

PHYSICS



EXAM QUESTION PACK

TOPIC 14: PARTICLE MODEL (PACK 2)

SCORE

/60

PERCENTAGE

%

STEMUP

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Q1.

A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

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(Total for question = 4 marks)

Q2.

A student measures the density of glass.

The student has

- a bag of marbles, all made from the same type of glass
- a weighing balance
- a plastic measuring cylinder containing water

Describe how the student could find, as accurately as possible, the density of the glass used for the marbles.

(4)

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(Total for question = 4 marks)

Q3.

Describe what happens when a substance experiences sublimation.

(2)

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(Total for question = 2 marks)

Q4.

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

(2)

- 1
- 2

(Total for question = 2 marks)

Q5.

Describe what happens when a substance experiences sublimation.

(2)

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(Total for question = 2 marks)

Q6.

Figure 1 shows some gas in a container.

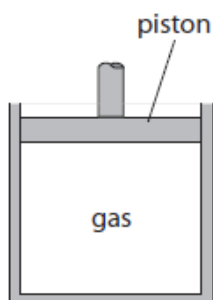


Figure 1

Explain, in terms of particles, how the gas exerts a pressure on the piston.

(2)

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(Total for question = 2 marks)

Q7.

Figure 10 shows some apparatus that may be used to determine the specific heat capacity of water.

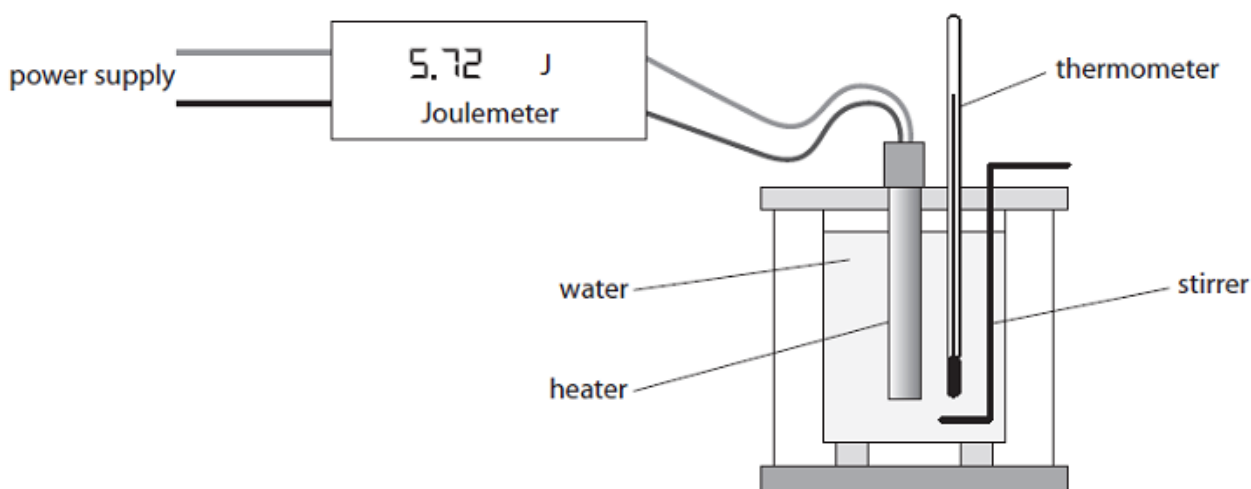


Figure 10

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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(Total for question = 3 marks)

Q8.

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

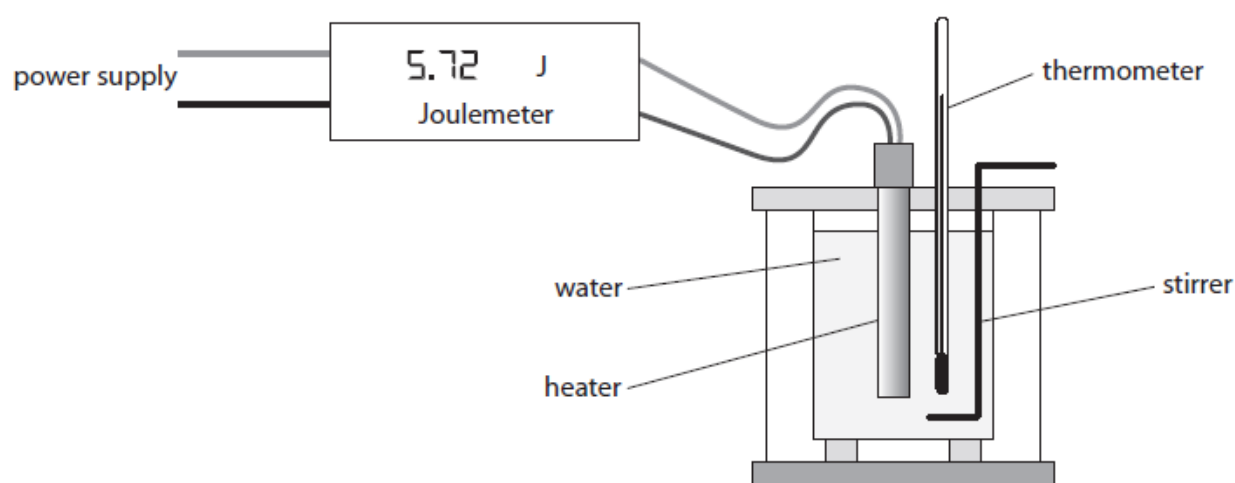


Figure 19

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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Q9.

* A container of gas is at room temperature.

The gas is then heated.

The volume of the container remains the same.

By considering changes in velocities of the gas particles, explain how the temperature increase affects

- the average kinetic energy of the particles
- the pressure the particles exert on the walls of the container.

(6)

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

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(Total for question = 6 marks)

Q10.

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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(Total for question = 2 marks)

Q11.

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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(Total for question = 2 marks)

Q12.

A container of gas is at room temperature.

The gas is then heated.

The volume of the container remains the same.

By considering changes in velocities of the gas particles, explain how the temperature increase affects

- the average kinetic energy of the particles
- the pressure the particles exert on the walls of the container.

(6)

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Q13.

Figure 3 shows some water in a measuring cylinder and a lump of iron.

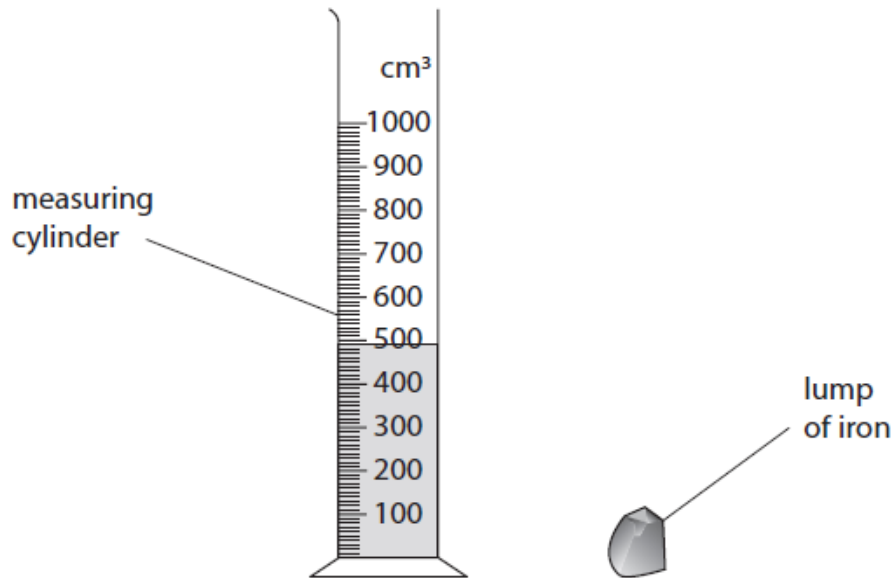


Figure 3

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.

To find the mass of the lump of iron you would use the equation

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

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

The density of the wood is 0.82 g / cm³.

The density of water is 1.00 g / cm³

Explain why the method used for the lump of iron cannot be used to determine the mass of the piece of wood.

(2)

(Total for question = 2 marks)

Q14.

Figure 5 shows some water in a measuring cylinder and a lump of iron.

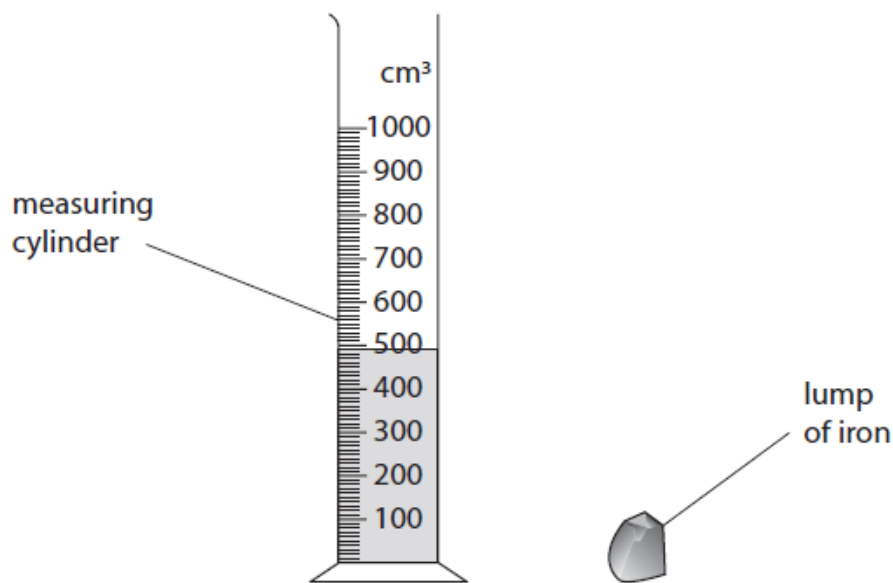


Figure 5

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.

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

The density of the wood is 0.82 g / cm³.

The density of water is 1.00 g / cm³

Explain why the previous method used cannot be used to determine the mass of the piece of wood.

(2)

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(Total for question = 2 marks)

Q15.

Figure 1 shows some gas in a container.

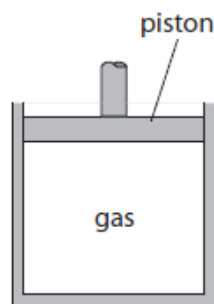


Figure 1

The piston is forced down to a new position, compressing the gas, as in Figure 2.

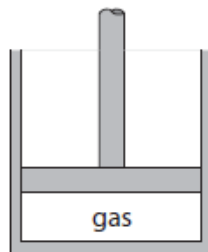


Figure 2

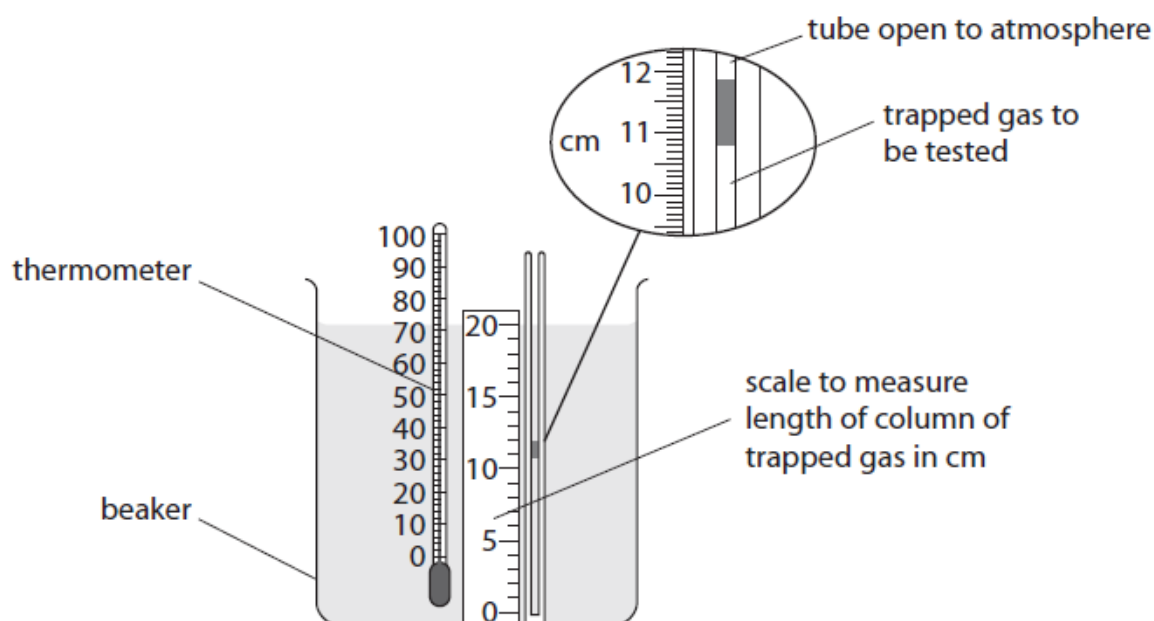
The temperature of the gas remains constant.
Explain, in terms of particles, why the pressure of the gas increases.

(2)

Q16.

A student investigates how the volume of a gas changes when its temperature increases.

The diagram shows the equipment used and the length of the trapped gas at 25°C.



(a) (i) Use the scale to estimate the length of the column of trapped gas.

(1)

length of column of trapped gas = ... cm

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The cross-sectional area of the capillary tube is $1.94 \times 10^{-3} \text{ cm}^2$.

The volume of the column of trapped gas at 25°C is about

(1)

☒ **A** $5.6 \times 10^{+3} \text{ cm}^3$

☐ **B** $2.1 \times 10^{-2} \text{ cm}^3$

☐ **C** $2.1 \times 10^{-3} \text{ cm}^3$

☐ **D** $5.6 \times 10^{-4} \text{ cm}^3$

(iii) The gas is heated to 50°C.

The volume of the trapped gas at 50°C is $2.31 \times 10^{-2} \text{ cm}^3$.

Calculate the volume of the trapped gas at 100°C.

(3)

volume of the trapped gas = ... cm³

(b) Describe how the average kinetic energy of the particles of the gas changes as the temperature of the gas changes.

(3)

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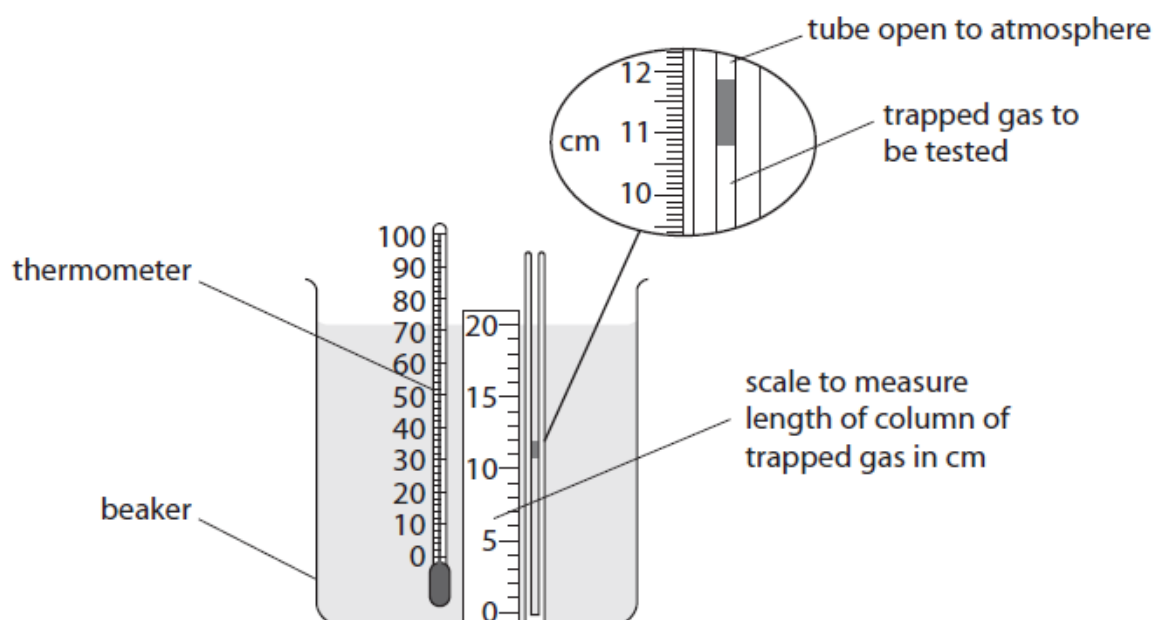
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Q17.

A student investigates how the volume of a gas changes when its temperature increases.

The diagram shows the equipment used and the length of the trapped gas at 25°C.



(a) (i) Use the scale to estimate the length of the column of trapped gas.

(1)

length of column of trapped gas = ... cm

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The cross-sectional area of the capillary tube is $1.94 \times 10^{-3} \text{ cm}^2$.

The volume of the column of trapped gas at 25°C is about

(1)

☐ **A** $5.6 \times 10^{+3} \text{ cm}^3$

☐ **B** $2.1 \times 10^{-2} \text{ cm}^3$

☐ **C** $2.1 \times 10^{-3} \text{ cm}^3$

☐ **D** $5.6 \times 10^{-4} \text{ cm}^3$

(iii) The gas is heated to 50°C .

The volume of the trapped gas at 50°C is $2.31 \times 10^{-2} \text{ cm}^3$.

Calculate the volume of the trapped gas at 100°C .

(3)

volume of the trapped gas = ... cm^3

(b) Describe how the average kinetic energy of the particles of the gas changes as the temperature of the gas changes.

(3)

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Q18.

Kinetic theory describes the behaviour of gas particles.

(a) (i) Complete the sentence by putting a cross (X) in the box next to your answer.

At -273°C the particles in a gas are

(1)

☐ **A** moving rapidly

☐ **B** moving slowly

☐ C stationary

☐ D vibrating

(ii) The temperature of a gas changes from 300 K to 150 K.

State how the average kinetic energy of the gas particles changes.

(1)

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(b) The photograph shows a weather balloon filled with helium.

When released the balloon rises rapidly to a height of 30 000 m above the Earth.



Explain how the helium gas exerts a pressure on the balloon.

(3)

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(c) On the surface of the Earth the weather balloon has a volume of 9.1 m^3 , when the temperature is 0°C and the pressure inside the balloon is 101 kPa.

At 30 000 m above the Earth, the temperature is -46°C and the pressure inside the balloon is 1.12 kPa.

(i) Show that -46°C is 227 K.

(1)

(ii) Calculate the volume of the weather balloon when it is at a height of 30 000 m.

(3)

volume = ... m³

(iii) Suggest what will happen to the balloon as it carries on rising above 30 000 m.

(1)

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(Total for Question = 10 marks)

Q19.

As part of the testing of different types of steel, a steelworker needs to obtain a temperature-time graph for **solidifying** molten steel.

Figure 9 shows an arrangement the steelworker could use.

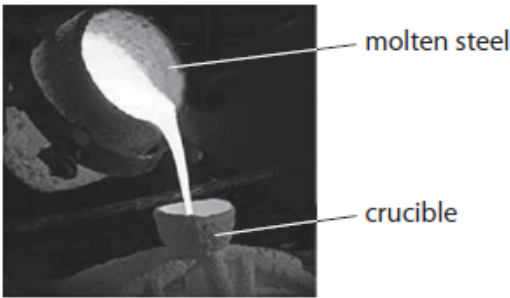


Figure 9

The following devices are available to the steel worker.
The melting point of these steels is between 1425 and 1540 °C

device	range of temperatures	other notes
Thermocouple thermometer	–50 to 1800 °C	Fast response time Probe inserted into melt
Infrared thermometer (pyrometer)	1200 to 2000 °C	Remotely read, using infrared radiation, measures the temperature of the surface it is aimed at
Platinum resistance thermometer	–200 to 850 °C	The most accurate of thermometers based on how resistance changes with temperature

Describe how the steelworker could obtain a temperature-time graph for steel as it goes from the liquid to the solid state.

(4)

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(Total for question = 4 marks)

Q20.

As part of the testing of different types of steel, a steelworker needs to obtain a temperature-time graph for **solidifying** molten steel.

Figure 6 shows an arrangement the steelworker could use.

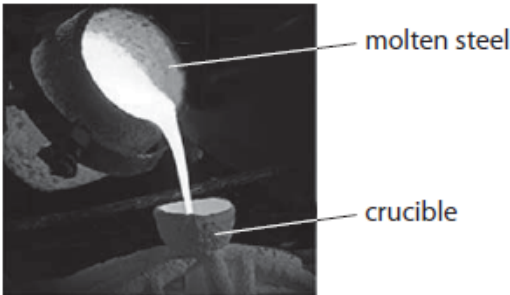


Figure 6

The following devices are available to the steel worker.
The melting point of these steels is between 1425 and 1540 °C

device	range of temperatures	other notes
Thermocouple thermometer	–50 to 1800 °C	Fast response time Probe inserted into melt
Infrared thermometer (pyrometer)	1200 to 2000 °C	Remotely read, using infrared radiation, measures the temperature of the surface it is aimed at
Platinum resistance thermometer	–200 to 850 °C	The most accurate of thermometers based on how resistance changes with temperature

Describe how the steelworker could obtain a temperature-time graph for steel as it goes from the liquid to the solid state.

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(Total for question = 4 marks)

Q21.

A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

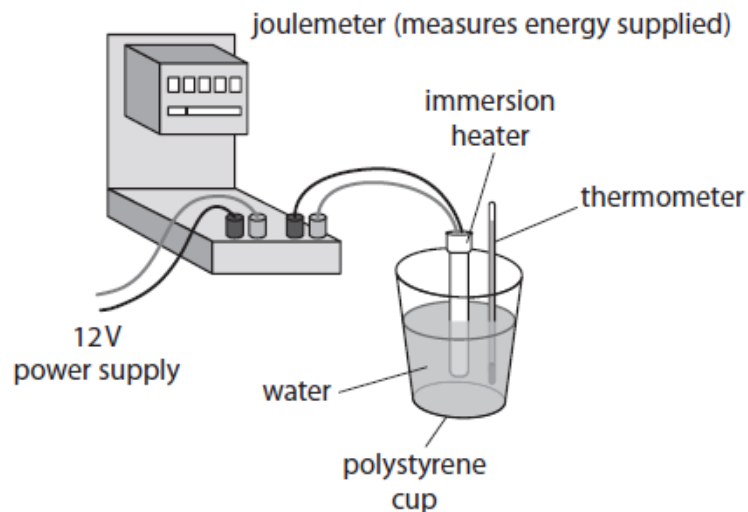


Figure 3

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.

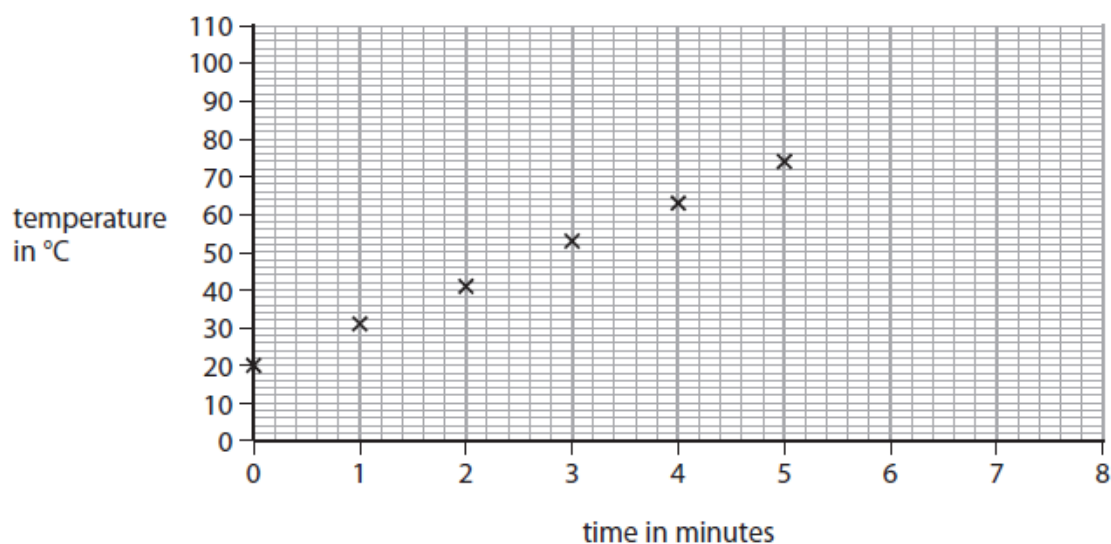


Figure 4

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

(1)

temperature of the water = ... °C

(Total for question = 1 mark)

Q22.

A student uses the apparatus in Figure 3 to determine the specific heat capacity of water.

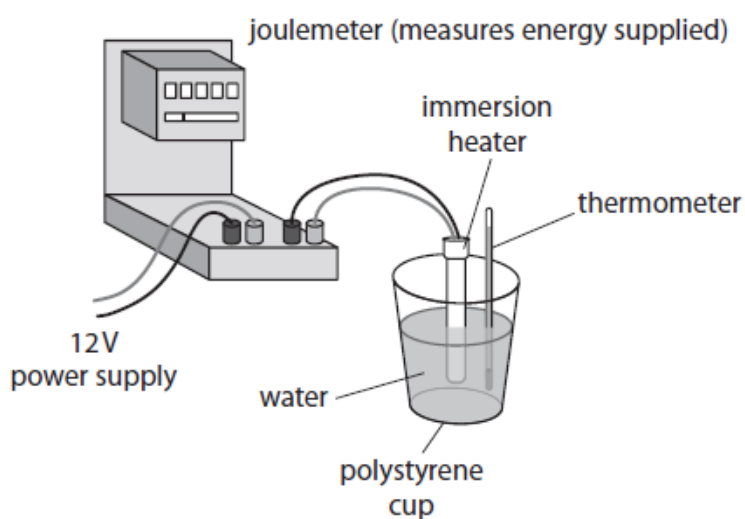


Figure 3

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.

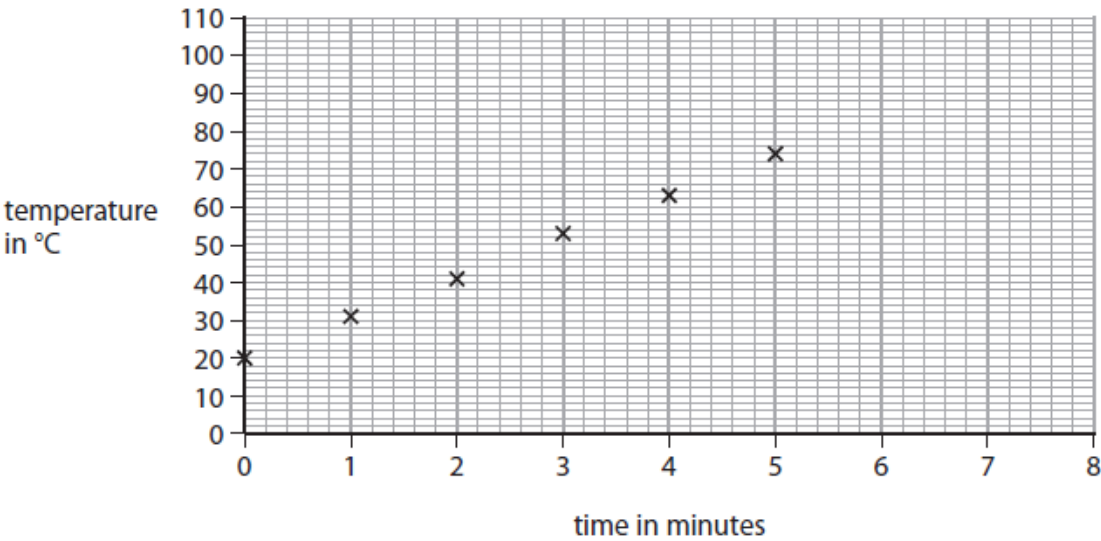


Figure 4

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

(1)

temperature of the water = ... °C

(Total for question = 1 mark)

Q23.

Figure 4 shows a shed made mostly of concrete blocks.

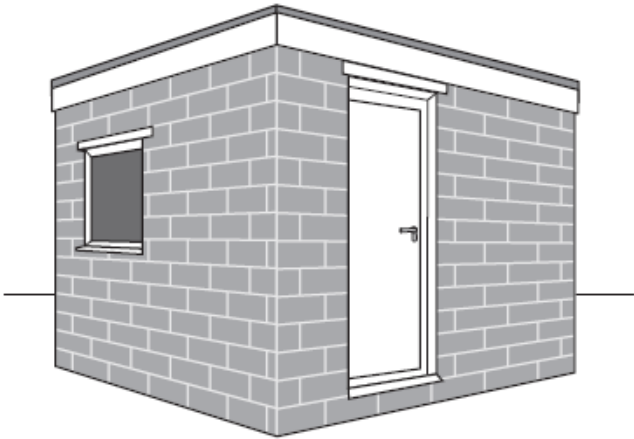


Figure 4

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

(2)

- 1
- 2

(Total for question = 2 marks)

Q24.

Figure 7 shows a shed made mostly of concrete blocks.

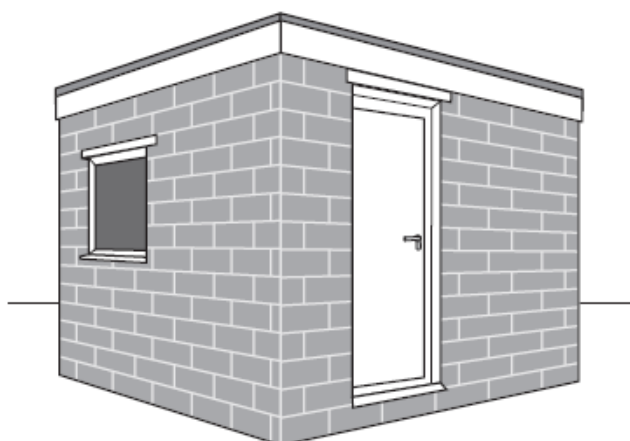


Figure 7

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

(2)

- 1
- 2

(Total for question = 2 marks)

Q25.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.

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

(Total for question = 1 mark)

Q26.

Some questions must be answered with a cross in a box (☐). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☐).

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

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
	A description including: find mass of marble(s) (1) put marble(s) into water (in cylinder) and measure change in water level (1) divide mass by volume (1) suitable idea to improve accuracy such as use several marbles (1)	weigh marble(s) accept volume for water level note level before and after marble(s) added find volume of water displaced density = mass/volume in words or symbols subtract mass of bag from total mass of marbles and bag ensure water measured at eye level use appropriately sized measuring cylinder ignore reference to repeating and taking average	(4)

Q2.

Question Number	Answer	Additional guidance	Mark
	A description including: find mass of marble(s) (1) put marble(s) into water (in cylinder) and measure change in water level (1) divide mass by volume (1) suitable idea to improve accuracy such as use several marbles (1)	weigh marble(s) accept volume for water level note level before and after marble(s) added find volume of water displaced density = mass/volume in words or symbols subtract mass of bag from total mass of marbles and bag ensure water measured at eye level use appropriately sized measuring cylinder ignore reference to repeating and taking average	(4)

Q3.

Question number	Answer	Additional guidance	Mark
	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

Q5.

Question number	Answer	Additional guidance	Mark
	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

Q6.

Question number	Answer	Mark
	An explanation that combines identification –knowledge and reasoning / justification • (particles / atoms / molecules) {hit / collide with} piston (1) • causing a force (on the piston) (1)	(2)

Q7.

Question number	Answer	Additional guidance	Mark
	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) AO1.2

Q8.

Question number	Answer	Additional guidance	Mark
	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

Q9.

SSQ NO:	CS NO:	Answer	Mark
*		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 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.
	0	No rewardable material.	
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)
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Q10.

Question number	Answer	Additional guidance	Mark
	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

Q11.

Question number	Answer	Additional guidance	Mark
	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

Q12.

SSQ NO:	CS NO:	Answer	Mark
*		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
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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)

Q13.

Question number	Answer	Additional guidance	Mark
	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

Q14.

Question number	Answer	Additional guidance	Mark
	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

Q15.

Question number	Answer	Mark
	An explanation that combines identification – knowledge and reasoning / justification • volume decrease makes the density of particles increase / more crowded idea (1) • increasing the rate at which particles collide (with the piston) (1)	(2)

Q16.

Question Number	Answer	Acceptable answers	Mark
(a) (i)	10.8 + or – 0.2 (cm)	Any value between 10.6(cm) and 11.0 (cm) Accept 11 cm	(1)

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	B $2.1 \times 10^{-2} \text{ cm}^3$		(1)

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	Temperature conversion to K 50°C to 323K OR 100°C to 373K (1) Substitution $V_1 = \frac{2.31 \times 10^{-2} \times 373}{323}$ (1) Evaluation $2.67 \times 10^{-2} \text{ (cm}^3\text{)}$ (1)	If equation is transformed to give V_2, allow correct substitution mark. 0.0267(cm³), $2.7 \times 10^{-2} \text{ (cm}^3\text{)}$, 0.027(cm³), $2.67 \times 10^{-8} \text{ m}^3$, $2.7 \times 10^{-8} \text{ m}^3$ Allow power of ten error for 2 marks e.g. 267 Allow 2.6×10^{-2} for 3 marks Full marks for correct answer with no working If temperature is not converted to Kelvin, maximum two marks e.g. $V_1 = \frac{2.31 \times 10^{-2} \times 100}{50}$ $4.62 \times 10^{-2} \text{ (cm}^3\text{)}$ Allow power of ten error for 1 mark e.g. 4.62 2 marks for $4.62 \times 10^{-2} \text{ (cm}^3\text{)}$ with no working	(3)

Question Number	Answer	Acceptable answers	Mark
(b)	A description including: (Average) KE/it increases as the temperature increases (1) Idea of proportionality / KE doubles when the temperature doubles (1) (when) temperature in Kelvin /K (1)	Allow energy for kinetic energy Or reverse argument (Average) KE/it is (directly) proportional to the Kelvin temperature gets all three marks (Average) KE/it is (directly) proportional to the temperature gets first two marks Allow absolute scale	(3)

Q17.

Question Number	Answer	Acceptable answers	Mark
(a) (i)	10.8 + or – 0.2 (cm)	Any value between 10.6(cm) and 11.0 (cm) Accept 11 cm	(1)

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	B $2.1 \times 10^{-2} \text{ cm}^3$		(1)

Question Number	Answer	Acceptable answers	Mark
(a)(iii)	Temperature conversion to K 50°C to 323K OR 100°C to 373K (1) Substitution $V_1 = \frac{2.31 \times 10^{-2} \times 373}{323}$ (1) Evaluation $2.67 \times 10^{-2} (\text{cm}^3)$ (1)	If equation is transformed to give V_2, allow correct substitution mark. 0.0267(cm³), $2.7 \times 10^{-2} (\text{cm}^3)$, 0.027(cm³), $2.67 \times 10^{-8} \text{ m}^3$, $2.7 \times 10^{-8} \text{ m}^3$ Allow power of ten error for 2 marks e.g. 267 Allow 2.6×10^{-2} for 3 marks Full marks for correct answer with no working If temperature is not converted to Kelvin, maximum two marks e.g. $V_1 = \frac{2.31 \times 10^{-2} \times 100}{50}$ $4.62 \times 10^{-2} (\text{cm}^3)$ Allow power of ten error for 1 mark e.g. 4.62 2 marks for $4.62 \times 10^{-2} (\text{cm}^3)$ with no working	(3)

Question Number	Answer	Acceptable answers	Mark
(b)	A description including: (Average) KE/it increases as the temperature increases (1) Idea of proportionality / KE doubles when the temperature doubles (1) (when) temperature in Kelvin /K (1)	Allow energy for kinetic energy Or reverse argument • (Average) KE/it is (directly) proportional to the Kelvin temperature gets all three marks (Average) KE/it is (directly) proportional to the temperature gets first two marks Allow absolute scale	(3)

Q18.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	C stationary		(1)

Question Number	Answer	Acceptable answers	Mark
(a)(ii)	(Average KE/it is) halved	divided by 2,multiplied by 0.5	(1)

Question Number	Answer	Acceptable answers	Mark
(b)	Explanation in terms of particles linking the following:- - particles collide with / hit /strike / bombard (1) - the wall / sides of the balloon (1) (causing a) force / (rate of) change in momentum (1)	Accept "molecules/atoms" for particles Must mention particles etc to gain this mark Ignore "push"	(3)

Question Number	Answer	Acceptable answers	Mark
(c)(i)	-46 + 273 (1)	273-46 / any use of 273	(1)

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	substitution: (1) $\frac{101 \times 9.1}{273} = \frac{1.12 \times V_2}{227}$ Transposition (1) $V_2 = \frac{101 \times 9.1 \times 227}{273 \times 1.12}$ evaluation: (1) 682 (m ³)	Accept either Pa or kPa for substitution substitution and transposition in any order ignore power of ten error until evaluation 680 (m ³), 682.4 (m ³), 682.35 (m ³) full marks for the correct numerical answer without working	(3)

Question Number	Answer	Acceptable answers	Mark
(c)(iii)	bursts/explodes or words to that effect		(1)

(Total marks for question = 10 marks)

Q19.

Question number	Answer	Additional guidance	Mark
	An answer that combines any four of the following points of understanding to provide a logical description: - chooses either thermocouple or infra-red thermometer (1) - molten steel is poured into a crucible (1) - a stopwatch is started (1) - the crucible + contents are allowed to cool down (in the room) (1) - temperatures are taken at regular intervals (e.g. every minute) (1)	any interval with steel – every 10 minutes etc.	(4)

Q20.

Question number	Answer	Additional guidance	Mark
	An answer that combines any four of the following points of understanding to provide a logical description: - chooses either thermocouple or infra-red thermometer (1) - molten steel is poured into a crucible (1) - a stopwatch is started (1) - the crucible + contents are allowed to cool down (in the room) (1) - temperatures are taken at regular intervals (e.g. every minute) (1)	any interval with steel – every 10 minutes etc.	(4)

Q21.

Question Number:	Answer	Additional Guidance	Mark
	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

Q22.

Question Number:	Answer	Additional Guidance	Mark
	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

Q23.

Question number	Answer	Additional guidance	Mark
	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

Q24.

Question number	Answer	Additional guidance	Mark
	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

Q25.

Question number	Answer			Mark
	[x] B	bigger than in water	less than water	(1) AO1.1
	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.			

Q26.

Question number	Answer			Mark
	[x] B	bigger than in water	less than water	(1) AO1.1
	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.			