

Questions

Q1.

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)

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(Total for question = 3 marks)

Q2.

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 = 1 mark)

Q3.

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

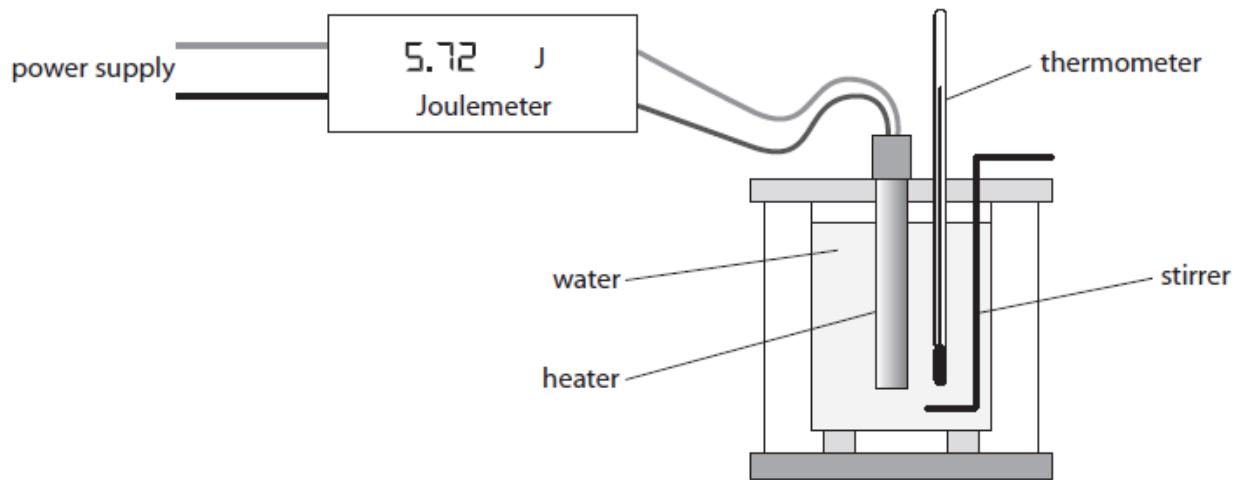


Figure 19

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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(Total for question = 3 marks)

Q4.

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)

(Total for question = 6 marks)

Q5.

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.

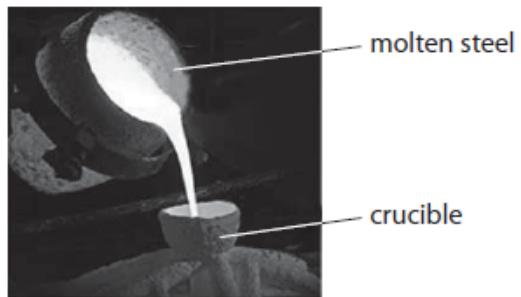


Figure 9

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)

Q6.

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

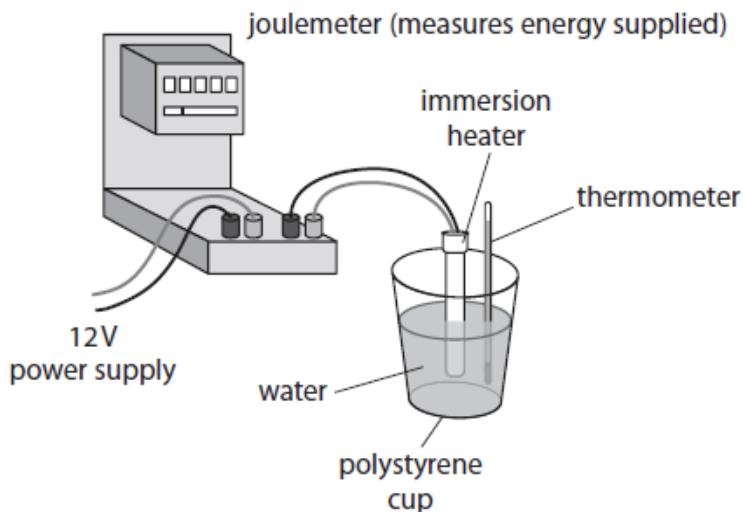


Figure 3

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.

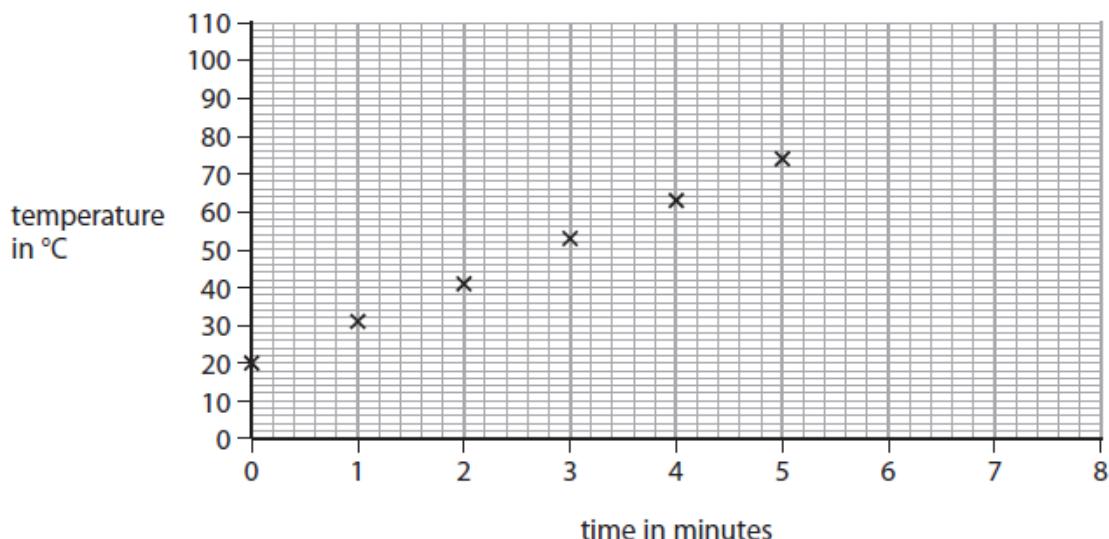


Figure 4

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)

Mark Scheme

Q1.

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

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

Q2.

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

Q3.

Question number	Answer	Additional guidance	Mark
	<p>an explanation linking any three from:</p> <p>stir the water before taking a reading of temperature (1)</p> <p>(continue to) observe temperatures after switching off (1)</p> <p>record the maximum / highest / peak temperature reached (1)</p> <p>take temperature reading at eye level (1)</p> <p>conduction (and convection) take time (1)</p>	<p>allow "for longer than 10 minutes"</p> <p>allow wait(ing period) in correct context</p> <p>until the temperature stops changing</p> <p>takes time (for water / thermometer) to heat through</p>	(3) AO1.2

Q4.

SSQ NO:	CS NO:	Answer	Mark
*		<p>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.</p> <p>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.</p> <p style="text-align: center;">AO1 strand 1 (6 marks)</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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)

Q5.

Question number	Answer	Additional guidance	Mark
	An answer that combines any four of the following points of understanding to provide a logical description: <ul style="list-style-type: none"> • 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)

Q6.

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