PEARSON EDEXCEL IGCSE PHYSICS · 4PH1

PHYSICS



MARK SCHEME

SECTION 5: SOLIDS, LIQUIDS AND GASES (PACK 2)

SCORE	PERCENTAGE
/152	%

STEMUP

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Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a)	idea of regular pattern/tightly packed; particles vibrating; (about) fixed positions / eq;	allow diagram condone molecules or atoms for particles ignore reference to force	3
(b)	increases continuously from -40 to 44 °C ; remains constant (at 44 °C); increases continuously from 44 to 80 °C;	 ECF incorrect plateau responses with no period of time at 44 score max 1 mark accept any gradient, straight lines or curves for the increasing temperature parts ignore any numbers on the time axis ignore second plateau after 44 if drawn	3

Q2.

Question number	Answer	Notes	Marks
(a)	density = mass / volume;	allow standard symbols and rearrangements e.g. ρ = m / V condone use of d for density	1
(b)	substitution OR rearrangement; evaluation; unit; e.g. 8.46 = 454 / V OR V = m / ρ (V =) 53.7 cm^3	equation must be correct -1 for POT error allow m^3 only if consistent with data used 53.664... 5.37×10^{-5} m^3 gains 3 marks	3

Q3.

Question number	Answer	Notes	Marks
(a)	Any FIVE from: MP1. measure current and voltage to work out power; MP2. use ammeter and voltmeter; MP3. measure temperature increase AND time taken; MP4. find total energy (E = Pt or E = VIt); MP5. measure mass of substance; MP6. use a balance; MP7. rearrange to give c = E / m $\Delta\theta$; MP8. plot a temperature-time graph; MP9. use gradient (so c = P/(m × gradient));	 accept 'known power' accept 'power meter' or 'joulemeter' accept idea of 'known voltage' accept measure initial and final temperature for temp increase accept idea of waiting for highest temperature after power switched off accept 'use a stopwatch' for time taken	5

(b)	(i)	34 (°C);		1
	(ii)	any TWO from: MP1. bonds between particles are weakened or broken; MP2. particles go from regular to irregularly packed/EQ; MP3. particles go from vibrating (about a fixed position) to sliding past each other / EQ;	allow particles get (slightly) further apart /EQ ignore references to KE	2
	(iii)	reference to different temperature changes in the same time; different specific heat capacities/EQ;	accept recognition that the states are different condone incorrect SHC comparisons between phases	2
			Total for Question: 10 marks	

Q4.

Question number	Answer	Notes	Marks
(a) (i)	Selection of P=F/A; Conversion of g to kg; Evaluation of weight; Evaluation of pressure; Correct answer: 140 (Pa) i.e. $W = 3.7 \times 10^{-3} \times 10 = 3.7 \times 10^{-2}$ N; $P = 3.7 \times 10^{-2} / (2.6 \times 10^{-4})$; P = 140 (Pa);	 0.0037 seen anywhere Accept any value that rounds to 140. i.e 142, 142.3, Accept use of 9.8(1) for 'g', giving 139(.46)	4
(ii)	Same weight (and larger cross-sectional area); P=F/A so smaller pressure;	Allow 'force' for weight	2
(b)	Increases continuously from -10 °C to 0 °C; Remains constant at 0 °C; Increases continuously from 0 °C to 20 °C;	Responses with no period of time at 0 °C score max 1 mark. Accept • Any gradient • Straight lines or curves for the increasing temperature parts • Any non-zero amount of time at 0 °C by eye Ignore any numbers on the time axis.	3
(c)	Any TWO from: Bonds between particles are weakened or broken; Particles go from regular to irregularly packed/EQ; Particles go from vibrating (about a fixed position) to sliding past each other/EQ;	 Allow particles get (slightly) further apart/EQ; ignore references to KE	2

Q5.

Question number	Answer	Notes	Marks
(a) (i)	Substitution (including conversion of time to seconds); Re-arrangement of given equation P = W/t; Evaluation; e.g. Energy = 75 x (22 x 60) = 99 000 (J)	 Allow W or E for energy or work. Can be implied from their working. Accept 1650 or 5.9 million for 2 marks.	3
(ii)	Any ONE assumption from • dog does not change temperature • dog does not change power output • rate of transfer is constant (despite increase in temp of water) • no heating of outside world/surroundings/material of bag • no heating from the surroundings	 Ignore unqualified '100% efficient' or 'no energy lost'	1
(iii)	Use of Q = m x c x $\Delta\theta$; Substitution of their energy, mass, c; Evaluation of temp change; Calculation of final temp = temp change + 16; e.g. 99 000 = 8.7 x 4200 x $\Delta\theta$ temp rise = 99 000/(8.7 x 4200) = 2.7 final temp = 19 (°C);	 Allow ECF from (a)(i) Allow ECF from evaluation of temp change. Accept 16.04... for all marks (ecf E without min->s conversion) Accept answer to 3 or more sf i.e 18.7	4

(b)	Any THREE from MP1 Dog and water are at different temperatures; MP2 Dog and water in physical contact so likely to be conduction; MP3 No movement of particles from dog to water, so not convection / EQ; MP4 Dog and bag are both solids, so convection impossible; MP5 Not much radiation as dog and water similar temperatures;	 Allow "no gap between dog and bag so no convection"	3

Q6.

Question number		Answer	Notes	Marks
(a)	(i)	particles with larger spaces between them; particles in less regular structure;	max space in body or surface one of particles from diagram on left.	2
	(ii)	particles {slide/move/flow} past each other;	ignore 'more freely'	1
(b)	(i)	safety goggles/gauntlets/gloves/not splashing/eq;		1
	(ii)	balance;	condone 'scales' ignore 'meter(s)'	1
	(iii)	74 (g);		1
	(iv)	density = mass/volume;	allow any accepted letters for density, mass or volume allow d, ρ for density	1
	(v)	substitution; evaluation; matching unit; correct answer: 0.84 g/cm^3 e.g. density = mass / volume density = 74/88 density = 0.84 g/cm^3 to 2 sf	ECF for incorrect mass allow 0.8409090...	3
(c)		(particles) far apart / much further apart; particles move with (much) higher speed / have higher kinetic energy; move (more) randomly;	allow KE for kinetic energy	3
			Total for Question = 13 marks	

Q7.

Question number	Answer	Notes	Marks
(a) (i)	C (nuclear); A is incorrect because chemical reactions do not happen in the Sun B is incorrect because the kinetic store of particles increases during nuclear fusion D is incorrect because the thermal store of the Sun remains constant whilst fusion is taking place		1
(ii)	B (by radiation); A is incorrect because transfers by heating cannot happen in a vacuum C is incorrect because there is no electrical circuit or flow of ions D is incorrect because the transfer does not happen due to forces		1
(b) (i)	evaluation of total power / conversion of hours to seconds; evaluation of energy in J; evaluation of energy in MJ; e.g. power = (1000 × 15 =) 15 000 (m^2) OR time = (2 × 60 × 60 =) 7200 (s) energy = (15 000 × 7200 =) 108 000 000 (J) energy = (108 000 000 ÷ 1 000 000 =) 108 (MJ)	allow ×3600 seen anywhere in working	3
(ii)	substitution into $\Delta Q = m \times c \times \Delta T$; rearrangement; evaluation of ΔT; evaluation of final temperature; e.g. 100 000 000 = 1100 × 4200 × ΔT ΔT = 100 000 000 / (1100 × 4200) (ΔT =) 22 (°C) T = (20 + 22 =) 42 (°C)	 -1 for POT error allow ECF from incorrect ΔT allow 23.3..., 21.6... allow 41.6-43.8 (°C)	4
(iii)	any sensible suggestion; e.g. • heating process is not 100% efficient • energy also heats up pipes / not all energy is transferred to water • some energy is transferred to the surroundings • power of Sun may change	 allow energy transferred to (solar) panel ignore 'heat is lost'	1

Q8.

Question number	Answer	Mark
(a)	A description that makes reference to three of the following points. For a liquid: • molecules closely spaced (1) • molecules slide over one another (1) For a gas: • molecules spread out (1) • molecules move with random motion (1)	3

Question number	Answer	Additional guidance	Mark
(b)(i)	Process includes: • Conversion of time into seconds substitution into or rearrangement of • $P = W/t$ • Evaluation e.g. time = 120 seconds (1) 2200 = W/120 (1) W = 260 000 (joules) (1)	seen anywhere in working allow 264 000 answer of 4400 (joules) gains 2 marks max	3

Question number	Answer	Additional guidance	Mark
(b)(ii)	Energy transferred = mass × specific heat capacity × change in temperature	equation can be given in words or symbols e.g. $\Delta Q = m \times c \times \Delta\theta$ allow E for Q, T for θ	1

Question number	Answer	Additional guidance	Mark
(b)(iii)	Process includes: • rearrangement of equation (1) • substitution into correct equation (1) • evaluation of temperature difference (1) • calculation of final temperature (1) e.g. 264 000 = 1.1 × 4200 × $\Delta\theta$ (1) $\Delta\theta = \frac{264\,000}{1.1 \times 4200}$ (1) ($\Delta\theta$ =) 57 (°C) (1) final temperature = 77 (°C) (1)	allow ecf from (b)(i)	4

Question number	Answer	Additional guidance	Mark
(c)(i)	Thermometer	allow temperature sensor AND data logger	1

Question number	Answer	Mark
(c)(ii)	An explanation that makes reference to the following points: • actual temperature lower than calculated (1) • energy is lost to the surroundings not all the energy is transferred to the water (1)	2

(Total for question = 14 marks)

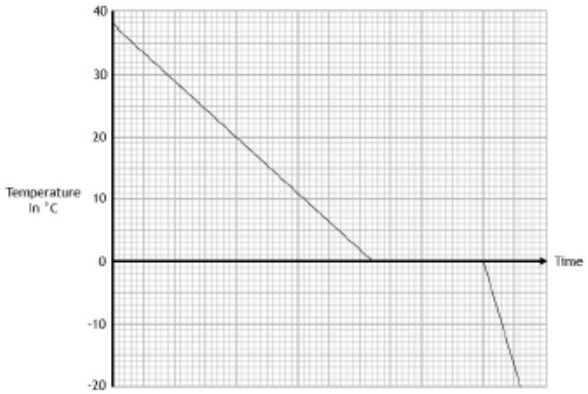
Q9.

Question number	Answer	Notes	Marks
(a)	(some) bonds (between particles) are broken or weakened; particles begin to move around or slide over each other;	award either or both marks if clear from diagram accept idea of reduction in intermolecular forces reject MP2 if there is a reference to the speed of particles or KE changing during melting	2

(b)	(i)	any two from: MP1. energy is transferred to air/particles (by heating); MP2. idea that particles move faster; MP3. temperature (in K) is (directly) proportional to KE of particles;	accept molecules for particles accept particles gain KE	2
	(ii)	particles hit (flask) walls **more frequently**; particles hit (flask) walls with more force / harder;		2
	(iii)	136 (kPa);	allow answers in the range 135-137 (kPa)	1
	(iv)	substitution; rearrangement; evaluation; e.g. 136 / 400 = p_2 / 230 (p_2 =) (136 x 230) / 400 (p_2 =) 78 (kPa)	allow ecf from (b)(iii) e.g. 86 (kPa) for (iii) gives 79 (kPa) for (iv) substitution and rearrangement in either order allow 78.2... accept extrapolation back to T = 230 for 2 marks accept value between 79 and 77 by this method accept calculation using graph (i.e. extrapolation numerically/algebraically) back to 230 for 2 marks accept value between 79 and 77 by this method	3
			Total for question = 10 marks	

Q10.

Question number	Answer	Notes	Marks
(a)	energy to change temperature by 1 °C; per kilogram of mass;	accept 1 K DOP	2
(b)	any two from: MP1. leave block in oven for longer / check it is definitely at 220 °C; MP2. idea of transferring block from oven to water as quickly as possible; MP3. adding insulation to the container (of water); MP4. place a lid on container (of water); MP5. use container (of water) with low (specific) heat capacity or low thermal conductivity; MP6. idea of repeating **and** {average/remove anomalies};	 e.g. wrap it in wool e.g. use a polystyrene cup 	2
(c) (i)	38 (°C);		1
(ii)	(38 - 20 =) 18 °C;		1
(iii)	substitution; rearrangement of $\Delta Q = m \times c \times \Delta T$; evaluation; e.g. $190\,000 = 2.3 \times c \times 18$ $c = 190\,000 \ / \ (2.3 \times 18)$ (c =) 4600 (J/kg °C)	allow ECF from (c)(ii) -1 for POT allow 4589.37..., 4590 etc	3

(d)	line has two downward sloping sections of different gradient; horizontal line at 0 °C in between downward sloping sections; line starts at 38 oC and finishes at -20 °C; initial downward sloping line has smaller gradient than final downward sloping line;  	ignore where lines intersect the time axis throughout sections do not need to be straight, but one must be clearly steeper than the other reject this MP if there is more than one horizontal line lower than 38 and higher than -20 ignore start/finish time by eye note: responses with initial downward section and final downward section parallel (by eye) can only score MP2 and MP3	4	exp
		Total for Question = 13 marks		

Q11.

Question number	Answer	Notes	Marks
(a) (i)	(in solids) particles vibrate only; (in liquids) particles slide over each other; (in gases) particles move freely / randomly;		3
(b) (i)	energy starts in a chemical store (in the fuel); energy is transferred by heating; to a thermal store (in the water);	 allow transfer by convection / radiation allow kinetic store of water allow heat energy for thermal energy	3
(ii)	horizontal line shows the change of state; (because) temperature remains constant during change of state;	can be shown on graph	2

Q12.

Question number	Answer	Notes	Marks
(a) (i)	B – QR; A is not correct as the substance is a solid C is not correct as the substance is a liquid D is not correct as the substance is boiling		1
(ii)	A – PQ; B is not correct as the substance is part solid, part liquid C is not correct as the substance is a liquid D is not correct as the substance is boiling		1
(iii)	any **irregular**, spaced out collection of particles;		1
(iv)	D – they move quickly and randomly; A is not correct as this is how particles in a solid move B is not correct as only particles at 0 K can theoretically be stationary C is not correct as this is how particles in a liquid move		1
(b) (i)	thermometer;	allow temperature sensor, temperature probe	1
(ii)	80 (°C);		1
(c)	temperature difference = 27 (°C); substitution; evaluation; e.g. $\Delta T = 37 - 10 = 27$ (°C) energy = 1.2 × 840 × 27 (energy =) 27 000 (J)	 allow ECF from incorrect temperature difference 37296, 10080 = 2 marks allow 27216, 27220, 27200	3
		(Total for Question = 8 marks)	

Q13.

Question number	Answer	Notes	Marks
(a)	goggles/safety spectacles/tongs/gloves/hair tied back		1
(b) (i)	substitution of 'water' data into given equation; correct energy gain of water to more than 1sf; e.g. energy gain by water = 0.138 × 4200 × 5 = 2898 (J)	 -1 POT error	2
(ii)	evidence that the energy loss by nail=energy gain by water; rearrangement to find temperature change of nail; correct evaluation of temperature change for nail; correct answer: 1300 (°C) (using 2898) or 1400 (°C) (using 3000) e.g. 2898 = 0.0048 × 450 × ΔT ΔT = 2898 ÷ (0.0048 × 450) ΔT = 1342 (°C)	e.g. 3000 = 0.048 x 450 x temp change allow correctly rounded 1388.8... for 3 marks	3
(iii)	{heat / energy} lost to surroundings (by water)	accept {heat / energy} lost by nail during transfer from flame to water	1

Q14.

Question number	Answer	Notes	Marks
(a)	attempt to draw tangent to the curve at 70°C; attempt at finding gradient of tangent; correct evaluation of gradient; final answer given as negative; e.g. tangent seen on graph at 70°C gradient = [57-79]/600 gradient = −0.037 (°C/s)	 allow range of 0.030-0.045 independent mark	4
(b)	curve drawn of similar shape to original starting at 82 °C; curve drawn above original;		2

Q15.

Question number	Answer	Notes	Marks
(a)	temperature difference calculated; substitution into given formula; correct evaluation; e.g. $\Delta T = 100 - 16 = 84$ (°C) energy supplied = $0.45 \times 4200 \times 84$ (energy supplied =) 160 000 (J)	e.g. 84 seen or 100 - 16 seen allow ecf for incorrect temperature difference 158 000 (J) scores 2 marks only allow 159 000, 158 760 (J)	3
(b) (i)	(7.4 - 3.0) = 4.4 (minutes);	allow 4 minutes and 24 seconds, 4 and $^4/_{10}$ minutes	1
(ii)	conversion of time into seconds; substitution into P = W/t OR rearrangement; correct evaluation; e.g. time = 264 (s) 2200 = W / 264 OR W = P × t energy supplied = 580 000 (J)	allow ECF from (i) allow ECF from (i) allow substitution in minutes 9700, 9680 (J) scores 2 marks allow 581 000, 580 800 (J)	3
(c)	idea of all water being the same temperature;	allow idea of distributing thermal/heat (energy) evenly throughout water	1
(d)	**arrangement** idea that liquid has molecules that are close together; idea that gas has (widely) spaced molecules; **motion** idea that liquid has molecules that move/slide past each other; idea that gas has molecules that move {faster/freely/randomly/straight lines};	allow marks if seen on diagrams allow particles for molecules ignore random/irregular arrangement for liquid and gas	4
		Total for Question = 12 marks	

Q16.

Question number	Answer	Notes	Marks
(a) (i)	reference to reflection or absorption; white is a good reflector/poor absorber;	ignore reference to emission	2
(ii)	any TWO from: air is a (good) insulator / poor conductor; reduction in convection; idea that trapped air cannot circulate;		2
(b)	substitution into given equation (energy = $mc\Delta\theta$); rearrangement; evaluation of temperature change; evaluation of final temperature; e.g. 210 000 = 4.5 x 4200 x ΔT ΔT = 210 000/(4.5 x 4200) ΔT = 11 (°C) final temperature = 46 (°C)	ecf incorrect temp change accept 35(°C) for 3 marks if supported with working that shows evidence of a temperature change of 11 x 10^{-3} (°C)	4
		Total for Question	= 8 marks