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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Particle Model (14)

GCSE Physics (Foundation) Topic 14

14 questions · 153 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Foundation Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

14 questions · 153 marks · lowest tariff first



7-MARK QUESTIONS

1 question in this booklet



- 2 (a) Figure 1 shows a fixed mass of gas inside a cylinder with a movable piston.

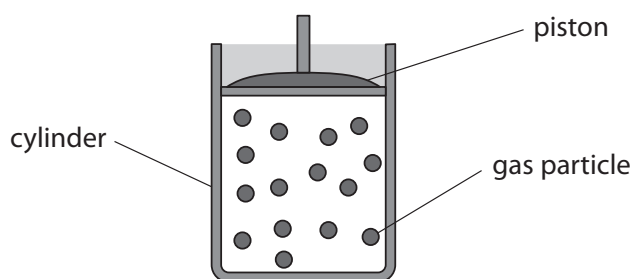


Figure 1

- (i) Describe, in terms of **gas particles**, how the gas exerts a pressure on the cylinder.

(3)

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- (ii) Figure 2 shows the same gas squashed into a smaller volume.

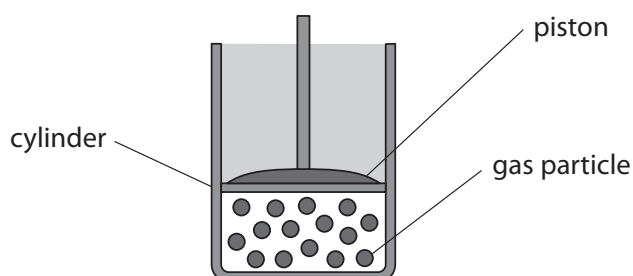


Figure 2

State what happens to the pressure the gas exerts on the cylinder when the volume of gas is reduced, as in Figure 2.

(1)

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.....

(iii) State what happens to the gas particles when the volume of the gas is reduced, as in Figure 2.

(1)

(b) Figure 3 shows an oxygen cylinder.



Figure 3

The volume of the gas in the cylinder is 2100 cm^3 .

When the gas is released into the atmosphere the volume of the gas is 8600 cm^3 .

The pressure of the atmosphere is 98 kPa .

Calculate the pressure of the gas when it is in the cylinder.

Use the equation

$$P_1 = \frac{P_2 \times V_2}{V_1}$$

(2)

pressure of the gas in the cylinder = ... kPa

(Total for Question 2 = 7 marks)



9-MARK QUESTIONS

4 questions in this booklet



3 (a) When the pressure in a container of gas increases, the particles of the gas

(1)

- ☐ **A** hit the sides of the container less often
- ☐ **B** hit the sides of the container more often
- ☐ **C** move with lower speeds
- ☐ **D** vibrate more energetically about fixed positions



- (b) A student investigates the pressure and volume of some trapped gas.
Figure 4 shows the apparatus used.

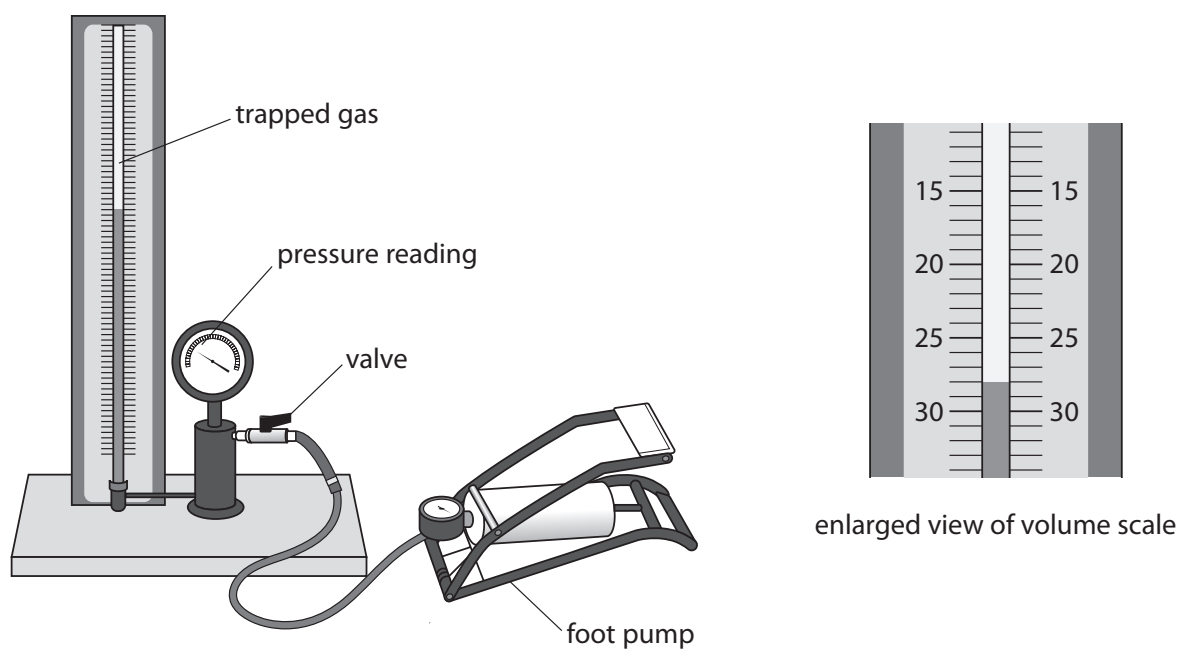


Figure 4

Figure 5 shows the student's table of results.

p	V	$p \times V$
100	28.0	2800
123	23.0	2829
140	20.0	2800
160	18.0	2880
180	16.5	2970

Figure 5

- (i) Suggest what the student should add to the headings of the table in Figure 5.

(1)

.....

.....

(ii) Use Figure 5 to estimate the volume of gas for a pressure reading of '170'.

(2)

volume of gas = ...

(iii) Suggest **two** ways the student could improve the investigation.

(2)

1

.....

2

.....

(iv) Explain whether the values, in the column headed ' $p \times V$ ' in Figure 5, fit the equation

$$p_1 \times V_1 = p_2 \times V_2$$

(3)

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(Total for Question 3 = 9 marks)



- 3 (a) Figure 6 shows helium gas inside a container.

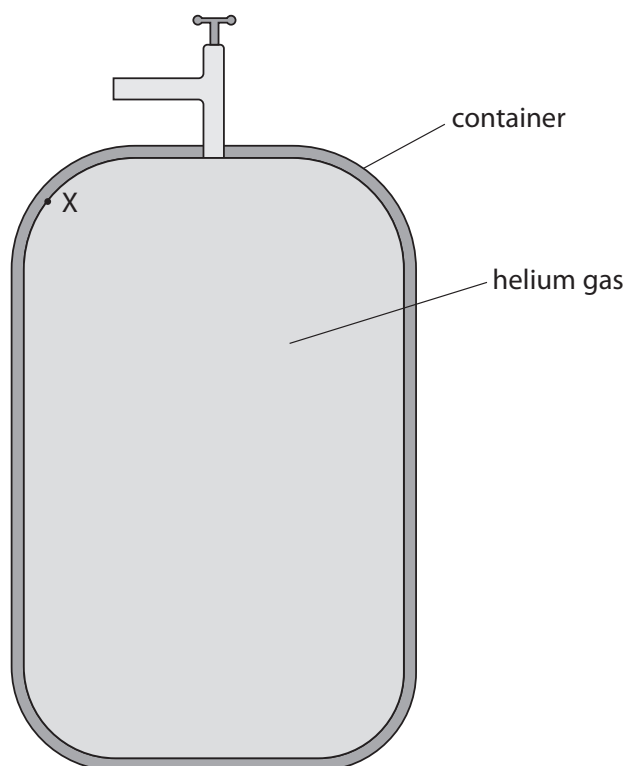


Figure 6

- (i) Draw an arrow on Figure 6 to show the direction of the force due to the helium gas, at the point labelled X.

(1)

- (ii) Explain, in terms of particles, why the helium gas exerts a force on the sides of the container.

(2)

.....

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- (b) The container of helium is moved from a cold room to a warmer room.

State the effect of an increase in temperature on the helium gas particles inside the container.

(1)

.....

.....



- (c) A fixed mass of helium gas is compressed into a container, with no change in temperature.

The table in Figure 7 shows the pressure P_1 and volume V_1 before the gas is compressed, and the volume V_2 after the gas is compressed.

	pressure in kPa	volume in m ³
before the gas is compressed	$P_1 = 105$	$V_1 = 2.3$
after the gas is compressed	$P_2 =$	$V_2 = 0.20$

Figure 7

- (i) Calculate the pressure P_2 after the gas is compressed.

(2)

Use the equation

$$P_2 = \frac{P_1 \times V_1}{V_2}$$

pressure $P_2 =$ kPa



(ii) A shop sells the container of helium gas shown in Figure 8.

The container of helium gas can be used to fill party balloons.



Figure 8

A filled party balloon has a volume of 0.07 m^3 at a pressure of 105 kPa .

The shop claims that you can fill at least 30 party balloons using the gas from the container.

Comment on the shop's claim.

Use information about the volume of the gas at a pressure of 105 kPa as shown in the table in Figure 7.

(3)

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(Total for Question 3 = 9 marks)

- 3 (a) Figure 5 shows the apparatus used to investigate the melting of some crushed ice.

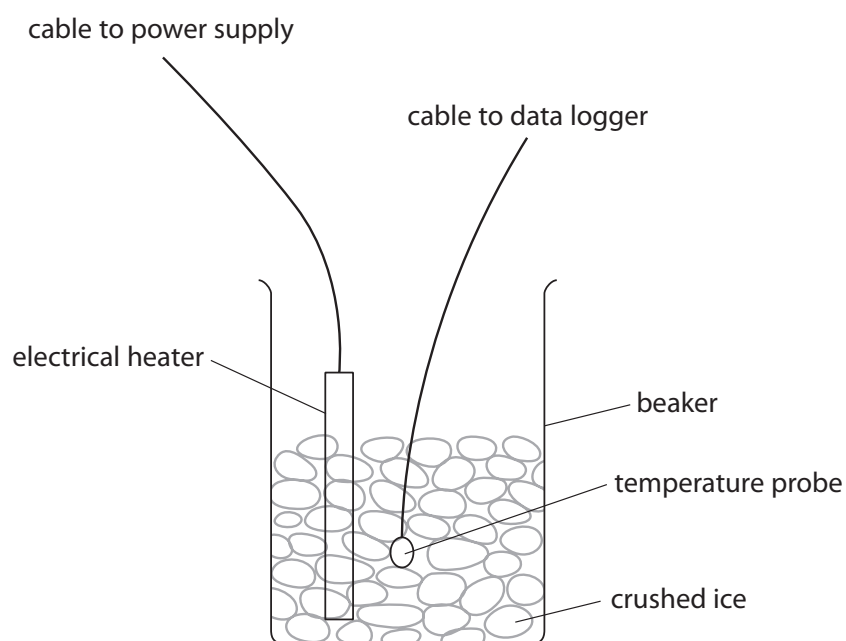


Figure 5

- (i) Suggest **one** safety precaution needed when using the electrical heater.

(1)

.....

.....

- (ii) Suggest **one** way of heating the crushed ice without using electricity.

(1)

.....

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- (b) Figure 6 shows a graph produced from the data collected by the data logger in Figure 5.

Labels P, Q, R and S have been added.

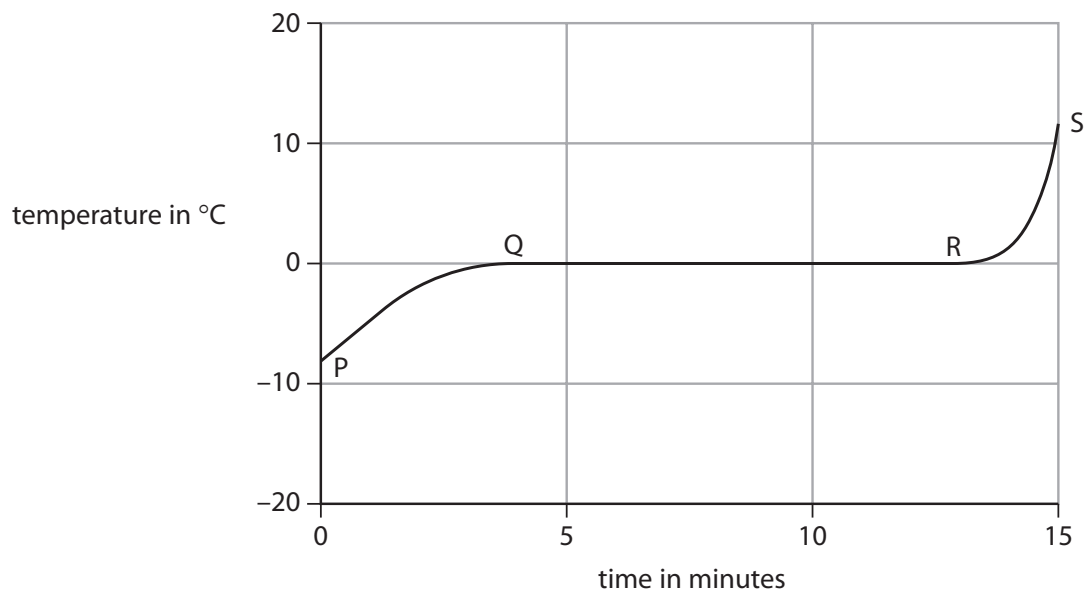


Figure 6

At the start, P, the beaker contains crushed ice at -8°C .

Describe what happens to the crushed ice during the next 15 minutes.

You may use labels P, Q, R and S to help your answer.

(3)

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(c) Figure 7 shows bubbles of air that a diver breathes out.

The bubbles rise towards the surface.

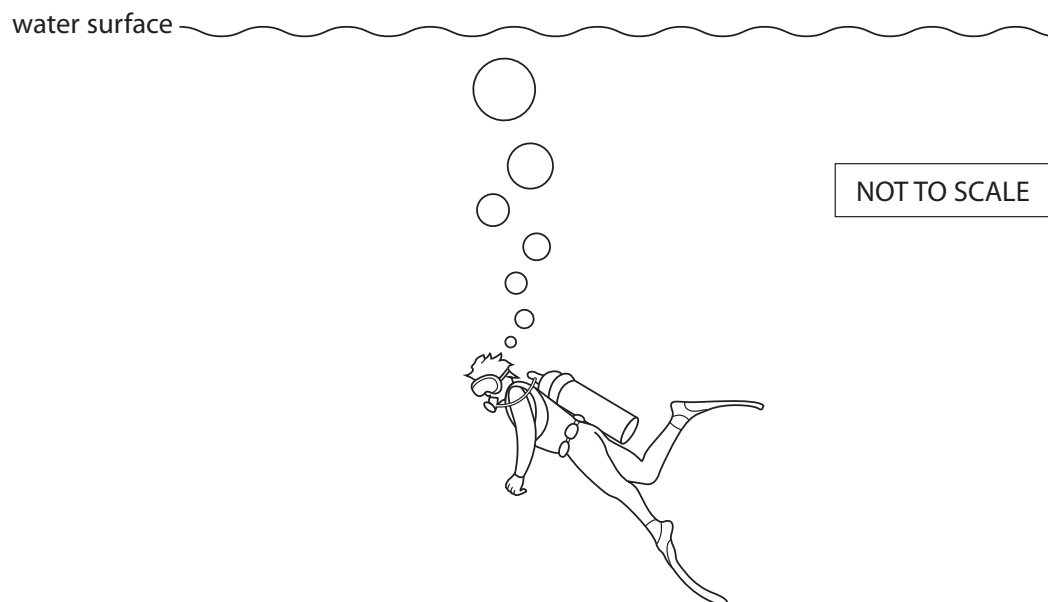


Figure 7

(i) Which row of the table is correct as one bubble rises?

(1)

	the air pressure in the bubble	the volume of the bubble
☐ A	decreases	decreases
☐ B	decreases	increases
☐ C	increases	decreases
☐ D	increases	increases

(ii) Which of these is a unit of pressure?

(1)

- ☐ **A** g/cm^3
- ☐ **B** J
- ☐ **C** kg/cm
- ☐ **D** Pa

(iii) The diver measures air pressure in atmospheres.

A bubble has an initial volume, V_1 , of 0.50 litres, at a pressure, P_1 , of 3.30 atmospheres.

The bubble rises towards the surface of the water, where the pressure, P_2 , is 1.07 atmospheres.

Calculate the volume, V_2 , of the bubble near the surface.

Use the equation

$$V_2 = \frac{P_1 \times V_1}{P_2} \quad (2)$$

volume, V_2 , of the bubble = ... litres

(Total for Question 3 = 9 marks)



4 (a) Which of these describes the motion of particles in a liquid?

(1)

- ☐ A particles move around and are very close together
- ☐ B particles move very quickly and are a long way apart
- ☐ C particles do not move and are a long way apart
- ☐ D particles vibrate about fixed positions

(b) A student is asked to find the density of a metal key.

Figure 8 shows a metal key and some apparatus.

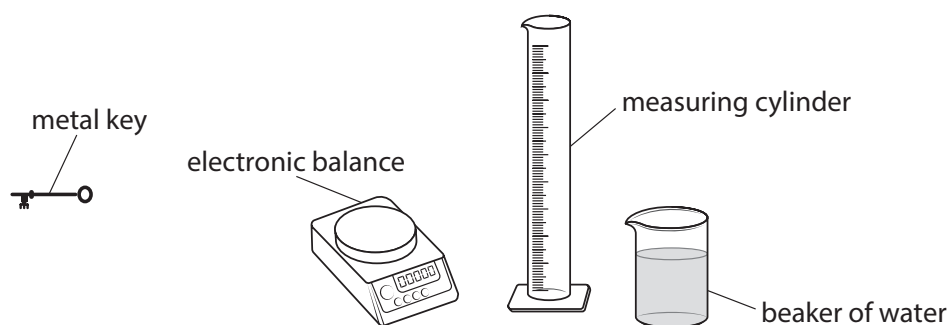


Figure 8

Using the apparatus shown in Figure 8, describe how the student can find the density of the metal key.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

(4)

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- (c) (i) A student heats an aluminium block, as shown in Figure 9.

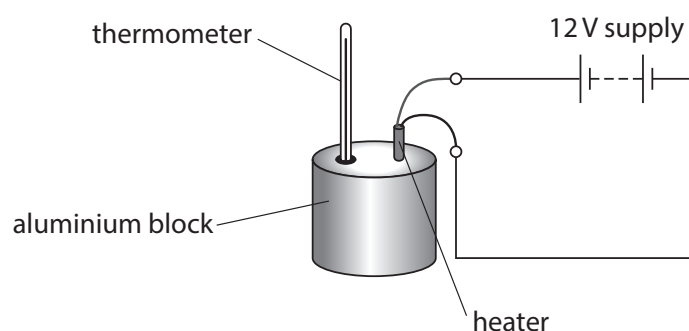


Figure 9

The aluminium block has a mass of 0.96 kg.

The specific heat capacity of aluminium is $920 \text{ J/kg}^\circ\text{C}$.

The temperature of the block increases from 18°C to 35°C .

Calculate the change in thermal energy of the aluminium block.

Use the equation

$$\text{change in thermal energy} = \text{mass} \times \text{specific heat capacity} \times \text{change in temperature} \quad (2)$$

change in thermal energy = ... J

- (ii) Suggest **one** way the student could reduce the energy loss from the aluminium block during the experiment.

(1)

- (iii) The thermometer does not show the maximum temperature reached by the aluminium block until some time after the heater is switched off.

Give **one** reason for this.

(1)

(Total for Question 4 = 9 marks)



11-MARK QUESTIONS

3 questions in this booklet



- 8 (a) A student uses the apparatus in Figure 17 to determine the specific heat capacity of water.

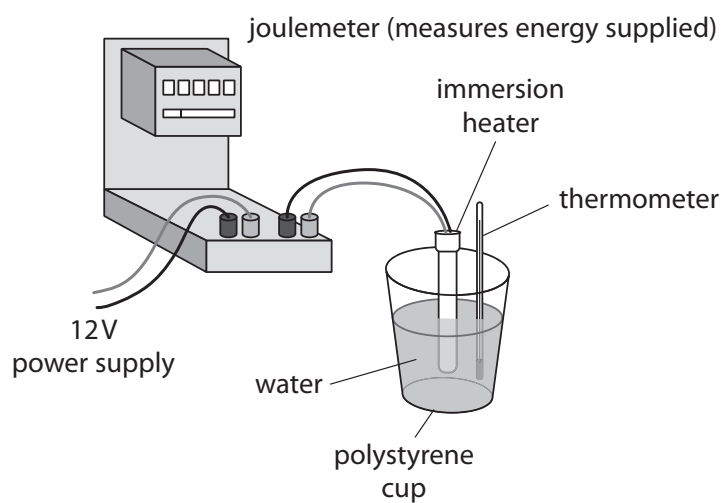


Figure 17

- (i) State the measurements needed to calculate the specific heat capacity of water.

(4)

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(ii) State **two** ways that the apparatus could be adapted to improve the procedure. (2)

1

2

(b) The student decides to measure the temperature of the water every minute while it is being heated.

Figure 18 shows a graph of the student's results.

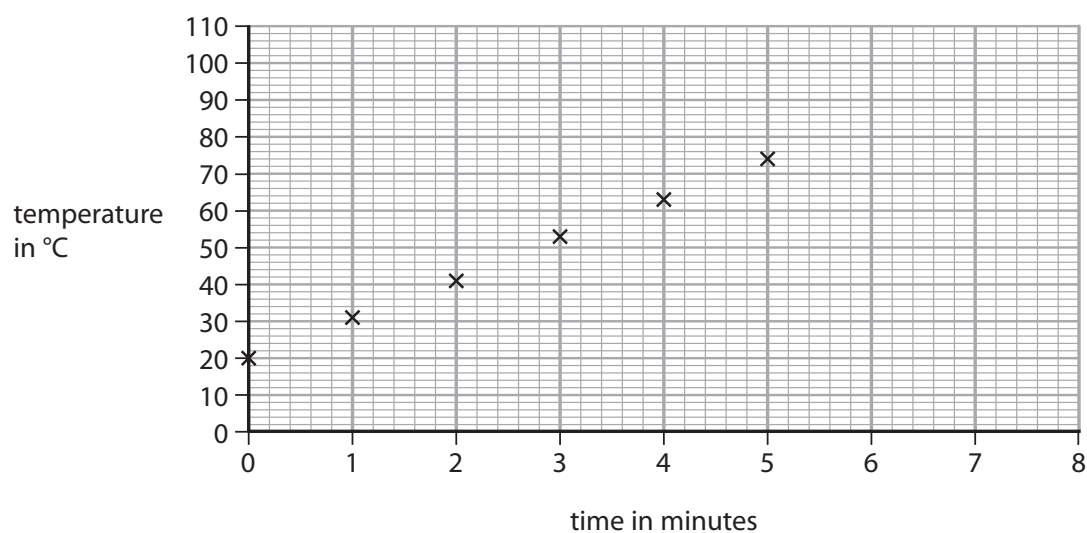


Figure 18

Predict the temperature of the water if the heating continues up to 8 minutes.

(1)

temperature of the water = ... °C

(c) Another student decides to melt some ice.

The student melts 380 g of ice at 0°C.

The specific latent heat of fusion of ice is 3.34×10^5 J/kg.

Calculate the thermal energy needed to melt the ice.

Select an equation from the list of equations at the end of this paper.

(2)

thermal energy needed = ... J

(d) The volume of 380 g of ice is 410 cm³.

Calculate the density of the ice in g/cm³.

(2)

density = ... g/cm³

(Total for Question 8 = 11 marks)



- 8 (a) Figure 19 shows a small piece of copper about 3 cm high.



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Figure 19

A student wants to determine the density of copper.

The student uses a balance to measure the mass of the piece of copper.

- (i) Explain how the student could measure the volume of the piece of copper.

(3)

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- (ii) The mass of the piece of copper is 0.058 kg.

The volume of the piece of copper is $6.5 \times 10^{-6} \text{ m}^3$.

Calculate the density of copper.

(2)

density of copper = ... kg/m³

(b) A student wants to determine the specific heat capacity of copper.

Figure 20 shows a piece of copper, with a thread tied around it, in a glass beaker of boiling water.

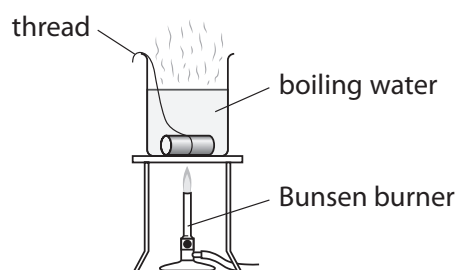


Figure 20

The student leaves the piece of copper in the boiling water so that the copper reaches a temperature of 100°C .

The student uses the thread to take the piece of copper out of the boiling water.

The student puts the hot piece of copper into a different beaker of cold water at 20°C .

The apparatus is shown in Figure 21.

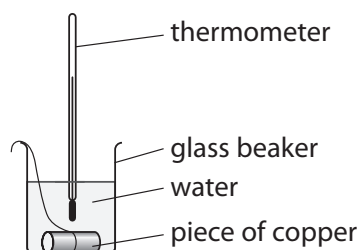


Figure 21

The student assumes that the thermal energy gained by the water equals the thermal energy lost by the piece of copper.

The water and copper both reach a temperature of 22°C .

The cold water gains 1050 J of energy.

The mass of the piece of copper is 0.058 kg .

- (i) Calculate a value for the specific heat capacity of copper, using these results.

Use the equation

change in thermal energy = mass $\times$ specific heat capacity $\times$ change in temperature

$$\Delta Q = m \times c \times \Delta\theta \quad (2)$$

specific heat capacity of copper from these results = ... J/kg °C

- (ii) The value for the specific heat capacity of copper obtained from the student's results is lower than the correct value.

State **two** ways that the experiment could be improved to give a value that is closer to the correct value.

(2)

1

.....

2

.....



(c) A long piece of wire is made into a coil as shown in Figure 22.

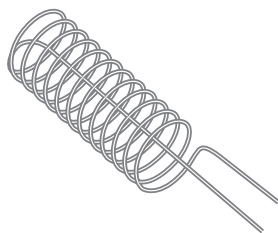


Figure 22

The coil is connected to a low voltage power supply.

Describe how this coil could be used instead of the Bunsen burner in Figure 20.

(2)

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.....

(Total for Question 8 = 11 marks)

- 6 Figure 14 shows a saucepan of milk being heated on an electric cooker.



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Figure 14

- (a) Figure 15 is a table of data about the milk being heated.

mass of milk	0.82 kg
starting temperature of milk	10 °C
final temperature of milk	40 °C
change in thermal energy of milk	96 000 J

Figure 15

- (i) Using data from the table in Figure 15, calculate the increase in temperature of the milk.

(1)

increase in temperature = ... °C

- (ii) Using data from the table in Figure 15, calculate the specific heat capacity of the milk.

Use the equation

$$\text{specific heat capacity} = \frac{\text{change in thermal energy}}{\text{mass} \times \text{increase in temperature}} \quad (2)$$

specific heat capacity = ... J/kg °C

(b) The cooker supplies 130 000 J of energy in a time of 87 s.

(i) Calculate the power supplied by the cooker.

Use the equation

$$P = \frac{E}{t}$$

Give your answer to 2 significant figures.

(3)

power = ... W

(ii) The cooker supplies 130 000 J of energy but only 96 000 J of this energy is used to heat the milk.

Calculate the efficiency of heating the milk using this cooker.

Use the equation

$$\text{efficiency} = \frac{\text{useful energy transferred}}{\text{total energy supplied}}$$

(2)

efficiency = ...



(c) The wiring for the cooker has safety features.

(i) Which of these wires would help to protect a person from getting an electric shock if a fault developed in the cooker?

(1)

- ☐ **A** earth
- ☐ **B** live
- ☐ **C** negative
- ☐ **D** positive

(ii) Explain how a fuse can prevent overheating of the wiring for the cooker.

(2)

.....

.....

.....

.....

(Total for Question 6 = 11 marks)



12-MARK QUESTIONS

1 question in this booklet



- 7 Figure 16 shows a metal container with a movable piston.

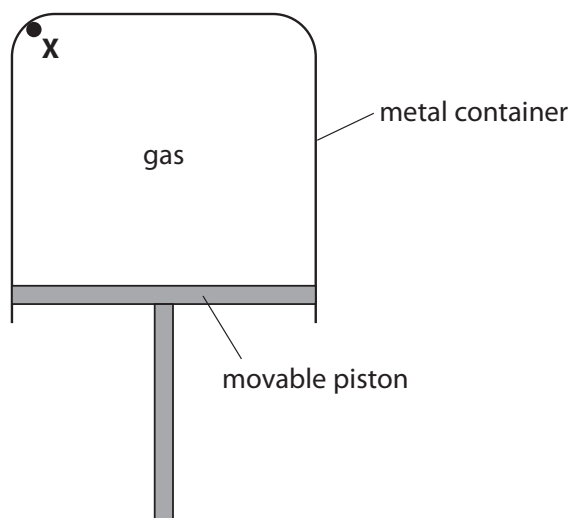


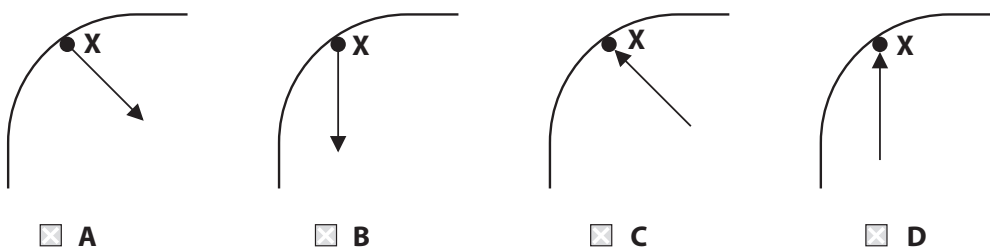
Figure 16

Point X is on the inner surface of the container.

The gas in the container is at a higher pressure than the air outside the container.

- (a) Which of these shows the direction of the force, due to the gas, on the container at point X?

(1)



(b) The pressure of the gas in Figure 16 (P_1) is 120 kPa.

The volume of the gas in Figure 16 (V_1) is 2500 cm³.

The piston is pushed up slowly so that the temperature of the gas does not change.

The new volume of the gas (V_2) is 1600 cm³.

Calculate the new pressure of the gas, P_2 .

Use the equation

$$P_2 = \frac{P_1 \times V_1}{V_2} \quad (2)$$

new pressure, $P_2 =$ kPa



(c) Figure 17 shows a bicycle pump with a closed end.

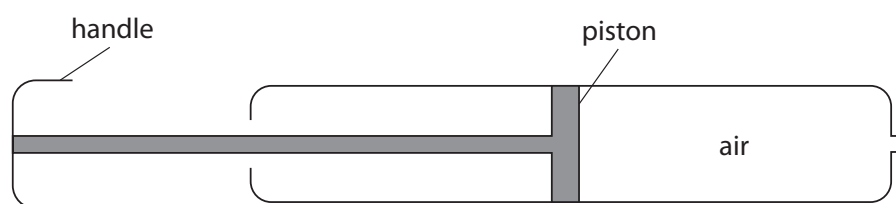


Figure 17

The area of the piston is 2 cm^2 .

A force of 28 N is applied to the piston.

Calculate the pressure, in N/cm^2 , of the piston on the air in the bicycle pump.

(3)

pressure = ... N/cm^2

13-MARK QUESTIONS

5 questions in this booklet



- 9 (a) Describe, in terms of particles, **two** differences between a solid and a liquid of the same substance.

(2)

1

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2

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- (b) Figure 20 shows the dimensions of a solid block of concrete.

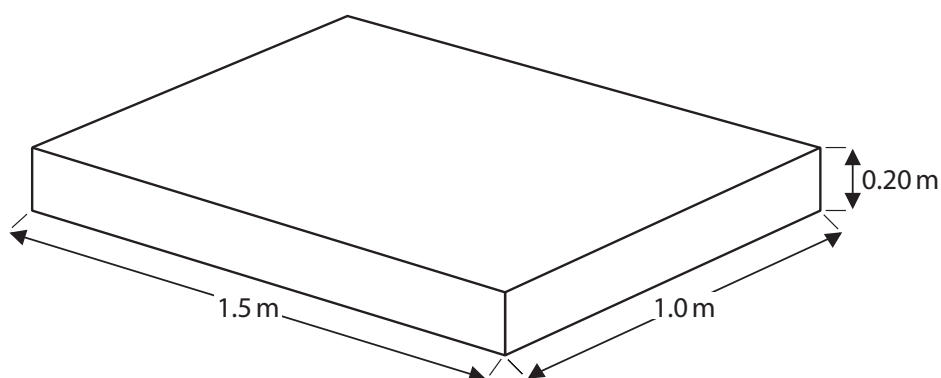


Figure 20

Density of concrete, ρ , = 2100 kg/m^3 .

Calculate the mass of the concrete block.

Use the equation:

$$m = \rho \times V$$

(3)

mass of concrete block = ... kg



(c) Figure 21 shows a shed made mostly of concrete blocks.

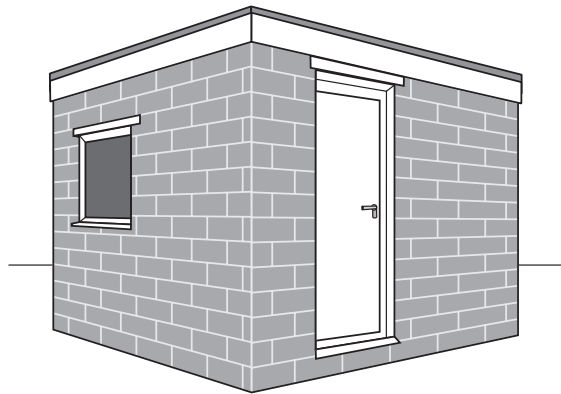


Figure 21

State **two** practical ways to reduce heat loss from this shed.

(2)

1.
2.

- 9 (a) When water boils and turns into steam, there are changes in the arrangement of particles and the density.

Which of these shows the changes?

(1)

	space between particles in steam	density of steam
☐ A	bigger than in water	greater than water
☐ B	bigger than in water	less than water
☐ C	smaller than in water	greater than water
☐ D	smaller than in water	less than water



(b) Figure 21 shows some water in a measuring cylinder and a lump of iron.

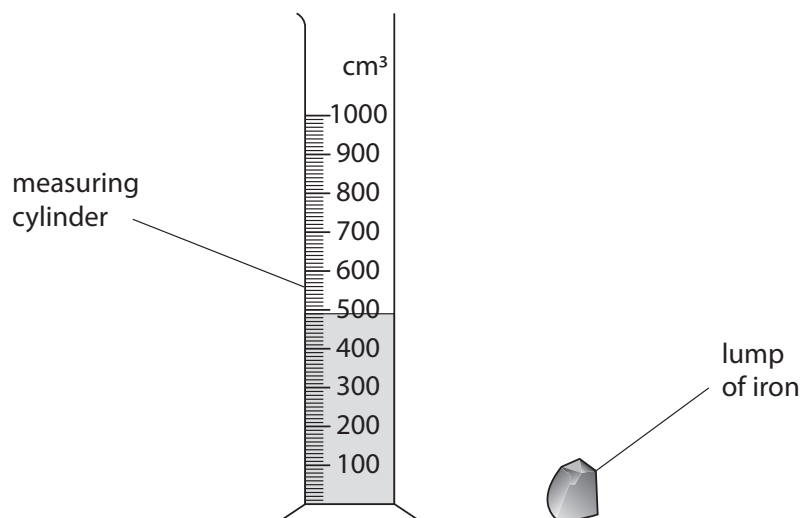


Figure 21

The lump of iron is lowered fully into the water.

The water level in the measuring cylinder rises to 530 cm³.

The density of iron is 7.9 g/cm³.

Calculate the mass of the lump of iron.

Use the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Give your answer to 2 significant figures.

(4)

mass = ... g

(c) A piece of wood has a similar shape and volume to the lump of iron.

The density of the wood is 0.82 g/cm^3 .

The density of water is 1.00 g/cm^3

Explain why the method used in part (b) cannot be used to determine the mass of the piece of wood.

(2)

.....

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*(d) A student needs to determine the specific heat capacity of water.

Figure 22 shows some of the equipment the student uses.

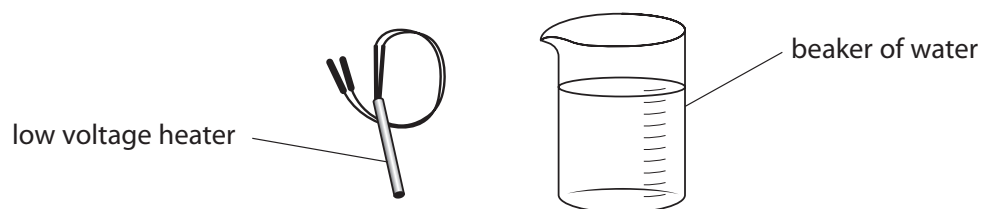


Figure 22

Describe the method the student should use to determine the specific heat capacity of water.

Your description should include, with reasons,

- any other equipment needed
- the measurements needed.

You may draw a diagram if it helps your answer.

(6)

(Total for Question 9 = 13 marks)

9 (a) Which of these means changing state from solid directly to gas?

(1)

- ☐ A condensing
- ☐ B freezing
- ☐ C melting
- ☐ D sublimating

(b) An object has a mass of $7.22 \times 10^{-2} \text{ kg}$ and a volume of $2.69 \times 10^{-5} \text{ m}^3$.

Calculate the density, ρ , of the object.

Use the equation

$$\rho = \frac{m}{V}$$

(3)

State the unit.

density = ... unit

(c) Aluminium has a melting point of 660°C .

The absolute zero of temperature is -273°C .

(i) Calculate the melting point of aluminium in kelvin.

(1)

melting point of aluminium = ... K



(ii) Describe the motion of particles in liquid aluminium (above 660°C).

(2)

.....

.....

.....



7 (a) A technician is investigating the pressure and volume of some gas trapped in a container.

The table in Figure 16 shows the results from the investigation.

pressure in kPa	volume in cm ³
100	270
110	245
130	208
150	180
170	159
190	142
210	129

Figure 16

Figure 17 is a graph of the results.

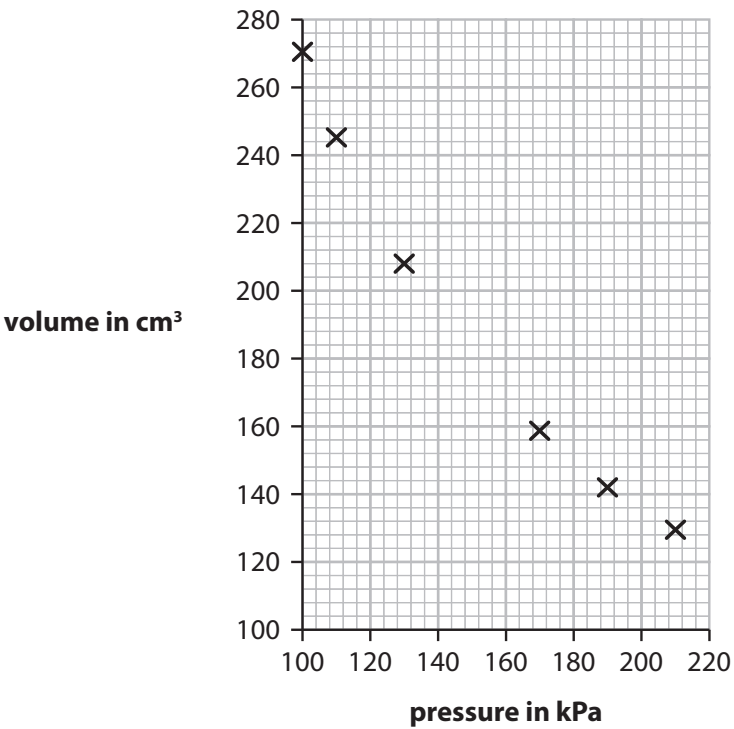


Figure 17

- (i) One point has not been plotted on the graph in Figure 17.

The values for this point are shaded in the results table in Figure 16.

Plot the missing point on the graph in Figure 17.

(1)

- (ii) Draw a smooth curve through the points on the graph in Figure 17.

(1)

- (iii) Use the graph in Figure 17 to estimate the volume at a pressure of 120 kPa.

(1)

volume = ... cm³

- (iv) The temperature of the gas in the container is 293 K.

Which of these is the same temperature as 293 K?

(1)

☐ A -20 °C

☐ B 0 °C

☐ C 20 °C

☐ D 273 °C

- (b) (i) Figure 18 shows a cylinder containing some gas.



Figure 18

The cylinder of gas warms up and the temperature of the gas increases.

Complete the following sentence to describe what happens as the gas warms up.

(1)

Thermal energy transfers to energy of the gas particles.

(ii) Figure 19a shows a container of gas.

The gas has a pressure of P_1 and volume V_1 .

Figure 19b shows the same container after the gas has been compressed.

The pressure is now P_2 and the volume is V_2 .

The temperature of the gas does not change.

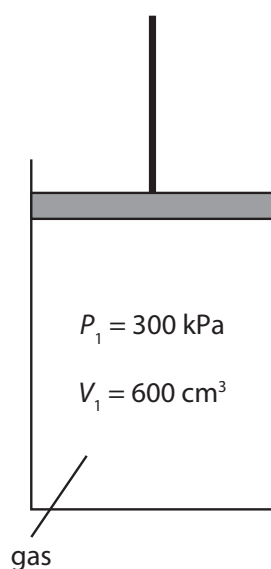


Figure 19a

Not to scale

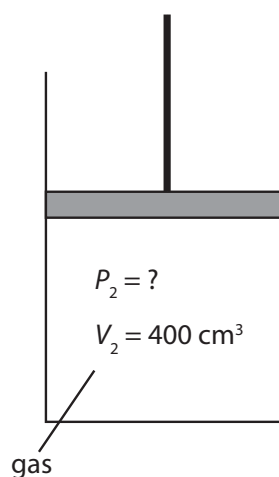


Figure 19b

Use data from Figure 19a and Figure 19b to calculate the pressure P_2 of the gas in Figure 19b.

Use the equation

$$P_2 = \frac{P_1 \times V_1}{V_2} \quad (2)$$

$P_2 = \dots\dots\dots$ kPa

- 9 (a) A coil of copper wire has a mass of 14.1 g.

The density, ρ , of copper is 8.96 g/cm^3 .

Calculate the volume of the copper wire.

Use the equation

$$\rho = \frac{m}{V}$$

(3)

volume = ... cm^3



(b) Figure 23 gives information about the density of aluminium.

	density in g/cm ³
solid aluminium	2.70
liquid aluminium	2.38

Figure 23

Explain the difference between the density of solid aluminium and the density of liquid aluminium in terms of the arrangement of particles.

(2)

.....

.....

.....

.....

(c) A student boils some water.

Calculate the amount of thermal energy needed to change 60.0 g of water to steam at its boiling point.

The specific latent heat of vaporisation of water, L , is 2.26×10^6 J/kg.

Use the equation

$$Q = m \times L$$

(2)

amount of thermal energy = ... J



*(d) A student is investigating the melting of ice.

The student has some crushed ice in a beaker at a temperature of -20°C .

The student heats the beaker and its contents for 20 minutes.

Figure 24 is a graph of the student's results.

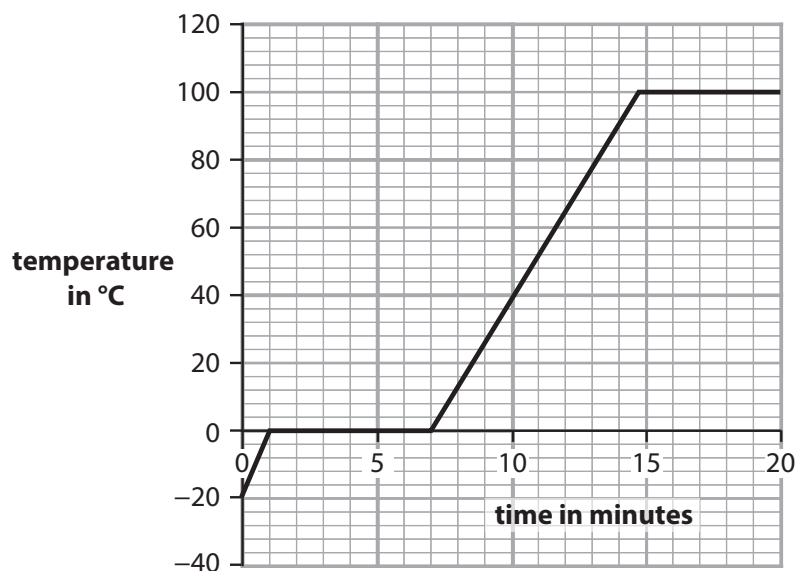


Figure 24

Using information from the graph, describe the changes that take place in the 20 minutes shown on the graph.

Your answer should refer to

- data from the graph
- the state (solid, liquid or gas) of the contents of the beaker.

(6)

Answer lines for this question start on page 31

This image shows a single sheet of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(Total for Question 9 = 13 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number:	Answer	Additional guidance	Mark
2(a)(i)	a description to include 3 of the following: gas particles/molecules/atoms are continually in motion (1) collide /hit/bombard (1) with the (sides/walls) of the container (1) (gas particles) exert force (on the side of the container) (1)	allow cylinder /glass	(3) AO 1 1

Question Number:	Answer	Additional guidance	Mark
2(a)(ii)	pressure (of gas) increases (1)		(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
2(a)(iii)	more (frequent) collisions (of particles with walls) (1)	accept particles move closer together particles move faster	(1) AO 1 1

Question Number:	Answer	Additional guidance	Mark
2(b)	substitution (1) $(P_1) = \frac{98 \times 8600}{2100}$ evaluation (1) 400 (kPa)	accept any answer that rounds to 400 eg. 401.33 (kPa) award full marks for the correct answer without working.	(2) AO 2 1

(Total for Question 2 = 7 marks)



Question number	Answer	Mark
3(a)	B hit the sides of the container more often Options A, C and D are incorrect associations	(1) AO1

Question number	Answer	Additional guidance	Mark
3bi	(headings to the table should have) units or names (1)	accept any correct unit suggestion e.g. cm^3 / Pascals or any correct name e.g. pressure / volume	(1) AO3

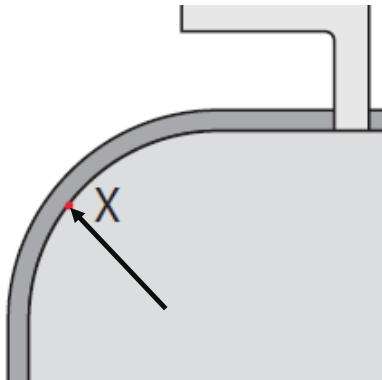
Question number	Answer	Additional guidance	Mark
3bii	attempts to find any 'in between number' (interpolates) (1) evaluation (1) 17.2, 17.3 or 17.25	accept any number between 16.6 and 17.9 award full marks for correct answer without working	(2) AO3

Question number	Answer	Additional guidance	Mark
3biii	Suggestions, including any two from: take intervening pressure reading(s) (1) give (plenty of) time between readings (1) use apparatus with smaller scale divisions (1) take repeat readings and average (1) make sure temperature stays constant (1)	e.g. steps of 0.2 cm³ on volume scale allow repeat to check for anomaly e.g. check temperature of the room ignore any ideas of extending the investigation	(2) AO3

Question number	Answer	Additional guidance	Mark
3biv	An explanation including any three from: any reference to data from the table (1) (the product) $p \times V$ remains constant (1) for most readings $p \times V$ is similar / close to 2800 (1) which points to $p_1 \times V_1 = p_2 \times V_2$ (1) OR equation doesn't fit because values are different (mp4 dependent upon mp2 / mp3) last value(s) of $p \times V$ discordant compared with the others (1)	e.g. no, because almost all the (pV) values are different agrees / disagrees with hypothesis last value(s) values of pV don't agree	(3) AO3

(Total for Question 3 = 10 marks)



Question number	Answer	Additional guidance	Mark
3 (a)(i) Clip with fig 6	arrow normal to surface at point x 	Judge by eye may be inside or outside the container	(1) AO1

Question number	Answer	Additional guidance	Mark
3 (a)(ii)	particles are in (random) motion (1) collide with sides (of container) (1)	particles bounce off sides of container award 2 marks for change in momentum of particles.	(2) AO1

Question number	Answer	Additional guidance	Mark
3 (b)	particles have greater (kinetic) energy (1)	greater (average) velocity move faster/ more quickly more (frequent) collisions exert greater force on sides ignore changes pressure of the gas	(1) AO1

Question number	Answer	Additional guidance	Mark
3 (c)(i)	substitution (1) $P_1 = \frac{105 \times 2.3}{0.2}$ evaluation (1) $P_1 = 1200 \text{ (kPa)}$	allow values that round to 1200 e.g. 1207.5 award full marks for the correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
3 (c)(ii)	Use relevant information from table (1) relevant calculation (1) either (volume of 30 balloons =) 0.07×30 or (number of balloons =) $\frac{2.3}{0.07}$ or (volume per balloon =) $\frac{2.3}{30}$ comparison / supported conclusion (1) 2.1 is less than 2.3 Or 32 is more than 30 Or 0.077 is more than 0.07	2.3 used in a calculation or comparison 2.1 (m ³) scores MP2 only 32(.8) scores MP1 and MP2 0.077 (m ³) scores MP1 and MP2 32 therefore claim is correct	(3) AO3

Total 9 marks

Question number	Answer	Additional guidance	Mark
3 (a) i	any one from do not touch heater (when it is switched on) (1) do not use mains (voltage) (1) use gloves/cloth to handle beaker/heater (after water is heated) (1)	accept only switch on when in beaker/water 'use gloves' must be qualified with a purpose in using them e.g. use gloves to prevent burns	(1) AO1

Question number	Answer	Additional guidance	Mark
3 (a) ii	any one from bunsen (burner) (1) putting out in the sunlight (1) water bath (1)	gas (heating) solar accept use hands (to warm)	(1) AO1

Question number	Answer	Additional guidance	Mark
3 (b)	A description to include any three from from P to Q temperature (of ice) increases (1) from Q to R temperature (of ice and water mixture) stays constant (at 0°C) (1) from R to S temperature (of water) increases (1) any reference to melting / melts (1) melting from Q to R (1) PQ (contents are) solid (1) QR (contents are) {solid + liquid} / {ice + water} (1) RS (contents are) liquid / water (1)	accept time interval references as equivalent to PQ, QR and RS intervals take PQ as from -8/-9°C to Q take RS as from R to to 11/12 °C accept solid/ice turns to liquid/water temperature stays constant when melting if no other mark scored, allow one mark for correct description of temperature changes without references to PQRS or time	(3) AO3

Question number	Answer	Mark
3 (c) i	B decreases increases A is wrong because the volume of the bubble does not decrease C and D are wrong because the air pressure in the bubble does not increase	(1) AO1

Question number	Answer	Additional guidance	Mark
3 (c) ii	D Pa A , B and C are wrong because they are all wrong units for pressure		(1) AO1

Question number	Answer	Additional guidance	Mark
3 (c) iii	substitution (1) ($V_2 =$) $\frac{0.5 \times 3.3}{1.07}$ evaluation (1) (volume of the bubble =) 1.5	any number that rounds to 1.5 (m/s) accept 1.54 award full marks for the correct answer without working	(2) AO2

Total for Q3 = 9 marks



Question Number	Answer	Mark
4(a)	A particles move around and are very close together B is incorrect because describes particles in a gas C is incorrect because does not describe solid, liquid or gas as the particles always move D is incorrect because describe particles in a solid	(1) AO1.1

Question Number	Answer	Additional guidance	Mark
4(b)	a description including: use the balance to find the mass of the key (1) (add water and) measure (initial) volume / level of water using the (measuring) <u>cylinder</u> (1) place the key in the measuring <u>cylinder</u> (1) subtract the (two) volumes (to give the volume of the key) (1)	accept weigh the key using the balance allow scales for balance ignore weight accept fill measuring <u>cylinder</u> to a named volume e.g. 100ml accept find the increase/ difference in volume / level of water allow alternative method: use the balance to find the mass of the key (1) fill beaker/eureka can (to the top) with water (1) place key in beaker/eureka can and catch overflow (in measuring cylinder) (1) measure volume / level of water using the (measuring) <u>cylinder</u> (1)	(4) AO1.2

Question Number	Answer	Additional guidance	Mark
4(c)(i)	substitution (1) ($\Delta Q =$) $0.96 \times 920 \times 17$ evaluation (1) 15000 (J)	$0.96 \times 920 \times (35-18)$ accept 15014 (.4) 15000 to any other power of ten scores 1 mark award full marks for the correct answer without working	(2) AO2.1

Question Number	Answer	Additional guidance	Mark
4(c)(ii)	add insulation (around aluminium block) (1)	accept any named insulator allow polish aluminium block allow wrap in foil or put in a box ignore 'lids' unless with a (named) insulator	(1) AO3b

Question Number	Answer	Additional guidance	Mark
4(c)(iii)	any one from: energy needs (time) to transfer (through the aluminium) (1) heater and thermometer are not close together (1) there is a gap between the thermometer and the block (1)	accept heat for energy accept travel/conduct/spread for transfer	(1) AO1.1

Total for Question 4 = 9 marks

Question number:	Answer	Additional guidance	Mark
8(a)(i)	(measurement of) the mass of water (1) (measurement of) the temperature (rise/change) (1) (measurement of) the energy supplied / from heater (1) detail of any of the above (1)	accept volume / weight of water ignore amount accept (take) thermometer reading accept (take) reading of the joulemeter ignore 'change in thermal energy' (from equation) e.g. measure temp at the start and end or measure mass of empty cup or start and end readings on the meter	(4) AO 1 2

Question Number:	Answer	Additional guidance	Mark
8(a)(ii)	any two improvements from: add lid /cover (1) add lagging / insulation (1) add a stirrer (1) use a more sensitive thermometer (1) ensure heater fully submerged (1)	both marks can be scored in one answer space ignore repeating readings ignore increase voltage / power / energy ignore use of clamp to hold thermometer / heater accept use better insulator or better insulated / thicker cup accept use calorimeter ignore use glass beaker unless cup is inside it ignore different type of cup accept use digital / electric thermometer / data logger	(2) AO 3 3b

Question Number:	Answer	Additional guidance	Mark
8(b)	100 (°C) (1)	accept any answer between and including 95 and 102 (possibility that it is not pure water and possibility of heat loss prevents reaching boiling point)	(1) AO 2 1

Question Number:	Answer	Additional guidance	Mark
8(c)	substitution (1) $(Q =) \frac{380 \times 3.34 (\times 10^5)}{(1000)}$ evaluation (1) $1.27 \times 10^5 \text{ (J)}$	 127 kJ 126920 (J) accept answers that round to 1.27×10^5 e.g. 1.2692×10^5 accept 130 kJ or $1.3 \times 10^5 \text{ (J)}$ POT error max. 1 mark award full marks for correct answer without working	(2) AO 2 1

Question Number:	Answer	Additional guidance	Mark
8(d)	recall and substitution (1) $(\text{density } \rho) = \frac{380}{410}$ evaluation (1) $0.93 \text{ (g/cm}^3\text{)}$	 allow substitution of a mass / a volume accept any value that rounds to 0.9 allow truncated 0.92 (g/cm ³) only accept 1(g/cm ³) if working shown. award full marks for correct answer without working	(2) AO 2 1

(Total for Question 8 = 11 marks)



Question number	Answer	Additional guidance	Mark
8 (a)(i)	an explanation linking any three of the following : use a measuring cylinder /beaker or use a eureka can /displacement can/container with spout (1) (partly) fill measuring cylinder /beaker (with water) note the reading or fill (eureka) can to spout (1) immerse piece of copper (in water) (1) note difference in readings of water level (in measuring cylinder /beaker) or collect water from spout in a measuring cylinder /beaker (1)	give credit for other acceptable methods If no other marks scored then allow 1 mark for attempt to measure volume directly: e.g. fill copper tube with water, tip out and measure volume or measure dimension(s) of copper tube	(3)

Question number	Answer	Additional guidance	Mark
8(a)(ii)	recall and substitution (1) density = $\frac{m}{V}$ (density =) $\frac{0.058}{6.5 \times 10^{-6}}$ evaluation (1) $8.9 \times 10^3 \text{ (kg/m}^3\text{)}$	accept values that round to 8900 e.g. 8923(kg/m³) or 9000 8.9 to any other power of ten gains 1 mark award full marks for correct answer without working.	(2)

Question number	Answer	Additional guidance	Mark
8(b)(i)	rearrangement (and substitution) (1) (c) = $\frac{1050}{0.058 \times 78}$ evaluation (1) 230 (J/kg °C)	$c = \frac{\Delta Q}{m \times \Delta\theta}$ award 1 mark if 78 seen accept 232(J/kg °C) award full marks for correct answer without working.	(2)

Question number	Answer	Additional guidance	Mark
8(b)(ii)	any two of the following reduce heat loss from water/insulate beaker/add cover (1) make the temperature rise larger/use a larger piece of copper/ use a smaller amount of water (1) (use) a stirrer (1) account for heat gained by glass beaker (1) transfer the hot copper faster (1) use a different heating method (1) measure the temperature of the boiling water (1)	ignore more accurate measurements e.g. thermometer, balance etc. ignore taking repeats start with colder water	(2)

Question number	Answer	Additional guidance	Mark
8 c	a description including two from: put the coil in the water (1) (electric) current in the wire/coil (1) thermal energy transferred (in the wire) (1)	allow electricity for electric current heat(energy) in wire / temperature of wire increases/ produces heat/ gives energy/ to heat the water	(2)

Total marks for question 8 = 11 marks



Question	Answer	Additional guidance	Mark
6(a)(i)	30 (°C) (1)		(1) AO3.1

Question	Answer	Additional guidance	Mark
6(a)(ii)	substitution (1) $(c =) \frac{96\,000}{0.82 \times 30}$ evaluation (1) $(c =) 3900 \text{ (J/kg °C)}$	allow ECF from (a)(i) throughout allow values that round to 3900 e.g. 3902.4 (J/kg °C) award full marks for the correct answer without working	(2) AO3.1

Question	Answer	Additional guidance	Mark
6(b)(i)	substitution (1) $(P =) \frac{130\,000}{87}$ evaluation (1) $(P =) 1494 \text{ (W)}$ value to 2sf (1) 1500 (W)	award two marks for the correct answer without working independent mark for any number to 2sf	(3) AO2.1

Question	Answer	Additional guidance	Mark
6(b)(ii)	substitution (1) (efficiency =) $\frac{96\,000}{130\,000}$ evaluation (1) (efficiency =) 0.74	 accept values that round to 0.74 e.g. 0.7385 accept 74 % for 2 marks allow 74 without % sign for 1 mark only allow 0.73 or 73% for 1 mark award full marks for the correct answer without working	(2) AO2.1

Question	Answer	Mark
6(c)(i)	A earth <i>B, C and D would not help to protect from shock</i>	(1) AO1.1

Question	Answer	Additional guidance	Mark
6(c)(ii)	 an explanation linking two from:	ignore references to p.d./voltage current is greater than fuse	(2) AO1.1

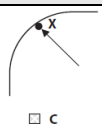
	if the current is too large (1) (fuse) melts/breaks (1) switches off (current/circuit) (1)	value/size/rating blows stops current OR stops flow of charge	
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(Total for question 6 = 11 marks)



Question	Answer	Additional guidance	Mark
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Question number	Answer	Additional guidance	Mark
7(a)	 B and D are incorrect because they are not normal to the surface A is incorrect because the force should act outwards		(1)

Question number	Answer	Additional guidance	Mark
7(b)	substitution (1) $(P_2 =) \frac{120 \times 2500}{1600}$ evaluation (1) 190 (kPa)	award full marks for the correct answer without working accept values that round to 190; e.g. 187.5, 188, 187	(2)

Question number	Answer	Additional guidance	Mark
7(c)	recall equation (1) pressure = $\frac{\text{force}}{\text{area}}$ substitution (1) $(\text{pressure} =) \frac{28}{2}$ evaluation (1) 14 (N/cm²)	accept $P = \frac{F}{A}$ ignore powers of ten errors for attempted unit conversions award full marks for the correct answer without working if no other marks scored then allow 1 mark for either $\frac{2}{28}$ or 0.07	(3)

Question number	Indicative content	Mark
*7(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • Gas particles are in (random) motion • Particles hit sides of container / each other • This produces (net) force on (sides of) container • This causes a pressure (on the container) • As volume increases the particles have more space to move • This means that particles hit sides less frequently • Smaller (net) force on sides of container • Pressure decreases. • Change in pressure (with increase in volume) is not linear • Pressure never becomes zero	(6)

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Summary for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> simple description of how pressure is caused or how it changes	<u>Possible candidate responses</u> Particles hit sides of container or Pressure becomes less as volume increases
Level 2	3–4	<u>Additional guidance</u> description of how pressure is caused and how it changes	<u>Possible candidate responses</u> Particles hit sides of container. This causes a (net) force on sides of container. Pressure becomes less as volume increases
Level 3	5–6	<u>Additional guidance</u> Description of how pressure is caused, and why it changes in the way shown	<u>Possible candidate responses</u> Particles hit sides of container. This causes a (net) force on sides of the container. As volume increases the particles hit the sides less frequently so the pressure becomes less.

Question 7 = 12 marks

Question number	Answer	Additional guidance	Mark
9(a)	descriptions to include any two of - particles / atoms in solid close(r) together (1) - particles / atoms in solid (vibrate) in fixed positions but particles in liquid move (freely) (1) - particles in a solid in regular arrangement but particles in liquid are randomly arranged (1) - particles in a liquid have more (kinetic) energy (than in a solid) (1)	reverse argument difference asked for, so must compare for subsequent marking points allow answers in terms of forces between particles	(2) AO1

Question number	Answer	Additional guidance	Mark
9(b)	volume substitution (1) $1.5 \times 1.0 \times 0.2(0) (= 0.3)$ substitution in equation (1) $\text{mass} = 2100 \times (0.3(0))$ evaluation (1) $= 630 \text{ (kg)}$	ecf from calculated value of volume for this mark only award 2 marks for $6.3 \times$ any other power of 10 5670 gains 1 mark from use of $1.5+1.0+0.2=2.7$ award full marks for correct answer without working	(3) AO2

Question number	Answer	Additional guidance	Mark
9(c)	statements to include any two from use cladding / (extra) insulation (1) use double thicknesses of the concrete (1) use silver / reflective / white (paint) (1) plant trees around (wind break) (1) use double glazed windows (1) (properly) close window(s)/door	create cavity draft exclusion	(2) AO1

Question number	Indicative content	Mark
9 (d) *	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (strand 2) (6 marks) Indicative content • measure the length and width of a strip with the ruler / a metre rule • measure the thickness of the strip with a more accurate device e.g. digital callipers OR place 5 (say) of the same strip on top of each other and measure their thickness with the ruler then $\div 5$ to calculate a single thickness [plus air gap] • measure the mass of a strip with an electronic balance • measure the mass of (say) 5 strips then $\div 5$ to calculate the mass of one of them • calculate the volume ($= l \times w \times t$) in m^3 and the mass in kg • use displacement can/measuring cylinder to find the volume • mass / volume to get density • check if it's near one of the teacher's two values of density given • if it's close / not so far off it's safe to assume that strip is of the identified material • repeat for the other strip • other repeat measurements	(6) AO1

AO targeting: AO1.2

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) - Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)



Summary for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Partially complete description of a suitable procedure with at least two measurements OR one measurement and another procedural point	<u>Possible candidate responses</u> measure the length measure the width of a strip measure the mass/weight of a strip e.g. repeat measurements
Level 2	3–4	<u>Additional guidance</u> Mostly complete description of a suitable procedure with at least three measurements and some description of processing the results.	<u>Possible candidate responses</u> As above with measure the thickness of the strip calculate the volume (= l x w x t) OR immerse in liquid to get volume
Level 3	5–6	<u>Additional guidance</u> Detailed description of a suitable procedure with all necessary measurements and a clear description of processing the results.	<u>Possible candidate responses</u> As above with extra detail e.g. measure the mass of (say) 5 strips then ÷5 to calculate the mass of one of them detail of obtaining volume by immersion use density = mass /volume check if density value obtained is near one of the teacher's two values

Question 9 =13 marks


Question number	Answer	Mark
9 (a)	[x] B bigger than in water less than water A is incorrect because the density of steam is less than water. C is incorrect because the space between the particles increases. D is incorrect because the space between the particles increases and density of steam is less than water.	(1) A01

Question number	Answer	Additional guidance	Mark
9 (b)	calculation of change in volume (1) (530 cm³ – 490 cm³) = 40 (cm³) substitution (1) $7.9 = \frac{\text{mass}}{40}$ rearrangement and evaluation (1) (mass = 7.9 x 40) (mass =) 316 (g) evaluation to 2 sig fig (1) 320 (g)	measurement mark – using scale allow use of incorrect volume answers without working 316 scores 3 marks 0.316 kg scores 3 marks 316 to any other power of 10 scores 2 marks 4187 or 3871 scores 2 marks (incorrect volume) any answer written to 2sf independent mark answers without working 320 scores 4 marks 320 to any other power of ten scores 3 marks 4200 scores 3 marks 3900 scores 3 marks	(4) A02

Question number	Answer	Additional guidance	Mark
9 (c)	an explanation linking density of wood less (than that of water) (1) less (volume of) water displaced (than volume of wood) (1)	allow wood floats / should be submerged allow wood absorbing water allow (idea of) incorrect volume reading allow (idea that) the volume cannot be measured this way	(2) A02

Question number	Indicative content	Mark
*9(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Equipment • Thermometer • Measuring cylinder / balance • Power supply • Stirrer • Joule meter / ammeter / voltmeter • Stopwatch / clock Measurements • Mass / volume of water • Initial / final / change of temperature of water • Voltage / current / energy / power • Time (heated for) Detail • Lid/insulation to reduce energy loss • Ensure heater fully immersed / keep stirring the water • Use of equation $\Delta Q = m \times c \times \Delta\theta$ / calculation of input energy • Repeat and find average • Plot graph of temp change and time / energy Credit can be given for correctly labelled diagrams	(6) A01

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) - Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels
	0	No rewardable material.	e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
Level 1	1–2	<u>Additional guidance</u> one measurement or two items of equipment or one piece of detail	<u>Possible candidate responses</u> measure the temperature of the water to start with or the student needs a power supply and a thermometer or insulated material around the beaker
Level 2	3–4	<u>Additional guidance</u> two items of equipment and at least one measurement or one piece of equipment and two measurements or two items of equipment and one piece of detail or one measurement and one piece of detail	<u>Possible candidate responses</u> The student needs a measuring cylinder to measure the volume of water. They also need a thermometer Or Measure the temperature rise of the water and use a balance to measure the mass or They need a power supply for the heater and a voltmeter. Keep the heater in the water. or Measure temperature rise of the water. Keep stirring the water all the time.
Level 3	5–6	<u>Additional guidance</u> two items of equipment and two measurements and one piece of detail.	<u>Possible candidate responses</u> The student needs a balance to find the mass of water. They also need a thermometer to measure the rise in temperature of the water. Then use the equation $\Delta Q = m \times c \times \Delta\theta$

Total 13 marks

Question number	Answer	Mark
9 (a)	☒ D sublimating A is incorrect because it describes a change of state from gas to liquid. B is incorrect because it describes a change of state from liquid to solid C is incorrect because it describes a change of state from solid to liquid	(1) AO1



Question number	Answer	Additional guidance	Mark
9 (b)	substitution (1) $(\rho) = \frac{7.22(\times 10^{-2})}{2.69(\times 10^{-5})}$ evaluation (1) (ρ =) 2680 unit (1) kg / m³	2.68 to any power of ten seen allow any value that rounds to 2680; e.g. 2684 accept 2700 allow values in standard form e.g. 2.68×10^3 kg m⁻³ allow for three marks: 2.68 to any power of ten with a consistent unit, e.g. 2680 kg/m³ 2680 g/dm³ 2.68 g/cm³ 2.68 kg/dm³ 0.00268 kg/cm³ 2 680 000 g/m³ allow for two marks: • 2680 with no or incorrect unit • 2.68 to any other power of 10 with an inconsistent unit of density • correct substitution with an inconsistent unit of density allow for one mark: • 2680 to any other power of ten with no or incorrect unit • appropriate unit of density with no or an incorrect value	(3) AO2



Question number	Answer	Additional guidance	Mark
9 (c) (i)	933 (K) (1)	do not accept -933	(1) AO2

Question number	Answer	Additional guidance	Mark
9 (c)(ii)	A description to include any two from: (motion is) random (1) various {speeds / velocities / kinetic energies} (1) bump into each other / collide (1) fast(er than solid) (1)	move freely / move in any direction / move around different speeds range of speeds slide over / past each other / touch each other / in contact with each other more kinetic energy (than in solid) ignore bulk properties of liquids e.g. take shape of container. ignore vibrate "random speeds" on its own scores 1 mark	(2) AO1

Question number	Indicative content	Mark
*9(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Fibre glass • has lower R-value • similar R-value (to polystyrene) • derived from sand so plentiful / cheap • non-flammable • dangerous to install • concludes / uses other arguments to say that it is a suitable or unsuitable material Polystyrene • high(est) R-value so suitable on that score • (but) involves petroleum / oil extraction so (could be) environmentally damaging • melting / flammable / fire hazard / release of toxic fumes • concludes / uses other arguments to say that it is a suitable or unsuitable material	(6) AO2, AO3

AO targeting: 3 marks AO2 strand 1 and 3 marks AO3 strand 1a and 1b

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)



Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> at least two pieces of information from the table used OR one piece of information on the table and makes a simple choice	<u>Possible candidate responses</u> R is 4.0 for polystyrene + fibreglass is not flammable OR we should use fibreglass
Level 2	3–4	<u>Additional guidance</u> compares at least two properties OR compares one property and gives a conclusion about suitability uses information from the two materials used AND makes some comparison(s) / concludes logically about suitability	<u>Possible candidate responses</u> fibreglass has a lower R-value and is not flammable, but polystyrene is OR fibreglass is not flammable, but polystyrene is, so fibreglass better
Level 3	5–6	<u>Additional guidance</u> compares at least two properties AND gives a conclusion (both materials involved, allow one to be discussed in greater detail than the other) WITH logical connections between elements argued from the table.	<u>Possible candidate responses</u> fibreglass and polystyrene have similar R-values. Fibreglass is not flammable, but polystyrene is, so fibreglass is better

Total for Q9 = 13 marks



Question	Answer	Additional guidance	Mark
7(a)(i)	point plotted at 150,180 (1)	$\pm$ half a square 	(1) AO3.1

Question	Answer	Additional guidance	Mark
7(a)(ii)	smooth curve through the points (1)	smooth curve through/touching at least 5 crosses ignore slight shakiness in drawing do not accept tramlining (multiple curves)	(1) AO3.1

Question	Answer	Additional guidance	Mark
7(a)(iii)	224 ± 4 (cm ³) (1)	any number between 220 and 228 inclusive	(1) AO3.1

Question	Answer	Mark
7(a)(iv)	C 20 °C <i>A is incorrect as it is 253 K</i> <i>B is incorrect as it is 273 K</i> <i>D is incorrect as it is 546 K</i>	(1) AO1.1

Question	Answer	Additional guidance	Mark
7(b)(i)	kinetic (1)	movement / internal reject mechanical / potential / elastic	(1) AO1.1

Question	Answer	Additional guidance	Mark
7(b)(ii)	substitution (1) $(P_2 =) \frac{300 \times 600}{400}$ evaluation (1) $(P_2 =) 450 \text{ (kPa)}$	 allow values to 1sf e.g. 400 or 500 allow one mark for 400 OR 450 OR 500 to any other power of ten award full marks for the correct answer without working	(2) AO2.1

Question	Indicative content	Mark
7(c)*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 particles exerting pressure: • particles in (rapid) (random) motion/have high speed • particles move freely • particles collide • particles collide with the (walls of) the container • there is a change in momentum of the particles • producing a force on the walls • pressure = force/area OR $P = F/A$ effect of decreasing volume: • when volume decreases collisions increase • when volume decreases rate/frequency of collisions increases • force on walls increases so pressure increases • area of walls decreases • ($P = F/A$) (so) as area decreases pressure increases	(6) AO1.1

Level	Mark	Descriptor
	0	• No rewardable material.



Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material	
Level 1	1–2	<u>Additional guidance</u> isolated facts, statements from either section	<u>Possible candidate responses</u> particles are moving
Level 2	3–4	<u>Additional guidance</u> limited explanation of both sections OR detailed explanation of one section	<u>Possible candidate responses</u> particles are moving and collide more particles in a gas are moving freely colliding with the walls of the container
Level 3	5–6	<u>Additional guidance</u> detailed explanation from both sections	<u>Possible candidate responses</u> particles in a gas are moving freely, colliding with the walls of the container as the volume decreases (rate of) collisions increases

(Total for question 7 = 13 marks)



Question	Answer	Additional guidance	Mark
9(a)	substitution (1) $8.96 = \frac{14.1}{V}$ rearrangement (1) $(V =) \frac{14.1}{8.96}$ evaluation (1) $(V =) 1.57 \text{ (cm}^3\text{)}$	allow substitution and rearrangement in either order allow substitution of correct values into a visible, incorrectly rearranged algebraic equation for this mark only $(V =) \frac{m}{\rho}$ accept numbers that round to 1.57 allow 1.6 award full marks for the correct answer without working allow 1.6 or answers rounding to 1.57 to any other power of 10 scores 2 marks	(3) AO2.1

Question	Answer	Additional guidance	Mark
9(b)	an explanation linking: density of solid is greater (than density of liquid) (1) (because) distance between particles in solid is less (than distance between particles in liquid) (1)	solids are denser accept in solids, particles are closer accept in solids, there are more particles per unit volume / particles are more (tightly) packed	(2) AO1.1

Question	Answer	Additional guidance	Mark
9(c)	substitution into $Q = m \times L$ (1) ($Q =$) $60 (\times 10^{-3}) \times 2.26 (\times 10^6)$ evaluation (1) 1.36×10^5 (J)	136 000 (J) 135 600 (J) accept numbers that round to 1.4×10^5 (J) award full marks for the correct answer without working any answer rounding to 1.4 to any other power of 10 scores 1 mark	(2) AO2.1

Question	Indicative content	Mark
9(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 • ice melts at 0 °C • water boils at 100 °C • 0 to 1 minute temperature of ice rising • 1 to 7 minutes ice melting • 1 to 7 minutes energy supplied is used to increase (potential) energy of ice particles • 1 to 7 minutes energy supplied is used to break bonds (between ice particles) • 7 to about 15 minutes temperature of water rising • 7 to about 15 minutes energy supplied is used to increase (kinetic) energy of water particles • about 15 to 20 minutes water boiling • about 15 to 20 minutes energy supplied is used to break bonds (between water particles)	(6) AO1.2

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)



Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)
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Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material	
Level 1	1–2	<u>Additional guidance</u> limited description including isolated facts for any section	<u>Possible candidate responses</u> temperature of ice/solid increases OR ice melts OR water boils
Level 2	3–4	<u>Additional guidance</u> limited description relating knowledge and understanding to interpretation of graph in one section plus an isolated fact	<u>Possible candidate responses</u> temperature of ice/solid increases for 1 minute AND temperature of the water increases
Level 3	5–6	<u>Additional guidance</u> detailed description relating knowledge and understanding to interpretation of graph in two sections plus an isolated fact	<u>Possible candidate responses</u> temperature of ice/solid increases for 1 minute AND ice melting while 0 °C for 6 minutes AND water boils

(Total for question 9 = 13 marks)

Question	Answer	Mark
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