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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Particle Model (14)

GCSE Physics (Higher) Topic 14

11 questions · 104 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Higher 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.

QUESTION	SOURCE	MARKS	PAGE
1. Q1	Paper 2 June 2018	7	4
2. Q3	Paper 2 November 2021	8	7
3. Q2	Paper 2 June 2018	9	10
4. Q2	Paper 2 November 2020	9	13
5. Q3	Paper 2 June 2022	9	16
6. Q3	Paper 2 June 2023	9	19
7. Q3	Paper 2 June 2024	9	21
8. Q5	Paper 2 June 2025	9	24
9. Q9	Paper 2 June 2022	11	28
10. Q10	Paper 2 November 2021	12	31
11. Q9	Paper 2 June 2024	12	34



QUESTIONS

11 questions · 104 marks · lowest tariff first



7-MARK QUESTIONS

1 question in this booklet



- 1 (a) Figure 1 shows air inside a cylinder with a movable piston.

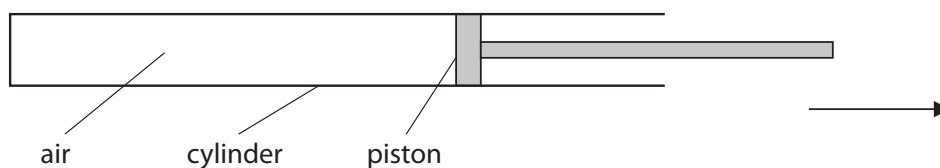


Figure 1

The piston is pulled a little way in the direction of the arrow, but stays inside the cylinder.

Which of these increases?

(1)

- ☐ A The mass of the air inside the cylinder.
- ☐ B The rate at which air particles collide with the walls of the cylinder.
- ☐ C The volume of the air inside the cylinder.
- ☐ D The pressure of the air inside the cylinder.

- (b) Figure 2 shows a rubber tube that can be used inside a bicycle tyre.

The tube is inflated with a bicycle pump.

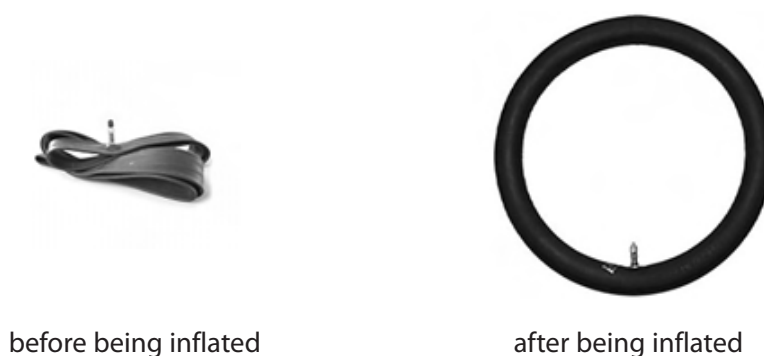


Figure 2

- (i) The air inside the tube exerts an outward force on the wall of the tube.

State the angle that this outward force makes with the wall of the tube.

(1)

- (ii) It takes 4.8 litres of air from the atmosphere to inflate the empty tube to a pressure of 400 000 Pa.

Atmospheric pressure is 100 000 Pa.

Calculate the volume of air inside the tube.

Assume the temperature of the air inside the tube is the same as the temperature of the air outside the tube.

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

(3)

volume = ... litres

- (iii) When a bicycle pump is used to inflate the tube, the air in the bicycle pump gets warm.

You should ignore any effects of friction in the pump.

Explain why the air in the bicycle pump gets warm.

(2)

(Total for Question 1 = 7 marks)



8-MARK QUESTIONS

1 question in this booklet



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

(2)

1

.....

2

.....

- (b) Figure 6 shows the dimensions of a solid block of concrete.

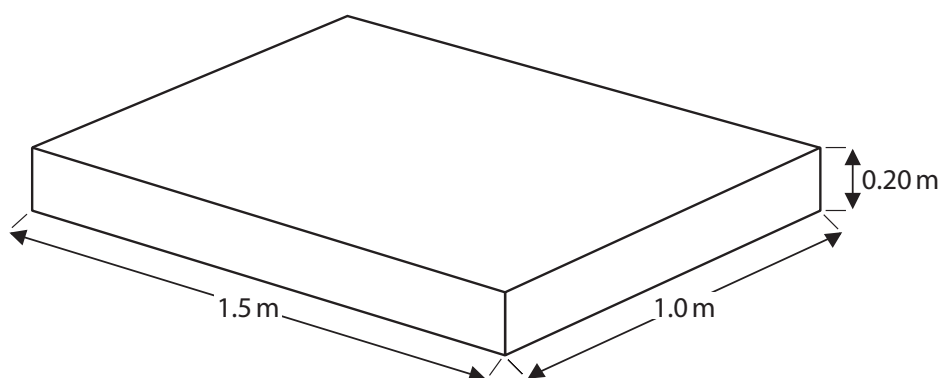


Figure 6

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 7 shows a shed made mostly of concrete blocks.

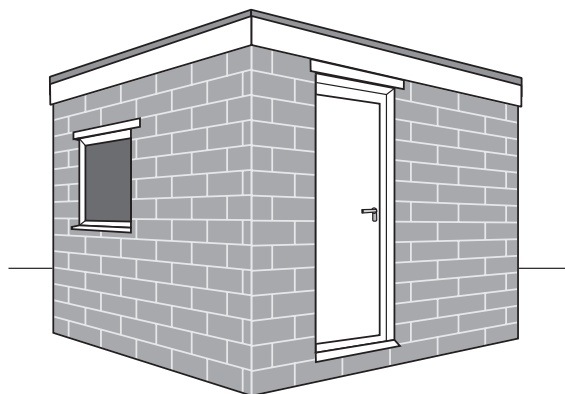


Figure 7

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

(2)

1

.....

2

.....

(d) On a very cold day, the temperature of the air is -4°C .

Calculate the value of this temperature on the kelvin scale.

(1)

temperature = ... K

(Total for Question 3 = 8 marks)

9-MARK QUESTIONS

6 questions in this booklet



- 2 (a) A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

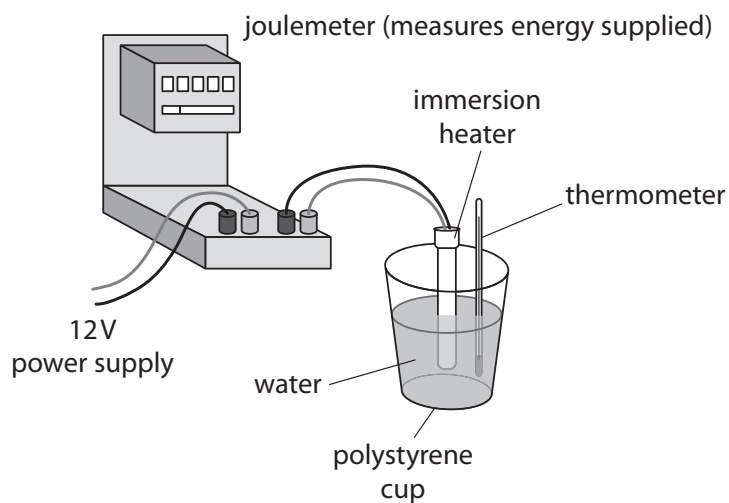


Figure 3

- (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 4 shows a graph of the student's results.

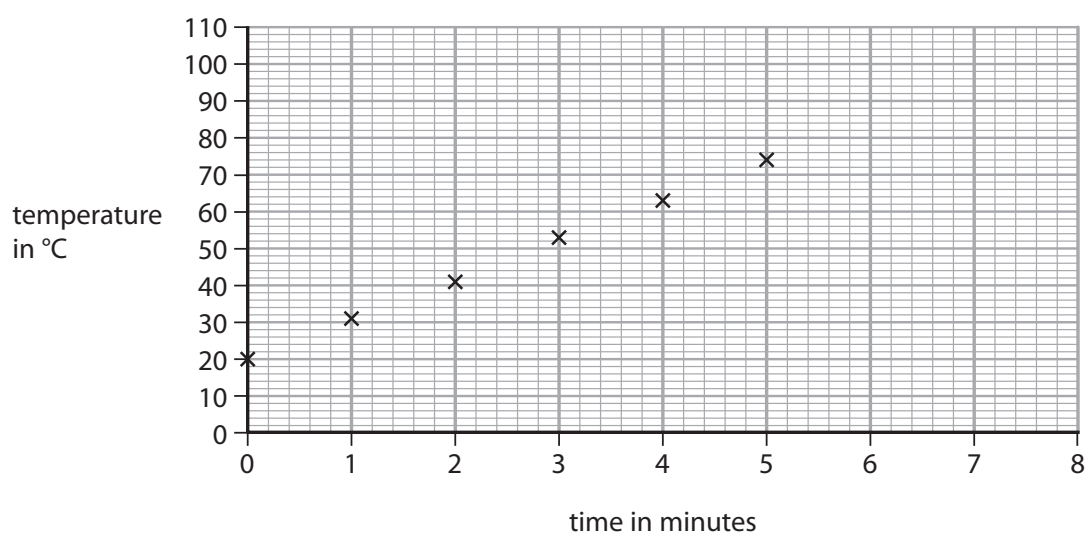


Figure 4

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

(Total for Question 2 = 9 marks)



- 2 (a) Figure 4 shows a small piece of copper about 3 cm high.



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Figure 4

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)

.....

.....

.....

.....

.....

.....

- (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 5 shows a piece of copper, with a thread tied around it, in a glass beaker of boiling water.

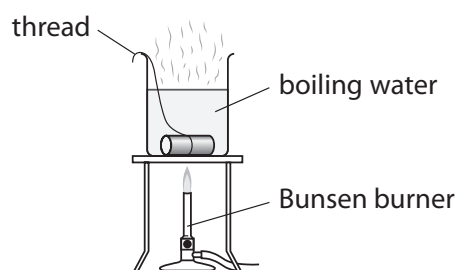


Figure 5

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 6.

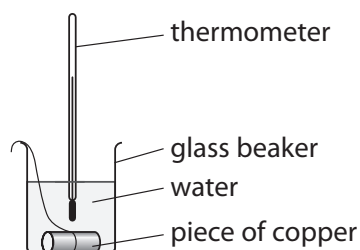


Figure 6

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

(Total for Question 2 = 9 marks)



- 3 (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 5 shows some water in a measuring cylinder and a lump of iron.

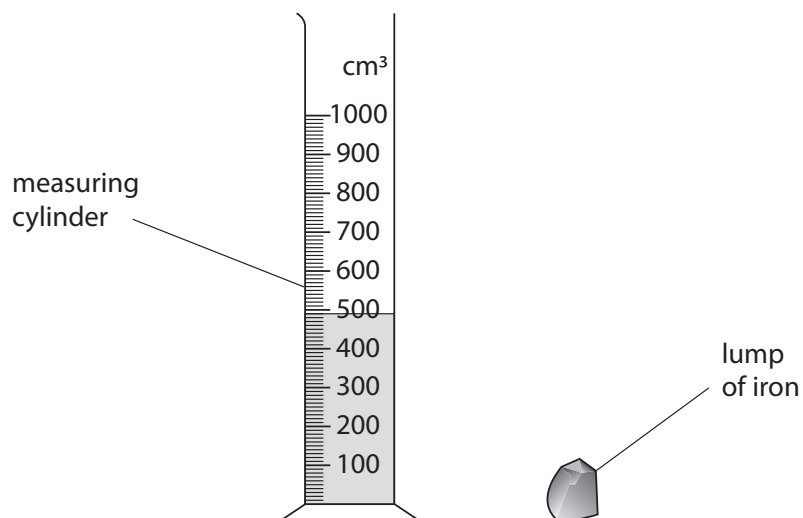


Figure 5

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)

.....

.....

.....

.....

(d) Describe what happens when a substance experiences sublimation.

(2)

.....

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.....

(Total for Question 3 = 9 marks)



3 (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)

.....

.....

.....

(d) A student determines the volume of a piece of metal by measuring the volume of water that it displaces.

The student wrote the following in his notebook.

I put some water into a measuring cylinder.
I put the piece of metal into the water in the measuring cylinder.
I took the reading of the new water level in the measuring cylinder.
This was the volume of the piece of metal.

The student's description is incomplete.

Suggest **two** sentences that the student could have included to provide a more complete description of the correct procedure.

(2)

1

.....

2

.....

(Total for Question 3 = 9 marks)



- 3** (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 7 gives information about the density of aluminium.

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

Figure 7

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) Some students measure the volume of a lump of modelling clay using a measuring jug, as shown in Figure 8.

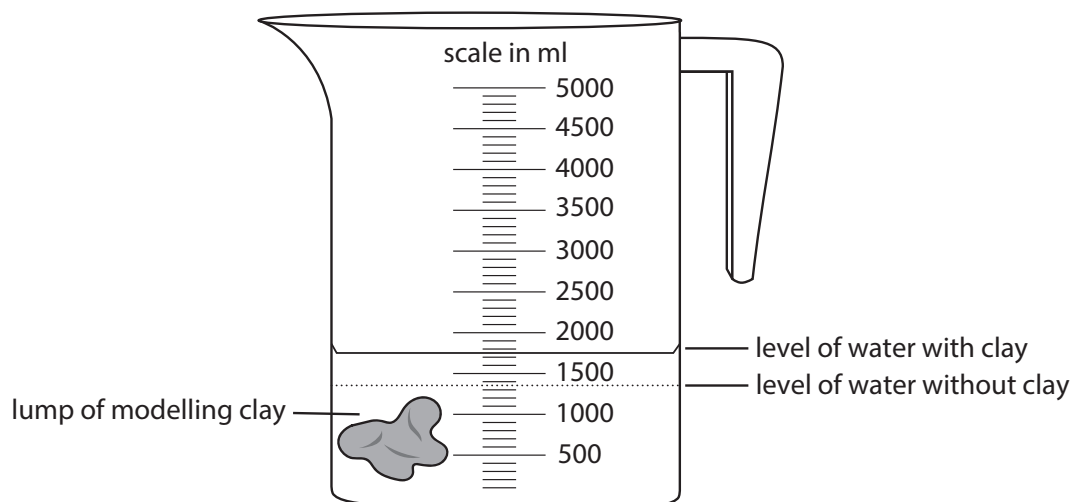


Figure 8

Using Figure 8, estimate the volume of the modelling clay in cm^3 .

You may assume that 1 litre = 1000 cm^3 .

(2)

volume = ... cm^3

(Total for Question 3 = 9 marks)

5 A teacher heats a block of wax until all the wax melts.

The teacher pours the melted wax into a container and allows the wax to cool.

Figure 7 shows how the temperature of the wax changes during a time of 20 minutes.

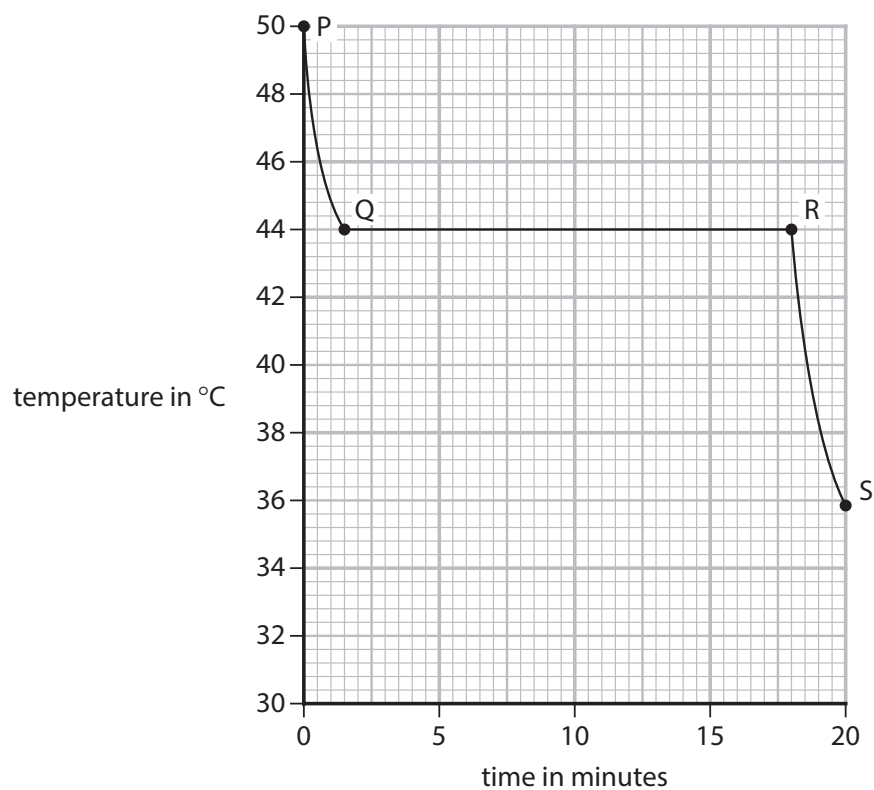


Figure 7

Four different points on the graph are labelled P, Q, R and S.

(a) Between which two points is **all** the wax liquid?

(1)

- ☐ A P and Q
- ☐ B P and R
- ☐ C Q and S
- ☐ D R and S

(b) Describe the change in the motion of the wax particles as the wax changes from liquid to solid.

(2)

(c) Figure 8 shows the values of some properties of the wax.

property	value
density when solid	930 kg / m ³
density when liquid	830 kg / m ³
specific latent heat	190 kJ / kg
specific heat capacity of solid wax	2.1 kJ / kg °C

Figure 8

(i) The wax has a mass of 3.9 kg.

Using information from Figure 8, calculate the volume of the wax when it is all liquid.

Use the equation

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

(2)

volume = ... m³

- (ii) State, using information from Figure 8, how the volume of the wax changes when it becomes a solid.

(1)

- (iii) Explain why, using Figure 8, the time from R to S is much shorter than the time from Q to R on the graph in Figure 7.

(3)

(Total for Question 5 = 9 marks)



11-MARK QUESTIONS

1 question in this booklet



- 9 (a) Explain the difference between the term 'specific heat capacity' and the term 'specific latent heat' when applied to heating substances.

(2)

.....

.....

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.....

- (b) Figure 19 shows some apparatus that may be used to determine the specific heat capacity of water.

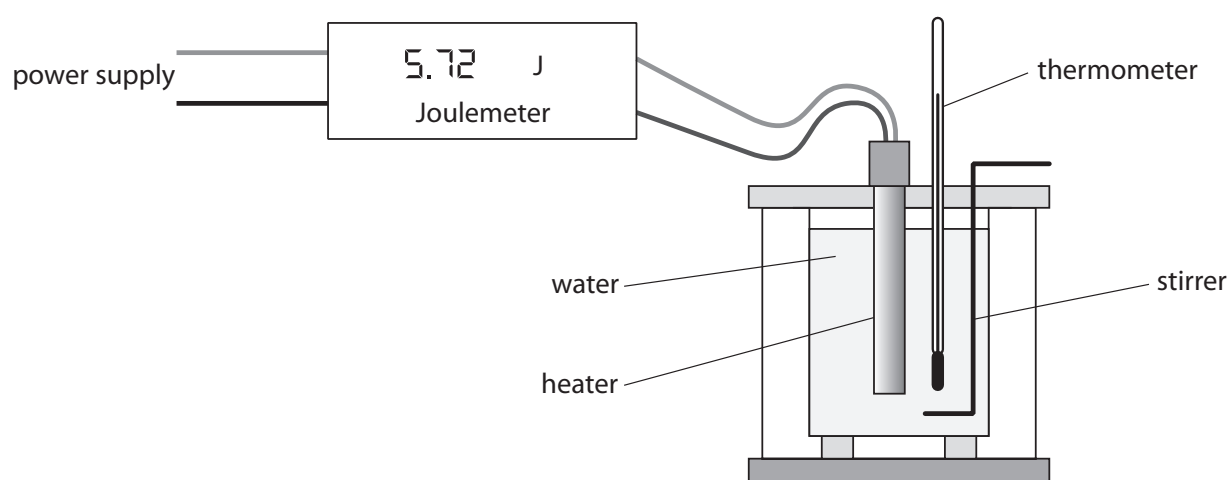


Figure 19

A student measures the initial temperature of the water.

The power supply is switched on for 10 minutes and then switched off.

Explain how the student should then obtain an accurate reading for the final temperature of the water, to be used in the calculation of the specific heat capacity.

(3)

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12-MARK QUESTIONS

2 questions in this booklet



10 (a) An electric kettle contains 1.41 kg of water at 25 °C.

The kettle is switched on.

After a while, the water reaches boiling point at 100 °C.

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

- (i) Calculate the amount of thermal energy supplied to the water by the kettle.
Give your answer to the appropriate number of significant figures.

Use an equation selected from the list of equations at the end of the paper.

(3)

energy supplied = ... J

- (ii) The kettle is kept switched on and the water continues to boil.

After a while, the mass of the water in the kettle has decreased to 1.21 kg.

The thermal energy supplied to the water during this time was 450 000 J.

Calculate the specific latent heat of vaporisation of water.

Use an equation selected from the list of equations at the end of the paper.

(3)

specific latent heat of vaporisation = ... J/kg



*(b) This question is about determining the specific heat capacity of aluminium. An aluminium block is placed in boiling water as shown in Figure 21.

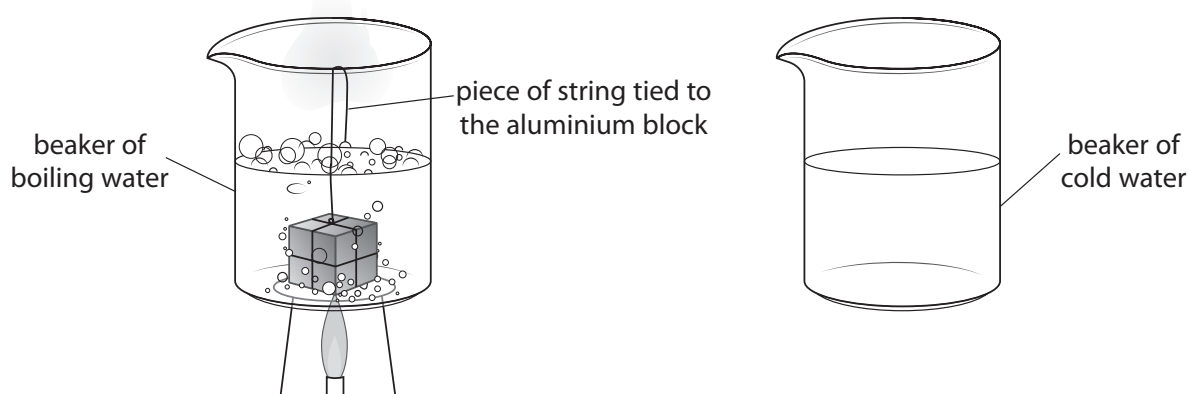


Figure 21

The piece of string is tied to the aluminium block so the block can be transferred from the boiling water to the cold water.

Describe how a student could use this apparatus, and any additional items needed, to determine the specific heat capacity of aluminium.

Your answer should include how the student would

- obtain the necessary measurements
- use the measurements to calculate the specific heat capacity of aluminium.

(6)

(Total for Question 10 = 12 marks)



9 (a) Which of these changes of state describes sublimation?

(1)

- ☐ A from gas to liquid
- ☐ B from liquid to solid
- ☐ C from solid to gas
- ☐ D from solid to liquid

(b) Figure 21 shows a sealed aerosol can.



Figure 21

The sealed can is taken from a cold room into a warm room.

If the volume of the can remains the same, which of these does **not** change?

- ☐ A the pressure inside the can
- ☐ B the mean speed of the particles inside the can
- ☐ C the mean distance between the particles inside the can
- ☐ D the mean size of the momentum of the particles inside the can

(1)

(c) Figure 22 shows a storage heater.

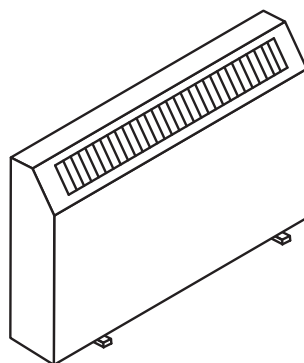


Figure 22

The storage heater contains bricks.

The bricks are heated electrically.

The electrical heater supplies 210 kJ of energy to each brick in the storage heater.

One brick has a mass of 5.8 kg.

The specific heat capacity for the brick is 860 J/kg K.

(i) Use this data to calculate the increase in temperature of the brick.

(2)

temperature increase = ... °C

(ii) The actual temperature increase will be smaller than you calculated in (i).

Explain why the actual temperature increase will be smaller than the value in (i).

(2)

.....

.....

.....

.....

*(d) Describe an investigation to determine the value for the specific heat capacity of water.

Your answer should include details of

- the apparatus needed
- the experimental procedure
- how the value may be calculated from the measurements taken.

You may draw a diagram to help your answer.

(6)



[illegible]

MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Mark
1(a)	C The volume of the air inside the cylinder. The only correct answer is C <i>A is not correct because the mass remains unchanged</i> <i>B is not correct because the rate of collision decreases</i> <i>D is not correct because the pressure decreases</i>	(1) AO 1 1

Question Number:	Answer	Additional Guidance	Mark
1(b)(i)	at right angles / 90°	perpendicular / normal to the tube wall	(1) AO 1 1

Question Number:	Answer	Additional Guidance	Mark
1(b)(ii)	select and substitute into $P_1 \times V_1 = P_2 \times V_2$ (1) $400\,000 \times V_1 = 100\,000 \times 4.8$ rearrangement (1) $V_1 = \frac{100\,000 \times 4.8}{400\,000}$ evaluation (1) ($V_1 =$) 1.2 (litres)	substitution and rearrangement in either order award full marks for the correct answer without working POT error 2 marks	(3) AO 2 1

Question Number:	Answer	Additional Guidance	Mark
1(b)(iii)	an explanation linking: work is done (in compressing the air) (1) increases the kinetic energy of the (air) particles / thermal energy (of the system) (1)	heat for thermal accept answer in terms of $p \Delta V$ $W = F \times d$ $= p \times (A \times d)$ $= p \Delta V$	(2) AO 1 1

(Total for Question 1 = 7 marks)



Question number	Answer	Additional guidance	Mark
3 (d)	269 (K)	allow use of 273.14? 269.14 (K)	(1) AO2

Total 8 marks

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

(Total for Question 2 = 9 marks)



Question number	Answer	Additional guidance	Mark
2(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
2(a)(ii)	recall and substitution (1) $\text{density} = \frac{m}{V}$ (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
2(b)(i)	Rearrangement (and substitution) (1) (c) $= \frac{1050}{0.058 \times 78}$ evaluation (1) $230 \text{ (J/kg } ^\circ\text{C)}$	$c = \frac{\Delta Q}{m \times \Delta\theta}$ 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
2(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)

Total marks for question 2 = 9 Physics



Question number	Answer	Mark			
3 (a)	<table border="1"> <tr> <td>[x] B</td><td>bigger than in water</td><td>less than water</td></tr> </table> 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.	[x] B	bigger than in water	less than water	(1) AO1.1
[x] B	bigger than in water	less than water			

Question number	Answer	Additional guidance	Mark
3 (b)	calculation of change in volume (1) $(530 \text{ cm}^3 - 490 \text{ cm}^3) = 40 \text{ (cm}^3\text{)}$ substitution (1) $7.9 = \frac{\text{mass}}{40}$ rearrangement and evaluation (1) $(\text{mass} = 7.9 \times 40)$ $(\text{mass} =) 316 \text{ (g)}$ evaluation to 2 sig fig (1) 320 (g)	measurement mark – using scale allow use of incorrect volume answers without working 316 (g) 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 mark	(4) AO2.2

Question number	Answer	Additional guidance	Mark
3 (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) AO2.2

Question number	Answer	Additional guidance	Mark
3 (d)	A description including idea of change of state / solid changes (1) to gas / vapour (directly) (1)	accept equivalents e.g. turns into / goes from to allow reverse i.e. gas → solid may be via appropriate example e.g. ice → water vapour / steam or reverse (2 marks)	(2) AO1.1

Total 9 marks

Question number	Answer	Additional guidance	Mark
3 (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
3 (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
3 (c) (i)	933 (1)	do not accept -933 ignore K ignore degrees ignore °	(1) AO2

Question number	Answer	Additional guidance	Mark
3 (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	Answer	Additional guidance	Mark
3 (d)	Any two from the following in any order (I took a) reading of the water level in the measuring cylinder without the metal. (1) (I made sure that) the metal was fully immersed / submerged (1) (I) subtracted the two readings / volumes (1)	Answers need not be exactly the same as those given here provided that the meaning is clear. accept measured / read for take a reading accept reading of original level / volume accept starting with a specified amount e.g. 50ml all the metal was under water took one from the other / found the difference ignore: - repeat and/or average - other measurements such as mass - other methods such as Eureka can - ideas of spillage - reading from bottom of meniscus	(2) AO1

Total 9 marks

3(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
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	Answer	Additional guidance	Mark
3(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 number	Answer	Additional guidance	Mark
3 (d)	estimation (1) reading off scale either 1750 or 1350 seen evaluation (1) 400 (cm³)	allow estimate in range 1300-1400 or 1700-1800 for 1 mark accept any answer between 350 and 450 (cm³) award full marks for the correct answer without working if no other marks scored accept an answer between 350 and 450 to any other power of 10 for one mark	(2) AO2.2

Question 3 total 9 marks



Question number	Answer	Additional guidance	Mark
5(a)	A P and Q B, C and D are incorrect because at least some of the wax is solid in each case.		(1) AO3

Question number	Answer	Additional guidance	Mark
5(b)	A description to include any two from no longer move (around / past each other) (1) vibrate (1) particles move more slowly (in a solid) (1)	(in a) fixed position have less (kinetic) energy	(2) AO1

Question number	Answer	Additional guidance	Mark
5(c) (i)	substitution (1) $830 = \frac{3.9}{\text{volume}}$ rearrangement and evaluation (1) (volume =) 0.0047 (m³) OR ALTERNATIVE METHOD rearrangement (1) (volume =) $\frac{\text{mass}}{\text{density}}$ substitution and evaluation (1) (volume =) 0.0047 (m³)	accept values that round to 0.0047; e.g. 0.004699 volume = $\frac{3.9}{830}$ accept values that round to 0.0047; e.g. 0.004699 award full marks for correct answer without working if no other mark scored allow 1 mark for values that round to 0.0042 (use of incorrect density)	(2) AO2

Question number	Answer	Additional guidance	Mark
5(c)(ii)	(the volume will) decrease (1)		(1) AO3

Question number	Answer	Additional guidance	Mark
5(c) (iii)	an explanation linking three from specific heat capacity is (much) less than specific latent heat (1) specific heat capacity is $2.1(\text{kJ/kg } ^\circ\text{C})$ and specific latent heat is $190 (\text{kJ/kg})$ (1) less (thermal) energy is transferred (to surroundings during R to S) (1) (thermal) energy transferred (to surroundings) at similar / constant rate (1)	allow reverse arguments less heat is dissipated	(3) AO3

Total for Question 5 = 9 marks

Question number	Answer	Additional guidance	Mark
9(a)	an explanation linking specific heat capacity concerns change in temperature (1) whereas specific latent heat concerns change of state (1)	accept specific heat capacity concerns heating <u>up</u> / cooling accept any named change of state e.g. melting / freezing / evaporating /boiling accept specific latent heat related to no change in temperature	(2) A01.1

Question number	Answer	Additional guidance	Mark
9 (b)	an explanation linking any three from: stir the water before taking a reading of temperature (1) (continue to) observe temperatures after switching off (1) record the maximum / highest / peak temperature reached (1) take temperature reading at eye level (1) conduction (and convection) take time (1)	allow "for longer than 10 minutes" allow wait(ing period) in correct context until the temperature stops changing takes time (for water / thermometer) to heat through	(3) A01.2

SSQ NO:	CS NO:	Answer	Mark
9(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 strand 1 (6 marks) • particles move faster (at a higher temperature) • greater velocity / speed means greater kinetic energy • since $KE = \frac{1}{2} m v^2$ • heating increases KE (store) • KE (store) increase leads to higher (average) speeds • faster particles (at higher temperature so) hit container with more force / momentum exchange • bigger pressure because $p = F / A$ • particles hit container more frequently (at higher temperature) • so more force exerted on (walls of) container	(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)

Summary for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels
	0	No rewardable material.	Eg - 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> isolated idea(s) of physics e.g. recognising the speed-temperature relationship or the pressure temperature relationship	<u>Possible candidate responses</u> particles faster (at higher temperature) KE increases pressure increases (at a higher temperature)
Level 2	3–4	<u>Additional guidance</u> limited details about KE or limited details about pressure or linked ideas about kinetic energy and pressure	<u>Possible candidate responses</u> faster particles have greater kinetic energy (store) (particles) hitting container more often causes greater pressure faster particles cause greater force bigger pressure because force increased
Level 3	5–6	<u>Additional guidance</u> understanding is detailed and fully developed. includes detail about both kinetic energy and force involvement in pressure, but one aspect may be covered in greater detail than the other one	<u>Possible candidate responses</u> greater speed means greater kinetic energy since $KE = \frac{1}{2} m v^2$ AND bigger pressure because more frequent collisions causes an increase in force greater speed means greater kinetic energy AND bigger pressure because $p = F / A$ and (total) force increased because of hitting container walls with bigger momentum (changes)

Total 11 marks



Question number	Answer	Additional guidance	Mark
10ai	substitution into $\Delta Q = m \times s \times \Delta T$ (1) $(\Delta Q) = 1.41 \times 4200 \times (100-25)$		(3) AO2
	evaluation (1) (energy =) 444,150 (J) answer to 2 sf (1) 440,000 (J)	ignore POT error for this mark independent mark allow 3 sf 444,000 award full marks for the correct answer without working award 1 mark for answers with values 148,050 or 592,200 (incorrect temp and sf) award 2 marks for answers with values 150,000 or 148,000 or 590,000 or 592,000 (incorrect temp but allowed sf)	

Question number	Answer	Additional guidance	Mark
10aii	substitution into $\Delta Q = m \times L$ $450,000 = (1.41 - 1.21) \times L$ (1) rearrangement $L = \frac{450,000}{0.2}$ (1) evaluation $(L) = 2\,200\,000 \text{ (J/kg)}$ (1)	allow substitution and rearrangement in either order accept 2 250 000 award full marks for the correct answer without working award 1 mark for answers that round to 330,000 or 370,000 (incorrect mass used)	(3) AO2

Question number	Indicative content	Mark
*10(b)	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. Procedure • Measure the temperature of the boiling water • Allow sufficient time for block to reach temperature of boiling water • Measure temperature of cold water in beaker • Using a thermometer • Transfer (hot) aluminium block to cold water in the beaker. • Work quickly to avoid thermal energy loss during transfer • Measure temperature of water • Stir to ensure even distribution • Measure maximum temperature reached by water • Calculate temp rise of water by subtracting initial from final temperature. • Calculate temp drop of aluminium by subtracting final temperature from 100. • Find mass of beaker and water and aluminium • Use a balance • Empty water from beaker and dry beaker and block • Weigh beaker and block alone • Find mass of water by subtraction. • Allow plausible method of finding mass of water before putting block in. Process results • Calculate thermal energy gained water using $\Delta Q = m \times c \times \Delta\theta$ • Thermal energy gained by water = thermal energy lost by aluminium • Specific heat capacity of aluminium = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$	(6) AO2 and AO3

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- The plan attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	- The plan is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	- The plan is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)



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 one measurement	<u>Possible candidate responses</u> Heat up the block in the boiling water. Then put the block into the cold water. Measure the temperature reached by the water.
Level 2	3–4	<u>Additional guidance</u> Mostly complete description of a suitable procedure with at least two measurements and some description of processing the results.	<u>Possible candidate responses</u> As above with Measure mass of water. Use $\Delta Q = m \times c \times \Delta\theta$ to find thermal energy transferred
Level 3	5–6	<u>Additional guidance</u> Detailed description of a suitable procedure with most of the necessary measurements and a clear description of processing the results.	<u>Possible candidate responses</u> As above with Calculate temperature changes by subtraction. Calculate thermal energy lost by Al as being equal to thermal energy gained by water. Specific heat capacity of Al = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$

Question 10 = 11 marks

Total for paper = 100 marks

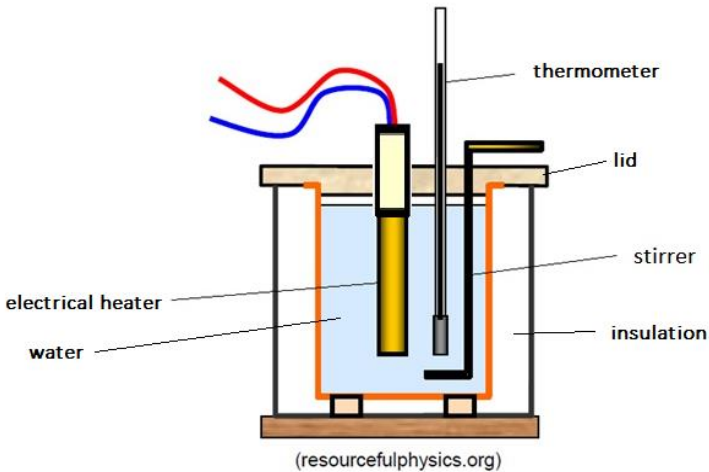


Question Number	Answer	Mark
9(a)	The only correct answer is C from solid to gas <i>A</i> is 'condensation' <i>B</i> is 'freezing' <i>D</i> is 'melting'	(1) AO1.1

Question Number	Answer	Mark
9(b)	The only correct answer is C the mean distance between the particles inside the can <i>A, B and D have physical quantities which will all increase upon heating</i>	(1) AO3.1

Question number	Answer	Additional guidance	Mark
9 (c) i	rearrangement and substitution (1) $(\Delta\theta =) \frac{210 (x10^3)}{5.8 \times 860}$ evaluation (1) 42 (°C)	$(\Delta\theta =) \frac{210 (x10^3)}{4988}$ accept any value which rounds to 42 e.g. 42.10 award full marks for the correct answer without working 4.2 to any other power of 10 scores 1 mark	(2) AO2.1

Question number	Answer	Additional guidance	Mark
9 (c) ii	an explanation linking any two from not all the energy supplied goes to the <u>brick</u> (1) not all the energy supplied stays in the <u>brick</u> (1) energy transferred to the storage heater parts (1) energy transferred to the surroundings (1) argument linking $\Delta\theta$ to ΔQ using $\Delta\theta = \frac{\Delta Q}{m \times c} \text{ (1)}$	ignore: • energy is lost / wasted, unqualified • not 100% efficient • arguments about sound energy accept heat for energy throughout less (thermal) energy given to <u>brick</u> energy transfers from the <u>brick</u> energy dissipated from the equation, if energy supplied to the block is smaller the change of temperature will be smaller ‘brick transfers (thermal) energy to the surroundings’ scores 2 marks	(2) AO2.1

SSQ NO:	CS NO :	Answer	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. (Accept the method of cooling a heated object in water but consult your TL.) AO1 strand 2 (6 marks) Details of the apparatus to include:  (resourcefulphysics.org) • credit all elements seen in diagram or stated • may also include power supply / electrical circuitry • other apparatus – balance / scales ; stopwatch ; voltmeter / ammeter / joulemeter	(6) AO1.2

		- ignore bunsen burner <i>(continued ...)</i> Steps taken with the procedure and calculation including: - measure mass of water (with a balance) - measure initial temperature (with thermometer) - switch on for a (set) time / use of stopwatch - measure final / highest temperature (reached) - measure energy input on joulemeter / measure V, I and t - extra detail e.g. stirring / how to get final maximum temperature - rearrange $\Delta Q = m \times c \times \Delta\theta$ to find c $c = \frac{\Delta Q}{m \times \Delta\theta}$ - correct use of graph to determine c	
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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> list of relevant apparatus: at least 2 items AND at least one reasonable step described OR gives equation to find c	<u>Possible candidate responses</u> some apparatus named e.g. thermometer, balance, stirrer, joulemeter, ammeter, voltmeter, beaker diagram with some labels measure mass of water use a thermometer use of $\Delta Q = m \times c \times \Delta\theta$
Level 2	3–4	<u>Additional guidance</u> list of apparatus for measurements AND logical steps including how to find $\Delta\theta$ OR ΔQ	<u>Possible candidate responses</u> balance / thermometer together with joulemeter / stopwatch etc. measure initial and final temperatures with a thermometer realistic use of joulemeter
Level 3	5–6	<u>Additional guidance</u> understanding is detailed and fully developed. includes detail about apparatus used to obtain measurements AND details in steps taken, including how to find $\Delta\theta$ AND ΔQ	<u>Possible candidate responses</u> (use of) balance / thermometer / stopwatch / insulated can / electrical heater etc. measure mass of water (with a balance) / measure initial and final temperatures with a thermometer + electrical heating applied
		AND how to determine c	for a (set) time + realistic use of joulemeter (or power (VI) and time) $c = \frac{\Delta Q}{m \times \Delta\theta}$

Question 9 total 12 marks

