PEARSON EDEXCEL GCSE PHYSICS (HIGHER) · 1PH0

PHYSICS



MARK SCHEME

TOPIC 14: PARTICLE MODEL (PACK 1)

SCORE	PERCENTAGE
/141	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions, mark schemes and examiner comments in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question, mark scheme or examiner report material in this pack. Pearson Edexcel has not endorsed, approved or been involved in the production of it. Pearson Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson Edexcel publishes its past papers, mark schemes and examiner reports. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Mark Scheme

Q1.

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

Question Number:	Answer	Additional Guidance	Mark
(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

Q2.

Question Number:	Answer	Additional Guidance	Mark
(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
(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

Q3.

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

Question Number:	Answer	Additional Guidance	Mark
(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
(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 ΔV $W = F \times d$ $= p \times (A \times d)$ $= p \Delta V$	**(2)** AO 1 1

Q4.

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

Q5.

Question number	Answer	Additional guidance	Mark
(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
(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)

Q6.

Question number	Answer	Additional guidance	Mark
(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
(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)

Q7.

Question number	Answer	Additional guidance	Mark
(i)	Substitution: Density = mass/ volume (1) = 28 x10^{-3}/ 3.6 x 10^{-6} (1) Evaluation = 7777 kg / m^3 (1)	 (recalled / used) ignore any power of ten (pot) error here do not penalise any sf errors (7.77 etc. would get 2 marks: losing the pot mark in the evaluation)	(3)

Question number	Answer	Additional guidance	Mark
(ii)	(Use $\Delta Q = m \times c \times \Delta\theta$) substitution thermal energy gained = 0.028 x 510 x 80 (1) evaluation = 1100 (J) (1)	 ignore any pot error here 1142 (J)	(2)

Question number	Answer	Mark
(iii)	An explanation that combines identification – knowledge (2 marks) and reasoning / justification (1 mark) Solid state → particles vibrate (1) → about fixed positions (1) Liquid state → particles move randomly / freely (1)	(3)

Q8.

Question number	Answer	Additional guidance	Mark
(i)	Substitution: Density = mass/ volume (1) = 28 x10^{-3}/ 3.6 x 10^{-6} (1) Evaluation = 7777 kg / m^3 (1)	 (recalled / used) ignore any power of ten (pot) error here do not penalise any sf errors (7.77 etc. would get 2 marks: losing the pot mark in the evaluation)	(3)

Question number	Answer	Additional guidance	Mark
(ii)	(Use $\Delta Q = m \times c \times \Delta\ \theta$) substitution thermal energy gained = 0.028 x 510 x 80 (1) evaluation = 1100 (J) (1)	 ignore any pot error here 1142 (J)	(2)

Question number	Answer	Mark
(iii)	An explanation that combines identification – knowledge (2 marks) and reasoning / justification (1 mark) Solid state → particles vibrate (1) → about fixed positions (1) Liquid state → particles move randomly / freely (1)	(3)

Q9.

Question Number	Answer	Additional guidance	Mark
(i)	substitution into $\Delta Q = m \times c \times \Delta\theta$ (1) $84\,000 = 0.25 \times 4200 \times \Delta\theta$ rearrangement $\frac{\Delta Q}{m \times c}$ (1) $(\Delta\theta =) \frac{84\,000}{0.25 \times 4200}$ $(= 80)$ evaluation (1) (temperature before heating =) 20 (°C)	accept substitution and rearrangement in either order answer of 80 (°C) scores 2 marks award full marks for the correct answer without working	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	substitution into $Q = m \times L$ (1) $0.34 = 0.15 \times L$ re-arrangement and evaluation (1) $(L = \frac{0.34}{0.15} =)$ 2.3 (MJ/kg)	 allow values that round to 2.3 (MJ/kg) allow 1 mark for POT error award full marks for the correct answer without working	(2)

Question Number	Answer	Additional guidance	Mark
(iii)	A description that makes reference to any **two** of the following (density) increases between 0°C and 4 °C (1) reaches a maximum at 4 °C (1) (density) decreases above 4 °C (1)	 increases initially / at first / up to 4 °C then decreases if no other marks scored then credit reference to large volume means low density (OWTTE) for 1 mark only	(2)

Q10.

Question Number	Answer	Additional guidance	Mark
(i)	substitution into $\Delta Q = m \times c \times \Delta\theta$ (1) $84\,000 = 0.25 \times 4200 \times \Delta\theta$ rearrangement $\frac{\Delta Q}{m \times c}$ (1) $(\Delta\theta =) \frac{84\,000}{0.25 \times 4200}$ $(= 80)$ evaluation (1) (temperature before heating =) 20 (°C)	accept substitution and rearrangement in either order answer of 80 (°C) scores 2 marks award full marks for the correct answer without working	**(3)**

Question Number	Answer	Additional guidance	Mark
(ii)	substitution into $Q = m \times L$ (1) $0.34 = 0.15 \times L$ re-arrangement and evaluation (1) $(L = \frac{0.34}{0.15})$ 2.3 (MJ/kg)	allow values that round to 2.3 (MJ/kg) allow 1 mark for POT error award full marks for the correct answer without working	**(2)**

Question Number	Answer	Additional guidance	Mark
(iii)	A description that makes reference to any **two** of the following (density) increases between 0°C and 4 °C (1) reaches a maximum at 4 °C (1) (density) decreases above 4 °C (1)	 increases initially / at first / up to 4 °C then decreases if no other marks scored then credit reference to large volume means low density (OWTTE) for 1 mark only	**(2)**

Q11.

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

Q12.

Question number	Answer	Additional guidance	Mark
(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
(ii)	recall and substitution (1) density= $\frac{m}{V}$ (density=) $\frac{0.058}{6.5 (\times 10^{-6})}$ evaluation (1) 8.9×10^3 (kg/m³)	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)

Q13.

Question number	Answer	Additional guidance	Mark
	volume substitution (1) 1.5 x 1.0 x 0.2(0) (= 0.3) substitution in equation (1) mass = 2100 x (0.3(0)) evaluation (1) = 630 (kg)	 ecf from calculated value of volume for this mark only award 2 marks for 6.3 x 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**

Q14.

Question number	Answer	Additional guidance	Mark
	volume substitution (1) 1.5 x 1.0 x 0.2(0) (= 0.3) substitution in equation (1) mass = 2100 x (0.3(0)) evaluation (1) = 630 (kg)	 ecf from calculated value of volume for this mark only award 2 marks for 6.3 x 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**

Q15.

Question number	Answer	Additional guidance	Mark
	calculation of change in volume (1) (530 cm^3 – 490 cm^3) = 40 (cm^3) substitution (1) $7.9 = \frac{mass}{40}$ 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 (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**

Q16.

Question number	Answer	Additional guidance	Mark
	calculation of change in volume (1) (530 cm^3 – 490 cm^3) = 40 (cm^3) substitution (1) $7.9 = \frac{mass}{40}$ 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 (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**

Q17.

Question number	Answer	Additional guidance	Mark
	Rearrangement (1) $P_2 = \frac{P_1V_1}{V_2}$ substitution (1) $P_2 = \frac{103 \times 0.010}{0.0070}$ evaluation **to 2 sf** (1) = 150 (kPa)	 147 (kPa) 1.5×10^2 kPa or 1.5×10^5 Pa **rearrangement and substitution in either order** award full marks for correct answer without working	**(3)**

Q18.

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

Q19.

Question number	Answer	Additional guidance	Mark
	Rearrangement (1) $V_2 = (p_1 \times V_1) \div p_2$ Substitution (1) $V_2 = (297 \times 10^3 \times 23.0) \div (101 \times 10^3)$ Evaluation (1) $V_2 = 67.6\ (cm^3)$	 67.633	 **(3)**

Q20.

Question number	Answer	Additional guidance	Mark
i	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
ii	substitution into $\Delta Q = m \times L$ $450{,}000 = (1.41 - 1.21) \times L$ (1) rearrangment $L = \frac{450{,}000}{0.2}$ (1) evaluation (L) = 2 200 000 (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**

Q21.

Question number	Answer	Additional guidance	Mark
(i)	substitution into $\Delta Q = m \times s \times \Delta T$ (1) $(\Delta Q) = 1.41 \times 4200 \times (100-25)$ 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)	**(3)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	substitution into $\Delta Q = m \times L$ $450{,}000 = (1.41 - 1.21) \times L$ (1) rearrangment $L = \frac{450{,}000}{0.2}$ (1) evaluation (L) = 2 200 000 (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**

Q22.

Question Number:	Answer	Additional Guidance	Mark
	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

Q23.

Question Number:	Answer	Additional Guidance	Mark
	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

Q24.

Question number	Answer	Mark
(i)	C	(1)

Question number	Answer	Additional guidance	Mark
(ii)	Equating the same variable in both equations (1) $\Delta Q = m \times c \times \Delta\theta = P \times t$ Rearrangement (1) $t = \frac{(m \times c \times \Delta\theta)}{P}$ Substitution and evaluation (1) $t = \frac{(1 \times 4200 \times 77)}{3500}$ = 92 s	allow $\Delta\theta$ seen as 95 − 18 92.4 evaluation must be seen to at least 2 s.f. at some point in the working	(3)

Q25.

Question number	Answer		Mark
(i)	An answer that combines the following points of understanding to provide a logical description: • when steam condenses, its molecules move closer together, so the internal energy decreases (1) • when the water from the condensed steam cools, its molecules move more slowly, therefore storing less kinetic energy (1)	allow as water cools, the distance between the particles decreases which increases the intermolecular forces	(2)

Question number	Answer	Additional guidance	Mark
(ii)	equating the variables in the three equations/principle of conservation of energy (1) $(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w) = (m_m \times c_m \times \Delta\theta_m)$ rearrangement (1) $m_m = \frac{(m_w \times l_w) + (m_w \times c_w \times \Delta\theta_w)}{(c_m \times \Delta\theta_m)}$ substitution of correctly calculated quantities (1) $= \left(\frac{\left(\left(\frac{25}{1000}\right) \times 2260000\right) + \left(\left(\frac{25}{1000}\right) \times 4200 \times 35\right)}{3840 \times 60} \right)$ evaluation (1) 0.26 (kg)	allow in words or with suitable alternative subscripts temperature changes and l_w must be correct allow maximum of 3 marks for calculations that omit the energy from cooling of water	(4)

Question number	Answer	Mark
(iii)	Any two of the following reasons: • more steam must condense and transfer the energy that is dissipated to the jug during the process (1) • more steam must condense and transfer the energy that is dissipated to the surroundings during the process (1) • more steam must condense and transfer the energy needed to cause the milk to froth (1) • more steam must condense to replace any steam that might leave the milk without condensing (1)	(2)

Q26.

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

Q27.

Question number	Answer	Additional guidance	Mark
(i)	rearrange $p = \rho g h$ to give $\rho = p / (g h)$ (1) substitution using any point from graph (1) e.g. depth = 50km and pressure = 1.5 GPa $\rho = p / (g h)$ $= 1.5 \times 10^9 / (10 \times 50 \times 10^3)$ Evaluation (2) $= 3000$ (kg/m^3)	rearrangement and substitution in any order allow any combination from the graph and ignore 'pot' error here 'pot' error scores 2 marks maximum	(4)

Question number	Indicative content	Mark
(ii)	Answers will be credited according to the 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 of the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (3 marks) A03 (3 marks)** **A03 Interpretation and evaluation from the graph** Similarities: • both show increasing pressure with depth • both show a range of pressures over kilometre depths / heights Differences: • ocean water shows a linear relationship (straight line) but atmosphere gives a non-linear (curved) relationship • density of ocean water not changing with depth but density of atmosphere changes as you go higher • The pressures in the ocean recorded are much bigger (GPA compared with kPa) The depth of the ocean shown is up to 100km whereas the height of the atmosphere involved is only up to 10km **A02 Link between graph shapes and underlying physics** Similarities: • pressure is due to (increasing) weight of fluid (liquid / gas) above • more molecules above Differences: • atmosphere becomes thinner the higher you go molecules in the ocean stay (on average) the same distance apart but in the atmosphere they get further apart (on average) as you go higher up	(6)

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)

Q28.

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**

Q29.

Question number	Indicative content	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. 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.	**(6)** **AO2 and AO3**

	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 = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$	

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	Additional guidance Partially complete description of a suitable procedure with at least one measurement	Possible candidate responses 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	Additional guidance Mostly complete description of a suitable procedure with at least two measurements and some description of processing the results.	Possible candidate responses 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	Additional guidance Detailed description of a suitable procedure with most of the necessary measurements and a clear description of processing the results.	Possible candidate responses 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 = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$

Q30.

Question number	Indicative content	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. 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.	**(6)** **AO2 and AO3**

	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 = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$	

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	Additional guidance Partially complete description of a suitable procedure with at least one measurement	Possible candidate responses 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	Additional guidance Mostly complete description of a suitable procedure with at least two measurements and some description of processing the results.	Possible candidate responses 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	Additional guidance Detailed description of a suitable procedure with most of the necessary measurements and a clear description of processing the results.	Possible candidate responses 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 = $\frac{\text{thermal energy transferred}}{\text{mass of Al} \times \text{temp drop of Al}}$