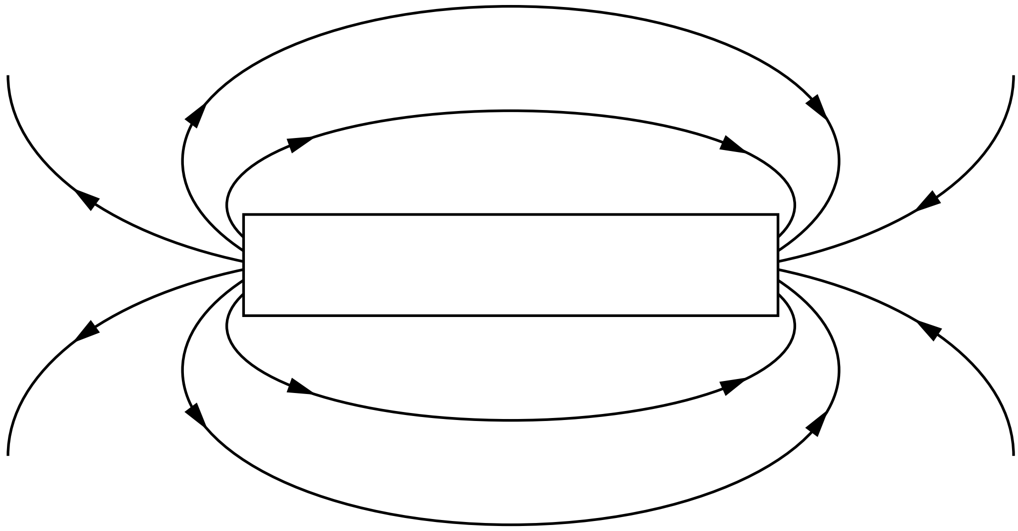


Fig. 11.1

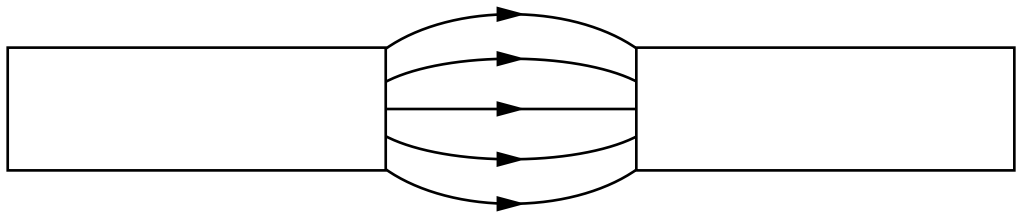
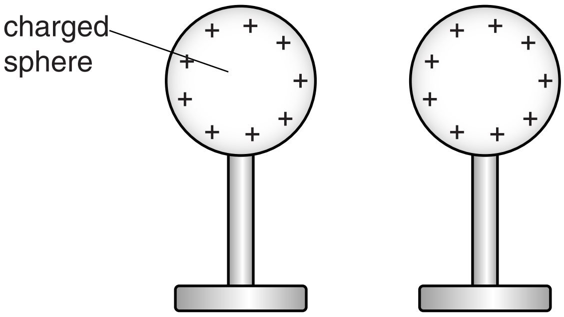


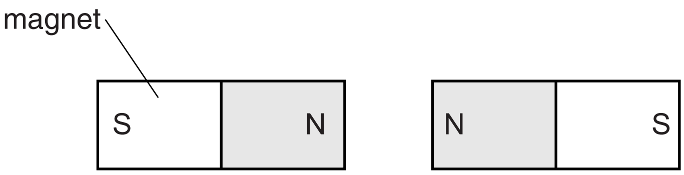
Fig. 11.2

[2]

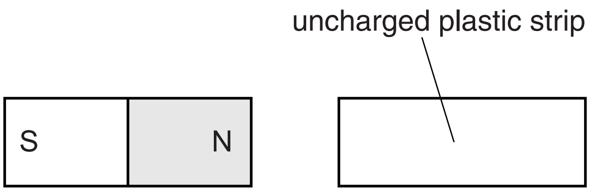
(c) For each diagram in Fig. 11.3, describe the force acting, if any. Use the words *attraction*, *repulsion*, or *no force*.



....



....



....

Fig. 11.3

[3]

[Total: 7]

10 A student uses a bar magnet to distinguish between an unlabelled magnet and an iron

bar.

(a) Describe how the student identifies which is the magnet and which is the iron bar.

....

....

....

....[2]

(b) The student suspends the iron bar near to a coil, as shown in Fig. 10.1. The iron bar is free to move.

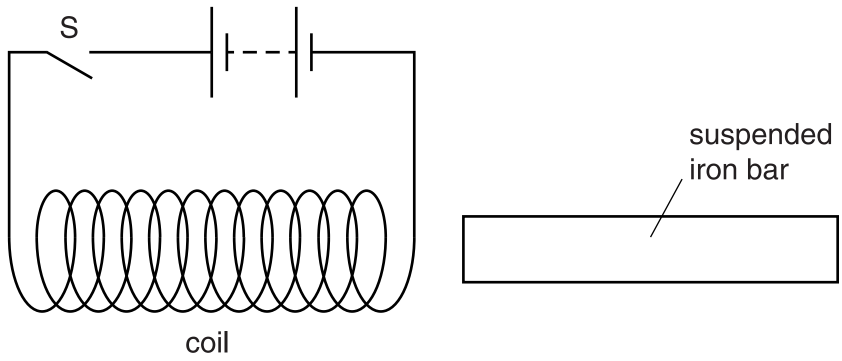


Fig. 10.1

Describe and explain what happens when the switch S is closed.

....

....

....

....

....

....[3]

(c) Fig. 10.2 shows a wire passing through a piece of card.

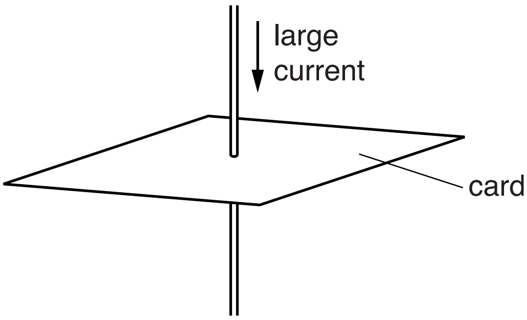


Fig. 10.2

There is a current in the wire in the direction of the arrow.

On Fig. 10.3, draw the pattern of the magnetic field lines due to the current in the wire. Include the direction of the field. [3]

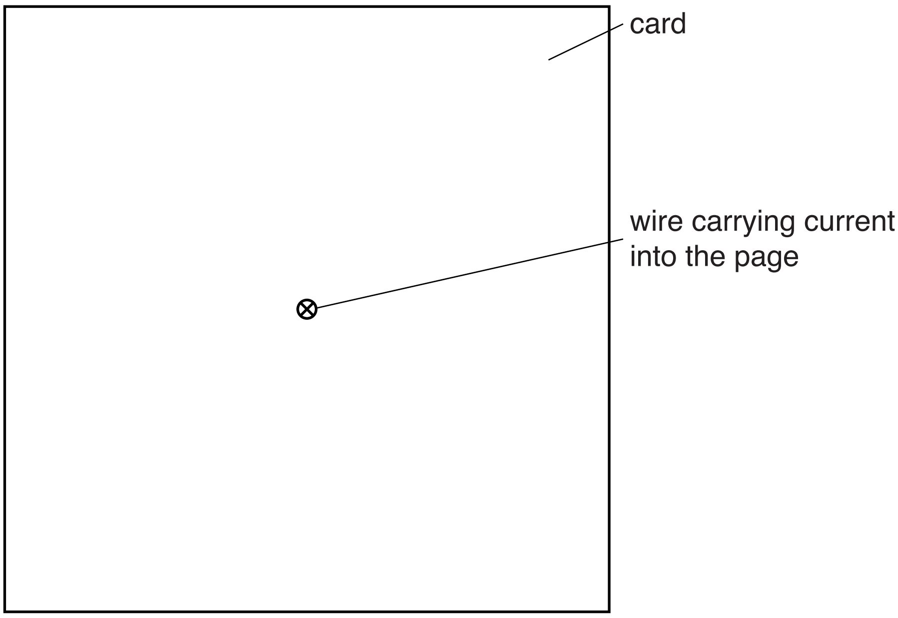


Fig. 10.3

[Total: 8]

9 The charger for a mobile phone contains a transformer. Fig. 9.1 shows a simple transformer.

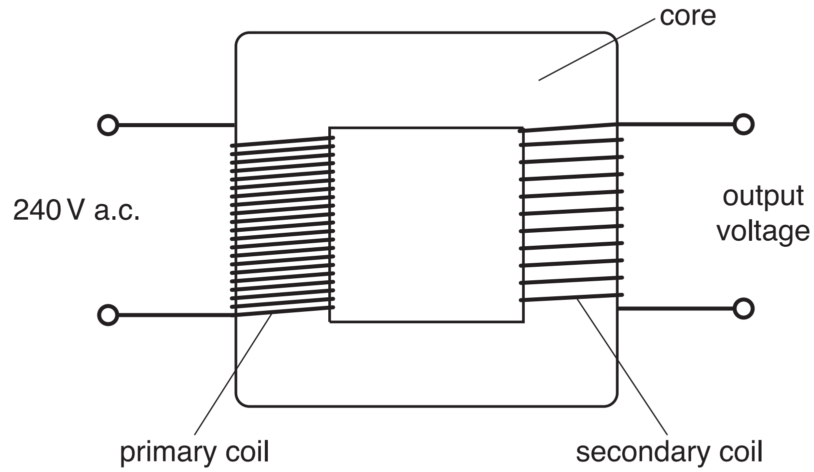


Fig. 9.1

(a) State the name of the material used in the core.

....[1]

(b) **(i)** The transformer has 36 000 turns on the primary coil and 900 turns on the secondary coil. The input voltage is 240 V.

Calculate the output voltage.

output voltage = ... V [3]

(ii) State whether this transformer is *step-up* or *step-down*. Give a reason for your answer.

....

....[1]

(c) Transformers can produce high voltages for transmitting electricity from power stations to towns.

Describe the advantages of transmitting electricity at a high voltage.

....

....

....[2]

[Total: 7]

Question	Answer	Mark
11 (a)	iron, steel	B2
11 (b)	N and S correctly labelled on Fig. 11.1 N and S correctly labelled on Fig. 11.2	B1 B1
11 (c) (i)	repulsion	B1
11 (c) (ii)	repulsion	B1
11 (c) (iii)	<u>No force</u>	B1
		Total: 7
10 (a)	(bar) magnet is brought close to both ends (of one of unknown bars) **either** If both ends attract it is an iron bar **or** If one end repels it is a magnet	B1 B1
10 (b)	iron bar moves toward coil any two from: • current in coil • coil becomes an electromagnet • soft iron attracted to coil • iron bar becomes (an induced) magnet (with opposite pole nearest coil)	B1 B2
10 (c)	at least one circle centred on wire (by eye) two or more circles centred on wire (by eye) arrow showing clockwise direction on at least one circle	M1 B1 B1
		Total: 8
9 (a)	(laminated) iron	B1
9 (a) (ii)	(Vp / Vs) = (Np / Ns) in any form 240 / Vs = 36 000 / 900 or Vs = 240 / 40 6.0 (V)	C1 C1 A1
9 (b) (ii)	step-down (transformer because) there are fewer turns on secondary (compared to primary coil) OR the output voltage is smaller than the input voltage	B1
9 (c)	Any 2 from: • less energy or power wasted or less heating or more efficient • accept lower current • can use thinner (transmission) wires or cables • fewer power stations needed • (so) lower cost for cable and supporting pylons • transmit (electricity over) longer distances (without drop in power)	B2
		Total: 7

Notes about the mark scheme are available separately.

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11: Electronics – Topic questions Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
9	2015	June	21
12	2015	June	22
9	2015	November	21

The mark scheme for each question is provided at the end of the document.

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9 In cold weather, houses are often heated with an electrical heater.

Fig. 9.1 shows a simplified electrical circuit for a household heater.

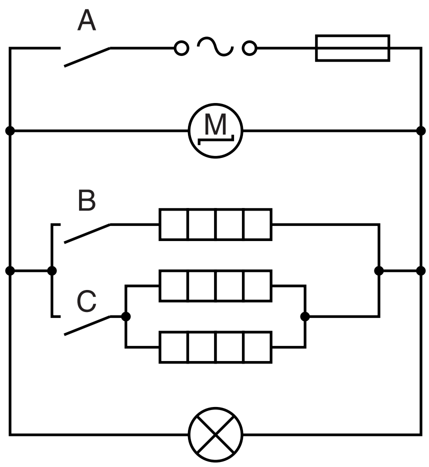


Fig. 9.1

(a) What does the symbol  represent?

.... [1]

(b) The heater has three identical heating elements, a fan driven by a motor and a lamp.

Name the components that are working when switch A only is closed.

.... [1]

(c) The heater has two switches, B and C, to give high, medium and low heat settings.

Identify how each heat setting is obtained. Complete the table by adding ticks to represent a closed switch.

heater settings	switch B	switch C
high		
medium		
low		

[3]

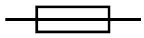
(d) Write down the equation that relates resistance, potential difference (p.d.) and current.

.... [1]

(e) The current in one of the heating elements is 5.0 A. The resistance of the heating element is 50 Ω.

Calculate the p.d. across the heating element. Include the appropriate unit.

p.d. = ... [2]

(f) Explain how the component with the symbol  protects the circuit.

....

....

....

.... [2]

[Total: 10]

12 A student sets up the circuit shown in Fig. 12.1.

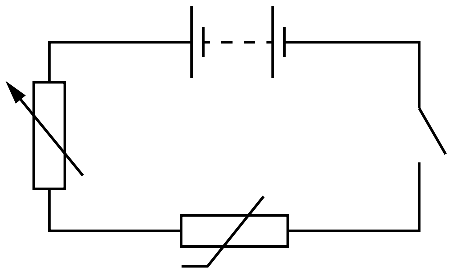


Fig. 12.1

(a) On Fig. 12.1, label the thermistor with a T. [1]

(b) The student wants to determine the resistance of the thermistor at different temperatures.

Complete the sentences for the meters he should use in the circuit.

(i) The meter to be connected in series with the thermistor is .... [1]

(ii) The meter to be connected in parallel with the thermistor is .... [1]

(c) These are the student's results for a temperature of 20 °C.

p.d. across thermistor / V	current in thermistor / A
3.2	0.0050

(i) Calculate the resistance of the thermistor at 20 °C.

resistance = ... Ω [3]

(ii) When the temperature increases, the resistance of the thermistor decreases.

State what happens, if anything, to the current in the thermistor.

....[1]

[Total: 7]

9 A student investigates how the resistance of a thermistor changes with temperature. Fig. 9.1 shows the circuit that the student uses.

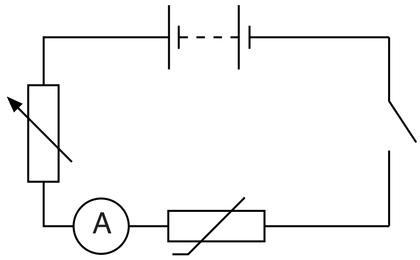


Fig. 9.1

(a) **(i)** Label clearly the thermistor in Fig. 9.1. [1]

(ii) On Fig. 9.1, draw a voltmeter connected so that the resistance of the thermistor can be determined. [2]

(b) The student varies the temperature of the thermistor and records the ammeter readings. The results are shown in Table 9.1.

Table 9.1

temperature of thermistor / °C	0	10	20	30	40	50
current in thermistor / mA	1.0	2.0	4.0	7.5	14.0	24.5

(i) The potential difference (p.d.) across the thermistor is 6.0 V at 20 °C.

Calculate the resistance of the thermistor at 20 °C. Include the unit.

resistance = ... [4]

(ii) Fig. 9.2 shows the student's results plotted on a graph.

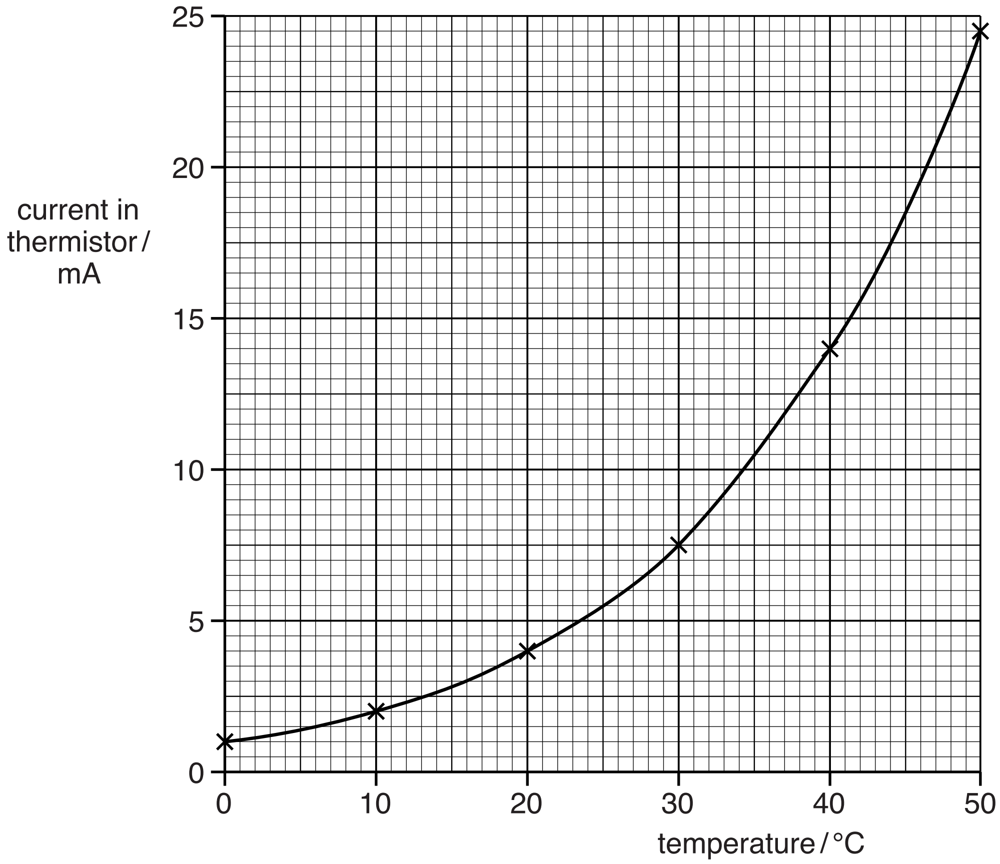


Fig. 9.2

The student suggests that the current in the thermistor is directly proportional to the temperature of the thermistor.

Explain how the graph shown in Fig. 9.2 shows that the suggestion is incorrect.

....

.... [1]

[Total: 8]

Question	Answer	Mark
9 (a)	alternating voltage **OR** a.c. (supply)	B1
9 (b)	motor (accept fan) **AND** lamp	B1
9 (c)	<table><tr><td>heater settings</td><td>switch B</td><td>switch C</td></tr><tr><td>high</td><td>✓</td><td>✓</td></tr><tr><td>medium</td><td></td><td>✓</td></tr><tr><td>low</td><td>✓</td><td></td></tr></table>	B3
9 (d)	$V = IR$ in any form	B1
9 (e)	50 x 5 250 <u>V</u>	C1 A1
9 (f)	any two from: • current too large • fuse wire melts/"blows" • breaks circuit • prevents overheating/fires/damage to other components	B2
		Total: 10
12 (a)	thermistor correctly identified (by letter T)	B1
12 (b) (i)	ammeter **NOT** ampmeter	B1
12 (b) (ii)	voltmeter	B1
12 (c) (i)	$(R =)\ V \div I$ in any form 3.2 ÷ 0.005 640 (Ω)	C1 C1 A1
12 (c) (ii)	increases	B1
		Total: 7
9 (a)	thermistor correctly labelled	B1
9 (a) (i)	correct symbol for voltmeter voltmeter in parallel with thermistor **OR** e.c.f. (a) (i)	B1 B1
9 (b) (i)	$V = IR$ in any form 6.0 ÷ 0.004 **OR** 6.0 ÷ 4.0 1500 Ω **OR** ohm(s)	C1 C1 A1 B1
9 (b) (ii)	not a straight line / constant gradient **OR** not through origin	B1
		Total: 8

Notes about the mark scheme are available separately.

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3: Energy – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	31
5	2016	March	32
7	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

3 Fig. 3.1 shows a metal plate-warmer.

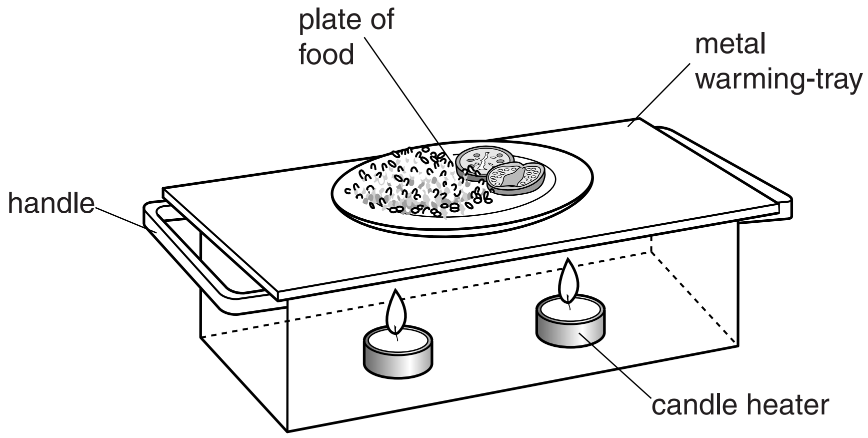


Fig. 3.1

The plate-warmer contains two small candle heaters. Plates of food are placed on top of the warming-tray.

(a) **(i)** State the name of a process by which the thermal energy from the candles passes to the warming-tray.

....[1]

(ii) State the name of the process by which thermal energy moves through the warming-tray.

....[1]

(b) The outside of the plate-warmer is shiny.

Suggest how this helps the plate-warmer to stay hot.

....[1]

(c) The handles of the plate-warmer are made from metal.

Identify a problem with this, and suggest how the problem could be solved.

problem: ....

action: ....

[2]

[Total: 5]

5 Fig. 5.1 shows a wave-powered generator. It generates electricity from the movement of sea waves.

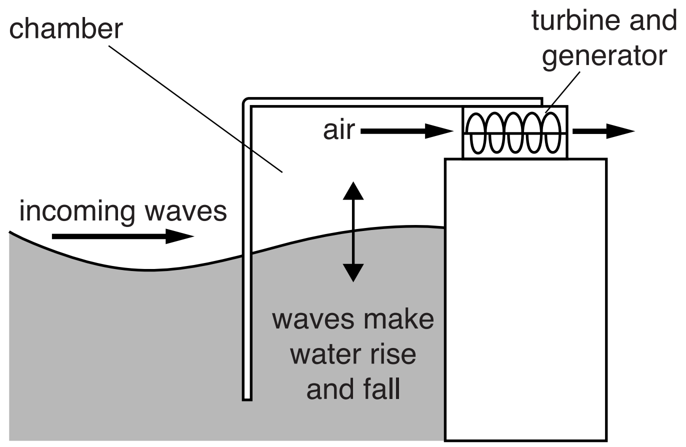
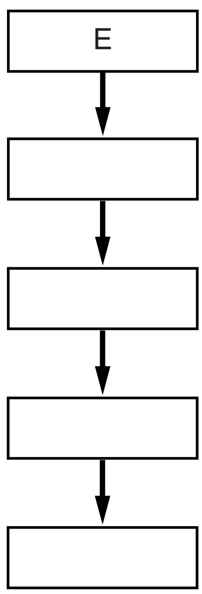


Fig. 5.1

(a) The sentences below describe how the wave-powered generator works.

A Air is pushed through the turbine, making it spin.
B Water rises and falls in the chamber.
C The turbine turns a generator.
D The generator produces electrical energy.
E Waves travel towards the chamber.

Write letters in the boxes below to arrange the sentences in the correct order. The first one is done for you.



[3]

(b) More electricity needs to be generated from renewable sources instead of from burning fossil fuels.

State **three** benefits of generating electricity from renewable sources rather than from fossil fuels.

....

....

....

....

....[3]

[Total: 6]

7 Fig. 7.1 shows a room with a heater.

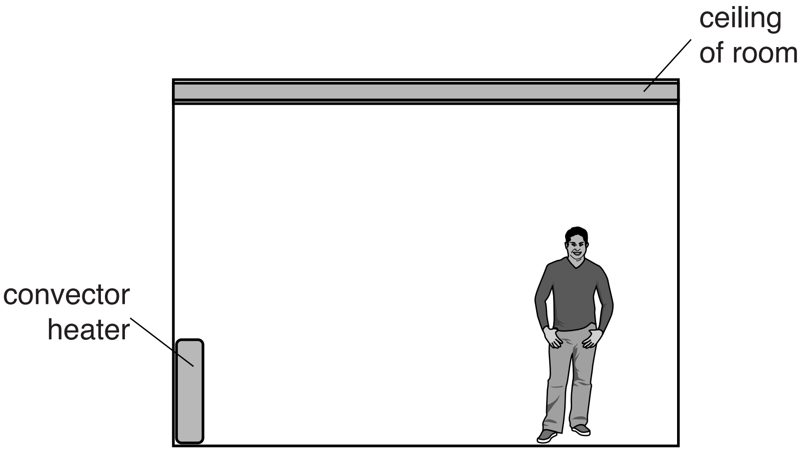


Fig. 7.1

(a) The temperature in the room is hottest near to the ceiling. Explain why.

....

....[2]

(b) The ceiling of the room is made from an insulating material as shown in Fig. 7.2.

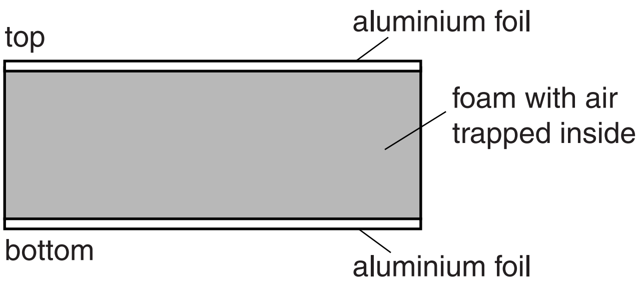


Fig. 7.2

Explain how this reduces the transfer of thermal energy through the ceiling.

....

....

....

....

....

....[4]

[Total: 6]

Question	Answer	Mark
3 (a) (i)	convection **OR** radiation	B1
3 (a) (ii)	conduction	B1
3 (b)	poor emitter **OR** poor radiator (of thermal energy)	B1
3 (c)	(handles) become hot use an insulator	B1 B1
		Total: 5
5 (a)	correct order: E B A C D 1 mark for B immediately before A 1 mark for C immediately before D 3 marks for all correct i.e. B, A, C then D	B3
5 (b)	any three from: • conserve non-renewable reserves • less atmospheric pollution / acid rain • reduces greenhouse gases / global warming • (renewable) energy source will not run out • reduces dependence on fossil fuels (from other countries)	B3
		Total: 6
7 (a)	any two from: • hot air expands / particles move (further) apart • hot air less dense • less dense air rises	B2
7 (b)	any four from: • aluminium / foil (on bottom) is a good reflector • infrared / radiation reflected back into room • (trapped) air is a good insulator / poor conductor • (insulation) reduces heat lost by conduction • foam reduces convection currents / prevents air moving • (air cannot move so) prevents heat loss by convection • aluminium / foil (on top) is a poor emitter (so reduces radiation into space above ceiling)	B4
		Total: 8

Notes about the mark scheme are available separately.

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1: Light – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
8	2016	June	31
6	2016	March	32
5	2016	November	31

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

8 A student directs a ray of light towards a plane mirror, as shown in Fig. 8.1.

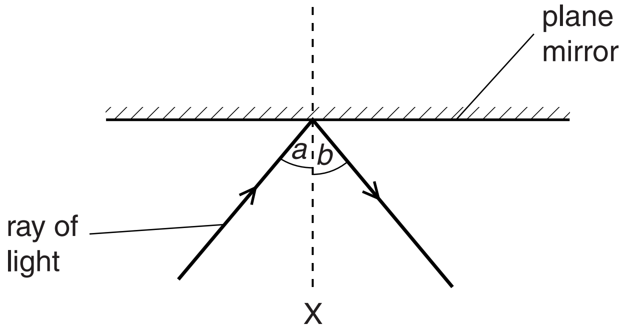

Fig. 8.1

(a) **(i)** Name the line labelled X.

....[1]

(ii) When angle *a* is 45°, angle *b* is also 45°.

Angle *a* is changed to 20°.

What is the new value of angle *b*? Tick **one** box.

20° ☐ 25° ☐ 45° ☐ 65° ☐ 80° ☐

[1]

(b) The student now makes the ray of light from Fig. 8.1 pass into a glass block, as shown in Fig. 8.2.

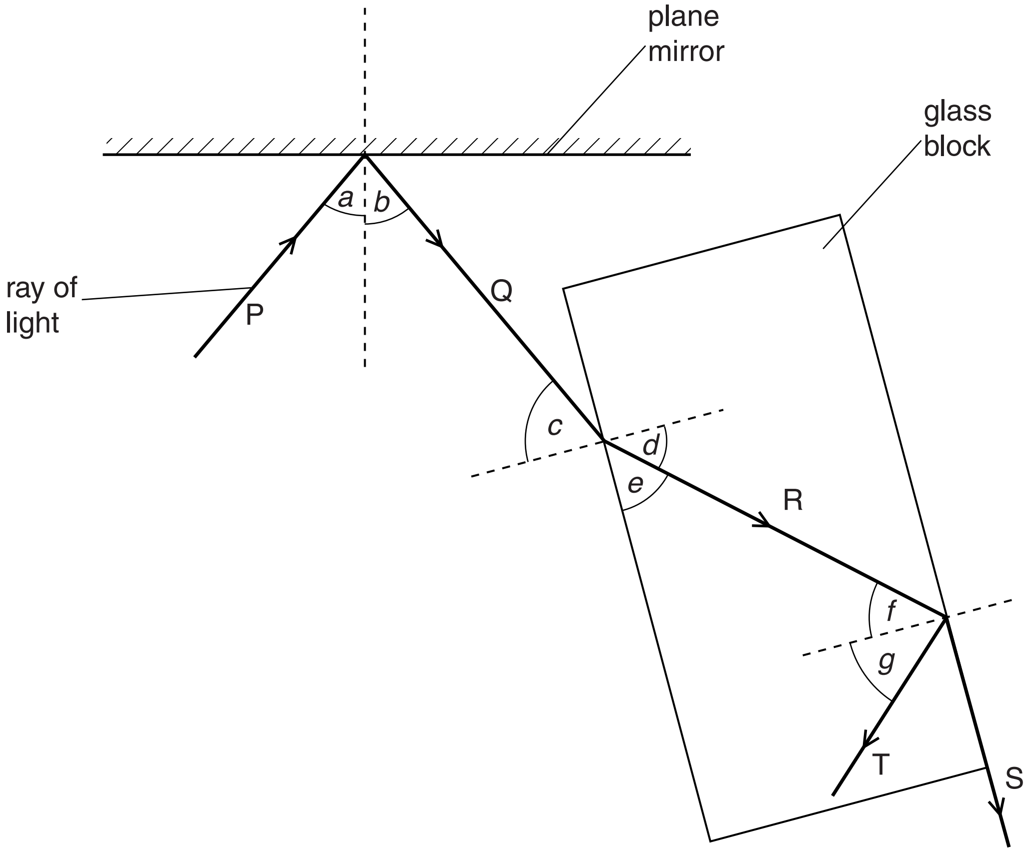

Fig. 8.2

Complete the table, using the labels from Fig. 8.2. The first label is done for you.

description	label
an angle of incidence	*a*
an angle of refraction	
an internally reflected angle	
a critical angle	
a refracted ray	

[4]

(c) The student uses a converging lens to produce an image of an object. Fig. 8.3 shows the arrangement.

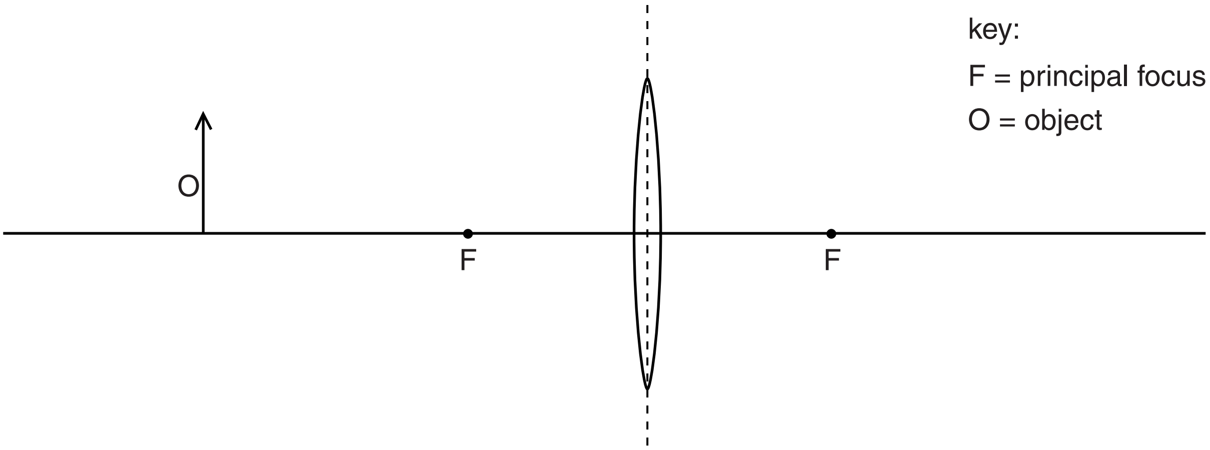

Fig. 8.3

On Fig. 8.3, using a ruler, carefully draw two rays from the object O to locate the position of the image. Use an arrow to represent the image. [3]

[Total: 9]

6 **(a)** Fig. 6.1 shows a plane mirror reflecting a ray of light.

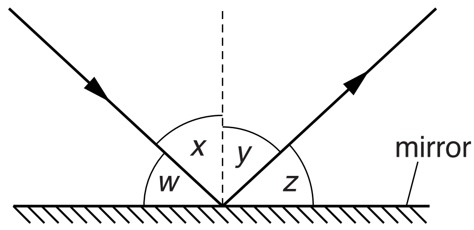

Fig. 6.1

(i) There is a dashed line drawn at right angles to the mirror.

State the name of this line.

....[1]

(ii) State which angle, *w*, *x*, *y*, or *z*, is the angle of reflection.

....[1]

(b) Fig. 6.2 shows a ray of white light entering a semi-circular glass block. The ray of light emerges at point R and travels alongside the flat surface.

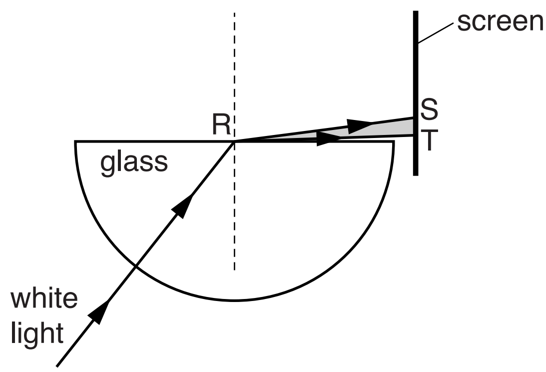

Fig. 6.2

A spectrum of colours can be seen on the screen between S and T.

(i) State the colours in the correct order. One has been done for you.

colour at S ....red.........

....

....

....

.... [1]

....

colour at T ....

(ii) The angle of the ray is changed.

On Fig. 6.3, complete the path of the ray of light. Explain your answer.

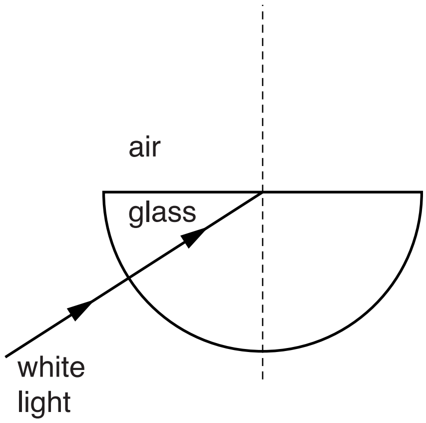

Fig. 6.3

....

....

....[3]

[Total: 6]

5 **(a)** Fig. 5.1 shows a ray of red light passing through a semi-circular glass block.

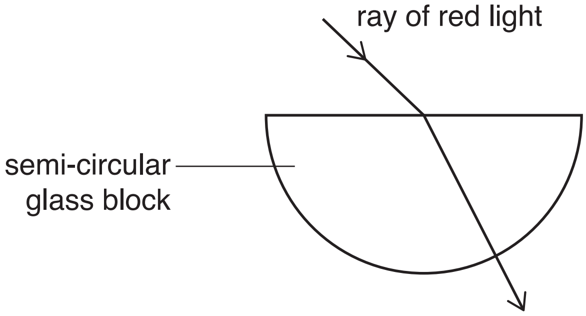

Fig. 5.1

(i) The ray of light changes direction as it travels into the block.

State the name that is given to this change of direction.

....[1]

(ii) Fig. 5.2 shows another ray of red light travelling into the semi-circular glass block. It meets the curved surface at 90°.

Inside the block, the ray meets the flat surface of the block at an angle greater than the critical angle.

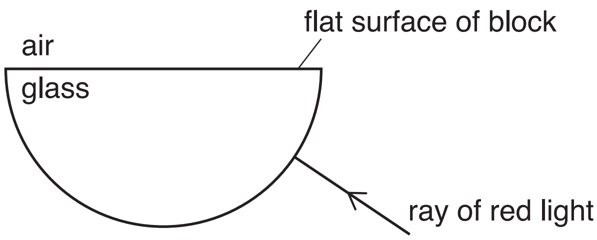

Fig. 5.2

On Fig. 5.2, complete the path of the ray of red light. [2]

(b) Fig. 5.3 shows the view from above of a car approaching an observer, marked with a cross (**×**).

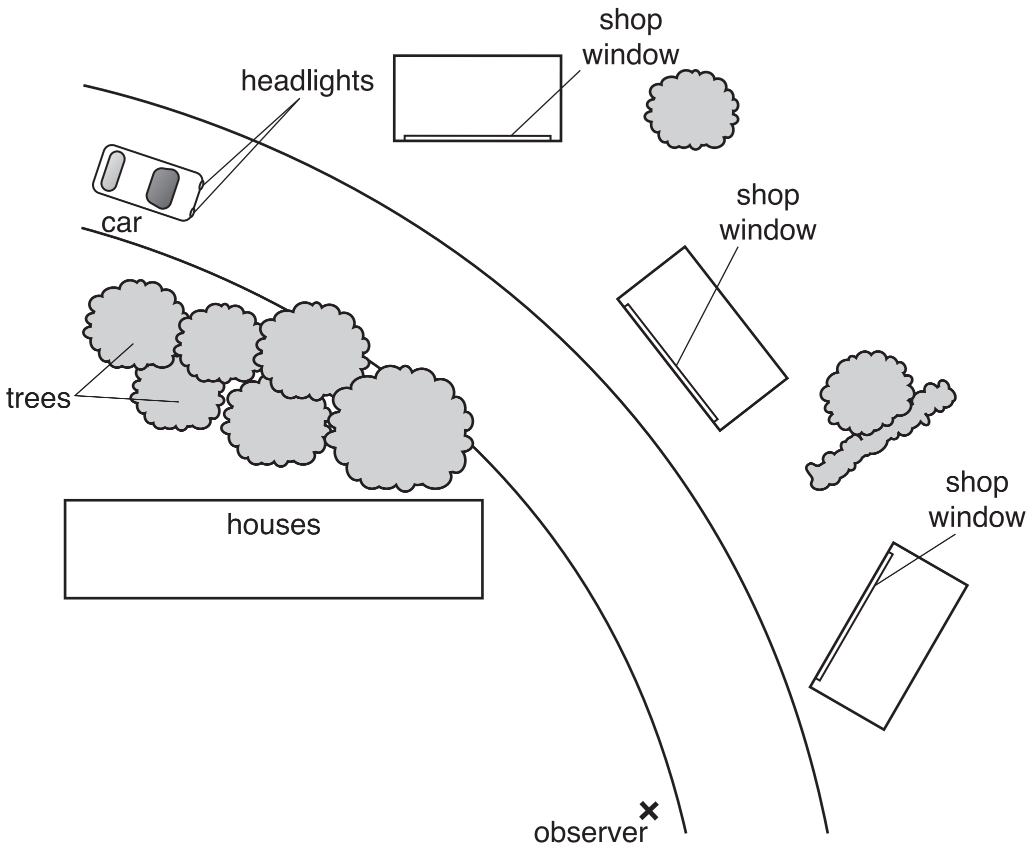

Fig. 5.3

(i) The observer sees the car's headlights reflected in one of the shop windows. The car's headlights are labelled.

In which shop window does the observer see the reflection? Show your answer by drawing, on Fig. 5.3, the path of a ray of light from a headlight to the observer. Use a ruler. [1]

(ii) State the law that you used to answer **(b)(i)**.

....[1]

(iii) Add labels to Fig. 5.3 to show how the law stated in **(b)(ii)** applies. [2]

[Total: 7]

Question	Answer	Mark
8 (a) (i)	normal	B1
8 (a) (ii)	20°	B1
8 (b)	d g f R **OR** S	B1 B1 B1 B1
8 (c)	any two rays correctly drawn from top of O: ray parallel to axis, through lens, and beyond F ray undeviated through centre of lens and beyond ray through F, through lens, then parallel to axis inverted image correctly drawn and positioned at intersection of two rays	M2 A1
		Total: 9
6 (a) (i)	(the) normal	B1
6 (a) (ii)	y	B1
6 (b) (i)	(red), orange, yellow, green, blue, indigo, violet/purple	B1
6 (b) (ii)	any three from: (ON DIAGRAM) ray reflected angle i = angle r (by eye) explanation: (incident angle) is greater than critical angle (so there is) total internal reflection	B3
		Total: 6
5 (a) (i)	refraction	B1
5 (a) (ii)	ray travels un-deviated through curved surface ray reflected with i = r by eye	B1 B1
5 (b) (i)	ray drawn from headlight to hit middle shop and reflected towards X	B1
5 (b) (ii)	angle of reflection = angle of incidence	B1
5 (b) (iii)	normal drawn at point of incidence on window angles of incidence and reflection correctly labelled	B1 B1
		Total: 7

Notes about the mark scheme are available separately.

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4: Mechanics 1 – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	31
1	2016	March	32
2	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

1 Fig. 1.1 shows part of the speed-time graphs for a cyclist and for a

runner.

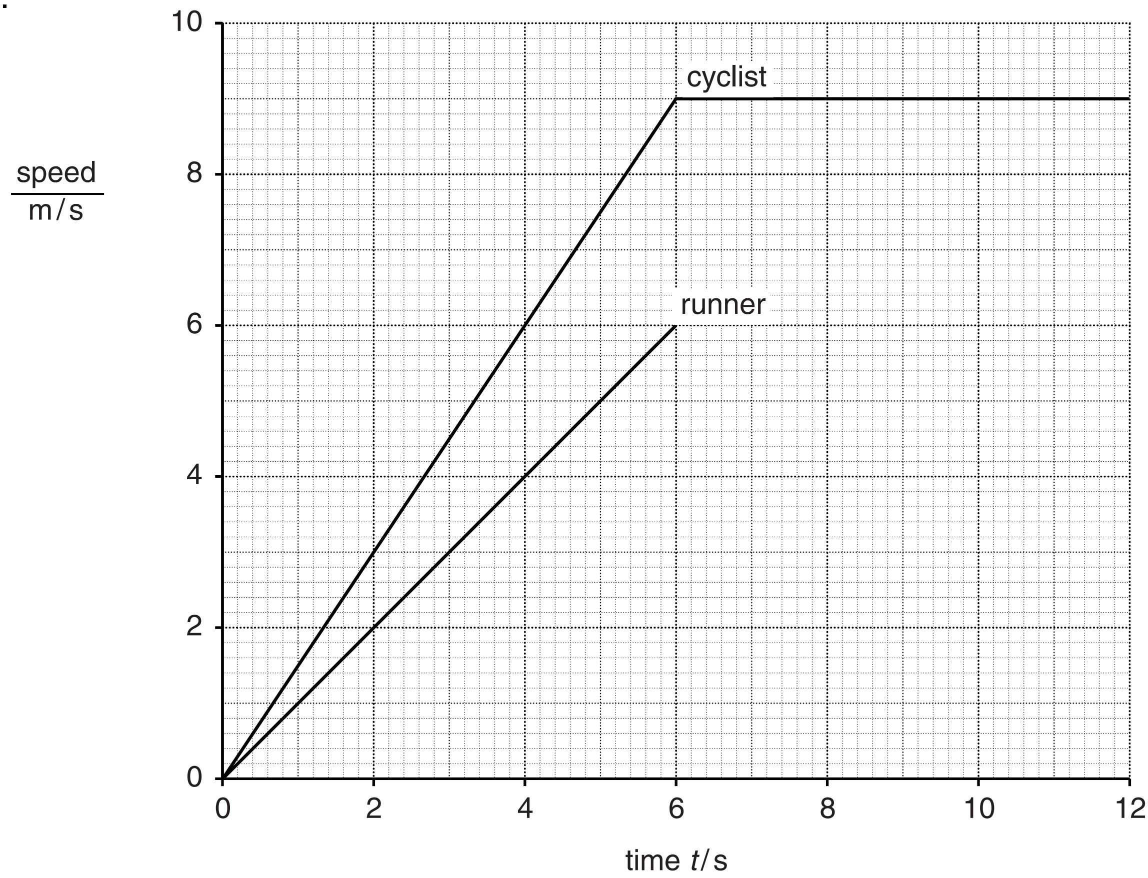

Fig. 1.1

(a) Compare the motion of the cyclist and the runner during the first 6 seconds. Explain your answer.

....

....

....

....[3]

(b) Describe the motion of the cyclist between time t = 6.0 s and time t = 12.0 s.

....[1]

(c) Calculate the total distance travelled by the cyclist between t = 0 and t = 12.0 s.

distance travelled = ... m [4]

(d) After the first 6.0 seconds, the runner moves at constant speed for 4.0 seconds. He then slows down uniformly and stops in a further 2.0 seconds.

On Fig. 1.1, complete the graph for the runner's motion. [2]

[Total: 10]

1 A student is investigating volume and density.

The student has a box, as shown in Fig. 1.1, a balance, a rule and some dry sand.

(a) Fig. 1.1 shows the dimensions of the inside of the box.

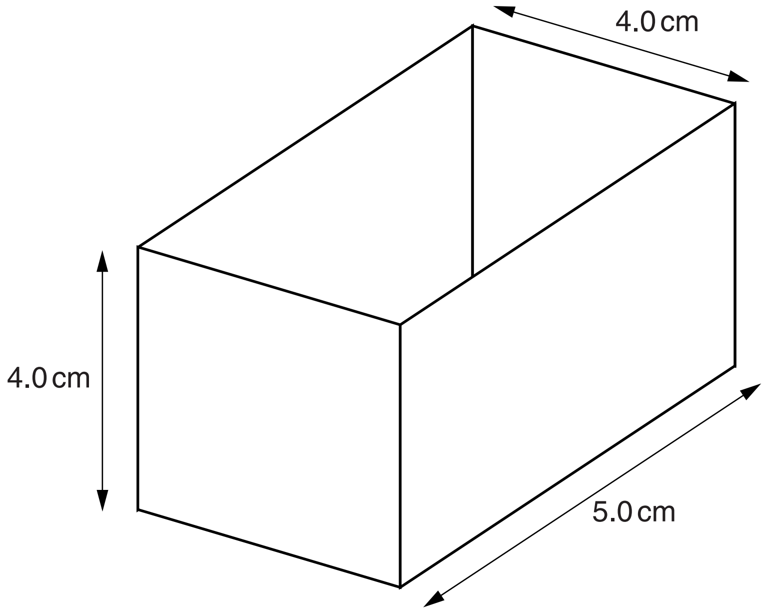

Fig. 1.1 (not to scale)

Calculate the volume of sand needed to fill the box.

volume of sand = ... cm^3 [1]

(b) The student measures the mass of the box when empty and when filled with sand.

quantity	mass / g
mass of box filled with sand	216.0
mass of empty box	40.0

Calculate the mass of the sand in the box, using her results.

mass of sand = ... g [1]

(c) Calculate the density of the sand.

density of sand = ... g/cm^3 [3]

(d) A miner has a bag containing a mixture of gold dust and sand. Gold has a density of $19.3\,g/cm^3$.

He heats the mixture until the gold melts.

Predict whether the sand will float on top of the molten gold. Explain your answer.

....

....

....[2]

[Total: 7]

2 Three students walk together from school to a bridge. The students stand together on the bridge for three minutes and then return separately to school.

The distance-time graphs for student A, student B and student C are shown in Fig. 2.1.

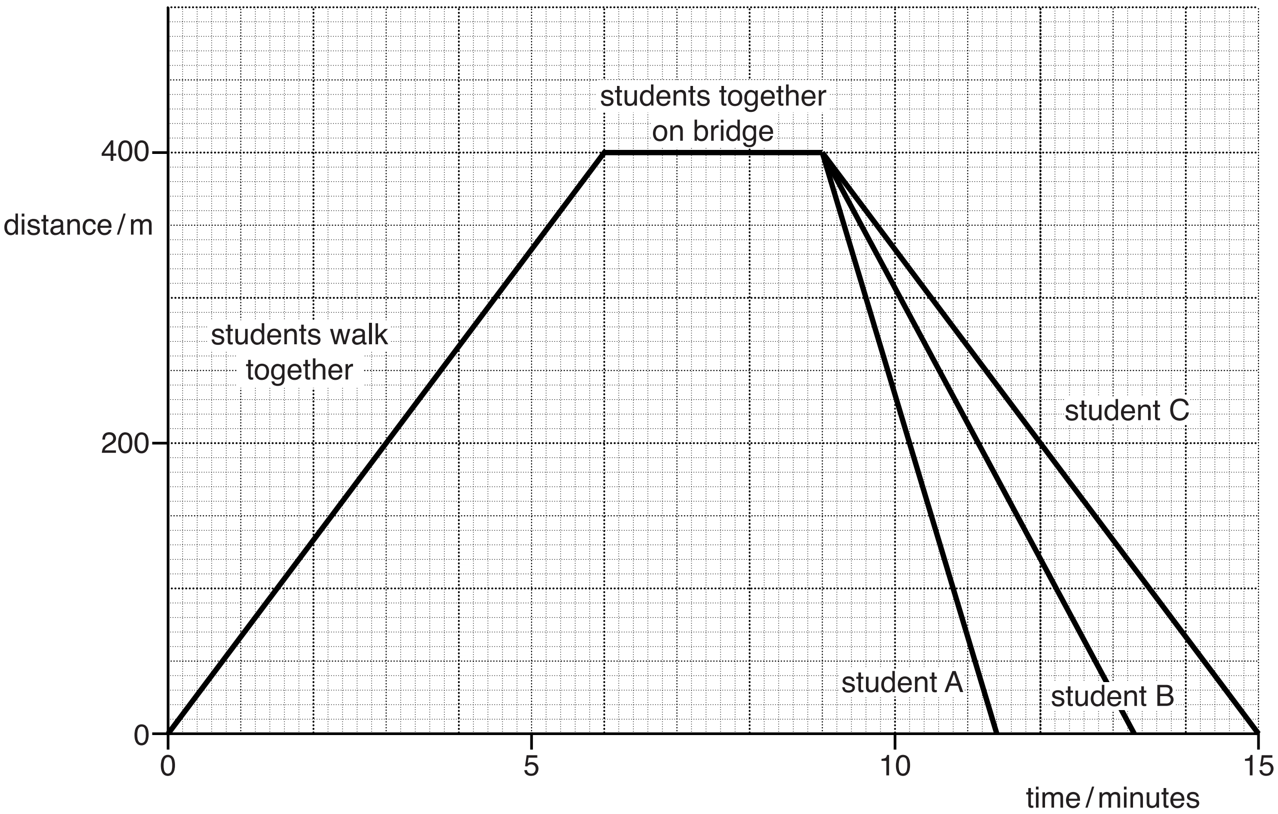

Fig. 2.1

(a) **(i)** Determine the distance from the school to the bridge.

distance = ... m [1]

(ii) Calculate the average speed of the students when they are walking to the bridge. Give your answer in m / s.

average speed = ... m / s [4]

(b) The students return to school at different speeds. One student walks slowly, one student walks quickly and the other student runs.

State which student runs. Explain how this is shown by the graph.

student ....

explanation ....

....[2]

[Total: 7]

Question	Answer	Mark
1 (a)	cyclist accelerating **OR** moving faster **OR** cyclist has higher speed both (cyclist and runner) accelerating cyclists gradient steeper **OR** acceleration values calculated	B1 B1 B1
1 (b)	Constant **OR** steady **OR** uniform (speed or motion)	B1
1 (c)	indication of an area calculated $6 \times 9 = 54$(m) ½ $(6 \times 9) = 27$(m) <u>81(m)</u>	C1 C1 C1 A1
1 (d)	horizontal line finishes at 10 seconds straight line to time zero in two seconds	B1 B1
		Total: 10
1 (a)	80 (cm^3)	B1
1 (b)	176.0 (g)	B1
1 (c)	D = *M* / *V* in words, numbers or symbols $176 \div 80$ 2.2 (g / cm^3)	C1 C1 A1
1 (d)	(sand) will float sand is less dense than gold	C1 A1
		Total: 7
2 (a) (i)	400 (metres)	B1
2 (a) (ii)	evidence of 6 minutes speed = distance / time in any form (e.g. $400 \div 360$ or **(a)(i)** / 6) $6 \times 60 = 360$ s 1.1(1) (m / s)	C1 C1 C1 A1
2 (b)	A shortest time (to return)/steepest gradient	B1 B1
		Total: 7

Notes about the mark scheme are available separately.

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8: Mechanics 2 – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2016	June	31
5	2016	June	31
3	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

2 A boy steps off a high board into a swimming pool.

Fig. 2.1 shows the forces acting on the boy at one point in his fall.

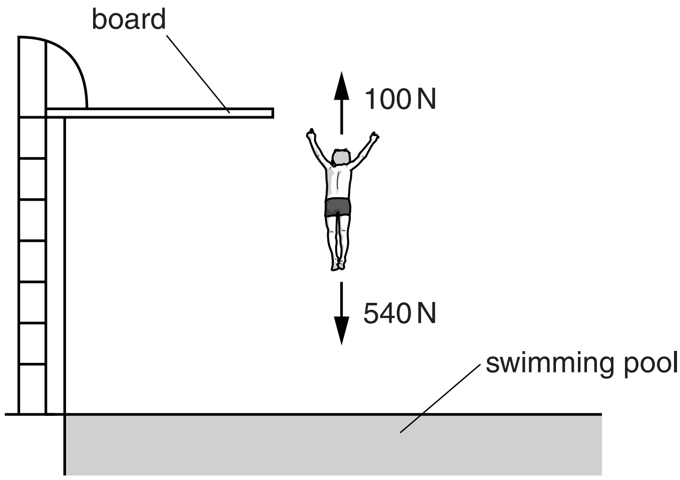

Fig. 2.1

(a) The 540 N force is caused by gravitational attraction.

State the cause of the 100 N force.

....[1]

(b) Calculate the mass of the boy.

mass of boy = ... kg [2]

(c) Calculate the resultant force on the boy. State its direction.

resultant force = ... N

direction = ...

[2]

[Total: 5]

5 Fig. 5.1 shows two men repairing a weak roof using a crawler-board.

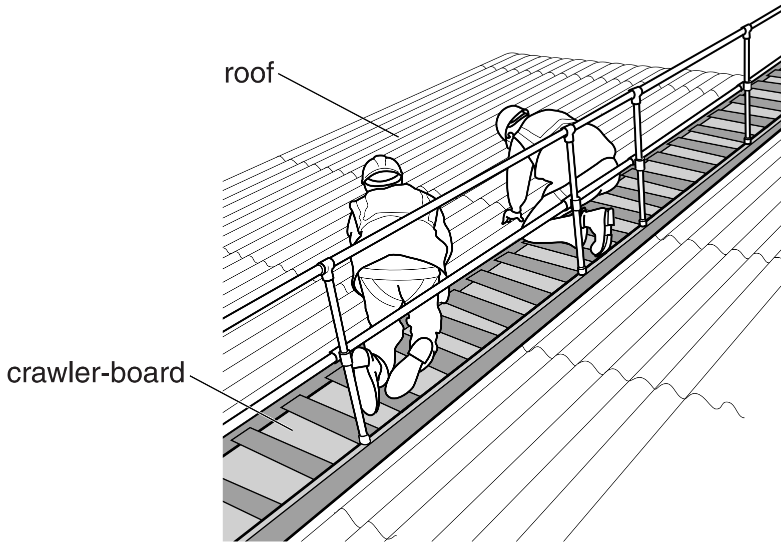

Fig. 5.1

(a) Explain why use of the crawler-board prevents the men from falling through the roof.

....

....

....

....[2]

(b) The crawler-board has a weight of 400 N. The total weight of the two men is 1600 N. The area of the crawler-board in contact with the roof is 0.8 m^2.

Calculate the pressure on the roof when the men are on the crawler-board. Include the unit.

pressure = ...[5]

[Total: 7]

3 Fig. 3.1 shows a see-saw. The see-saw is horizontal when not in use.

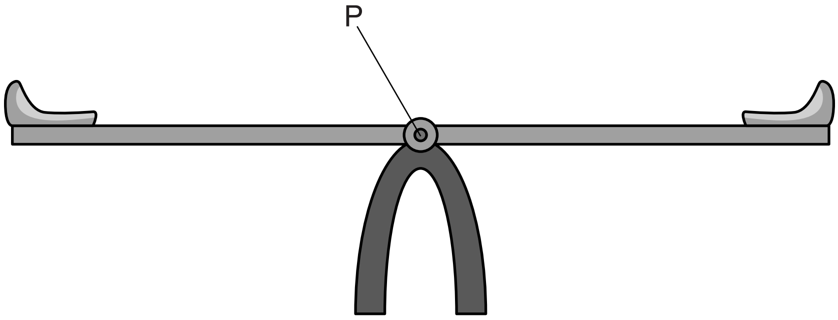

Fig. 3.1

A small child sits on one seat of the see-saw. This creates a turning effect about point P.

(a) Which of these words means the turning effect of a force? Tick one box.

☐ equilibrium

☐ moment

☐ resultant

[1]

(b) State the scientific name for point P.

....[1]

(c) A much heavier boy sits on the other end of the see-saw, as shown in Fig. 3.2.

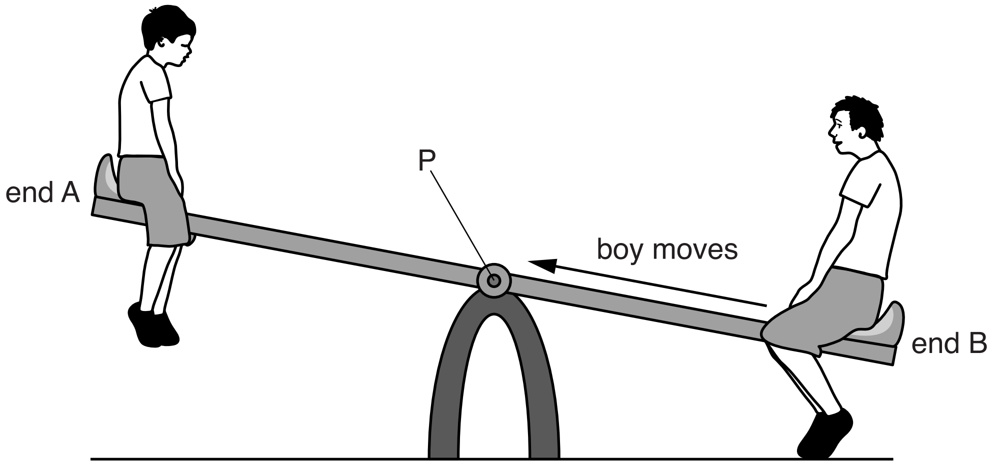

Fig. 3.2

The heavier boy moves slowly along the see-saw from end B until he reaches point P.

Describe and explain what happens to the see-saw.

....

....

....

....

....[4]

[Total: 6]

Question	Answer	Mark
2 (a)	air resistance	B1
2 (b)	W = m x g in any form 54 (kg)	B1 B1
2 (c)	(540 – 100) = 440(N) downwards	B1 B1
		Total: 5
5 (a)	**any two from**: larger area (in contact with roof) weight **OR** force spread out lower pressure (on roof)	B2
5 (b)	400 + 1600 seen OR 2000(N) P = F / A stated 2000 / 0.8 2500 N / m^2 **OR** Pa	B1 C1 C1 A1 B1
		Total: 7
3 (a)	middle box ticked – moment	B1
3 (b)	pivot/fulcrum	B1
3 (c)	any four from: • (heavier) boy has greater force / weight / moment • when (heavier) boy lifts feet initially tips clockwise • as boy moves his (clockwise) moment (about P) becomes less • as distance (of boy's weight) from the pivot decreases end B moves upward • see-saw level owtte (when) turning forces balanced / moments equal • then end A tips down as anticlockwise moment is greater	B4
		Total: 6

Notes about the mark scheme are available separately.

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7: Thermal physics – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
6	2016	June	31
7	2016	June	31
4	2016	March	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

6 Fig. 6.1 shows an experiment to observe the motion of smoke particles in air.

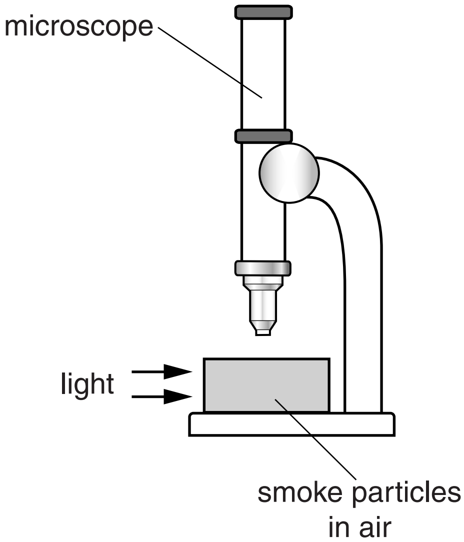

Fig. 6.1

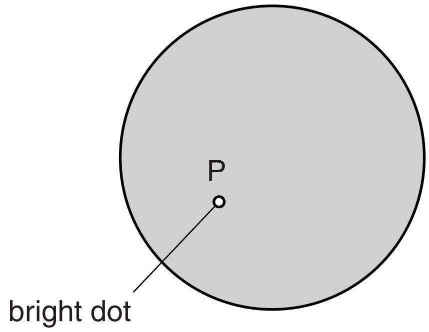

Fig. 6.2

(a) (i) Fig. 6.2 shows the view through the microscope of one smoke particle, labelled P.

On Fig. 6.2, draw 3 lines to show the movement of this particle.

[2]

(ii) Explain what causes the smoke particle to move.

....

....

....

....[2]

(b) The air containing the smoke particles becomes warmer.

Suggest how this changes the movement of the smoke particles.

....

....[1]

[Total: 5]

7 Fig. 7.1 shows equipment used to demonstrate thermal expansion.

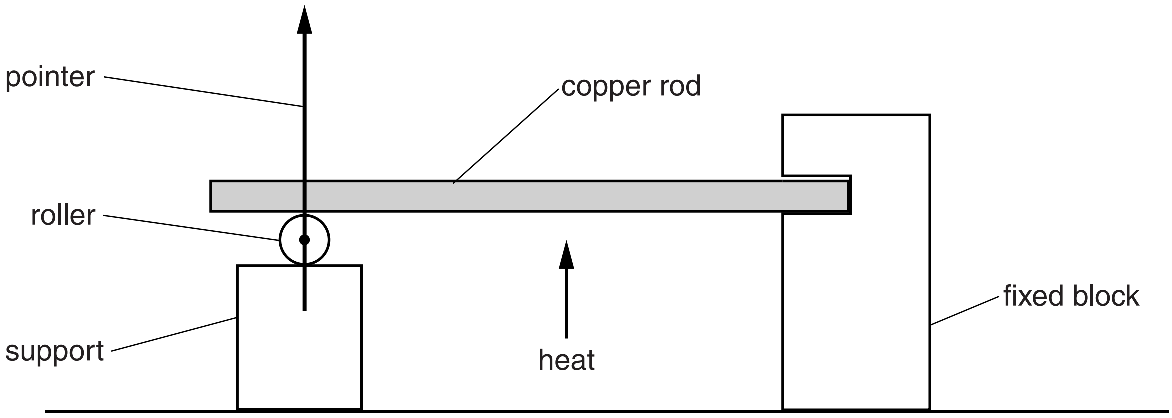

Fig. 7.1

(a) The copper rod is heated and expands. It turns the roller and moves the pointer.

On Fig. 7.1, draw the new position of the pointer.

[1]

(b) As the rod is heated, some of its properties change.

Identify how each property changes. Place **one** tick in each row of the table.

property of rod	decreases	increases	stays the same
volume			
mass			
density			

[3]

(c) Suggest **one** disadvantage of thermal expansion.

....[1]

[Total: 5]

4 Fig. 4.1 shows a balloon near a window on a warm sunny day.

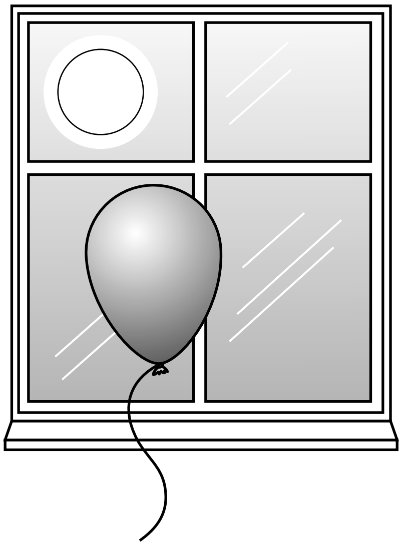

Fig. 4.1

Fig. 4.2 shows how the volume of the balloon changes throughout the day.

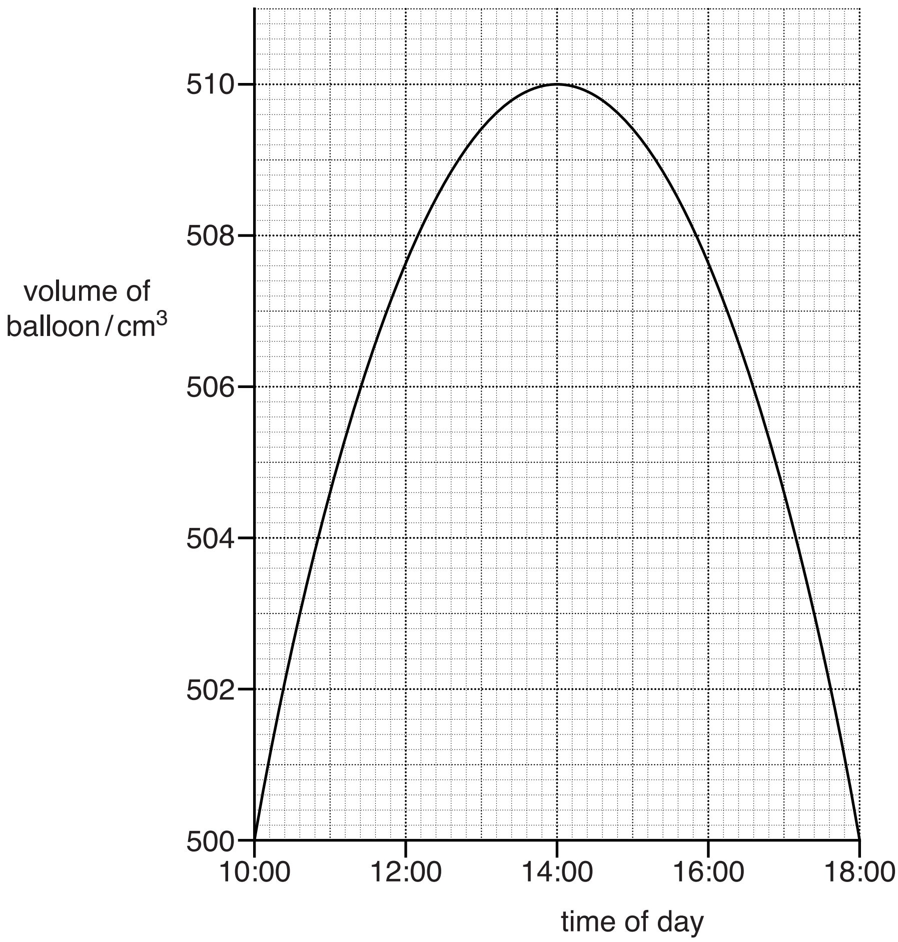

Fig. 4.2

(a) Describe how the volume changes throughout the day.

....[1]

(b) Explain, in terms of the gas molecules inside the balloon, why the volume changes in this way between 10:00 and 14:00.

....

....

....

....

....

....[3]

[Total: 4]

Question	Answer	Mark
6 (a) (ii)	three straight lines, joined end to end at least two changes of direction	B1 B1
6 (a) (ii)	collisions **OR** bumps **OR** bounces off (with moving) air molecules	B1 B1
6 (b)	more collisions OR changes of direction	B1
		Total: 5
7 (a)	to the left **OR** anticlockwise	B1
7 (b)	row 1 – increases row 2 – stays the same row 3 – decreases	B1 B1 B1
7 (c)	electric cables lower to ground **OR** telephone lines in summer **OR** buckling tracks	B1
		Total: 5
4 (a)	volume of balloon increases (until 14:00) then decreases again	B1
4 (b)	any three from: • temperature (in room / balloon) increases • gas molecules move faster / have more energy OR collisions more energetic when heated • more frequent / harder collisions • collisions result in greater force on balloon (surface) / gas pressure increases	B3
		Total: 4

Notes about the mark scheme are available separately.

9: Waves – Topic questions Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
9	2016	June	31
8	2016	March	32
9	2016	March	32

The mark scheme for each question is provided at the end of the document.

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9 Fig. 9.1 represents the regions of the electromagnetic spectrum.

radio waves	micro-waves		visible light	ultraviolet waves	X-rays	gamma rays

$\longrightarrow$

increasing ____________________

Fig. 9.1

(a) Complete Fig. 9.1:

(i) Add the label of the missing region. [1]

(ii) Complete the label under the arrow. [1]

(b) **(i)** State **two** uses of X-rays.

1. ....

2. ....
[2]

(ii) Describe **two** safety precautions taken by people using X-rays.

1. ....

2. ....
[2]

(iii) X-rays and light waves can both travel through a vacuum.

Identify the correct statement. Tick **one** box.

☐ X-rays travel at a slower speed than light waves.

☐ X-rays travel at the same speed as light waves.

☐ X-rays travel at a faster speed than light waves.

[1]

[Total: 7]

8 **(a)** Some students want to determine the speed of sound in air.

Describe a method they could use. Include the measurements they must make.

....

....

....

....

....

....

....

....

....

....

....

....[4]

(b) The graph in Fig. 8.1 represents a sound wave.

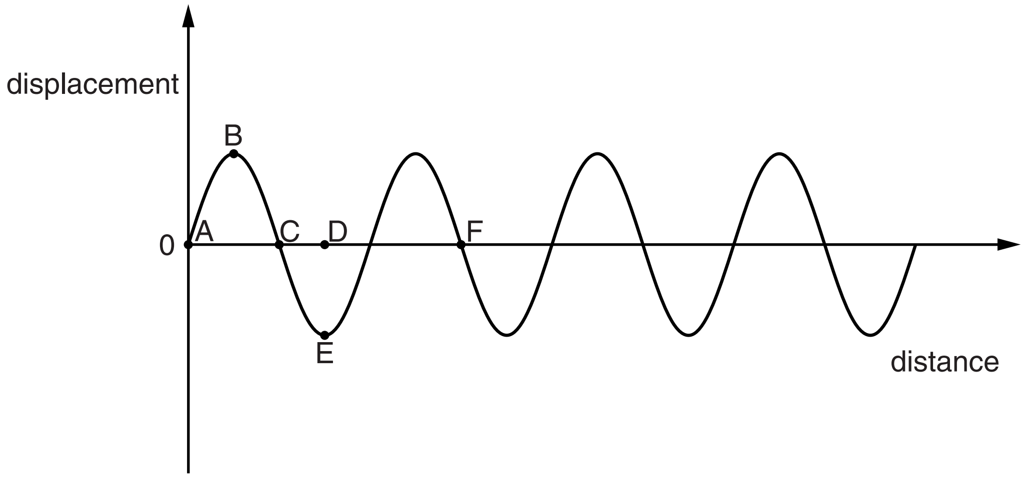

Fig. 8.1

(i) Which distance represents the amplitude of the wave? Circle your answer. [1]

AC AF BE DE CF

(ii) Which distance represents the wavelength of the wave? Circle your answer. [1]

AC AF BE DE CF

(iii) Another sound wave, of the same wavelength, is louder.

On Fig. 8.1, draw this wave. [2]

[Total: 8]

9 Waves from different regions of the electromagnetic spectrum have different uses.

(a) Draw **one** line from each type of electromagnetic wave to its use.

	household lights
microwaves	television remote control
	loudspeaker
infra-red waves	satellite communications
	security check of suitcases

[2]

(b) Many years ago, some shoe shops used X-ray machines to make images of feet, as shown in Fig. 9.1.

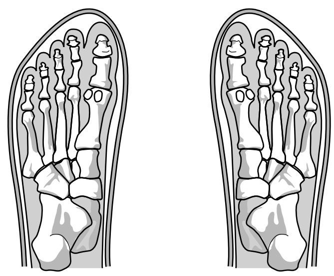

Fig. 9.1

Explain the risk to health of using these X-ray machines.

....

....

....

....[2]

[Total: 4]

Question	Answer	Mark
9 (a) (i)	<u>infra-red</u>	B1
9 (a) (ii)	frequency	B1
9 (b) (i)	any two different applications from: • (medical) imaging **OR** detecting fractures in bone **OR** specific example e.g. CT scan / imaging teeth at dentist • detecting faults in metal • security imaging e.g. airport security checks of bags • cancer treatment	B2
9 (b) (ii)	any two from: • behind a screen **OR** lead apron • large distance from X-ray beam • monitoring of **OR** restricting exposure • low dosage **OR** limit exposure time • monitor frequency of x-ray sessions • other people not allowed in room when X-ray being taken • avoid when pregnant	B2
9 (b) (iii)	same speed	B1
		Total: 7
8 (a)	for full marks the method described must work any four from: • means of producing sharp sound • use of suitable reflecting surface • measure total distance travelled by sound • measurement of time for sound to travel measured distance. • use of speed = distance / time	B4
8 (b) (i)	circle around DE	B1
8 (b) (ii)	circle around CF	B1
8 (b) (iii)	higher amplitude drawn line from infra-red waves to TV remote control	B1 B1
		Total: 8
9 (a)	line drawn from microwaves to satellite communications line drawn from infra-red waves to TV remote control	B1 B1
9 (b)	any two from: • X-rays may cause mutation of DNA / cells • X-rays are ionising • idea of unnecessary exposure • (sales assistants) exposed to large dose of X-rays	B2
		Total: 4

Notes about the mark scheme are available separately.

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10: Atomic physics – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
11	2016	June	41
10	2016	March	42
12	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

11 Bismuth-214 is radioactive. It has a half-life of 20 minutes.

(a) The nuclide notation for bismuth-214 is $^{214}_{83}Bi$.

State the composition of the nucleus of bismuth-214.

....

.... [2]

(b) Bismuth-214 decays by β-decay to an isotope of polonium, Po.

Complete the equation for the decay of bismuth-214.

$$^{214}_{83}Bi \rightarrow \,^{\dots\dots}_{\dots\dots}\beta + \,^{\dots\dots}_{\dots\dots}Po$$

[3]

(c) The count rate from a sample of bismuth-214 is 360 counts / s.

Predict the count rate from the sample after 60 minutes.

count rate = ... [2]

(d) State **two** of the social, economic or environmental issues involved in the storage of radioactive materials with very long half-lives.

....

....

....

.... [2]

[Total: 9]

10 **(a)** An iodine isotope $^{131}_{53}\mathrm{I}$ decays by β-emission to an isotope of xenon (Xe).

(i) State the number of each type of particle in a neutral atom of $^{131}_{53}\mathrm{I}$.

protons .... neutrons .... electrons .... [2]

(ii) State the symbol, in nuclide notation, for the xenon nucleus.

....[2]

(b) The background count rate of radioactivity in a laboratory is 30 counts/min.

A radioactive sample has a half-life of 50 minutes. The sample is placed at a fixed distance from a detector. The detector measures an initial count rate from the sample, including background, of 310 counts/min.

On Fig. 10.1, plot suitable points and draw a graph of the count rate from the sample, **corrected for background**, as it changes with time.

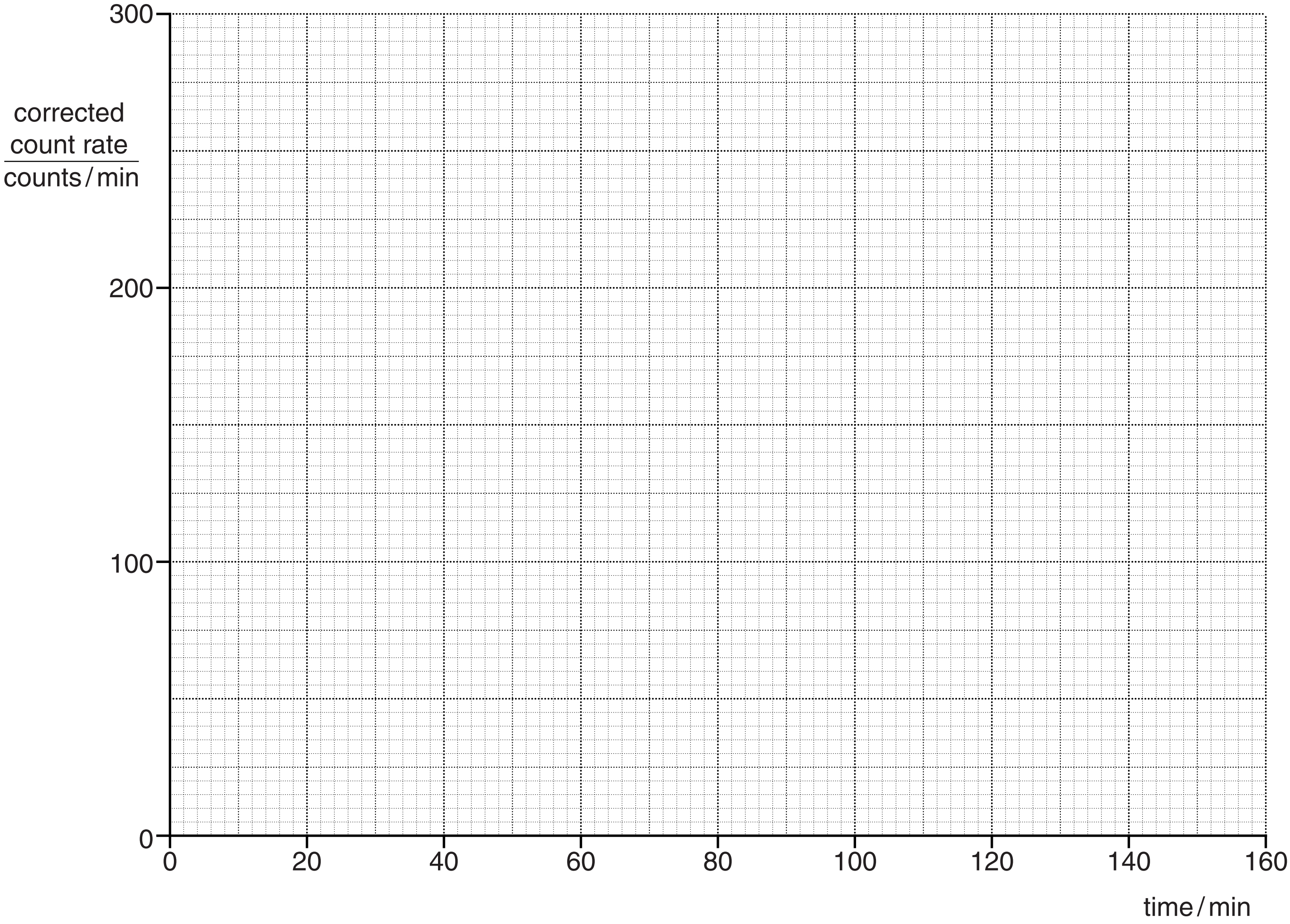

Fig. 10.1

[3]

[Total: 7]

12 The nuclear equation below shows the decay of a plutonium (Pu) nucleus to an americium (Am) nucleus and a β-particle.

$$^{241}_{Z}\text{Pu} \rightarrow {}^{241}_{95}\text{Am} + \beta$$

(a) **(i)** State the quantity that is represented by the letter Z in this equation.

....[1]

(ii) State the numerical value of Z.

Z = ...[1]

(b) The americium nucleus decays by the emission of an α-particle into a neptunium (Np) nucleus.

Complete the nuclear equation for this decay.

$$^{241}_{95}\text{Am} \rightarrow$$

[2]

(c) The half-life of this americium nuclide is 470 years. A sample of this nuclide contains 8.0×10^{14} atoms.

After some time, 6.0×10^{14} americium atoms have decayed.

Calculate the time required for this decay.

time = ...[3]

[Total: 7]

Question	Answer	Mark
11 (a)	83 protons 131 neutrons	B2
11 (b)	${}^{0}_{-1}\beta$ Superscript 0 Subscript –1 ${}^{214}_{84}Po$	 B1 B1 B1
11 (c)	(After 20 min count rate is) 360 / 2 or 180 (count / s) (After 40 min count rate is) 180 / 2 or 90 (counts / s) (After 60 min count rate is) 90 / 2 **OR** new count-rate = 360/(2 × 2 × 2) or 360 / 8 or 3 half-lives 45 (counts / s)	 C1 A1
11 (d)	Any two points chosen from the lists below: (economic): high cost of storage / shielding / guarding / need to store for a long time **OR** reduction in tourism **OR** loss of farming produce / land **OR** reduction of land / property values (social): fear of cancer / causes cancer / genetic mutations / radiation sickness in people / animals **OR** local objections **OR** cause people to move away (environmental): crop mutations **OR** leakage into water supplies **OR** pollution of atmosphere / water supply	B2
		Total: 9
10 (a) (i)	53 protons 78 neutrons 53 electrons	B2
10 (a) (ii)	${}^{131}_{54}Xe$	B1 B1
10 (b)	Points plotted at 3 of: 0 s, 50 s, 100 s, 150 s B1 3 corrected counts/minute plotted at any from : (0, 280) (50, 140) (100, 70) (150, 35) Graph drawn as curve through correct points	B1 M1 A1
		Total: 7

Question	Answer	Mark
12 (a) (i)	atomic number **OR** number of protons **OR** proton number	B1
12 (a) (ii)	94	B1
12 (b)	${}^{237}_{93}\mathrm{Np}$ **+** ${}^{4}_{2}\alpha$	B1 B1
12 (c)	(No of Am atoms remaining = 8 × 10^{14} – 6 × 10^{14}) = 2 × 10^{14} 4 × 10^{14} (Am atoms remain after) 470 yrs or 1 half-life (2 × 10^{14} Am atoms remain after) 940 yrs or 2 half-lives	C1 C1 A1
		Total: 7

Notes about the mark scheme are available separately.

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2: Electricity 1 – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
9	2016	June	41
8	2016	March	42
8	2016	November	41

The mark scheme for each question is provided at the end of the document.

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9 Fig. 9.1 shows a 12 V battery connected in a circuit containing resistors A, B, C and D. Each resistor has a resistance of 6.0 Ω.

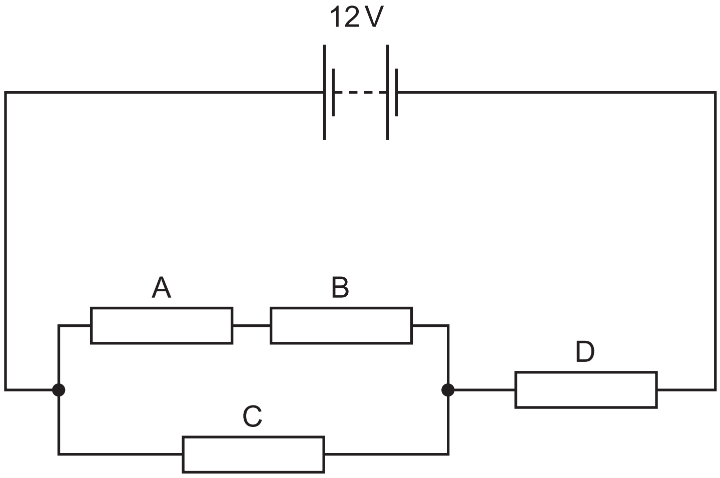

Fig. 9.1

(a) Calculate the combined resistance of

(i) resistors A and B,

resistance = ... [1]

(ii) resistors A, B and C,

resistance = ... [2]

(iii) resistors A, B, C and D.

resistance = ... [1]

(b) Calculate

(i) the current in the battery,

current = ... [1]

(ii) the energy transferred from the battery to the circuit in 50 s.

energy transferred = ... [2]

[Total: 7]

8 **(a)** Fig. 8.1 shows 3 lamps and a fuse connected to a power supply.

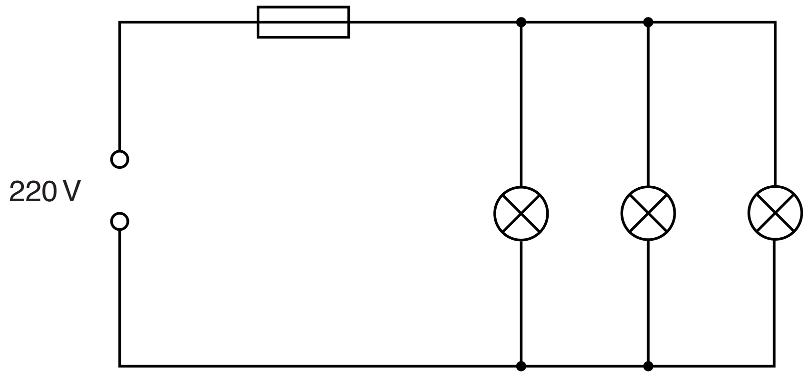

Fig. 8.1

The e.m.f. of the supply is 220 V. Each lamp is labelled 220 V, 40 W. The rating of the fuse is 2.0 A.

Calculate

(i) the current in each lamp,

current = ...[2]

(ii) the current in the fuse,

current = ...[1]

(iii) the total number of lamps, all in parallel, that could be connected without blowing the fuse.

number = ...[2]

(b) After a very long period of use, the wire filament of one of the lamps becomes thinner.

(i) Underline the effect of this change on the resistance of the filament.

resistance increases   resistance remains the same   resistance decreases   [1]

(ii) State and explain the effect of this change on the power of the lamp.

....

....

....[2]

[Total: 8]

8 A battery is made up of 8 cells in series. Each cell has an e.m.f. of 1.5 V.

The battery is connected to one 8.0 Ω resistor for 40 minutes.

(a) Calculate the e.m.f. of the battery.

e.m.f. = ...[1]

(b) Calculate the energy transferred from the battery in 40 minutes.

energy = ...[4]

(c) Describe the energy changes that take place during the 40 minutes.

....

....[2]

[Total: 7]

Question	Answer	Mark
9 (a) (i)	12 Ω	B1
9 (a) (ii)	$1 / R = 1 / R_1 + 1 / R_2$ **OR** 1 / R = 1 / 12 + 1 / 6 OR (R =) $R_1R_2 / (R_1 + R_2)$ **OR** (12 × 6) / (12 + 6) 4 Ω	C1 A1
9 (a) (iii)	4 + 6 = 10 Ω	B1
9 (b) (i)	(I = 12 / 10 =) 1.2 A	B1
9 (b) (ii)	(E =) IVt OR 1.2×12×50 **OR** I^2Rt **OR** 1.2^2 ×10×50 OR V^2t / R OR 12^2 × 50 / 10 720 J	C1 A1
		Total: 7
8 (a) (i)	P =IV OR 40 = 220 × I **OR** (I =) P / V OR 40 / 220 0.18 A	C1 A1
8 (a) (ii)	[3 × 0.18(2)] = 0.54 A **OR** 0.55 A	B1
8 (a) (iii)	2 / 0.182 = 10.99 **OR** 2 / 0.18 = 11.1 C1 10 lamps OR 11 lamps	C1 A1
8 (b) (i)	resistance <u>increases</u>	B1
8 (b) (ii)	power (of lamp) decreases P = IV and current in lamp decreases. OR $P = V^2 / R$	B1 B1
		Total: 8
8 (a)	12 V	B1
8 (b)	(I =) V/R 12 / 8 **OR** 1.5 (A) (W =) IVt OR 1.5 × 12 × 40 (× 60) **OR** (W =) I^2Rt OR 1.52 × 8 × 40 (× 60) **OR** $W = V^2t / R$ OR 122 × 40 (× 60) / 8 43 000 J	C1 C1 C1 A1
8 (c)	Chemical (energy) to electrical (energy) (in battery) Electrical (energy) to thermal / heat (energy) (in resistor)	B1 B1
		Total: 7

Notes about the mark scheme are available separately.

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6: Electricity 2 – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
9	2016	March	42
9	2016	November	42
11	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

9 **(a)** **(i)** State what is meant by the *direction* of an electric field.

....

....[1]

(ii) Fig. 9.1 shows a pair of oppositely-charged horizontal metal plates with the top plate positive.

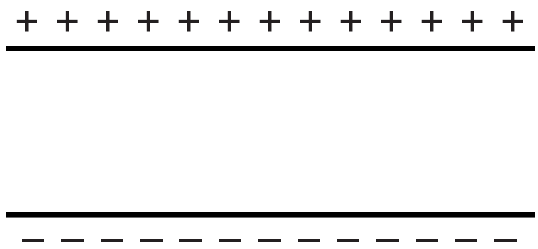

Fig. 9.1

The electric field between the plates in Fig. 9.1 is uniform.

Draw lines on Fig. 9.1 to represent this uniform field. Add arrows to these lines to show the direction of the field. [3]

(b) Fig. 9.2 shows a very small negatively-charged oil drop in the air between a pair of oppositely charged horizontal metal plates. The oil drop does not move up or down.

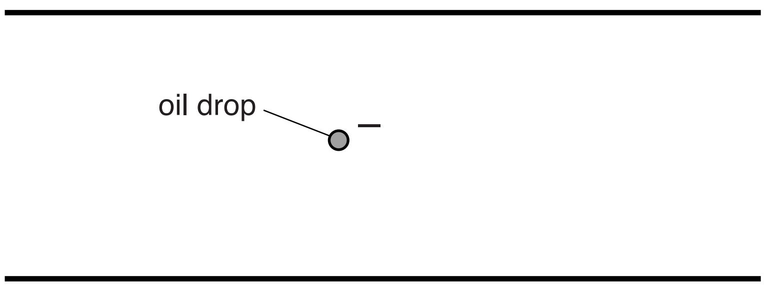

Fig. 9.2

(i) Suggest, in terms of forces, why the oil drop does not move up or down.

....

....[2]

(ii) Without losing any of its charge, the oil drop begins to evaporate.

State and explain what happens to the oil drop.

....

....[2]

[Total: 8]

9 Fig. 9.1 is a circuit diagram.

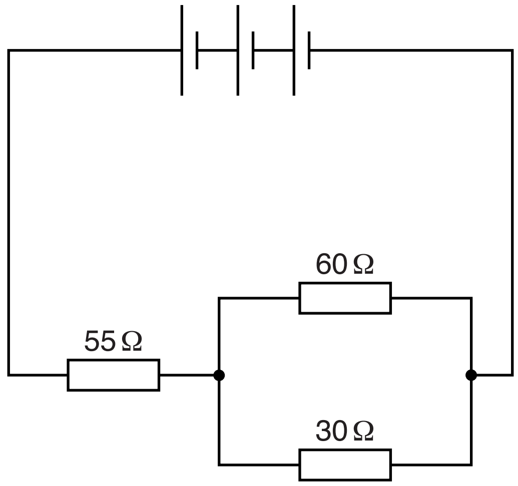

Fig. 9.1

The circuit consists of three resistors and three identical 1.5 V cells.

(a) State the total electromotive force (e.m.f.) of the three 1.5 V cells in series.

total e.m.f. = ... [1]

(b) Calculate

(i) the combined resistance of the resistors in parallel,

resistance = ... [2]

(ii) the total resistance of the circuit,

resistance = ... [1]

(iii) the current in the 55 Ω resistor.

current = ... [2]

(c) The currents in the 30 Ω, the 55 Ω and the 60 Ω resistors are all dif ferent.

State the resistance of the resistor in which the current is

(i) the largest,

resistance = ... [1]

(ii) the smallest.

resistance = ... [1]

[Total: 8]

11 **(a)** State what is meant by

(i) an *electric field*,

....

....[1]

(ii) the direction of an electric field at a point.

....

....[1]

(b) Fig. 11.1 shows a positively charged sphere.

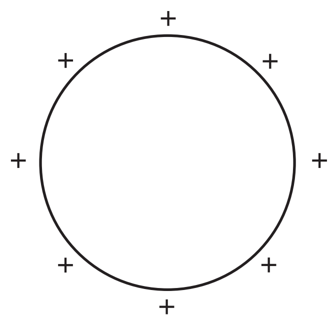

Fig. 11.1

On Fig. 11.1, draw the pattern of the electric field in the region around the positively charged sphere. Show the direction of the field with arrows. [2]

(c) The charge on the sphere in **(b)** is + 2.0×10^{-5} C. A high resistance wire is now connected between the sphere and earth. It takes 20 minutes for the sphere to become completely discharged through the wire.

(i) Suggest why there is a current in the wire between the sphere and earth.

....[1]

(ii) Calculate the average current in the wire between the sphere and earth.

average current = ...[2]

[Total: 7]

Question	Answer	Mark
9 (a) (i)	… direction of the force on a positive charge.	B1
9 (a) (ii)	straight parallel lines from upper to lower plate at least 3 lines drawn. All lines drawn equally spaced, approximately symmetrical with respect to plates arrows downwards	B1 B1 B1
9 (b) (i)	upward force (on drop) due to electric field / charge on plates = weight of drop upward force on drop = downward force on drop **OR** no resultant / net force on drop **OR** forces are balanced	B1 B1 (B1)
9 (b) (ii)	drop moves upwards weight / mass of drop decreases **OR** downward force decreases **OR** upward force (due to electric field) > weight of drop	B1 B1
		Total: 8
9 (a)	4.5 V	B1
9 (b) (i)	1 / R = 1 / R_1+1 / R2 **OR** R_1R_2 / (R_1+R_2) (R =) 20 Ω	C1 A1
9 (b) (ii)	adds 55 to candidate's previous line	B1
9 (b) (iii)	I = V / R in any form **OR** V / R (I = 4.5 / 75 =) 0.060 A	C1 A1
9 (c) (i)	reference to 55 Ω resistor	B1
9 (c) (ii)	reference to 60 Ω resistor	B1
		Total: 8
11 (a) (i)	(region) where a force acts on a charge	B1
11 (a) (ii)	direction of the force acting on a <u>positive</u> charge	B1
11 (b)	at least 4 radial equally spaced straight lines drawn from surface of sphere arrows on lines pointing away from sphere	B1 B1
11 (c) (i)	charges on sphere attract electrons (from earth) **OR** there is a p.d. between the sphere and the earth	B1
11 (c) (ii)	I = Q / t in any form OR Q / t **OR** 20×10^{-6} / (20 × 60) 1.7×10^{-8} A **OR** I = Q / t in any form OR Q / t OR 20 / (20 × 60) 0.017 μA	C1 A1 (C1) (A1)
		Total: 7

Notes about the mark scheme are available separately.

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5: Electromagnetism – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
8	2016	June	41
8	2016	June	42
10	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

8 **(a)** Two straight, vertical wires X and Y pass through holes in a horizontal card.

Fig. 8.1 shows the card viewed from above.

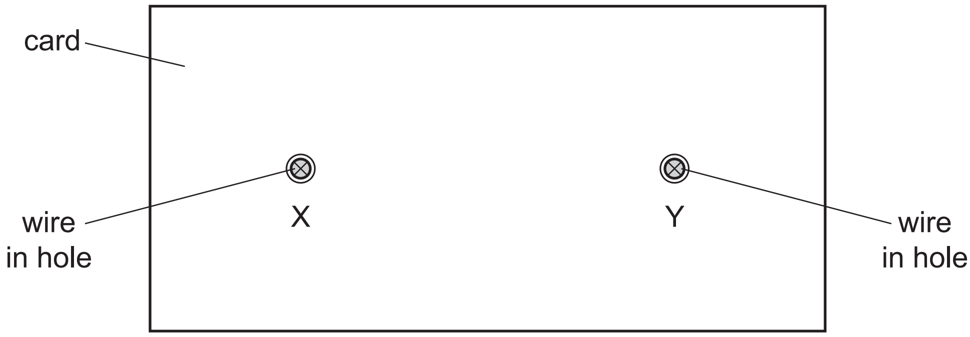


Fig. 8.1

There is a current in each wire in a downward direction (into the page).

(i) The magnetic field at Y due to the current in X produces a force on Y.

Place a tick in each blank column of the table to indicate the direction of this magnetic field and the direction of the force.

	magnetic field at Y	force on Y
towards the top of the page		
towards the bottom of the page		
to the left		
to the right		
into the page		
out of the page		

[2]

(ii) State and explain whether there is also a force on wire X.

....

.... [1]

(b) Fig. 8.2 shows a d.c. supply connected to the input of a transformer.

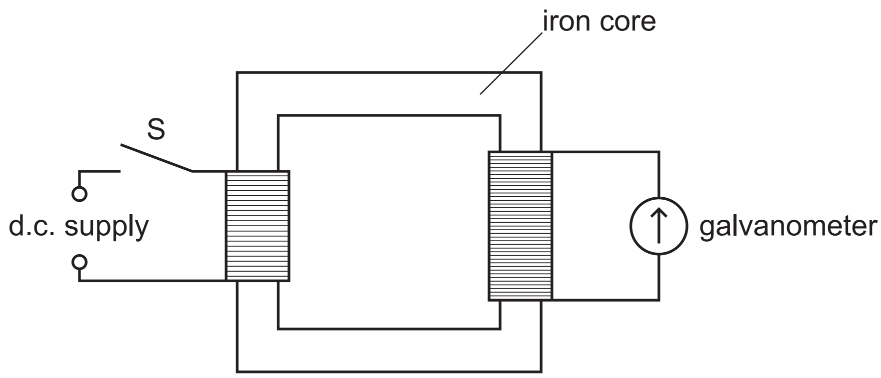


Fig. 8.2

When switch S is first closed, the needle of the galvanometer deflects briefly, then returns to zero.

Explain why the brief deflection occurs.

....

....

....

....

.... [3]

[Total: 6]

8 **(a)** Fig. 8.1 shows a coil wound around a steel bar that is initially unmagnetised.

Any appropriate power supply can be connected between the terminals A and B. No other apparatus is available.

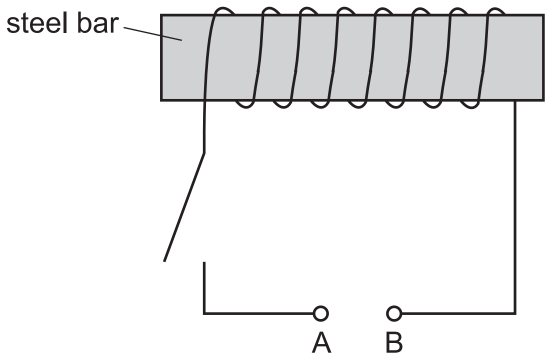


Fig. 8.1

Describe

- how the steel bar can be magnetised,
- how the steel bar can then be demagnetised.

magnetised: ....

....

....

demagnetised: ....

....

.... [4]

(b) Fig. 8.2 shows a transformer.

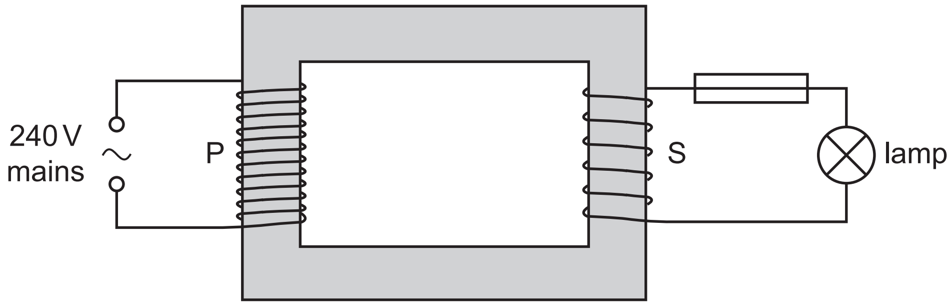


Fig. 8.2

A 240 V mains supply is connected to the primary coil P. The voltage across the secondary coil S is 12 V. A lamp, in series with a 3.0 A fuse, is connected to S.

The number of turns in the coils of the transformer is not shown accurately in Fig. 8.2.

Predict, with a suitable calculation, whether the fuse blows when there is a current of 0.20 A in the primary coil.

....

....

....

....

.... [3]

[Total: 7]

10 Fig. 10.1 shows a wire AB suspended on two supports so that it is between the poles of a strong magnet.

The wire AB is loosely held so that it is free to move.

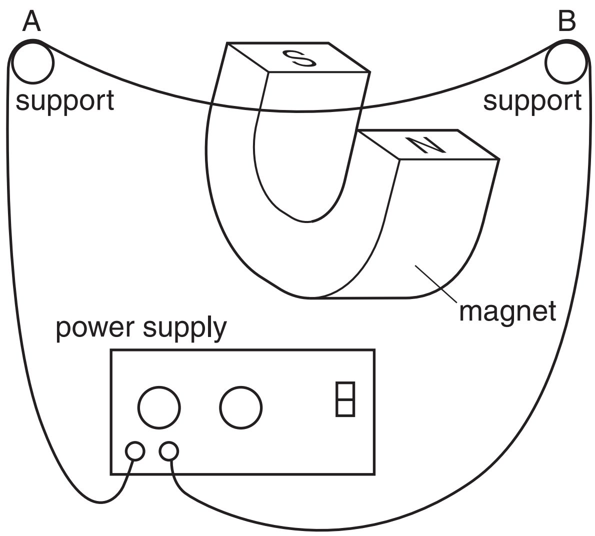


Fig. 10.1

Describe and explain any movement of the wire AB when there is

(a) a large direct current (d.c.) in the wire in the direction from A to B,

....

....

....

....[3]

(b) a large alternating current (a.c.) in the wire.

....

....

....

....[2]

[Total: 5]

Question	Answer	Mark
8 (a) (i)	Magnetic field at Y: ‘towards the bottom of the page’ ticked Force at Y: ‘to the left’ ticked	B1 B1
8 (a) (ii)	There is a force on X because of the (magnetic) field caused by Y **OR** due to the (magnetic) field around / of Y **OR** the (magnetic) fields due to X and Y interacting	B1
8 (b)	Change in current / field is brief / for short time / occurs as switch closes Changing magnetic field / flux links with secondary coil / other coil / core **OR** field / flux lines cut coil Causes induced voltage / current	B1 B1 B1
		Total: 6
8 (a)	connect d.c. supply (to terminals / circuit) switch on connect a.c. supply (to terminals / circuit) withdraw rod from solenoid / reduce current	B1 B1 M1 A1
8 (b)	$I_pV_p = I_sV_s$ **OR** (I_s =) I_pV_p / V_s (0.2 × 240 / 12 =) 4.0 (A) fuse blows / does not blow	C1 A1 B1
		Total: 7
10 (a)	(Wire) moves vertically or down (page) Moves up (page) **OR** Magnetic field is into the page **OR** (Fleming’s) left hand-rule applies	C1 A1 B1
10 (b)	Moves up and down (page) / vibrates up and down (page) (Vertical) force on wire alternates **OR** due to interaction of field of magnet and alternating field (of current)	B1 B1
		Total: 5

Notes about the mark scheme are available separately.

11: Electronics – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
10	2016	June	41
11	2016	March	42
7	2016	November	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

10 (a) (i) Fig. 10.1 shows the symbol for a circuit component.

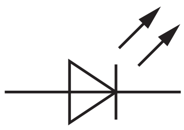


Fig. 10.1

Name this component.

.... [1]

(ii) In the space below, draw the symbol for a NOT gate.

[1]

(b) Fig. 10.2 shows a digital circuit.

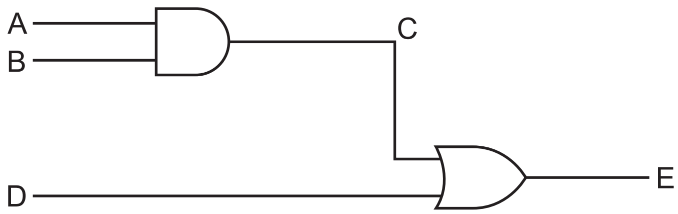


Fig. 10.2

Complete the truth table for this circuit.

input A	input B	output C	input D	output E
0	0		0	
0	0		1	
0	1		0	
0	1		1	
1	0		0	
1	0		1	
1	1		0	
1	1		1	

[3]

(c) Suggest a modification to the circuit in Fig. 10.2 to produce the output Z in the truth table below. It may help you to compare this truth table with the truth table in **(b)**.

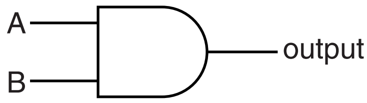
input A	input B	input D	output Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

....

.... [1]

[Total: 6]

11 (a) (i) Fig. 11.1 shows the symbol for a logic gate and its truth table.

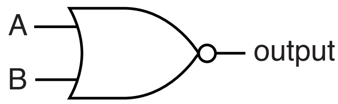


input A	input B	output
0	0	0
1	0	0
0	1	0
1	1	1

Fig. 11.1

State the name of this logic gate. ....[1]

(ii) Complete the truth table for the logic gate shown in Fig. 11.2.



input A	input B	output
0	0	
1	0	
0	1	
1	1	

Fig. 11.2

[2]

(b) Fig. 11.3 shows the system of logic gates used to ensure the security of the strongroom of a bank.

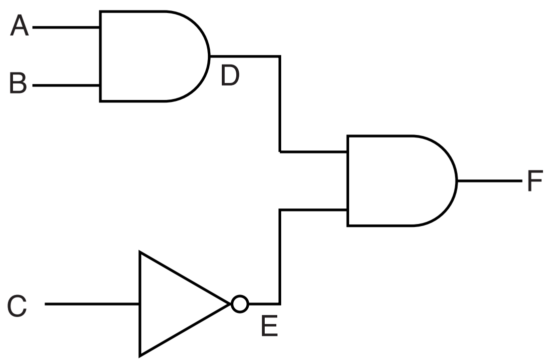


Fig. 11.3

The strongroom door will only open when the output F is logic 1.

Complete the table to show the logic states at A, B, C, D and E when the strongroom door can be opened.

input A	input B	input C	output D	output E	output F
					1

[3]

[Total: 6]

7 **(a)** In the space below, draw the circuit symbol for a thermistor.

[1]

(b) Fig. 7.1 shows the connections between two logic gates.

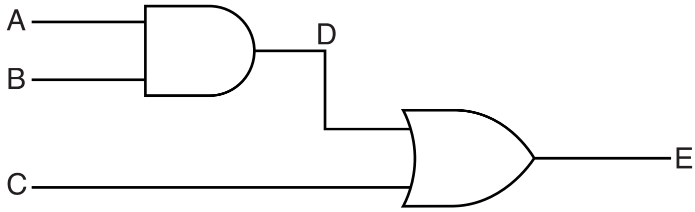


Fig. 7.1

Complete the truth table of this combination of logic gates.

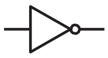
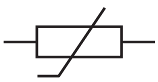
inputs			intermediate point	output
A	B	C	D	E
0	1	1		
1	0	1		
1	1	0		
1	1	1		

[3]

(c) In the space below, draw a truth table to show the action of a NOT gate.

[2]

[Total: 6]

<table>
<tr><th>Question</th><th>Answer</th><th>Mark</th></tr>
<tr><td>10 (a) (i)</td><td>light emitting diode OR LED</td><td>B1</td></tr>
<tr><td>10 (a) (ii)</td><td></td><td>B1</td></tr>
<tr><td>10 (b)</td><td><table>
<tr><th>column C</th><th>column E</th></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td></tr>
</table></td><td>B3</td></tr>
<tr><td>10 (c)</td><td>replace the OR gate with an AND gate</td><td>B1</td></tr>
<tr><td colspan="3">Total: 6</td></tr>
<tr><td>11 (a)</td><td>AND (gate)</td><td>B1</td></tr>
<tr><td>11 (b)</td><td>001
100
010
110</td><td>B2</td></tr>
<tr><td>11 (c)</td><td><table>
<tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
</table></td><td>B3</td></tr>
<tr><td colspan="3">Total: 6</td></tr>
<tr><td>7 (a)</td><td></td><td>B1</td></tr>
<tr><td>7 (b)</td><td>first 2 rows of D both 0
last 2 rows of D both 1
each row of column E logical OR of (column C and candidate’s column D)</td><td>B1
B1
B1</td></tr>
<tr><td>7 (c)</td><td>two single inputs 0 AND 1
two correct single outputs 1 AND 0</td><td>B1
B1</td></tr>
<tr><td colspan="3">Total: 6</td></tr>
</table>

Notes about the mark scheme are available separately.

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3: Energy – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2015	June	33
3	2016	June	42
4	2016	March	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

3 **(a)** The boxes on the left contain the names of some sources of energy. The boxes on the right contain properties of some sources of energy.

Draw **two** straight lines **from each box** on the left to the two boxes on the right which describe that source of energy.

	renewable
solar energy	not renewable
natural gas	polluting
	not polluting

[2]

(b) Coal-fired power stations are polluting.

State an advantage of using coal as a source of energy.

....

....[1]

(c) A coal-fired power station generates electricity at night when it is not needed.

Some of this energy is stored by pumping water up to a mountain lake. When there is high demand for electricity, the water is allowed to flow back through turbines to generate electricity.

On one occasion, 2.05×10^8 kg of water is pumped up through a vertical height of 500 m.

(i) Calculate the weight of the water.

weight = ...[1]

(ii) Calculate the gravitational potential energy gained by the water.

energy gained = ...[2]

(iii) The electrical energy used to pump the water up to the mountain lake is 1.2×10^{12} J. Only 6.2×10^{11} J of electrical energy is generated when the water is released.

Calculate the efficiency of this energy storage scheme.

efficiency = ...[2]

[Total: 8]

3 Fig. 3.1 shows a cabin used to transport passengers up a hillside.

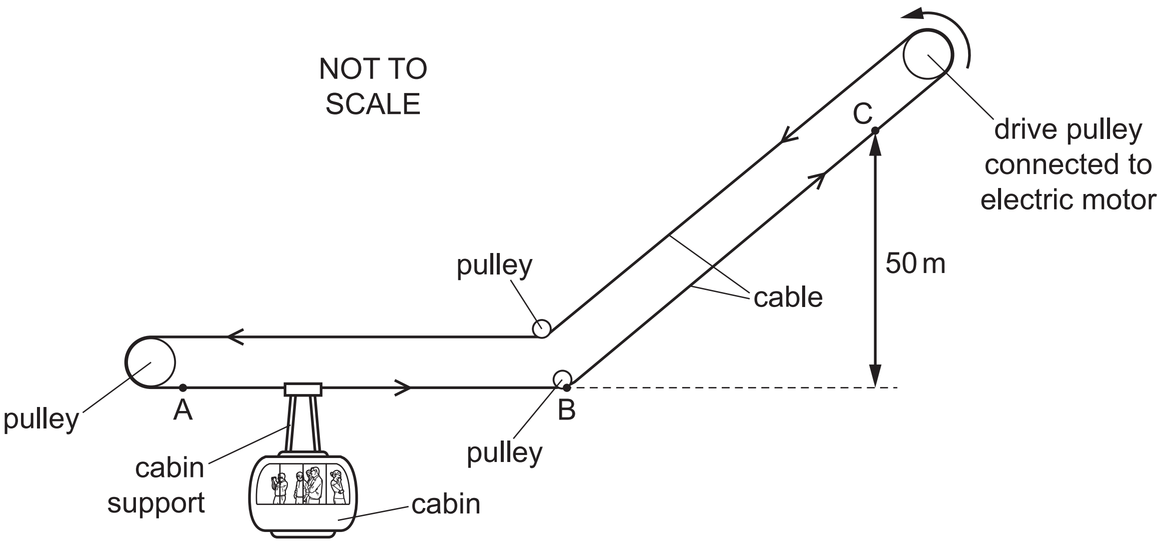

Fig. 3.1

The cabin is attached to a cable which moves horizontally from A to B, then up the hill from B to C.

(a) There is an electrical input of energy to the motor which moves the cable.

Place **two** ticks against types of energy that increase as the cabin moves **horizontally** at **constant speed** from A to B.

☐ kinetic energy of the cabin

☐ gravitational potential energy of the cabin

☐ gravitational potential energy of the cable

☐ internal energy of the surroundings

☐ internal energy of the wires of the motor

[2]

(b) The cabin and passengers have a total mass of 800 kg. The vertical distance between B and C is 50 m.

Calculate the increase of gravitational potential energy of the cabin and passengers when they move from B to C.

energy = ... [2]

(c) The cabin then descends back from C to B.

The weight of the cabin pulls the cable, which rotates the motor. The electric motor acts as a generator when rotated in this way.

Explain the environmental and economic benefits of this arrangement.

....

....

....

....

....

.... [3]

[Total: 7]

4 **(a)** The source of solar energy is the Sun.

Tick the box next to those resources for which the Sun is also the source of energy.

- ☐ coal
- ☐ geothermal
- ☐ hydroelectric
- ☐ nuclear
- ☐ wind

[2]

(b) Fig. 4.1 shows a solar water-heating panel on the roof of a house.

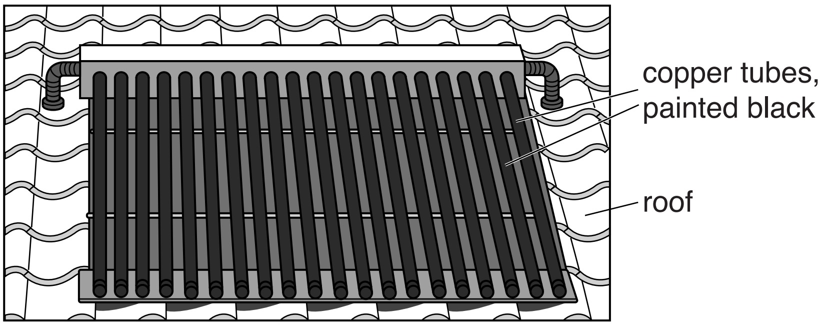

Fig. 4.1

Cold water flows into the copper tubes, which are heated by solar radiation. Hot water flows out of the tubes and is stored in a tank.

(i) Explain why the tubes are made of copper and are painted black.

....

....

....[2]

(ii) In 5.0 s, 0.019 kg of water flows through the tubes. The temperature of the water increases from 20 °C to 72 °C. The specific heat capacity of water is 4200 J/(kg °C).

Calculate the thermal energy gained by the water in 5.0 s.

thermal energy = ...[3]

(iii) The efficiency of the solar panel is 70%.

Calculate the power of the solar radiation incident on the panel.

power = ...[2]

[Total: 9]

Question	Answer	Mark
3 (a)	lines from solar energy to boxes 1 AND 4 only B1 lines from natural gas to boxes 2 AND 3 only	B1 B1
3 (b)	(relatively) cheap **OR** widely available **OR** can be used on a large scale **OR** always available	B1
3 (c) (i)	2.05×10^9 N	B1
3 (c) (ii)	use of *mgh* **OR** weight × h 1.03×10^{12} J **NOT** ecf from (i)	C1 A1
3 (c) (iii)	output energy ÷ input energy **OR** $6.2 \times 10^{11} \div 1.2 \times 10^{12}$ 0.52 **OR** 52 %	C1 A1
		Total: 8
3 (a)	internal energy of surroundings Box 4 internal energy of wires of motor Box 5	B1 B1
3 (b)	(change of g.p.e. =) mgh (800 × 10 × 50 =) 400 000 J **OR** 400 kJ	C1 A1
3 (c)	any three from the following four: • electrical energy generated • sensible use of electrical energy • sensible economic comment • sensible environmental comment	B3
		Total: 7
4 (a)	Coal, hydroelectric and wind boxes ticked	B2
4 (b) (i)	Copper is a good conductor of thermal energy / heat Black surface is a good / the best absorber <u>of radiation</u> / <u>infra-red</u>	B1 B1
4 (b) (ii)	Temp rise =) 72 – 20 = 52 (°C) (Q =) mcΔθ **OR** 0.019 × 4200 × 52 4100 J	C1 C1 A1
4 (b) (iii)	Efficiency = (power) output / (power) input (× 100) **OR** 70 $\frac{\left(\frac{4100}{5}\right) \times 100}{\text{power input}}$ OR $\frac{4100 \times 100}{\text{power input}}$ **OR** rearranged Power input = 1200 W	C1 A1
		Total: 9

Notes about the mark scheme are available separately.

Cambridge Assessment International Education

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1: Light – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
7	2016	June	41
7	2016	March	42
7	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

7 **(a)** **(i)** A ray of light passes through a length of curved optical fibre.

Draw a diagram showing the fibre and the path of the ray of light.

[1]

(ii) Describe one use of optical fibres in medicine. You may draw a diagram.

....

....

....

....

....

....

.... [3]

(b) Draw a straight line from each wave on the left to the most appropriate speed.

	90 m / s (9×10)
light in air	6000 m / s (6×10^3)
	100 000 m / s (1×10^5)
microwaves in a vacuum	1 000 000 m / s (1×10^6)
sound in steel	300 000 000 m / s (3×10^8)
	60 000 000 000 m / s (6×10^{10})

[3]

(c) The refractive index of a block of glass is 1.5.

Use your value for the speed of light from **(b)** to calculate the speed of light in this block.

speed = ... [2]

[Total: 9]

7 **(a)** Explain what is meant by

(i) *total internal reflection*,

....

....[1]

(ii) *critical angle*.

....

....[1]

(b) Fig. 7.1 shows a ray of light, travelling in air, incident on a glass prism.

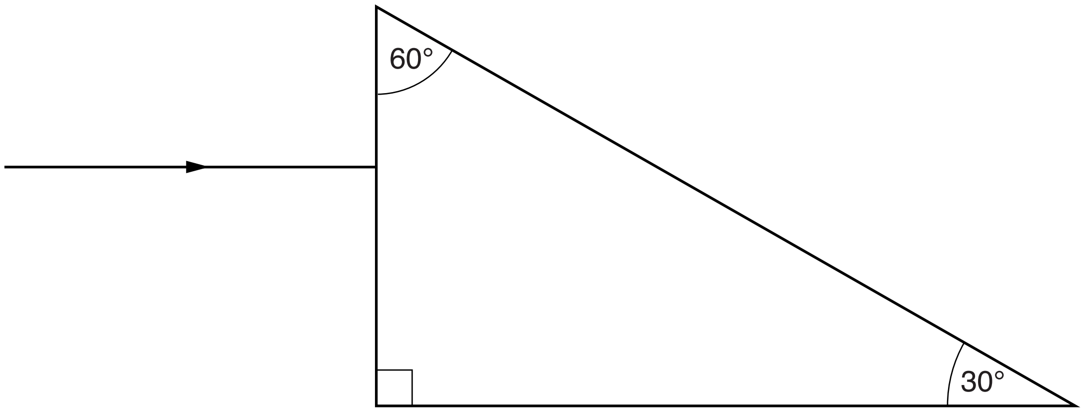

Fig. 7.1

(i) The speed of light in air is 3.0×10^8 m/s. Its speed in the glass is 2.0×10^8 m/s.

Calculate the refractive index of the glass.

refractive index = ...[2]

(ii) Show that the critical angle for the glass-air boundary is 42°.

[1]

(iii) On Fig. 7.1, draw carefully, without calculation, the continuation of the ray through the prism and into the air. [3]

[Total: 8]

7 Fig. 7.1 shows a box ABCD.

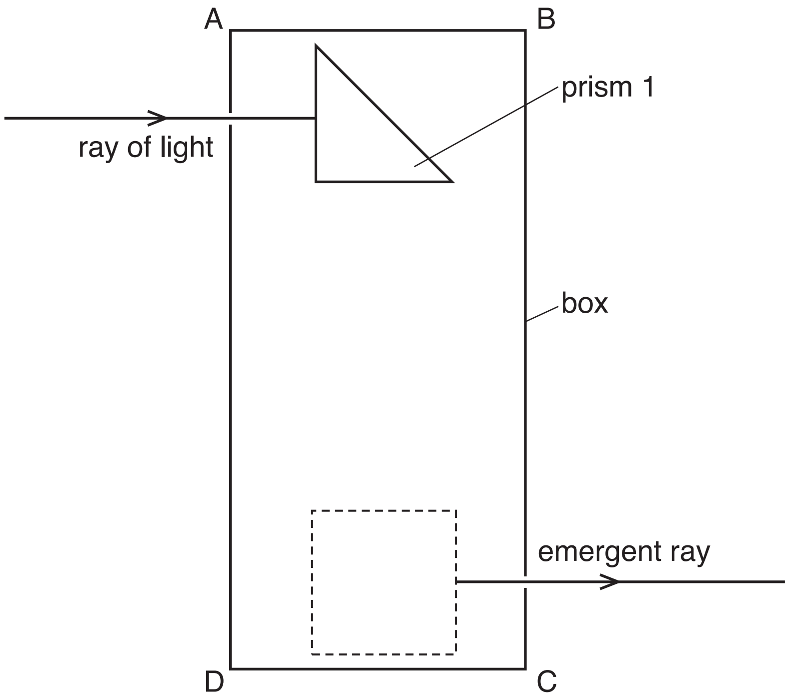

Fig. 7.1

The box contains two identical glass prisms, one of which is shown. Light incident on prism 1 undergoes total internal reflection within the glass.

(a) **(i)** On Fig. 7.1, complete the path of the ray of light through prism 1. [2]

(ii) On Fig. 7.1, draw a second prism inside the dashed square, positioned so that the light reflects inside the glass and emerges from the box as shown. Complete the path of the ray. [2]

(b) Select the statements that correctly describe the necessary conditions for the light to undergo total internal reflection. Tick **two** boxes.

☐ The angle of incidence in the glass is less than the critical angle of light in the glass.

☐ The angle of incidence in the glass is greater than the critical angle of light in the glass.

☐ The angle of reflection in the glass is equal to the angle of refraction.

☐ The speed of light in the glass is greater than the speed of light in air.

☐ The speed of light in the glass is equal to the speed of light in air.

☐ The speed of light in the glass is less than the speed of light in air.

[2]

[Total: 6]

Question	Answer	Mark
7 (a) (i)	sketch of <u>curved</u> optic fibre with light ray undergoing at least one total internal reflection	B1
7 (a) (ii)	light travels down (optic) fibres into or out of body to examine internal organ / part light travels both ways into and out of body **OR** to destroy (cancerous) cells by heating **OR** endoscope / fibre bundle inserted into body to view internal organ body part OR for keyhole surgery	B1 B1 B1 (B1) (B1) (B1) (B1)
7 (b)	Light in air: 3×10^8 m / s Microwaves in vacuum: 3×10^8 m / s Sound in steel: 6000 m / s	B1 B1 B1
7 (c)	n = speed in air / speed in glass (or rearranged) **OR** 1.5 = 3×10^8 / speed in glass (or rearranged) 2.0×10^8 m / s	C1 A1
		Total: 9
7 (a) (i)	reflection <u>in a more dense material</u> where there is no refracted ray owtte **OR** all light in a more dense material is reflected owtte	B1
7 (a) (ii)	e.g. the greatest angle of incidence (in the material) at which refraction occurs **OR** the angle of incidence (in the material) at which the refracted B1 ray travels along the boundary / angle of refraction is 90° **OR** the angle of incidence / (in the material) above which total internal reflection occurs	B1
7 (b) (i)	(refractive index =) speed of light in air / speed of light in glass **OR** $3.0 \times 10^8 / 2.0 \times 10^8$ = 1.5	M1 A1
7 (b) (ii)	sin c = 1 / n **OR** 1 / 1.5 seen (c = 42°)	B1
7 (b) (iii)	no change of direction at first face total internal reflection at hypotenuse with i = r by eye refraction with r greater than i at lower face	B1 B1 B1
		Total: 8

Question	Answer	Mark
7 (a) (i)	ray continues through first face, without bending, to sloping face ray reflected vertically down at sloping face	M1 A1
7 (a) (ii)	prism drawn with correct orientation in square correct reflection to produce emergent ray	M1 A1
7 (b)	tick in box 2 tick in box 6	B1 B1
		Total: 6

Notes about the mark scheme are available separately.

Cambridge Assessment International Education

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4: Mechanics 1 – Topic questions Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	41
1	2016	March	42
1	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

1 (a) A bus travels at a constant speed. It stops for a short time and then travels at a higher constant speed.

Using the axes in Fig. 1.1, draw a distance-time graph for this bus journey.

Fig. 1.1

[3]

(b) A lift (elevator) starts from rest at the ground floor of a building.

Fig. 1.2 is the speed-time graph for the motion of the lift to the top floor of the building.

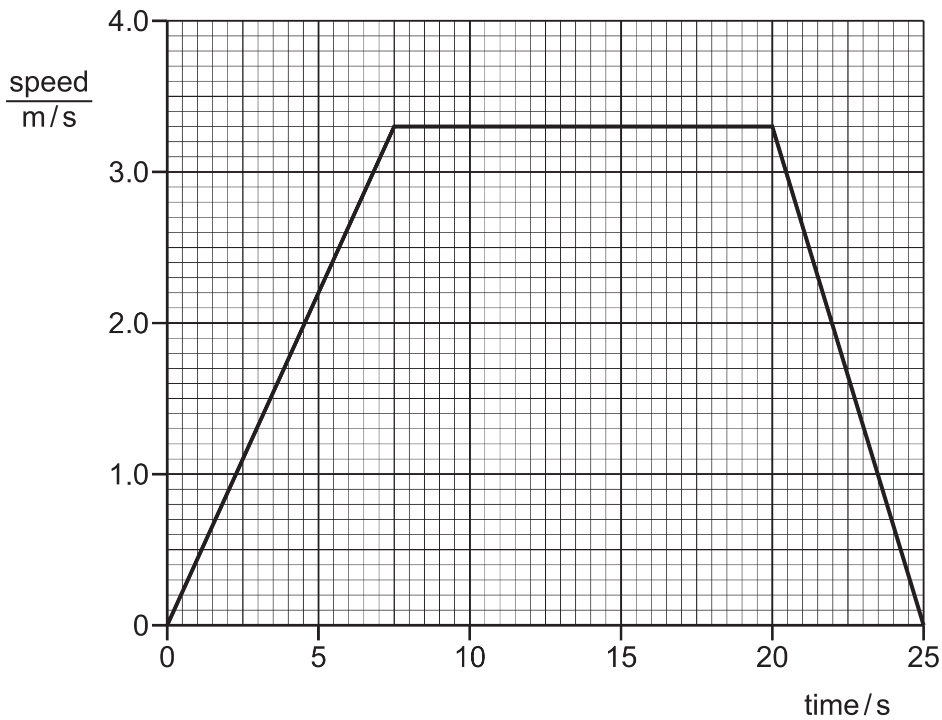

Fig. 1.2

Use the graph to determine the distance from the ground floor to the top floor of the building.

distance = ... [4]

[Total: 7]

1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time.

Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.

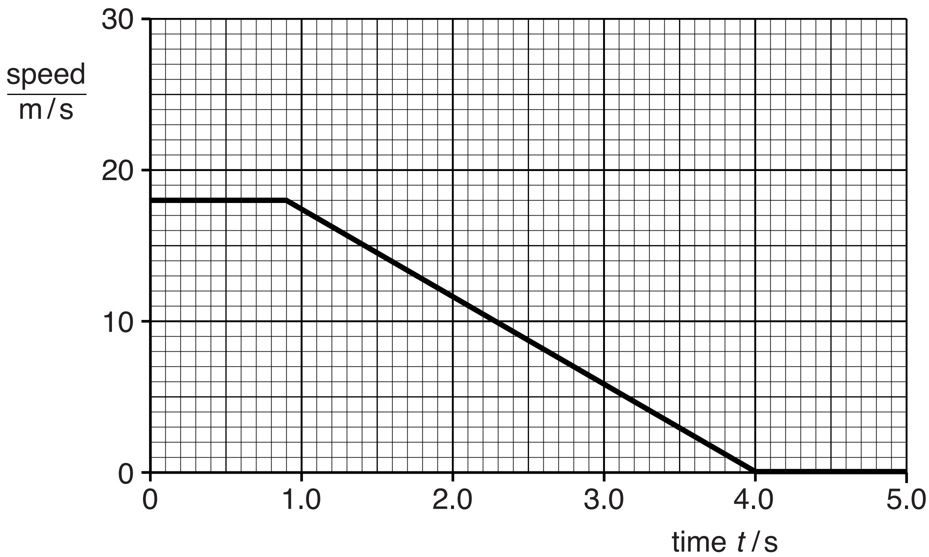

Fig. 1.1

(a) The order to stop is given at time $t = 0$ s.

(i) State the speed of the car at $t = 0$ s.

speed = ...[1]

(ii) Suggest why the car continues to travel at this speed for 0.9 s.

....

....[1]

(b) Calculate

(i) the deceleration of the car between $t = 0.9$ s and $t = 4.0$ s,

deceleration = ...[2]

(ii) the total distance travelled by the car from $t = 0$ s.

distance = ...[3]

(c) Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

....

....

....

....[2]

[Total: 9]

An astronaut on the Moon drops a feather from rest, off the top of a small cliff. The acceleration due to gravity on the Moon is $1.6\,m/s^2$. There is no air on the Moon.

(a) The feather falls for 4.5 s before it hits the ground.

(i) On Fig. 1.1, draw the speed-time graph for the falling feather. [2]

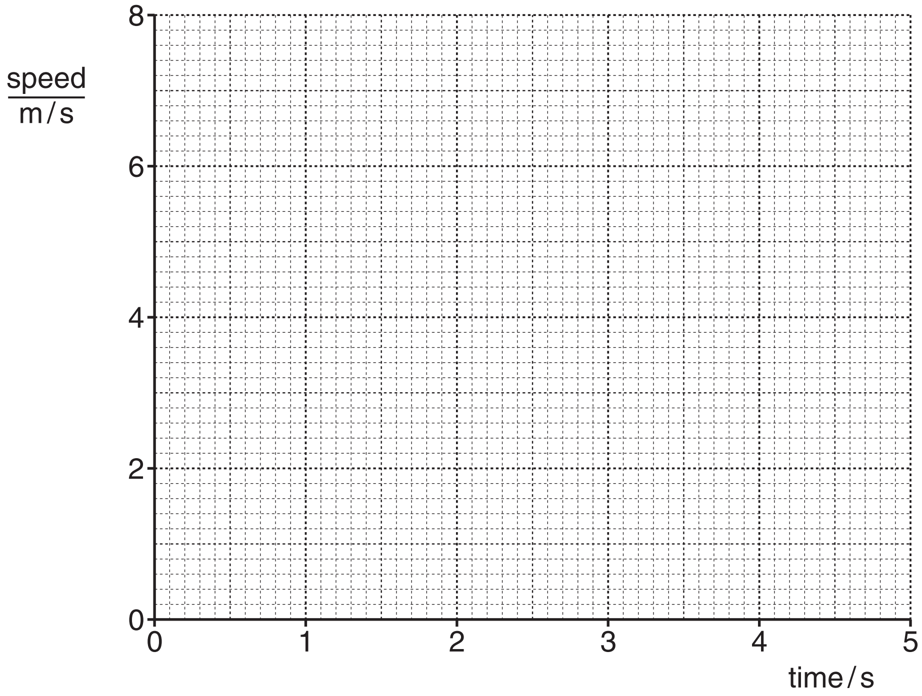

Fig. 1.1

(ii) Determine the distance fallen by the feather.

distance = ... [2]

(b) On Fig. 1.2, sketch the shape of a speed-time graph for the same feather falling on Earth.

Fig. 1.2

[2]

(c) Explain the difference between speed and velocity. Include the words *vector* and *scalar* in your answer.

....

....

....

....[2]

[Total: 8]

Question	Answer	Mark
1 (a)	from time zero, line of constant positive gradient, not necessarily from origin horizontal line from end of sloping line line of steeper positive gradient from end of horizontal line	B1 B1 B1
1 (b)	(distance =) area under graph stated 0.5 × 7.5 × 3.3 (= 12.375) + 12.5 × 3.3 (= 41.25) + 0.5 × 5 × 3.3 (= 8.25) **OR** ½ (a + b)h = 0.5 × (25 + 12.5) × 3.3 **OR** (25 × 3.3) – (0.5 × 12.5 × 3.3) 62 m	C1 C2 (C1) (C1) (C2) A1
		Total: 7
1 (a) (i)	8 m/s	B1
1 (a) (ii)	(0.90s is) driver's time to react	B1
1 (b) (i)	(a =) (v – u) / t **OR** Δv / t **OR** either in words **OR** (18 – 0) / 3.1 **OR** 18 / 3.1 5.8 m / s^2 **OR** Values from any correct points on graph Answer dependent on accuracy of chosen points	C1 A1 (C1) (A1)
1 (b) (ii)	Evidence of use of: (distance =) area under graph e.g. 1 / 2bh (18 × 0.9) + (0.5 × 3.1 × 18) 44 m	C1 C1 A1
1 (c)	(Without seat belt, driver:) e.g. keeps moving (forwards) / does not stop / has inertia / has momentum (Driver) hits steering wheel / windscreen / dashboard	B1 B1
		Total: 9
1 (a) (i)	Straight line from origin to (4.5 s, 7.2 m/s) Tolerance in plotting: ½ a square	B2
1 (a) (ii)	Use of area stated or implied by numbers used OR average speed · time OR s = (u+v) / t / 2 OR vt / 2 OR 0.5 · 4.5 · 7.2 16(.2) m	C1 A1
1 (b)	Rises from origin and curves with decreasing gradient Finishes horizontal	B1 B1
1 (c)	Speed is scalar Velocity is vector Speed has magnitude / size / value (only) Velocity has magnitude / size / value and direction OR velocity has direction; speed does not	B1 B1
		Total: 8

Notes about the mark scheme are available separately.

8: Mechanics 2 – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
2	2016	June	41
3	2016	June	41
2	2016	March	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

2 Fig. 2.1 shows a dummy of mass 70 kg used in a crash test to investigate the safety of a new car.

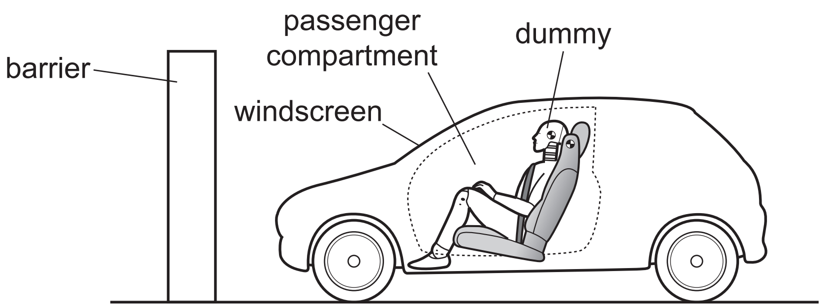

Fig. 2.1

The car approaches a solid barrier at 20 m / s. It crashes into the barrier and stops suddenly.

(a) **(i)** Calculate the momentum of the dummy immediately before the crash.

momentum = ... [2]

(ii) Determine the impulse that must be applied to the dummy to bring it to rest.

impulse = ... [1]

(b) In the crash test, the passenger compartment comes to rest in 0.20 s.

Calculate the deceleration of the passenger compartment.

deceleration = ... [2]

(c) The seat belt and air bag bring the dummy to rest so that it does not hit the windscreen. The dummy has an average deceleration of $80\,m/s^2$.

Calculate the average resultant force applied to the dummy, of mass 70 kg.

force = ... [2]

(d) The deceleration of the dummy is less than the deceleration of the passenger compartment.

Explain why this is of benefit for the safety of a passenger.

....

....

....

....

....

.... [2]

[Total: 9]

3 Fig. 3.1 shows an oil tank that has a rectangular base of dimensions 2.4 m by 1.5 m.

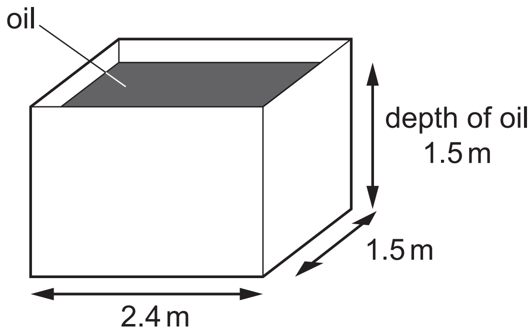

Fig. 3.1

The tank is filled with oil of density 850 kg / m^3 to a depth of 1.5 m.

(a) Calculate

(i) the pressure exerted by the oil on the base of the tank,

pressure = ... [2]

(ii) the force exerted by the oil on the base of the tank.

force = ... [2]

(b) The force calculated in **(a)(ii)** is the weight of the oil.

Calculate the mass of oil in the tank.

mass = ... [1]

(c) When he is checking the level of oil in the tank, a man drops a brass key into the oil and it sinks to the bottom of the oil.

(i) State what this shows about the density of brass.

.... [1]

(ii) Explain how attaching the key to a piece of wood could prevent the key from sinking.

....

....

.... [1]

[Total: 7]

2 Fig. 2.1 shows a hammer being used to drive a nail into a piece of wood.

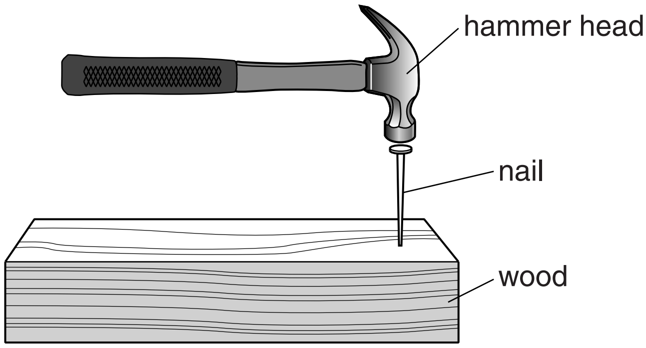

Fig. 2.1

The mass of the hammer head is 0.15 kg.
The speed of the hammer head when it hits the nail is 8.0 m/s.
The time for which the hammer head is in contact with the nail is 0.0015 s.

The hammer head stops after hitting the nail.

(a) Calculate the change in momentum of the hammer head.

change in momentum = ...[2]

(b) State the impulse given to the nail.

impulse = ...[1]

(c) Calculate the average force between the hammer and the nail.

average force = ...[2]

[Total: 5]

Question	Answer	Mark
2 (a)	mv – mu **OR** m(v – u) **OR** mv **OR** 0.15 × 8.0 1.2 N s or kg m / s	C1 A1
2 (b) (i)	1.2 N s or kg m / s	B1
2 (c)	F = (mv – mu) / t **OR** F = mv / t **OR** impulse / t **OR** 1.2 / 0.0015 800 N **OR** (F =) ma **OR** m[(v – u) / t] **OR** 0.15 × 8 / 0.0015 800 N	C1 A1 (C1) (C1)
		Total: 5
2 (a) (i)	(momentum =) mv **OR** 70 × 20 = 1400 kg m / s **OR** N s	C1 A1
2 (a) (ii)	same numerical answer as **(a)(i)** with either unit **OR** 1400 kg m / s	B1
2 (b)	(a =) change of velocity / time **OR** (v – u) /t **OR** 20 / 0.2 100 m / s^2	C1 A1
2 (c)	(F =) ma **OR** 70 x 80 5600 N	C1 A1
2 (d)	Force / impact on passenger or dummy less (than without seat belt / airbag) Passenger less likely to be injured / hurt / damaged	M1 A1
		Total: 9
3 (a) (i)	(P =) hdg **OR** 1.5 × 850 × 10 **OR** mg / area of base **OR** 850 × 2.4 × 1.5 × 1.5 × 10 / (2.4 × 1.5) 13 000 Pa or N/m^2	C1 (C1) A1
3 (a) (ii)	P = F/A **OR** (F =) PA **OR** 12 750 × 1.5 × 2.4 **OR** 12 750 × 3.6 46 000 N **OR** (Force =) weight of oil = mg = 2.4 × 1.5 × 1.5 × 850 × 10 46 000 N	C1 A1 (C1) (A1)
3 (b)	(46000 / 10 =) 4600 kg **OR** m = Vd = (2.4 × 1.5 × 1.5) × 850 = 4600 kg	B1
3 (c) (i)	(density of brass) greater than that of oil / 850 kg / m^3 **OR** brass denser than oil	B1
3 (c) (ii)	(it won't sink as average) density of wood + key less than density of oil	B1
		Total: 7

Notes about the mark scheme are available separately.

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7: Thermal physics – Topic questions Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
4	2016	June	41
5	2016	June	41
5	2016	March	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

4 **(a)** Explain, in terms of molecules, why it is possible to compress a gas, but not a liquid.

....

....

....

.... [2]

(b) Two containers made of insulating material contain the same volume of water at room temperature. The containers do not have lids. The volume of liquid in each container gradually decreases.

(i) After a certain time, the temperature of the water has decreased to below room temperature.

Explain, in terms of molecules, why the temperature has decreased.

....

....

....

.... [2]

(ii) One of the containers is wide and shallow. The other container is narrow and deep.

Predict which container has the greater rate of cooling. Explain your answer.

....

....

.... [2]

[Total: 6]

5 **(a)** State what happens to the molecules of a gas in a sealed container when the temperature of the gas is increased.

.... [1]

(b) A quantity of gas is contained in a sealed container of fixed volume. The temperature of the gas is increased.

State, in terms of molecules, **two** reasons why the pressure of the gas increases.

1. ....

2. ....

[2]

(c) A helium-filled weather balloon is held at ground level. The volume of the balloon is 4800 m^3. The pressure of the helium is 98 kPa.

The balloon is released and rises to a height where the volume of the balloon is 7200 m^3.

(i) Calculate the new pressure of the helium. Assume that the temperature stays constant.

pressure = ... [2]

(ii) Suggest why it may be necessary to release helium from the balloon as it rises even higher.

....

.... [1]

[Total: 6]

5 **(a)** A student carries out an experiment to find the relationship between the pressure p and the volume V of a fixed mass of gas. The table contains four of her sets of measurements.

p/kPa	250	500	750	1000
V/cm^3	30.0	15.2	9.8	7.6

(i) Use the data in the table to suggest the relationship between the pressure and the volume in this experiment. Explain how you reach your conclusion.

....

....

....

....[2]

(ii) State the property of the gas, apart from the mass, that remains constant during the experiment.

....[1]

(b) A lake is 5.0 m deep. The density of the water is 1000 kg/m^3.

(i) Calculate the pressure at the bottom of the lake due to this depth of water.

pressure = ...[2]

(ii) A bubble of gas escapes from the mud at the bottom of the lake and rises to the surface.

Place one tick in each row of the table to indicate what happens to the volume, the mass and the density of the gas in the bubble. Assume that no gas or water vapour enters or leaves the bubble.

	increases	stays the same	decreases
volume of bubble			
mass of gas in bubble			
density of gas in bubble			

[2]

[Total: 7]

Question	Answer	Mark
4 (a)	Gas molecules (very) far apart **OR** empty space between gas molecules Molecules of liquid (very) close together / compact **OR** are touching (each other)	B1 B1
4 (b) (i)	Faster / more energetic water molecules evaporate / escape / leave Slower / less energetic molecules remain (so temperature is lower)	B1 B1
4 (b) (ii)	Water in wide container **AND** has water with larger surface (area) Rate of evaporation higher / faster / quicker **OR** higher chance of evaporation	B1 B1
		Total: 6
5 (a)	One of 1, 2 or 3: 1 Molecules move faster **OR** have more k.e. / momentum 2 Molecules hit walls more often / more frequently 3 Molecules hit walls with greater force / impulse / harder	B1
5 (b)	1 mark for each of 1, 2 and 3 in (a) not given as answer to (a)	B2
5 (c) (i)	PV = constant **OR** $P_1V_1 = P_2V_2$ **OR** $98 \times 4800 = P \times 7200$ 65 kPa	C1 A1
5 (c) (ii)	To prevent the balloon bursting (as its volume increases) **OR** to reduce the pressure inside the balloon **OR** pressure difference between inside and outside balloon rises	B1
		Total: 6
5 (a) (i)	P × V values are 7500 or about 7500 **OR** If P / pressure doubles, V / volume halves **OR** vice versa (so) PV = constant **OR** P α 1 / V **OR** either in words	B1 B1
5 (a) (ii)	temperature	B1
5 (b) (i)	P = hdg **OR** $5.0 \times 10 \times 1000$ 50 000 Pa or 50 kPa	C1 A1
5 (b) (ii)	Volume of bubble <u>increases</u> Mass of gas <u>stays the same</u> Density of gas <u>decreases</u>	B2
		Total: 7

Notes about the mark scheme are available separately.

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9: Waves – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
6	2016	June	41
6	2016	March	42
6	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

6 **(a)** Two students are measuring the speed of sound.

The students are provided with a starting pistol, a stopwatch and a long measuring tape. The starting pistol, when fired, produces a loud sound and a puff of smoke at the same instant.

Describe how the students use the apparatus and how they calculate the speed. You may draw a diagram.

....

....

....

....

....

....

....

....

....

.... [4]

(b) A device at the bottom of the sea emits a sound wave of frequency 200 Hz.

(i) The speed of sound in sea-water is 1500 m / s.

Calculate the wavelength of the sound in sea-water.

wavelength = ... [2]

(ii) The sound wave passes from the sea-water into the air.

State what happens, if anything, to

- the frequency of the sound, ...

....

- the speed of the sound. ....

....

[2]

[Total: 8]

6 **(a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.

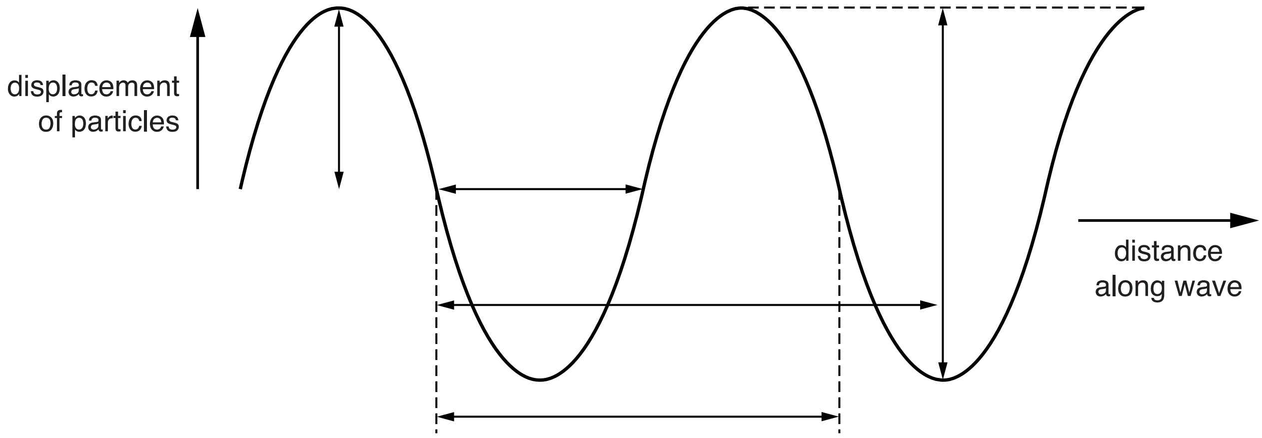

Fig. 6.1

(i) On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]

2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

(ii) State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,

amplitude ....

wavelength ....
[1]

2. the pitch of the sound is increased at constant loudness.

amplitude ....

wavelength ....
[1]

(b) A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m/s.

Calculate the depth of the sea beneath the ship.

depth = ...[3]

[Total: 7]

6 **(a)** **(i)** State a typical value for the speed of sound in air.

speed = ...[1]

(ii) State the range of frequencies that can be heard by a healthy human ear.

....[1]

(b) A sound wave in air has a wavelength of 22 mm.

Fig. 6.1 represents wavefronts of this sound. These wavefronts are successive compressions.

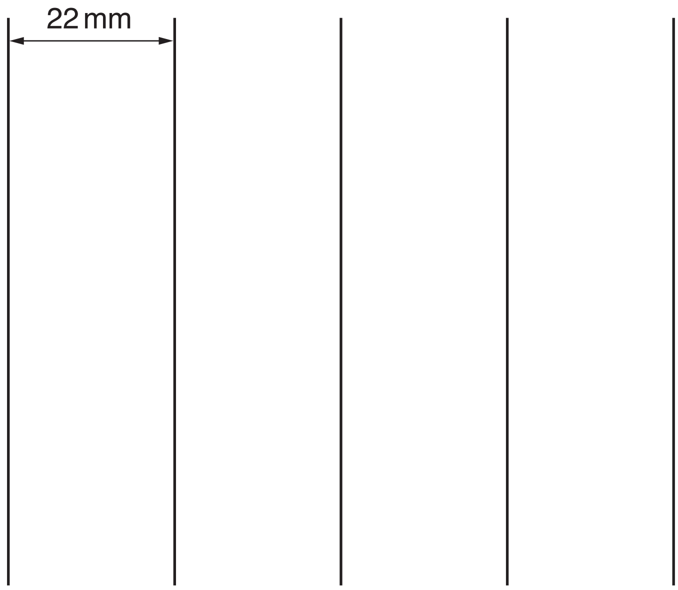

Fig. 6.1

(i) Using your value for the speed of sound in **(a)(i)**, calculate the frequency of the sound wave.

frequency = ...[2]

(ii) On Fig. 6.1, draw dotted lines to represent **three** different rarefactions. [1]

(iii) State, in terms of both molecules and pressure, what is meant by a *rarefaction*.

....

....

....

....[2]

[Total: 7]

Question	Answer	Mark
6 (a)	Method 1: Long distance / distance in field measured with the tape One student fires pistol at one end (of this distance) Student at other end starts stop-watch on seeing smoke / light from pistol and st / ops stop-watch on hearing sound of pistol speed = (measured) distance / (measured) time Method 2: Distance of 50 m or more from a vertical wall measured with the tape Student 1 fires pistol at this distance from the wall Student 2 standing next to student 1 starts stop-watch on hearing pistol and stops stop-watch on hearing echo speed = 2 × (measured) distance / (measured) time	B1 B1 B1 B1 (B1) (B1) (B1) (B1)
6 (b) (i)	v = fλ OR (λ =) v / f OR 1500 / 200 7.5 m	C1 A1
6 (b) (ii)	1 (frequency) does not change 2 (speed) decreases	B1 B1
		Total: 8
6 (a) (i)	1 mark amplitude with **X** 2 mark wavelength with **Y**	B1 B1
6 (a) (ii)	1 amplitude increase <u>and</u> wavelength stays the same 2 amplitude stays the same <u>and</u> wavelength decreases	B1 B1
6 (b)	v = (total) distance / time OR d / t OR 2d / t in any form d = 1500 × 0.054 / 2 40 m OR 41 m	C1 C1 A1
		Total: 7
6 (a) (i)	300 – 360 m / s	B1
6 (a) (ii)	20 Hz – 20 KHz	B1
6 (b) (i)	v = f λ **OR** (f =) v / λ OR (a)(i) / 0.022 Correct answer: e.g. 330 m / s gives 15 000 Hz	C1 A1
6 (b) (ii)	Vertical dotted lines midway (by eye) between each pair of compressions **OR** to right or left of compressions shown with correct spacing (by eye)	B1
6 (b) (iii)	(At rarefactions) molecules have above normal separation / far apart / spread out Pressure (of air) is below normal / low **OR** Molecules exert below normal / low pressure	B1 B1
		Total: 7

Notes about the mark scheme are available separately.

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2: Electricity 1 – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	61
4	2016	June	63
1	2016	March	62

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

3 A student is investigating the resistance of a lamp filament.

The circuit is shown in Fig. 3.1.

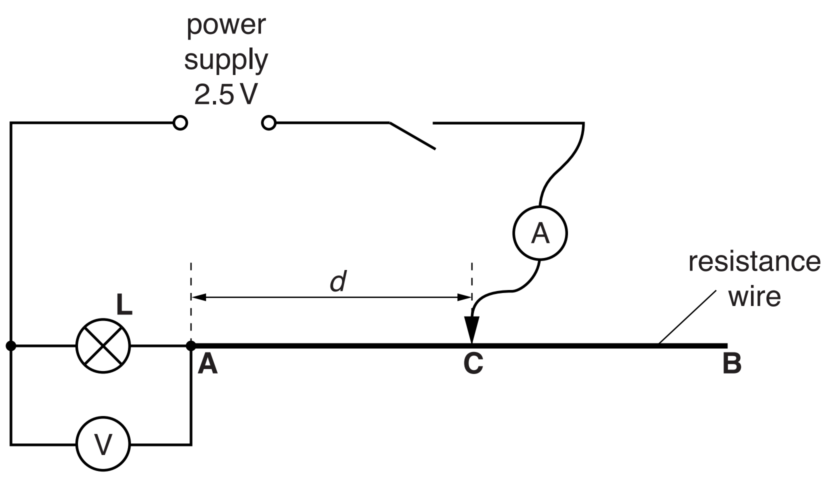


Fig. 3.1

(a) The student places a sliding contact **C** on the resistance wire at a distance d = 0.200 m from point **A**. He measures the current I in the circuit and the p.d. V across the lamp **L**.

He repeats the procedure using values for d of 0.400 m, 0.600 m and 0.800 m. The readings are shown in Table 3.1.

(i) Calculate the resistance R of the lamp filament for each set of readings. Use the equation $R = \frac{V}{I}$. [2]

(ii) Complete the column headings in the table. [1]

Table 3.1

d /	V /	I /	R /	appearance of lamp filament
0.200	1.6	1.00		very bright
0.400	1.3	0.86		bright
0.600	1.0	0.74		dim
0.800	0.8	0.66		does not glow

(b) The student notices that the lamp does not glow when he takes the final set of readings. He thinks that the filament has broken.

State whether the student is correct and give a reason for your answer.

statement ....

reason ....

.... [1]

(c) A student suggests that the resistance *R* of the lamp filament should be constant.

Suggest, referring to the observations, a reason why the resistance *R* may not be constant in this experiment.

....

....

....

.... [2]

(d) **(i)** Name an electrical component that could be used, instead of the resistance wire **AB** and sliding contact, to vary the current I.

.... [1]

(ii) Draw a diagram of the circuit including this component instead of the resistance wire and sliding contact.

[2]

[Total: 9]

4 The class is investigating a circuit containing two lamps in series.

They are using the circuit shown in Fig. 4.1.

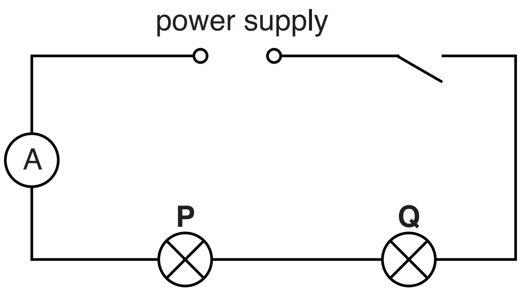


Fig. 4.1

(a) On Fig. 4.1, use the standard symbol to show a voltmeter connected to measure the potential difference (p.d.) across lamp **P**. [1]

(b) Record the current I in the circuit, as shown on the ammeter in Fig. 4.2.

I = ...[2]

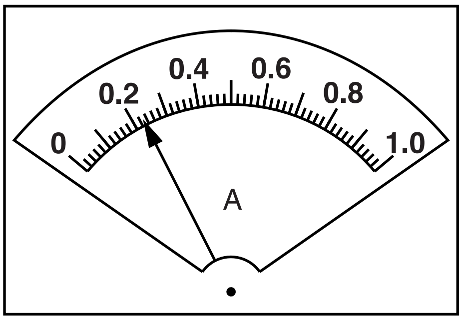
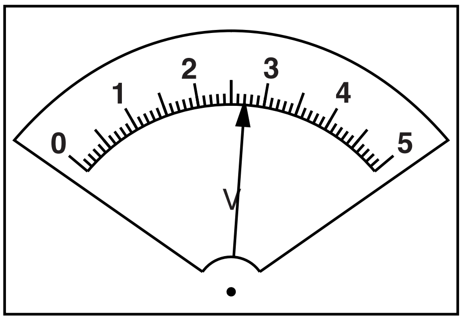
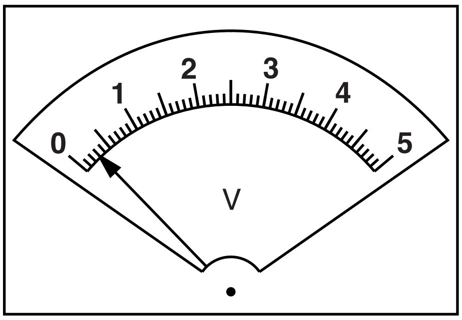


Fig. 4.2

(c) Fig. 4.3 shows the readings on voltmeters connected to measure the potential difference across each lamp.



lamp **P**



lamp **Q**

Fig. 4.3

In Table 4.1, record the potential difference V_P across lamp **P** and the potential difference V_Q across lamp **Q**.

Table 4.1

lamp	potential difference / V	observation of brightness
P	V_P = ...	very bright
Q	V_Q = ...	not glowing

[1]

(d) Table 4.1 also shows the brightness of each lamp.

(i) A student thinks that, as lamp **Q** is not glowing, its filament must have broken.

State one piece of evidence from the results in **(b)** and **(c)** that shows this cannot be the case.

....

....[1]

(ii) The working potential difference for each lamp to be at its full brightness is 2.5 V.

Suggest how the results for V_P and V_Q might help to explain the observations of the brightness of the lamps.

....

....

....

....[2]

(e) Calculate the total resistance R of the lamps in the circuit, using the equation $R = \frac{(V_P + V_Q)}{I}$.

$R =$ ....[2]

(f) A student measures the potential difference V_S across the power supply.

$V_S =$ ....3.1 V...............................

He suggests that V_S should be equal to $V_P + V_Q$.

State whether the measurements support this suggestion. Justify your statement by reference to the results.

statement ....

justification ....

....
[2]

[Total: 11]

1 Some students are investigating the relationship between potential difference and current for a resistor. They are using the circuit shown in Fig. 1.1.

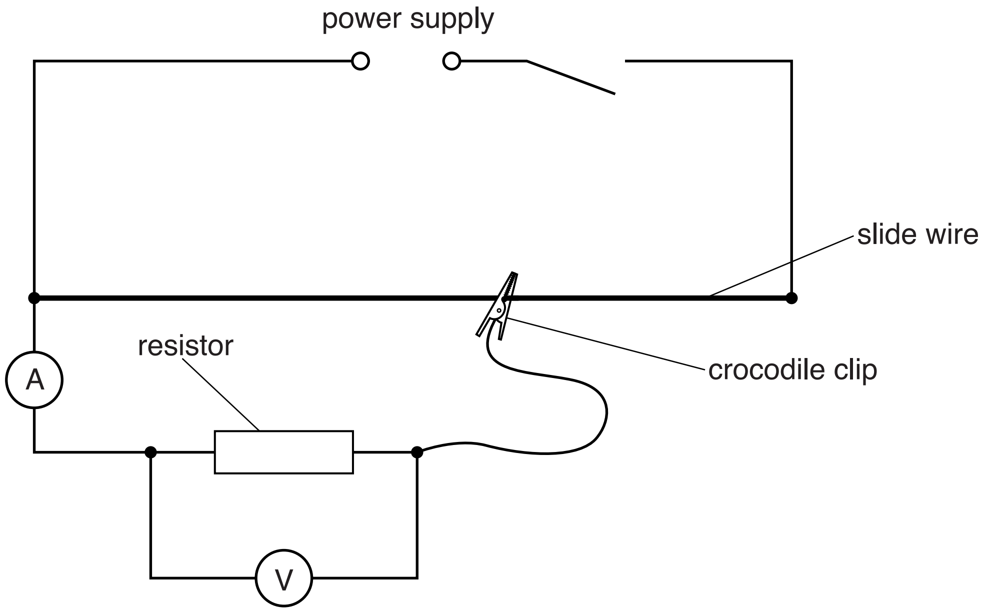


Fig. 1.1

The crocodile clip is connected at various positions on the slide wire, and the current and potential difference for the resistor are measured.

(a) The readings of potential difference V and current I for various positions of the crocodile clip are shown in Table 1.1.

Draw arrows on Figs. 1.2 and 1.3 to show the meter readings for the values of V and I in the first row of the table.

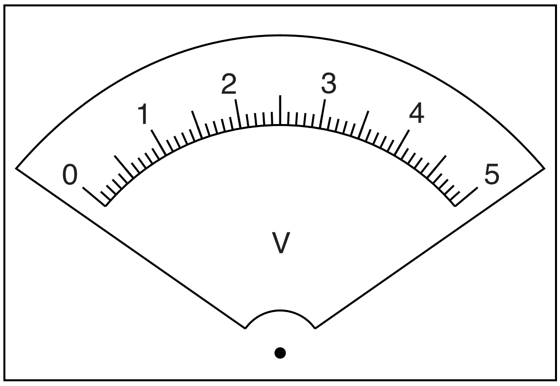


Fig. 1.2

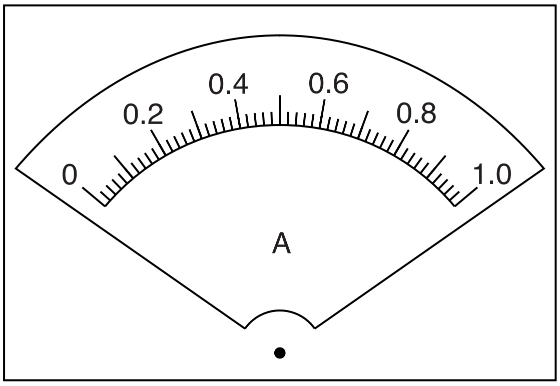


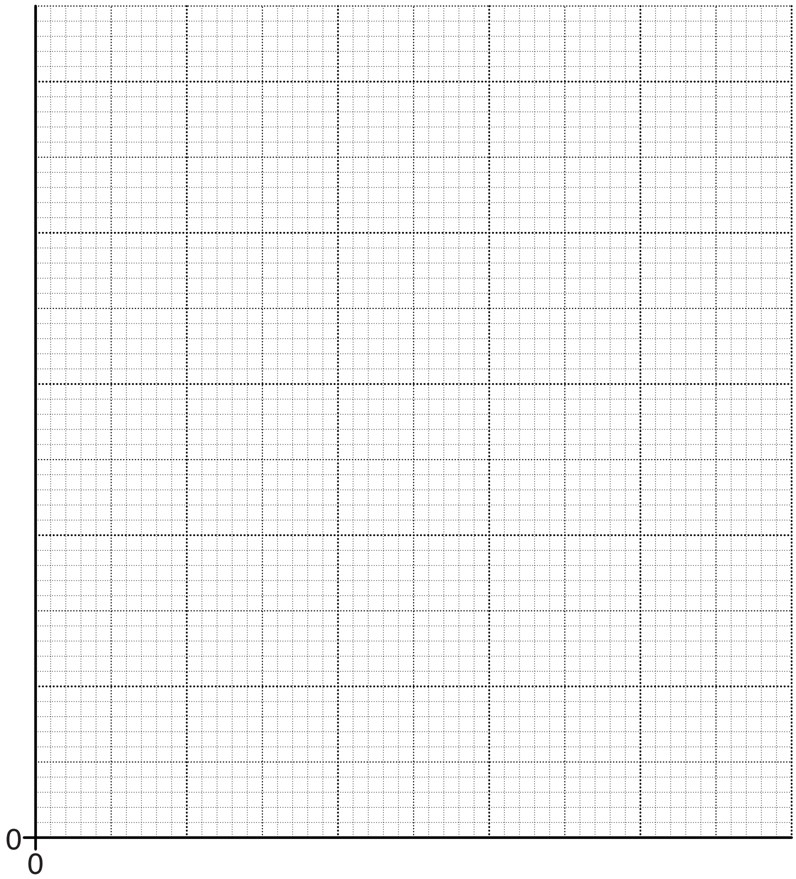
Fig. 1.3

[2]

Table 1.1

V/V	I/A
0.4	0.08
0.8	0.17
1.2	0.25
1.6	0.34
2.0	0.41

(b) Plot a graph of V/V (y-axis) against I / A (x-axis). Start both axes at the origin (0,0).



[4]

(c) **(i)** Determine the gradient G of the graph. Show clearly on the graph how you obtained the necessary information.

G = ...[1]

(ii) The resistance value R of the resistor is numerically equal to G.

Give a value for R, to a suitable number of significant figures for this experiment. Include the unit.

R = ...[2]

(d) A student suggests that potential difference and current for this resistor should be proportional.

State whether your graph supports this suggestion. Justify your statement by reference to your graph.

statement ....

....

justification ....

....

....
[2]

(e) The students notice that the slide wire becomes very hot during the experiment.

Suggest a change to the apparatus or procedure that might prevent this.

....

....

....[1]

[Total: 12]

Question	Answer	Mark
3 (a) (i)	*R* values 1.60, 1.51, 1.35, 1.21 *R* values all to 2 significant figures or all to 3 significant figures.	1 1
3 (a) (ii)	Column headings m, V, A, Ω	1
3 (b)	No; there is a <u>current</u> reading	1
3 (c)	filament changes brightness, owtte increase/decrease/change in temperature of <u>filament/lamp</u>	1 1
3 (d) (i)	variable resistor (rheostat)	1
3 (d) (ii)	correct symbol for variable resistor correct diagram, with variable resistor in series with power supply	1 1
		Total: 7
4 (a)	correct voltmeter symbol in parallel with lamp **P**	1
4 (b)	*I* = 0.23 Unit of A	1 1
4 (c)	V_P = 2.7 <u>and</u> V_Q = 0.3	1
4 (d) (i)	some current in the circuit, pd across lamp **Q** is small / not equal to supply voltage / reference to lamp P bright <u>and is in series</u>	1
4 (d) (ii)	V_P greater than/near working voltage V_Q <u>much</u> less than working voltage	1 1
4 (e)	*R* = 13(.0) allow e.c.f 2/3 sig figs and unit of Ω	1 1
4 (f)	statement matches results some correct values used and reference to 'within limits of experimental accuracy' owtte	1 1
		Total: 11

Question	Answer	Mark
1 (a)	arrow indicating 0.4 V arrow indicating 0.08 A	1 1
1 (b)	graph: • axes labelled with quantity AND unit • appropriate scales (plots occupy at least half of grid) • plots all correct • well-judged line AND thin line neat plots	1 1 1 1
1 (c) (i)	*G* present and triangle method seen using at least ½ line	1
1 (c) (ii)	R in range 4.6 Ω to 4.9 Ω to 2/3 sig figs and with correct unit	1 1
1 (d)	statement matching graph with reference to straight line reference to passing through origin (within limits of experimental accuracy / owtte)	1 1
1 (e)	suitable change, e.g. • reduce supply voltage/current • use thinner/longer wire • material with greater resistivity	1
		Total: 12

Notes about the mark scheme are available separately.

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3: Energy – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
4	2016	June	61
5	2016	March	62
1	2016	November	63

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

4 A student is investigating the effect of insulation on the rate of cooling of hot water in a 250 cm^3 container.

The student can choose from the following apparatus:

thermometer
250 cm^3 glass beaker
250 cm^3 plastic beaker
250 cm^3 copper can
250 cm^3 measuring cylinder
three different insulating materials
clamp, boss and stand
stopwatch.

Plan an experiment to investigate the effectiveness of the three insulating materials.

You should

- explain briefly how you would carry out the investigation,
- state the key variables that you would control,
- draw a table, or tables, with column headings, to show how you would display your readings. You are not required to enter any readings in the table,
- explain how you would use your readings to reach a conclusion.

A diagram is not required but you may draw a diagram if it helps your explanation.

[7]

[Total: 7]

1 A student is investigating the transfer of thermal energy.

He uses the apparatus shown in Fig. 1.1.

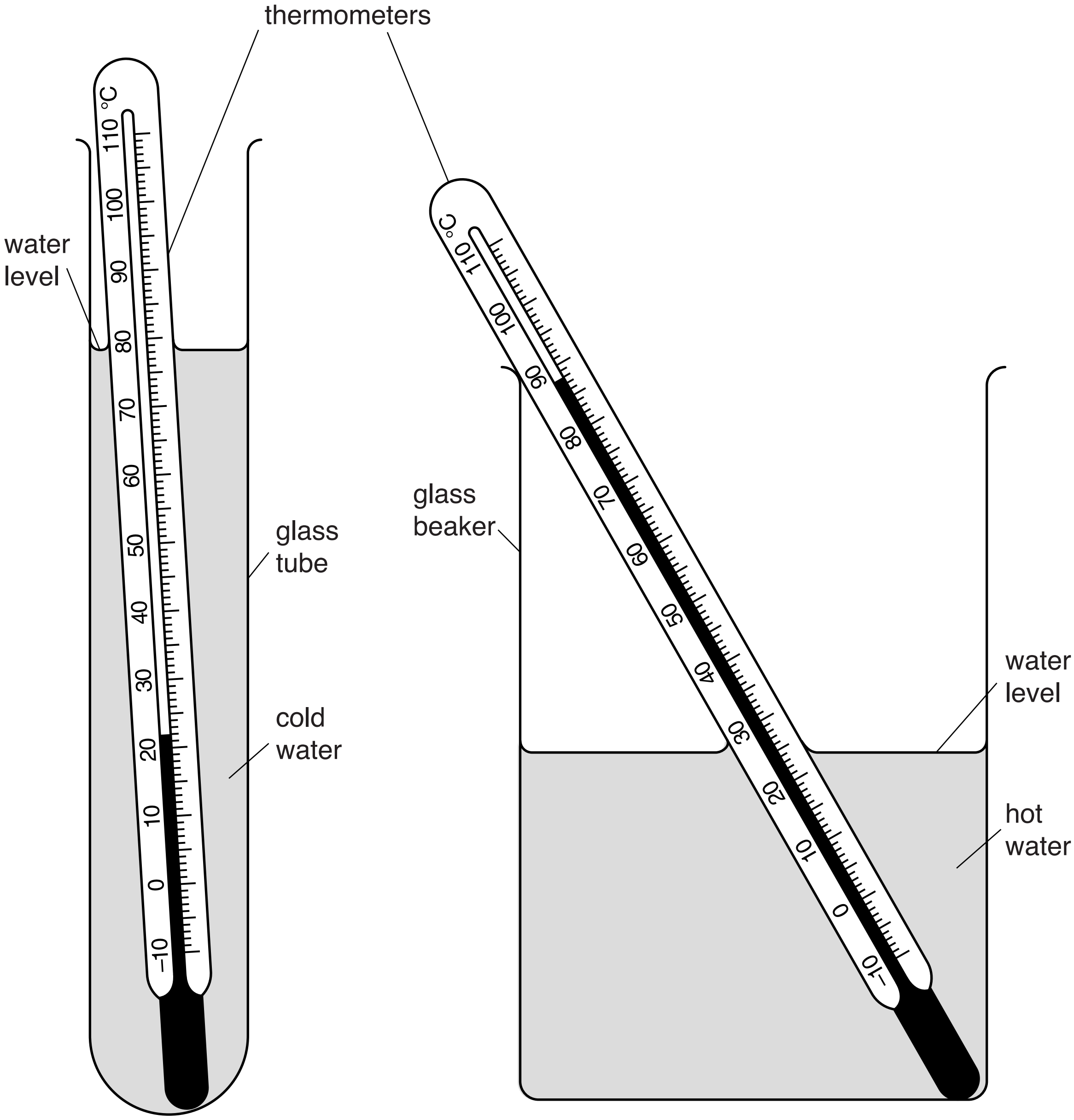

Fig. 1.1

(a) The student pours 50 cm^3 of cold water into the glass tube and 300 cm^3 of hot water into the beaker. The water levels are approximately as shown in Fig. 1.1.

In Table 1.1, record the temperatures θ_C of the cold water and θ_H of the hot water as shown on the thermometers in Fig. 1.1. [1]

Table 1.1

	tube with 50 cm^3 of cold water		tube with 25 cm^3 of cold water	
t/	θ_C/	θ_H/	θ_C/	θ_H/
0			20.0	87.0
30	33.0	82.0	34.0	82.0
60	40.5	79.0	49.0	79.5
90	49.0	78.0	59.5	76.0
120	56.0	76.0	65.5	75.0
150	60.0	75.0	69.5	74.5
180	63.0	74.0	72.0	74.0

(b) The student lowers the glass tube into the beaker of hot water and immediately starts a stopclock.

Table 1.1 shows the readings of the temperature θ_C of the cold water and the temperature θ_H of the hot water at times t = 30 s, 60 s, 90 s, 120 s, 150 s and 180 s.

The student repeats the procedure with the same volume of hot water in the beaker but with 25 cm^3 of cold water in the glass tube. The results are shown in the table.

Complete the column headings in the table. [1]

(c) Write a conclusion stating how the volume of cold water in the tube affects its temperature rise.

....

....

....[1]

(d) Another student wishes to check the conclusion by repeating the experiment with 12.5 cm^3 of cold water.

Suggest two conditions which he should keep the same so that the comparison will be fair.

1. ....

....

2. ....

....

[2]

(e) Scientists in an industrial laboratory wish to use this experiment as a model of a heat exchanger, which transfers thermal energy between liquids.

Suggest **two** different improvements to the apparatus which would make the heating of the cold water more efficient.

For your **first** suggestion, explain why it would be an improvement.

suggestion 1 ....

explanation ....

....

suggestion 2 ....

[3]

[Total: 8]

5 Two students are investigating thermal energy transfer.

They are using the apparatus shown in Fig. 5.1.

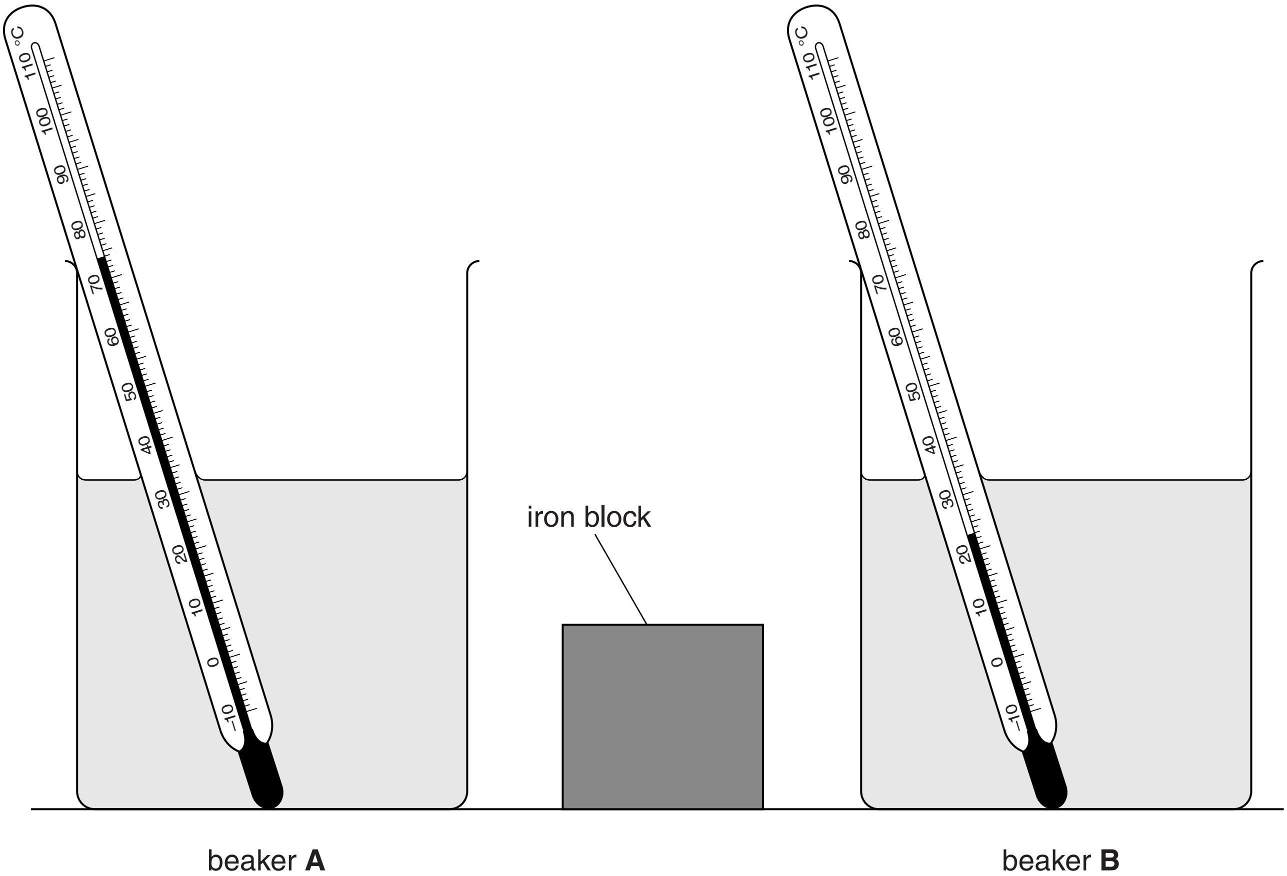

Fig. 5.1

Beaker **A** contains hot water and beaker **B** contains cold water at room temperature.

(a) Record the temperature θ_H of the hot water and the temperature θ_C of the cold water as shown on the thermometers in Fig. 5.1.

θ_H = ...

θ_C = ... [1]

(b) Using metal tongs, one of the students places the iron block in the hot water in beaker **A** for 30 seconds.

He then removes the block and places it in the cold water in beaker **B**.

The other student then measures the temperature of the water in beaker **B** and finds that it has risen to 35 °C. Their teacher suggests that this value is lower than expected.

(i) The students suggest that, immediately before the iron block was put into the cold water, the temperature of the iron block was not the same as θ_H.

Suggest one reason for this and a possible improvement to the experiment which could make the temperature of the block nearer to θ_H.

reason ....

....

....

improvement ....

....

....

[2]

(ii) The students also think that, when the block cooled in the water, not all of the thermal energy lost by the block raised the temperature of the water.

Suggest one reason for this and a possible improvement to the experiment which would reduce thermal losses.

reason ....

....

....

improvement ....

....

....

[2]

[Total: 5]

Question	Answer	Mark
4	**MP1** Uses same container throughout **MP2** Hot water in container (any) and takes temperatures at intervals or at start and after a fixed time OR Hot water in container (any) and takes time for a fixed temperature fall. **MP3** Repeats with different insulators (all three used) **MP4&5** Any two from: Constant room temperature Same starting temperatures (clearly stated) Same volumes of hot water (clearly stated) Same thickness/amount of insulator Use container without insulation Use of a lid Insulates bottom of container Uses the copper can only **MP6** Table or tables as appropriate to method: Temperatures with unit °C and time with unit s (or min) and different insulators shown **MP7** Use of readings: graph of temperature against time OR compare results and comment that longest time to cool = best insulator or smallest drop in temperature in fixed time = best insulator (or reverse arguments)	1 1 1 1 1 1
		Total: 7

Question	Answer	Mark
1 (a)	22(.0) AND 88(.0)	1
1 (b)	units correct and consistent (symbols or words)	1
1 (c)	conclusion which <u>matches</u> the temperature changes	1
1 (d)	any two from: • volume / level of hot water • initial temperature of hot water • initial temperature of cold water • same type of boiling tube • room temperature / draughts / appropriate environmental condition	2
1 (e)	any two improvements relating to <u>apparatus</u>: • lid on beaker / in boiling tube • insulation on beaker • thinner / metal walls on tube • all cold water in boiling tube below hot water level • greater contact area of tube • use of water bath explanation matching <u>first</u> improvement, including: • reduces loss of thermal energy from beaker / boiling tube • better thermal conduction • not affected by variation in hot water temperature	2 1
		Total: 8
5 (a)	θ_H = 74 AND θ_C 23(°C)	1
1 (b) (i)	suitable reason, e.g. • temperature not able to reach max θ_H (in 30s) • temperature dropped on transfer • conduction/transfer to metal tongs <u>matching</u> improvement, e.g. • leave block in hot water for longer • transfer more quickly • use insulated tongs/cotton round block	1 1
1 (b) (ii)	suitable reason, e.g. • some (thermal) energy transferred to beaker • some (thermal) energy transferred to surroundings • evaporation/convection (into atmosphere) <u>matching</u> improvement, .g. • use a less conducting material for beaker owtte • insulate beaker • allow for beaker in any calculation • lid on beaker	1 1
		Total: 5

Notes about the mark scheme are available separately.

Cambridge Assessment International Education

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1: Light – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	63
5	2016	June	61
3	2016	March	62

The mark scheme for each question is provided at the end of the document.

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3 A student notices that the size of the image produced by a converging lens changes when the lens is moved further away from an object.

Plan an experiment to investigate how the size of the image varies with the object distance for a converging lens suitable for school experiments.

Write a plan for the experiment, including:

- a labelled diagram of the apparatus needed
- instructions for carrying out the experiment
- the factors that will limit the range of object distances
- the graph you will plot
- one precaution you will take to ensure reliable results, explaining what might be the effect of not taking this precaution.

....

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....

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....[7]

[Total: 7]

5 A student determines the focal length of a lens.

The apparatus is shown in Fig. 5.1.

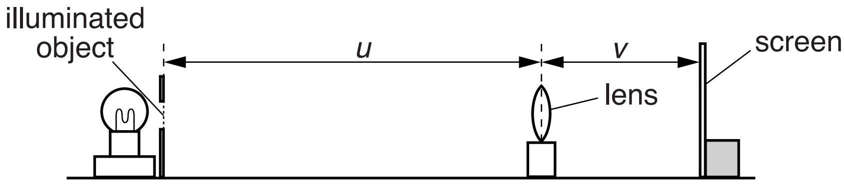

Fig. 5.1

(a) The student places the lens at a distance u from the illuminated object. He moves the screen until a sharply focused image of the object is seen on the screen.

On Fig. 5.1,

- measure the distance u from the illuminated object to the centre of the lens,

u = ... mm

- measure the distance v from the screen to the centre of the lens.

v = ... mm
[1]

(b) Fig. 5.1 is drawn 1/10th actual size.

(i) • Calculate the actual distance U from the illuminated object to the centre of the lens.

U = ... mm

• Calculate the actual distance V from the screen to the centre of the lens.

V = ... mm
[1]

(ii) Calculate a value f_1 for the focal length of the lens using the equation $f_1 = \frac{UV}{(U + V)}$.

f_1 = ... mm
[2]

(c) A second student repeats the experiment three times using a different lens. His values for the focal length of his lens are shown in Table 5.1.

Table 5.1

	1	2	3
focal length/mm	132	141	135

Calculate the average value f_2 for the focal length of this student's lens.

f_2 = ... mm [1]

(d) A third student, using the same method, finds that the focal length f of her lens is 200 mm.

She reads in a book that when $u = 2f$, the distances u and v, as shown in Fig. 5.1, are equal.

- Calculate $2f$ for this student's lens.

$2f$ = ... mm

The student sets up the apparatus as shown in Fig. 5.2. She adjusts both x and y to be 400 mm.

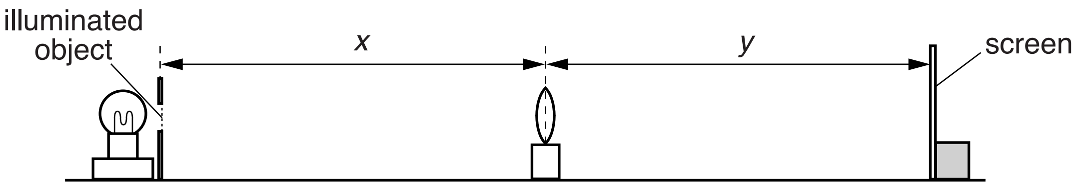

Fig. 5.2

She observes that the image is blurred. The student slowly increases the distance y, and obtains a sharply focused image when y = 406 mm.

Discuss whether the student's results confirm the statement in the book.

....

....

....
[2]

(e) Suggest two precautions that you would take in this investigation in order to obtain reliable results.

1. ....

....

2. ....

....
[2]

[Total: 9]

3 A student is investigating the refraction of light by a transparent block. She uses her results to determine a quantity known as the refractive index for the material of the block.

The student's ray-trace sheet is shown in Fig. 3.1.

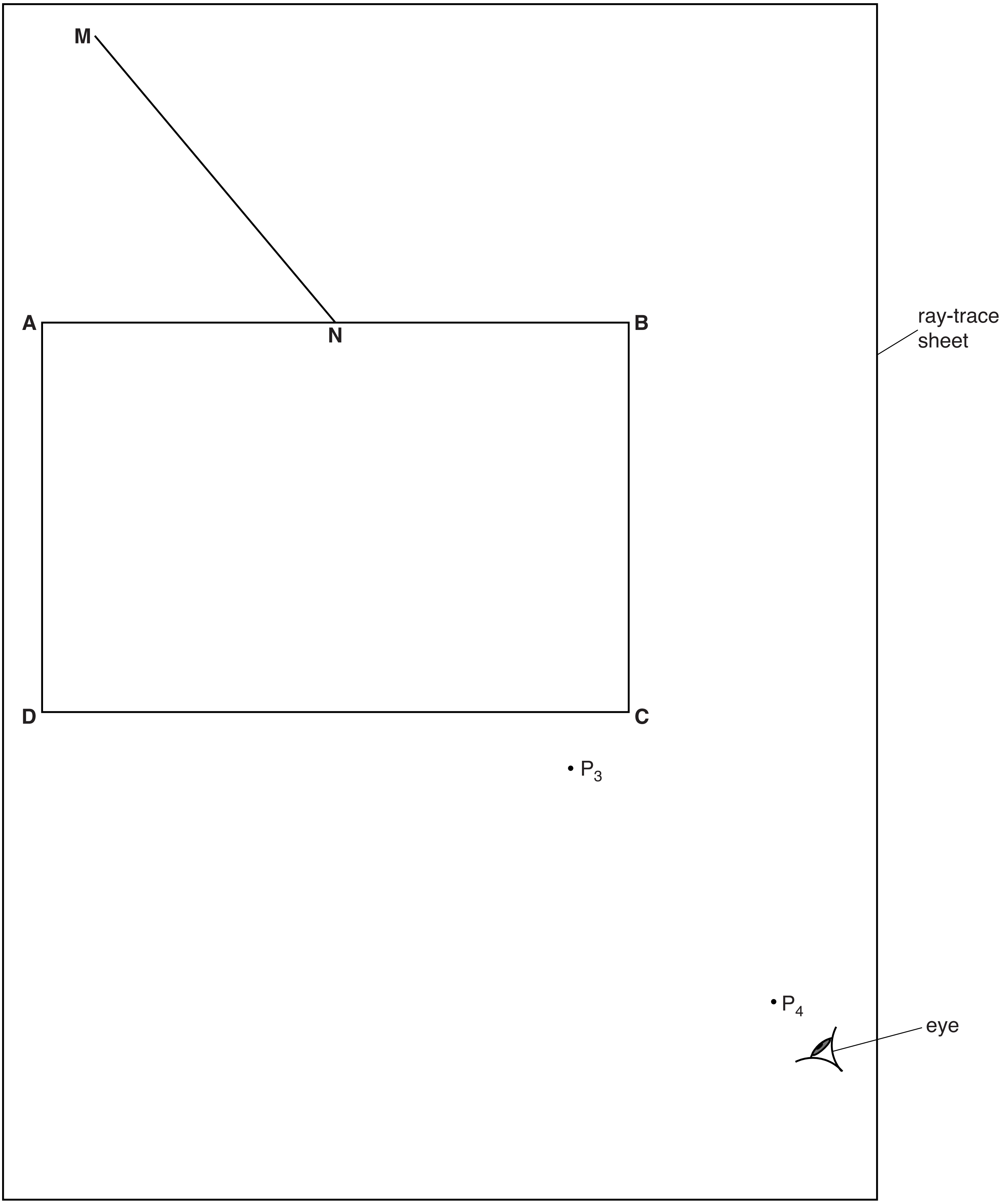

Fig. 3.1

(a) The student places a transparent block **ABCD** on the ray-trace sheet, as indicated in Fig. 3.1. She draws a line **NM**.

(i)
- Draw a normal to line **AB** at point **N**. The normal should start above **AB** and extend below **AB** so that it crosses line **CD**.
- Label the point at which the normal crosses **CD** with the letter **L**.

[1]

(ii) Measure the angle θ between the normal and line **NM**.

θ = ...[1]

(b) The student places two pins P_1 and P_2 on line **NM**, a suitable distance apart.

On Fig. 3.1, mark and label appropriate positions for P_1 and P_2. [1]

(c) The student views the images of P_1 and P_2 through the block, from the direction indicated by the eye in Fig. 3.1.

She places two pins P_3 and P_4, as shown in Fig. 3.1, so that pins P_3 and P_4, and the images of P_1 and P_2, all appear exactly one behind the other.

(i)
- Draw a line joining P_3 and P_4. Extend this line until it meets **NL**.
- Label the point at which this line crosses **CD** with the letter **E**, and the point at which it meets **NL** with the letter **F**.
- Draw a line joining points **N** and **E**.
- Measure the length *a* of line **NE**.

a = ...

- Measure the length *b* of line **FE**.

b = ...

[2]

(ii) Calculate a value *n* for the refractive index, using the equation $n = \frac{a}{b}$.

n = ...[2]

(d) Describe two precautions that you would take in order to obtain reliable results in this type of experiment.

1. ....

....

2. ....

....

[2]

[Total: 9]

Question	Answer	Mark
3	**apparatus:** diagram – lens, (illuminated) object, screen in suitable order for experiment in line on flat surface **instructions:** set / measure object distance, move screen to get image, measure image height, repeat for different object distances **limiting factor for range of object distances – one from:** • image virtual / too big for screen, • image too dim / too small to measure, • must be greater than focal length **graph:** image size / magnification against object distance **precaution:** any one suitable precaution and consequence of not taking it, e.g. • dark room / bright light – image might not be distinct, • lens and object at same height – image might not appear on screen • lens, object and screen perpendicular – image might be distorted, • fix rule – may move and give incorrect distances • mark position of lens on holder – cannot judge correct measurements / owtte • detailed means of obtaining a sharp image – might not be correctly focused • means of measuring image height accurately – might be obscured	1 1 1 1 1 1 1
		Total: 7

Question	Answer	Mark
5 (a)	*u* = 50, *v* = 21	1
5 (b) (i)	*U* = 500, *V* = 210 e.c.f from **(a)**	1
5 (b) (ii)	f_1 = 148 or 150 or 147.9 (mm) e.c.f from **(i)** 2 or 3 significant figures	1 1
5 (c)	f_2 136 (mm) c.a.o	1
5 (d)	Yes / statement is correct, owtte (6 mm) difference is very small / within limits of experimental error / Difference explained by uncertainty in her focal length measurement	1 1
5 (e)	Any two from: Use of darkened room / brighter lamp Mark position of centre of lens on holder Place metre rule on bench (or clamp in position) Ensure object and (centre of) lens are same height (from the bench) Object and lens and screen perpendicular to bench Move <u>screen</u> (slowly) back and forth to obtain best image (owtte) Ensure rule is touching object / lens / holder / screen or look perpendicular to ruler	2
		Total: 9
3 (a) (i)	normal correct	1
3 (a) (ii)	θ = 40(°)	1
3 (b)	P_1, P_2 marked on line NM and separation >5.0 cm	1
3 (c) (i)	thin lines all in correct place a = 8.1 to 8.3 (cm) <u>and</u> b = 5.2 to 5.5 (cm)	1 1
3 (c) (ii)	*n* correctly calculated 2/3 sig figs <u>and</u> no unit	1 1
3 (d)	any two suitable precautions, e.g. • view pins from base/ensure pins upright • large pin separations • use of thin pencil lines/sharp pencil/thin pins • repeat with different angles	2
		Total: 9

Notes about the mark scheme are available separately.

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4: Mechanics 1 – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	62
2	2016	June	61
2	2016	March	62

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

1 A student is investigating the stretching of a spring.

The apparatus is shown in Fig. 1.1.

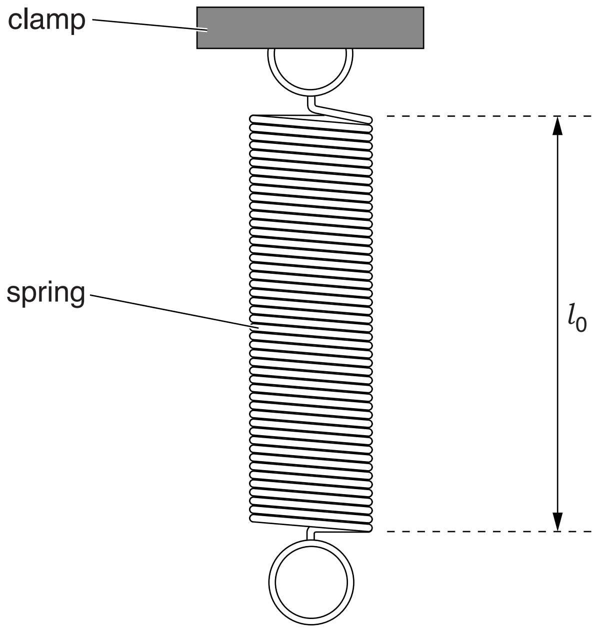


Fig. 1.1

(a) On Fig. 1.1, measure the unstretched length l_0 of the spring. Record l_0 in the first row of Table 1.1. [1]

(b) The student hangs a load L of 1.0 N on the spring and measures the new length l of the spring. She repeats the measurements using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

(i) For each set of readings, calculate the extension e of the spring using the equation $e = (l - l_0)$. Record the values of e in the table.

Table 1.1

L/N	l/mm	e/mm
0.0		0
1.0	59	
2.0	64	
3.0	69	
4.0	74	
5.0	78	

[1]

(ii) Explain briefly one precaution that you would take in order to obtain reliable readings.

....

....[1]

(c) Plot a graph of e/mm (y-axis) against L/N (x-axis).

[4]

(d) The student removes the load from the spring and hangs an unknown load **X** on the spring. She measures the length l of the spring.

l = 72 mm

(i) Calculate the extension e of the spring.

e = ... [1]

(ii) Use the graph to determine the weight W of the load **X**. Show clearly on the graph how you obtained the necessary information.

W = ... [2]

[Total: 10]

2 A student is heating water in a beaker using an electrical heater.

(a) He measures the potential difference V across the heater and the current I in the heater.

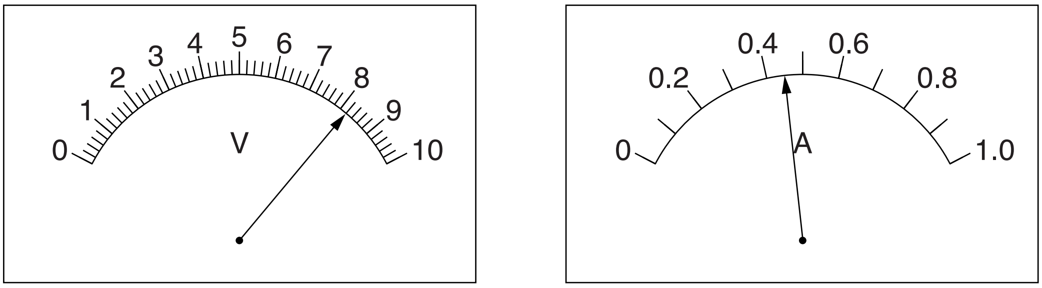


Fig. 2.1

Write down the readings shown on the meters in Fig. 2.1.

V = ...

I = ...

[3]

(b) He measures the temperature of the water before heating.

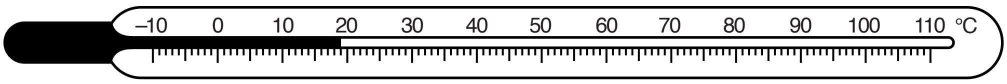
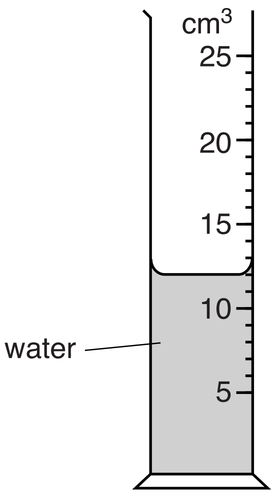


Fig. 2.2

Write down the temperature reading θ shown in Fig. 2.2.

θ = ... [1]

(c) On Fig. 2.3, draw a line and an eye to show clearly the line of sight required to read the volume of water in the measuring cylinder.



[1]

Fig. 2.3

[Total: 5]

2 The class is carrying out an experiment to determine the density of glass.

Each student has a test-tube, as shown in Fig. 2.1.

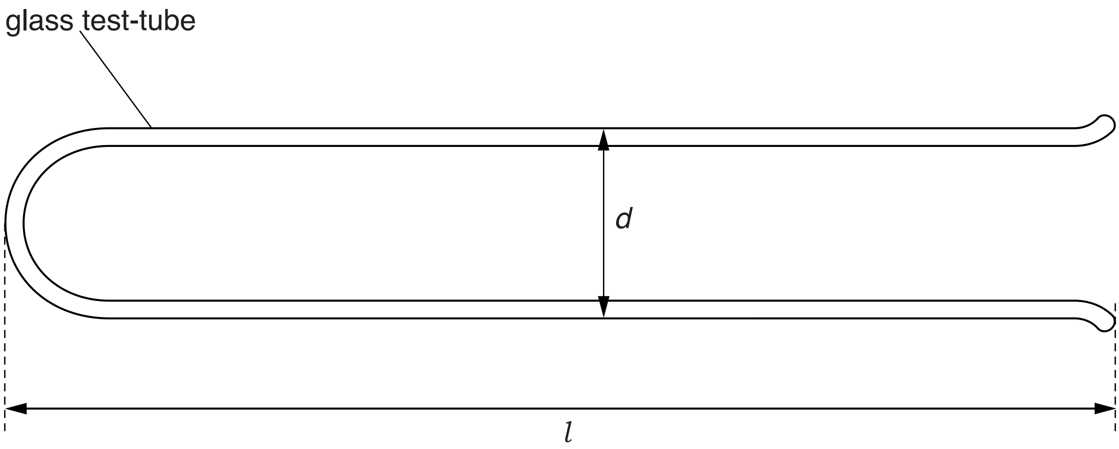


Fig. 2.1

(a) (i) • Measure the length l of the test-tube shown in Fig. 2.1.

l = ... cm

• Measure the external diameter d of the test-tube.

d = ... cm
[1]

(ii) A student uses two wooden blocks to help him to measure the diameter d of the test-tube.

Describe his method. You may draw a diagram. Include one precaution which could be taken to ensure that the value of d is as reliable as possible.

....

....

....[2]

iii) Assuming that the test-tube is an approximate cylinder, calculate a value for its external volume V_1 using the equation $V_1 = \frac{\pi d^2 l}{4}$.

V_1 = ... cm^3 [1]

(b) The test-tube is completely filled with water and then the water from the test-tube is poured into a measuring cylinder.

(i) Read and record the volume V_2 of the water as shown in Fig. 2.2.

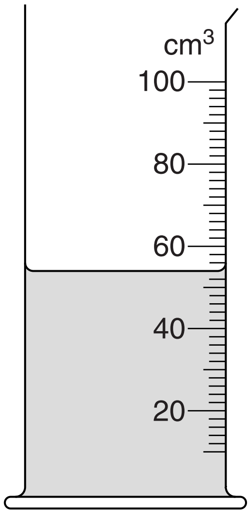


Fig. 2.2

V_2 = ... cm^3 [1]

(ii) Describe briefly how you would read the measuring cylinder to obtain a reliable value for the volume of water. You may add to Fig. 2.2 to illustrate your explanation.

....

....

....[1]

(iii) Calculate the volume V_3 of the glass, using the equation $V_3 = V_1 - V_2$.

V_3 = ... cm^3 [1]

(c) One student uses a balance to measure the mass m of the test-tube, as shown in Fig. 2.3.

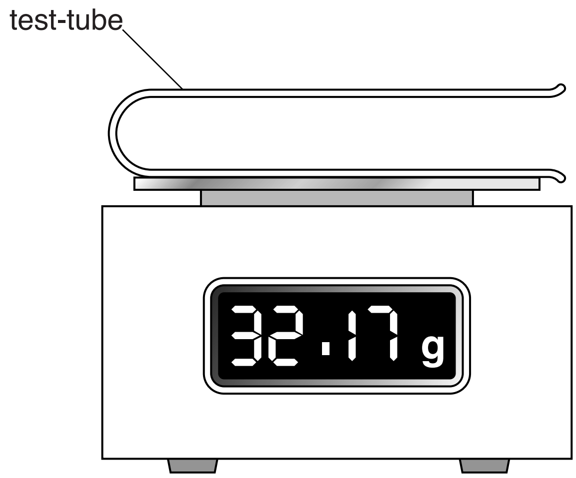


Fig. 2.3

(i) Calculate the density ρ of the glass, using the equation $\rho = \frac{m}{V_3}$.

ρ = ... [2]

(ii) Other students are using a balance which only measures to the nearest gram.

Record the mass m of the test-tube to the nearest gram.

m = ... g [1]

(d) The precision of the balance does not affect the accuracy of this experiment.

State one possible source of inaccuracy in the experiment. Explain what effect this inaccuracy would have on the value obtained for ρ.

....

....

....

....

....[2]

[Total: 12]

Question	Answer	Mark
1 (a)	l_0 = 55 (mm) c.a.o.	1
1 (b) (i)	4, 9, 14, 19, 23 ecf (a)	1
1 (b) (ii)	Viewing scale at right angles or use of straight edge / set square / pointer between bottom of spring and scale / ruler	1
1 (c)	Graph: • Axes correctly labelled with quantity and unit • Suitable scales • All plots correct to ½ small square • Good line judgement, thin, continuous line, neat plots	 1 1 1 1
1 (d) (i)	e = 17 (mm) ecf (a)	1
1 (d) (ii)	method clearly shown on graph W value 3.5–3.75 Unit N needed No ecf from (i)	1 1
		Total: 10
2 (a)	8.2 0.44–0.45 Units V and A	1 1 1
2 (b)	19(°C)	1
2 (c)	perpendicular to scale and at bottom of meniscus	1
		Total: 5

Question	Answer	Mark
2 (a) (i)	*l = 14.7 AND d = 2.5*	1
2 (a) (ii)	boiling tube between blocks and ruler spanning gap suitable precaution e.g. measure in (at least) 2 places and take average, avoid lip, ensure blocks smooth, no dirt between tube and block	1 1
2 (a) (iii)	$V_1 = 72$	1
2 (b) (i)	$V_2 = 54$	1
2 (b) (ii)	line of sight perpendicular to reading/read from bottom of meniscus	1
2 (b) (iii)	V_3 correctly calculated	1
2 (c) (i)	ρ = 1.7 to 1.8 unit g / cm^3	1 1
2 (c) (ii)	m = 32 (g)	1
2 (d)	suitable source of inaccuracy, e.g. • any reference to why tube is not a cylinder, • tube may contain some water when mass taken, • difficult to fill to brim and then pour out appropriate effect on value of ρ <u>explained</u>	1 1
		Total: 12

Notes about the mark scheme are available separately.

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8: Mechanics 2 – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	61
1	2016	June	62
1	2016	November	61

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

1 A student is determining the weight of a metre rule using a balancing method.

The apparatus is shown in Fig. 1.1.

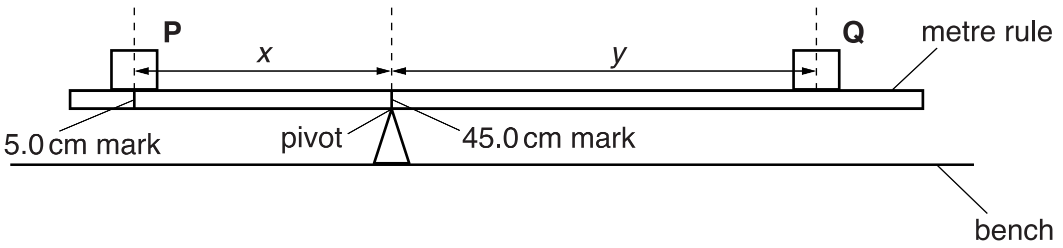


Fig. 1.1 (not to scale)

(a)
- The student places the load **P** on the metre rule at the 5.0 cm mark.
- She places the metre rule on the pivot at the 45.0 cm mark.
- She places load **Q** on the rule and adjusts its position so that the metre rule is as near as possible to being balanced.
- She measures the distance x between the centre of load **P** and the pivot and the distance y from the centre of load **Q** to the pivot.
- She repeats the procedure, placing the load **P** at the 10.0 cm mark, at the 15.0 cm mark, at the 20.0 cm mark and at the 25.0 cm mark. The readings are shown in Table 1.1.

Table 1.1

x /	y /	A /	B /
40.0	42.5		
35.0	36.0		
30.0	30.0		
25.0	24.0		
20.0	17.5		

(i)
- For each value of x, calculate $A = Px$, where $P = 1.00$ N. Record the values in the table. P is the weight of load **P**.
- For each value of y, calculate $B = Qy$, where $Q = 0.80$ N. Record the values in the table. Q is the weight of load **Q**.

[1]

(ii) Complete the column headings in the table. [1]

(b) Plot a graph of A/N cm (y-axis) against B/N cm (x-axis). Start both axes at the origin (0,0).

[4]

(c) Using the graph, determine the vertical intercept Y (the value of A when B = 0 N cm). Show clearly on the graph how you obtained this value.

Y = ... [1]

(d) Calculate the weight W of the metre rule using the equation $W = \frac{Y}{z}$, where z = 5.0 cm.

W = ... [1]

(e) Suggest one practical reason why it is difficult to obtain exact results with this experiment.

....

.... [1]

(f) The student uses an accurate electronic balance to obtain a second value for the weight of the metre rule.

weight obtained on the balance = ...1.24 N............

State and explain whether the two values for the weight agree within the limits of experimental accuracy.

statement ....

justification ....

.... [1]

[Total: 10]

1 A student is investigating the stretching of a spring.

The apparatus is shown in Fig. 1.1.

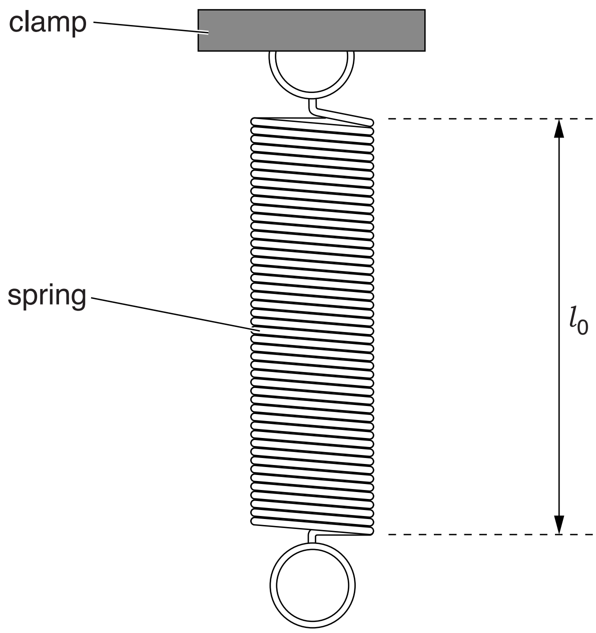


Fig. 1.1

(a) On Fig. 1.1, measure the unstretched length l_0 of the spring. Record l_0 in the first row of Table 1.1. [1]

(b) The student hangs a load L of 1.0 N on the spring and measures the new length l of the spring. She repeats the measurements using loads of 2.0 N, 3.0 N, 4.0 N and 5.0 N. The readings are shown in Table 1.1.

(i) For each set of readings, calculate the extension e of the spring using the equation $e = (l - l_0)$. Record the values of e in the table.

Table 1.1

L/N	l/mm	e/mm
0.0		0
1.0	59	
2.0	64	
3.0	69	
4.0	74	
5.0	78	

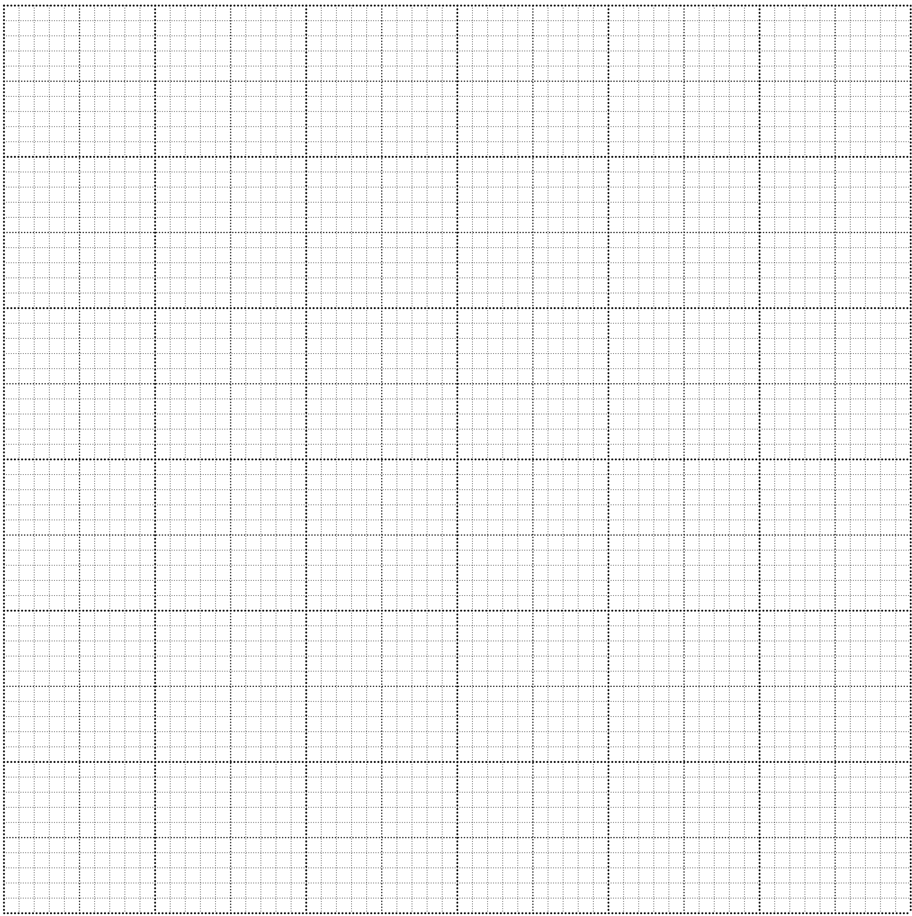
[1]

(ii) Explain briefly one precaution that you would take in order to obtain reliable readings.

....

....[1]

(c) Plot a graph of e/mm (y-axis) against L/N (x-axis).



[4]

(d) The student removes the load from the spring and hangs an unknown load **X** on the spring. She measures the length l of the spring.

l = ...72 mm..........

(i) Calculate the extension e of the spring.

e = ... [1]

(ii) Use the graph to determine the weight W of the load **X**. Show clearly on the graph how you obtained the necessary information.

W = ... [2]

[Total: 10]

1 A student uses a pendulum to determine a value for the acceleration of free fall g.

Figs. 1.1 and 1.2 show the apparatus.

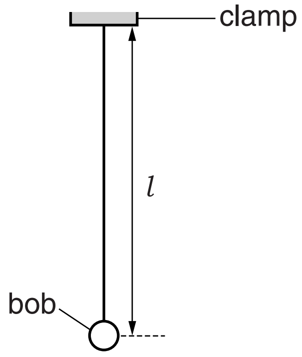


Fig. 1.1

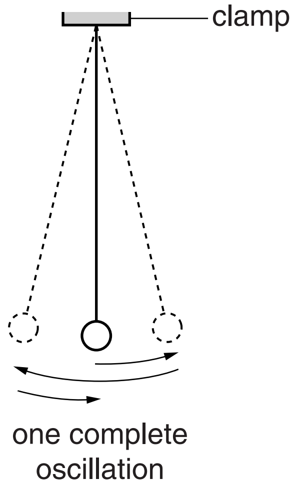


Fig. 1.2

(a) On Fig. 1.1, measure the length l of the pendulum.

l = ... cm [1]

(b) The student adjusts the pendulum until its length l = 50.0 cm. The length l is measured to the centre of the bob.

Explain briefly how the student avoids a parallax (line of sight) error when measuring length l.

....

....

....[1]

(c) The student displaces the pendulum bob slightly and releases it so that it swings.

He measures the time t for 20 complete oscillations of the pendulum.

t = ...27.8 s..........

(i) Calculate the period T of the pendulum. The period is the time for one complete oscillation.

T = ... [1]

(ii) Measuring the time for a large number of oscillations, rather than for one oscillation, gives a more accurate value for T.

Suggest one practical reason why measuring the time for 200 oscillations, rather than 20 oscillations, may **not** be suitable.

....

.... [1]

(iii) Calculate T^2.

T^2 = ... [1]

(iv) Calculate the acceleration of free fall g using the equation $g = \frac{4\pi^2 l}{T^2}$. Give your answer to a suitable number of significant figures for this experiment.

g = ... m/s^2 [2]

(d) The student checks the value of the acceleration of free fall *g* in a text book. The value in the book is 9.8 m/s^2.

(i) Suggest a practical reason why the result obtained from the experiment may be different.

....

....

....[1]

(ii) Suggest **two** improvements to the experiment.

1. ....

....

2. ....

....

[2]

[Total: 10]

Question	Answer	Mark
1 (a) (i)	A and B values correct A: 40.0, 35.0, 30.0, 25.0, 20.0 B: 34.0, 28.8, 24.0, 19.2, 14.0	1
1 (a) (ii)	cm, cm, N cm, N cm	1
1 (b)	Axes correctly labelled with quantity, right way round Appropriate scales, starting at origin (0,0) All plots correct to ½ small square Good line judgement, thin, continuous, single line through the plots; with neat plots	1 1 1 1
1 (c)	method shown on graph U and correct to ½ small square	1
1 (d)	W = 1.0–1.4 no e.c.f	1
1 (e)	difficulty of achieving balance or other sensible suggestion	1
1 (f)	expect agree; allow e.c.f. explanation includes idea of close enough (or, e.c.f. too different)	1
		Total: 10
1 (a)	l_0 = 55 (mm) c.a.o.	1
1 (b) (i)	4, 9, 14, 19, 23 e.c.f **(a)**	1
1 (b) (ii)	viewing scale at right angles or use of straight edge/set square/pointer between bottom of spring and scale/ruler	1
1 (c)	axes correctly labelled with quantity and unit suitable scales all plots correct to ½ small square good line judgement, thin, continuous line, neat plots	1 1 1 1
1 (d) (i)	e = 17(mm) e.c.f **(a)**	1
1 (d) (ii)	method clearly shown on graph W value 3.5–3.75 unit N needed, no e.c.f from **(i)**	1 1
		Total: 10

Question	Answer	Mark
1 (a)	l = 4.1–4.2 (cm)	1
1 (b)	either suitable use of a horizontal straight edge, explained briefly OR holding rule close to pendulum OR line of sight perpendicular (to rule)	1
1 (c) (i)	T = 1.39(s) **OR** 1.4	1
1 (c) (ii)	pendulum may stop **OR** student may lose count	1
1 (c) (iii)	1.93 s^2 (e.c.f. allowed)	1
1 (c) (iv)	10.2(2) 2 or 3 sig figs	1 1
1 (d) (i)	Explanation of cause of inaccuracy in measurement of *t* or *l*. e.g. student did not react quickly enough when starting/stopping stopwatch **OR** difficulty in measuring accurately to centre of bob	1
1 (d) (ii)	Any two from: Use different length(s) Repeat timing Use of a fiducial mark Increased number of oscillations Plot a graph using length and time or time^2	2
		Total: 10

Notes about the mark scheme are available separately.

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7: Thermal physics – Topic questions

Paper 6

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	63
4	2016	March	62
2	2016	November	61

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

1 Some students are comparing the rates of cooling of two thermometer bulbs under wet and dry conditions.

They are using the apparatus shown in Fig. 1.1.

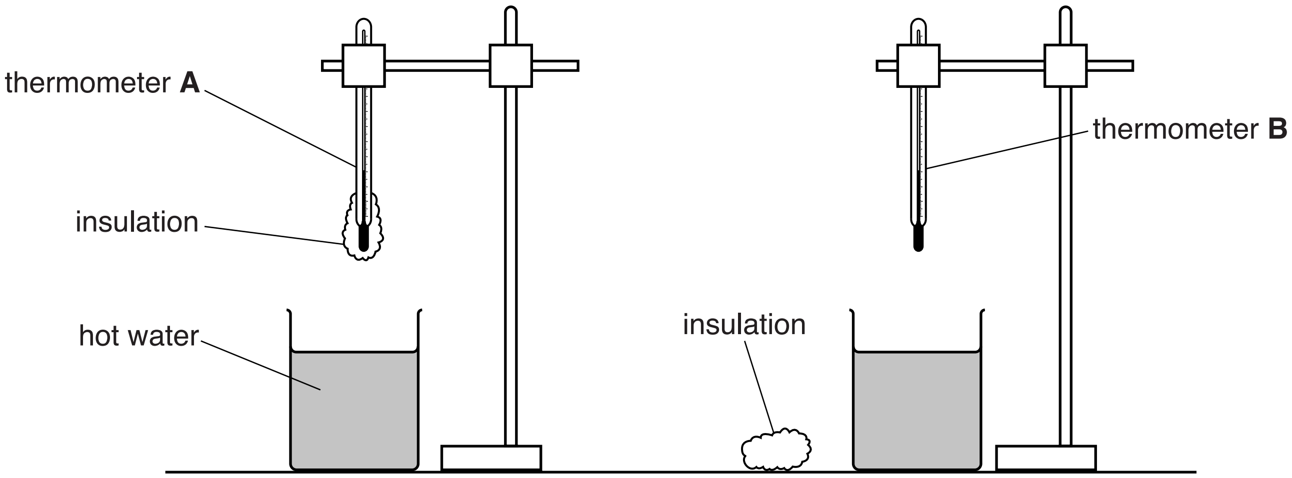

Fig. 1.1

Thermometer **A** has a layer of cotton wool insulation fixed around the bulb.

(a) Record the room temperature θ_R, as shown on the thermometer in Fig. 1.2.

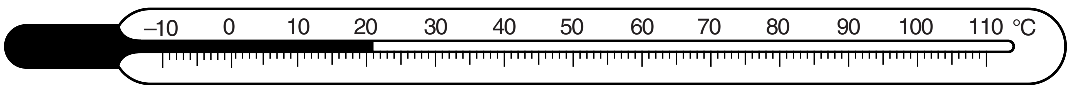

Fig. 1.2

θ_R = ...[1]

(b) • Thermometer **A** is placed into hot water, at 81.0 °C, for two minutes and then removed.

- A student records, in Table 1.1, the temperature θ of the thermometer bulb every 30 s.
- Thermometer **B** is placed into hot water, also at 81.0 °C, for two minutes.
- The student removes thermometer **B** from the water and quickly wraps a layer of dry cotton wool insulation around the bulb.
- He then records the temperature θ of the thermometer bulb every 30 s.

Complete the column headings and time column in Table 1.1.

Table 1.1

	thermometer **A** with wet insulation	thermometer **B** with dry insulation
time /	θ/	θ/
0	80.0	77.5
	75.0	70.5
	67.0	64.0
	59.5	59.0
	53.5	54.5
	48.0	50.5
	43.0	47.5

[2]

(c) (i) Write a conclusion to this experiment, stating for which thermometer the cooling is faster. Explain your answer by reference to the results.

....

....

....

....

....[2]

(ii) Describe what is unusual about the pattern of cooling for thermometer **A**.

....

....

....[1]

(d) The student first wrapped dry insulation around the bulb of thermometer **B** before starting the timing.

(i) Suggest why he did this.

....

....

....[1]

(ii) Suggest what problem this delay in starting the timing might have caused with the procedure.

....

....

....[1]

(e) Suggest two factors which should be kept constant to ensure that the comparison is fair.

1. ....

....

2. ....

....

[2]

[Total: 10]

4 A student suggests that the area of the water surface will affect the rate of cooling of hot water in a container.

Plan an experiment to investigate the relationship between surface area and rate of cooling.

Write a plan for the experiment, including:

- the apparatus needed
- how you will obtain a range of surface areas
- instructions for carrying out the experiment
- the measurements you will take
- the precautions you will take to ensure that the results are as reliable as possible
- the graph you will plot from your results – you should sketch the axes, with appropriate labels.

A diagram is not required but you may draw one if it helps to explain your plan.

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....[7]

[Total: 7]

2 A student is investigating the cooling of water.

(a) She pours 100 cm^3 of hot water into a beaker.

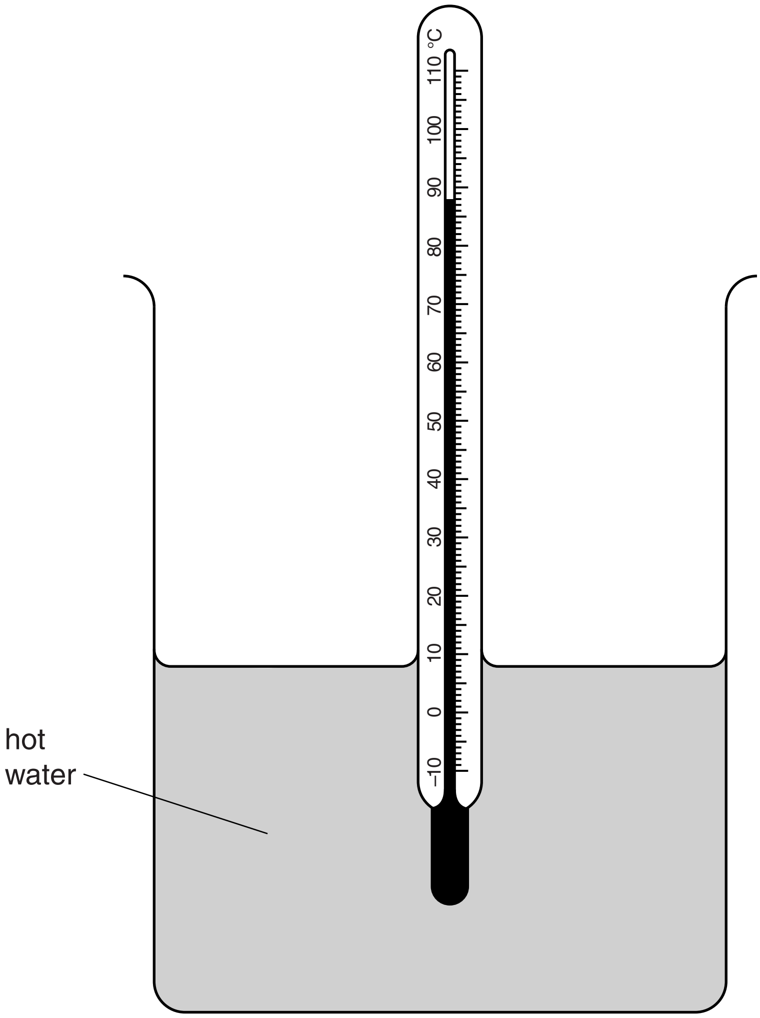

Fig. 2.1

(i) Record the temperature θ_H of the hot water, as shown in Fig. 2.1.

θ_H = ...[1]

(ii) The student measures the temperature θ_C of an equal volume of cold water.

θ_C = ...19 °C..............

Calculate the average temperature θ_{AV} using the equation $\theta_{AV} = \dfrac{\theta_H + \theta_C}{2}$.

θ_{AV} = ...[1]

(b) The student adds the cold water to the hot water. She records the temperature of the mixture.

θ_M = ...46 °C........................

State **one** precaution that you would take to ensure that the temperature readings are as reliable as possible.

....

....[1]

(c) The student is provided with:

- a lid, with a hole for the thermometer
- some insulating material
- two elastic bands.

In the space below, draw a labelled diagram to show how you would use these items to reduce the loss of thermal energy when the procedure is repeated.

[2]

Question	Answer	Mark
1 (a)	θ_R = 21(°C)	1
1 (b)	s, °C, °C time values correct 30, 60, 90, 120, 150, 180	1 1
1 (c) (i)	‘A cools more rapidly’ and ‘greater overall temperature change’ reference to ‘in the same time’	1 1
1 (c) (ii)	rate increases then decreases **OR** cooling is less in first 30s than in subsequent 30s periods	1
1 (d) (i)	makes comparison fair/only one factor changed	1
1 (d) (ii)	causes start temperature to be lower	1
1 (e)	any two appropriate factors, e.g. • start temperature, • room temperature, • draughts, • humidity, • amount of insulation, • type of thermometer	2
		Total: 10
4	**apparatus:** (set of) different sized beakers / containers, thermometer and stop clock / watch **method:** pour hot water into container (and allow to cool) <u>and</u> measure temperature and time repeat for a second container with a different surface area **precautions:** any two from: • same volume of hot water • same initial hot water temperature • same room temperature or other environmental condition **graph:** temperature change / rate of cooling against surface area, temperature against time, time to cool between fixed temperatures against surface area **additional point, any one from:** • at least 5 different surface areas, • sensible range of container sizes given, • sensible amount of water stated, • use of lagging / insulating material for container walls, • same type of container • how surface area may be calculated	1 1 1 2 1 1
		Total: 7

Question	Answer	Mark
2 (a) (i)	88(°C)	1
2 (a) (ii)	53.5(°C)	1
2 (b)	perpendicular viewing of scale OR stirring **OR** wait until temperature stops rising **OR** avoid delay (between adding water and taking temperature) allow thermometer not touching beaker owtte	1
2 (c)	correct diagram with lid drawn insulation placed round beaker	1 1
2 (d)	statement and justification to match results. A number or numbers must be seen comment must include yes or no or too close to call owtte	1
2 (e)	two from: • room temperature (or other environmental condition) • temperature of cold water • temperature of hot water • volumes of water • size/shape/material/surface area of beaker	2
		Total: 8

Notes about the mark scheme are available separately.