OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

P1.2 CHANGES OF STATE

SCORE	PERCENTAGE
/120	%

STEMUP

These questions belong to OCR, not to us.

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

What we do not own

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

Where to find the originals

OCR publishes its past papers, mark schemes and examiner reports. Always check the current specification at ocr.org.uk 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.

Question			Answer/Indicative content	Marks	Guidance
1	a	i	Temperature rise or start and end temperatures (1) Time that the heater is switched on (1) Mass of the block (1)	3	
		ii	Reference to: energy = voltage × current × time (1) SHC = energy / (mass × temp rise) (1)	2	
	b		Any two reasons and any two improvements Reasons Heat escapes to the surroundings (1) Part of the immersion heater is outside of the block (1) Poor thermal contact between the immersion heater and block (1) It takes time for the thermometer to reach its maximum temperature (once the heater is turned off) (1) Improvements Lag / insulate the aluminium block (1) Make sure all of the heater is in the block / use a smaller heater (1) Use petroleum jelly to transfer heat between the immersion heater and the block (1) Wait until the maximum temperature is reached (1)	4	**Max** 2 reasons and 2 improvements **ALLOW** (idea of) residual heat not reaching the block before the final temperature is recorded.
			Total	9	
2	a		Oil will not freeze (as easily as water) / **ORA** (1)	1	
	b		Reduces risk of burns to people / children (1)	1	
	c		Time conversion: 10 × 60 = 600 seconds (1) 800 × 600 / 480 000 (J) (1)	2	**ALLOW** 480 (kJ)
	d	i	Substitute into formula for specific heat capacity / 10 × 40 × 1 700 (1) 680 000 (J) (1)	2	**ALLOW** 680 (kJ)

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	Any two from: Some energy used to heat the radiator case (rather than the oil) (1) Energy passed from oil to air in room / oil undergoes cooling whilst heating up (1) Energy is dissipated to surroundings (1) It is not 100% efficient at transferring energy (1)	2	
			Total	8	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
3	a	i	Temperature rise **or** start and end temperatures (1) Time that the heater is switched on (1) Mass of the block (1)	3	
		ii	Reference to: energy = voltage × current × time (1) SHC = energy / (mass × temp rise) (1)	2	
	b		Any two reasons and any two improvements Reasons Heat escapes to the surroundings (1) Part of the immersion heater is outside of the block (1) Poor thermal contact between the immersion heater and block (1) It takes time for the thermometer to reach its maximum temperature (once the heater is turned off) (1) Improvements Lag / insulate the aluminium block (1) Make sure all of the heater is in the block/use a smaller heater (1) Use petroleum jelly to transfer heat between the immersion heater and the block (1) Wait until the maximum temperature is reached (1) Improvements Lag / insulate the aluminium block (1) Make sure all of the heater is in the block/use a smaller heater (1) Use petroleum jelly to transfer heat between the immersion heater and the block (1) Wait until the maximum temperature is reached (1).	4	Max 2 reasons and 2 improvements ALLOW (idea of) residual heat not reaching the block before the final temperature is recorded. ALLOW (idea of) residual heat not reaching the block before the final temperature is recorded.
			Total	9	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
4		i	water 60(^{0}C) [1] beaker 40(^{0}C) [1] **but** if answer is incorrect or incomplete then: **either** beaker t = $\frac{13\,440}{0.2 \times 1680}$ scores [1]	2	**Allow** the energies being used the wrong way round. — so gives 5.3(^{0}C) and 450(^{0}C) [1] **Examiner's Comments** This was a well answered question about calculating temperature rises.
		ii	(only) water (particles) absorbs microwaves [1] (only) water is heated by the microwaves [1]	1	**ignore** microwaves absorb water
		ii	beaker does not absorb / not heated by microwaves [1]		**allow** hot water heats the beaker / plastic heated indirectly [1] **Examiner's Comments** The candidates needed to say that the microwaves are absorbed by the water (rather than the plastic beaker). Some just said that the microwaves penetrated the beaker but failed to say that none were absorbed. Many referred to plastic being a poor conductor to explain their answer. Also the 'low SHC of plastic' was referred to unsuccessfully in many answers. It was rare to see explanations in terms of plastic not absorbing microwaves [1].
			Total	3	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
5			Level 3: (5 – 6 marks) Full quantitative AND a qualitative comparison. Quality of written communication does not impede communication of the science at this level. Level 2: (3 – 4 marks) Partial quantitative comparison OR qualitative comparison showing alloy has greater mass but smaller specific heat capacity. Quality of written communication partly impedes communication of the science at this level. Level 1: (1 – 2 marks) Idea of same mass of water OR water rises in temperature by the same amount OR same energy needed Quality of written communication impedes communication of the science at this level. Level 0: (0 marks) Insufficient or irrelevant science. Answer not worthy of credit.	6	This question is targeted up to grade A* Indicative scientific points at level 3 may include: relevant points for level 1 and level 2 and • idea that heat capacity / energy is the same for each • correct calculation to show heat energy capacity is the same for each e.g. 400 x 1.5 x 80 = 500 x 1.2 x 80 400 x 1.5 = 500 x 1.2 Indicative scientific points at level 2 may include: • alloy has a smaller specific heat capacity • alloy has greater mass • stainless steel has a larger specific heat capacity • stainless steel has smaller mass • heat capacity / (energy) correctly calculated e.g. 400 x 1.5 (x 80) 500 x 1.2 (x 80) Indicative scientific points at level 1 may include: • mass of water is the same / mass of water in each kettle is 1.8 kg • temperature rise of water in each kettle is the same / water rises from 200C to 1000C in each kettle / temperature rise of water in each kettle is 80°C • power of kettle is the same • same amount of water (1.8 kg) and temp rise (80°C) • water heating needs same energy for each kettle Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This was a six mark question targeted up

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					to A* Most candidates achieved level 1 by knowing that the power of the kettles and the mass of water in each kettle were the same. A significant number of candidates went on to say that the difference in mass between the kettles was not significant, which was incorrect. Similar statements about the specific heat capacity of the material of the two kettles were also made, again incorrect. About half the candidates realised that the effect of greater mass of kettle and lower specific heat capacity cancelled the smaller mass and higher specific heat capacity. Most f these candidates proved this by calculation to gain level 2. To achieve level 3, candidates needed to do the above calculation and give a full qualitative explanation of the two situations. The terms heat capacity and specific heat capacity were (incorrectly) freely interchanged by many candidates but this was not penalised.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
6			300 (seconds) to 500 (seconds) (1) energy used to break intermolecular bonds / bonds between molecules (1)	2	**allow** 300 to 310 (1) **allow** overcome intermolecular forces **ignore** breaks intermolecular forces **not** intra-molecular forces **ignore** bonds between particles **allow** breaks bonds between liquid particles (1) both marking points are independent of each other **Examiner's Comments** Most candidates gave the correct values [1] but rather fewer could explain that intermolecular bonds were broken. Many said forces were broken [0] or that the energy was used to change state [0]. Also 'bonds were broken' failed to reach this marking point. Some candidates talked about the breaking of intermolecular bonds, but whilst the temperature was rising. Others mentioned change of state but did not talk about the breaking of intermolecular bonds.
			Total	2	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
7	a		the temperature stays constant after 300s / 5 min / near the end / later in the experiment / AW (1)	1	**allow** flat line (1) **ignore** straight line **ignore** liquid cannot get any hotter **allow** horizontal / levels off / zero gradient Examiner's Comments About half the candidates were able to explain how the graph showed that the liquid was boiling. Many different expressions were accepted to describe the temperature as steady for the last 200 seconds. Examiners, however, did not accept the word straight as a correct description as this does not suggest horizontal.
	b		106 (°C)	1	Examiner's Comments Most candidates gave the correct answer of 106°C.
			Total	2	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
8	a		30240 **and** 35000 heater or **E** (2) **but if the answer incorrect or no heater selected** 0.6 × 12 × 4200 **or** 30240 (1)	2	no mark for just choosing E with no working or answer no mark for choosing E with an incorrect calculation **Examiner's Comments** Calculations were usually correct, but some correct answers failed to select the heater needed. Some candidates chose D but failed to recognise that D would not supply enough energy.
	b	i	idea that it **stays the same** (1)	1	**allow** reaches its maximum / does not go any higher **ignore** a given temperature value **Examiner's Comments** There was a low level of attainment in this question (only about 1/3 gained the mark). Incorrect answers stated that the temperature would rise. A smaller number of answers were centred on change of state.
		ii	10 200 (2) **but if the answer incorrect** 12 × 850 (1)	2	**Examiner's Comments** A very high number of candidates gained full credit. When errors did occur they were because of an attempt to convert 12g to kilograms or dividing the specific latent heat by the mass

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		iii	**any two from:** energy needed to heat beaker / heater (1) heat air / surroundings (1) counteract cooling / AW (1) idea of part of heater exposed / not in ethanol (1)	2	**ignore** efficiency **ignore** energy wasted or heat escapes unless qualified **ignore** greater mass amount of ethanol / s.l.h. greater than expected **Examiner's Comments** The last part of question 2 was poorly answered, with two mark answers at a premium. Incorrect answers often concentrated on the ideas of the ethanol having a higher than expected boiling point. Other wrong answers were about the energy needed to cause a change of state or to break intermolecular bonds. Few responses appreciated that some energy would be used to heat the heater or container or that energy would be lost to the air.
			Total	7	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

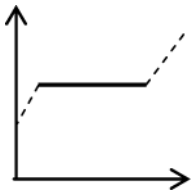
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
9	a		30240 (from the calculation) **and** E / the 35000 heater (2) **but** if the answer incorrect or no heater selected 0.6 × 12 × 4200 **or** 30240 (1)	2	no mark for just choosing E with no working or answer no mark for choosing E with an incorrect calculation **Examiner's Comments** This question was answered successfully in several ways by 75% of candidates.
	b	i	$\frac{48000}{20}$ or 2260 × 20 and liquid A indicated or named scores (2) **but** $\frac{48000}{(53 \text{ or } 20)}$ or s.l.h. × (20 or 53) without comment or incorrect comment scores (1)	2	Allow correct rearrangements: Eg $\frac{48\,000}{2260} = 21{,}2\ (38938)$ or 21 and liquid A [2] A chosen with incorrect calculation scores (0) **Examiner's Comments** This latent heat calculation was answered well by most candidates.
		ii	melting or freezing / solidification	1	**allow** condensation / sublimation **allow** acceptable named change of state **ignore** evaporation **ignore** liquid to gas / boiling **Examiner's Comments** Some candidates simply repeated the question here: eg. 'Boiling' or 'turning liquid to gas'. Evaporation was also common [0], as was 'change of state' [0], but just over half of the answers could name another change of state [1].
			Total	**5**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
10	a		solidifying (1) energy is given off due to a change in state / AW (1)	2	**allow** freezing (1) **allow** changing from liquid to solid (1) **allow** temperature staying the same (1)
	b		**any two from:** (approaches, stays) at room temperature (1) temperature difference is reduced / zero (1) no (net) transfer of energy (1)	2	
			Total	**4**	
11	a		7,910,000J / 7.91MJ / 7910kJ / 7.91×10^{6}J (1) **if incorrect or incomplete then:** 3.5 × 2260000 (1)	**2**	**allow** correctly rounded answers to 2 significant figures
	b		horizontal line shown on graph (1)	**1**	allow written description which covers the marking point 
			Total	**3**	
12			**B ✓**	1 (AO1.2)	
			Total	**1**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

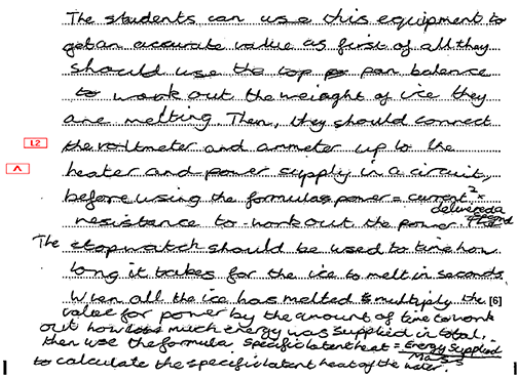
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
13	a		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 380 000 (J) award 3 marks	3	
			SLH = E ÷ m ✓	(AO 1.2)	Rearranging equation 95 ÷ 250 or 0.38 scores ✓ (evidence of rearranged formula)
			= 95000 ÷ 0.25 ✓	(AO 2.1)	95 000 ÷ 250 = 380 scores ✓✓ Or 95 ÷ 0.25 = 380 ✓✓ Or 380 ✓✓
			= 380000 (J/kg) ✓	(AO 2.1)	Examiner's Comments Slightly over a half gained all 3 marks for this calculation. Some gained fewer marks because of power of 10 errors in conversions for example 360 [2] rather than 360 000 [3]. Others gained [1] for the correct rearrangement of the formula.
	b		Please refer to the marking instructions on page 5 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) A detailed explanation of experimental procedure AND detailed discussion about accuracy *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* Level 2 (3–4 marks) EITHER a detailed explanation of the experimental procedure OR detailed discussion about accuracy OR a brief explanation of the experimental procedure and simple discussion about accuracy *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some*	6 (AO 2 × 2.2) (AO 2 × 3.3a) (AO 2 × 1.2)	AO1.2 and AO2.2 Applies knowledge and understanding of how to use the equipment to find specific latent heat of water. For example: • Measure the initial mass / weight of beaker • Turn on the heater • Start timing • Use the voltmeter, ammeter and stopclock to calculate the energy supplied (E=VIt) • Turn off the heater • Stop timing • Use a balance to measure the mass of the beaker and melted ice • Subtract the original mass of the beaker to find the mass / weight of the melted ice / calculate mass / weight of melted ice • Calculate specific latent heat by dividing energy by mass AO3.3a Analyses information and ideas to develop experimental procedures and consider accuracy of the experiment. For example: • Make sure that the heater is always covered with ice • Insulate / put lid on the funnel to reduce

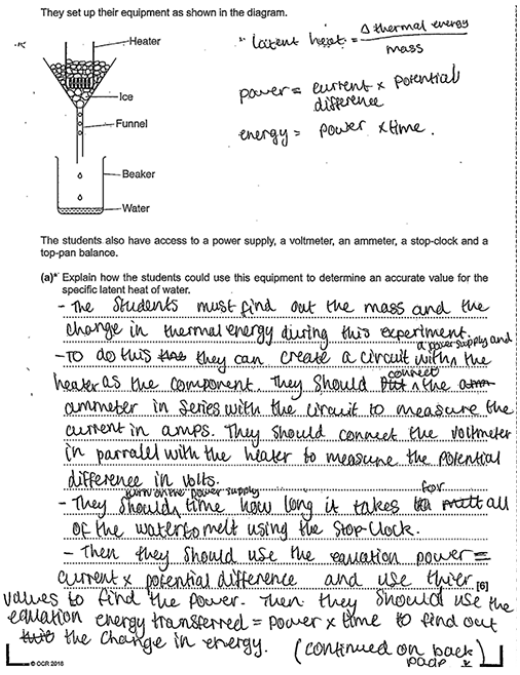
© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
	evidence. Level 1 (1–2 marks) Brief explanation of the experimental procedure OR simple comment about accuracy *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* 0 marks *No response or no response worthy of credit.*		heat losses • Make sure that the mass of water produced is sufficiently large – run the experiment for long enough • Repeat the experiment to minimise (random) errors Examiner's Comments This six mark level of response question is the only one on this paper. It gave the full range of marks and discriminated well at higher grade demand with about 10% giving level 3 answers and gaining 5 or 6 marks. The procedure was explained quite well with many gaining level 2 scores. A few were very brief with the description (level1) and did a little more than relate the equipment given in the question. Most got the idea of measuring the ice melted, measuring the voltage and current (and multiplying them to get power). Many showed how to calculate the energy and then use this to calculate the specific latent heat (SLH). Very few wrote about accuracy and therefore did not get level 3 rewards at all. A few misread the question and wrote about specific heat capacity (SHC) rather than SLH. As in previous qualifications candidates highlighted key words in the question. This helped them focus their attention on structuring their answers in a clear and concise manner thus gaining marks along the way. Exemplar 4  The students can use this equipment to get an accurate value as first of all they should use the top pan balance to work out the weight of ice they are melting. Then, they should connect the voltmeter and ammeter up to the heater and power supply in a circuit, before using the formulas power = current × voltage/current × resistance to work out the power. The stopwatch should be used to time how long it takes for the ice to melt in seconds. When all the ice has melted & multiply the value for power by the amount of time to work out how much energy was supplied in total. Then use the formula specific latent heat = Energy Supplied / Mass to calculate the specific latent heat of the ice. This answer has some idea of the method

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			but often restates the information in the diagram. For example connects the ammeter and voltmeter to the heater – rather than connects the voltmeter in parallel and the ammeter in series. The formula suggested seems a little insecure for a full level 2 answer so the candidate is credited 3 marks.
			Exemplar 5  They set up their equipment as shown in the diagram. Heater, Ice, Funnel, Beaker, Water. latent heat = Δ thermal energy / mass. power = current × potential difference. energy = power × time. The students also have access to a power supply, a voltmeter, an ammeter, a stop-clock and a top-pan balance. (a) Explain how the students could use this equipment to determine an accurate value for the specific latent heat of water. - The students must find out the mass and the change in thermal energy during this experiment. - To do this they can create a circuit with the connected a power supply and heater as the component. They should connect the ammeter in series with the circuit to measure the current in amps. They should connect the voltmeter in parrallel with the heater to measure the potential difference in volts. - They should time how long it takes for turn on the power supply all of the water to melt using the stop-clock. - Then they should use the equation power = current × potential difference and use their values to find the power. Then they should use the equation energy transferred = power × time to find out the change in energy. (continued on back page) [6] © OCR 2018 This answer clearly explains the method in some detail. It describes the measurements taken and the calculations and formulae needed. It does not attempt to describe anything about accuracy so it is limited to level 2 and is credited 4 marks.

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			Total	9	
14			D ✓	1 (AO 2.1)	Examiner's Comments Candidates were required to carry out a simple substitution into a given equation were generally answered well.
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
15	a	i	5250 (J/kg°C) ✓	1 (AO1.2)	<u>Examiner's Comments</u> Most candidates (≈ 90%) were able to calculate the mean specific heat capacity efficiently.
		ii	**Any three from:** specific heat capacity increases with temp rises ✓ specific heat capacity increases with energy supplied ✓ temp rise increases with energy supplied ✓ different amounts of energy were supplied ✓ all of the s.h.cs. are close together (within 5%) / within the range 5000 – 5500 ✓ the experiment was repeated / done 3 times ✓	3 (AO3 × 3.2b)	**ALLOW** other reasonable observation, e.g. s.h.c. increases with longer heating <u>Examiner's Comments</u> This question expected the candidate to describe the patterns in the tabulated data and to recognise that the table recorded values from three repeats of the experiment with the control variable changed. There were a number of different marking points to allowed candidates to achieve full marks. However, most candidates' answers were too brief and only described one or two possible conclusions. **AfL** For this style of question which is assessing AO3 it is important to encourage candidates to write about a minimum of three different conclusions that could be drawn. The space provided is indicative of the expected answer, so in this example describing four "conclusions" briefly (Exemplar 4) would be a better approach than one "conclusion" described in greater detail (Exemplar 3). Exemplar 3 (ii) Describe the conclusions that can be drawn from the data. As the energy supplied increases, the specific heat capacity also increases. [3]

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 4 {(ii)} Describe the conclusions that can be drawn from the data. As the energy supplied increases so does the temperature. The specific heat capacity increases by an interval of 250 J/kg°C after each attempt. Increased temperature and energy supplied causes the specific heat capacity to increase. [3]
	b	i	**Any two from:** more energy (than expected) heated the water ✓ energy losses must have occurred/not all the energy went into the water ✓ energy transferred to environment /AW ✓	2 (AO2 × 3.2b)	**ALLOW** heat for energy Examiner's Comments Only a very few candidates answered this question well. These candidates realised that a "higher" calculated value of specific heat capacity meant that more energy had to be transferred to the beaker than was expected. These candidates concluded that much energy had been lost to the environment.
		ii	**Any two linked answers from:** part of the immersion heater is out of the water ✓ make sure the heater is fully in the water/use a larger/deeper beaker ✓ beaker is not lagged/insulated ✓ lag/insulate the beaker ✓ there is no lid on the beaker ✓ put a lid on the beaker ✓ the temperature rises are quite small ✓ apply more energy to the water ✓ insufficient data ✓ take more readings ✓	4 (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b) (AO3.3a) (AO3.3b)	Examiner's Comments Most candidates appeared not to appreciate how the story of the topic being assessed was developed through Q18 and in particular how their answer to Q18(b)(i) should help them in answering Q18(b)(ii). Most candidates offered random comments unrelated to Q18(b)(i). A popular response was the suggestion that a Bunsen burner should be used rather than an electrical immersion heater.
			Total	**10**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
16	a	i	40 (g) ✓	1 (AO3.2b)	Examiner's Comments Most candidates correctly stated that the mass was 40 g.
		ii	Mass before = mass after / Mass is conserved AW ✓ Explanation in terms of particle rearrangement / conservation of numbers of particles✓	2 (AO1.1 x2)	ALLOW no mass is lost ALLOW matter for mass ALLOW atoms/molecules for particles Examiner's Comments Most candidates were able to state that the mass was conserved; few candidates explained their answer in terms of the number of particles (atoms or molecules) not changing but particles are rearranging.
	b		Any one from: Original properties return if change is reversed for physical changes ✓ Chemical change can't be reversed (easily) OR physical change easily reversible✓ The substance after the change is the same as the substance before the change for physical changes ORA ✓	1 (AO1.1)	ALLOW in a chemical change particles join together in a different way Examiner's Comments Most candidates answered this question in terms of a physical change being reversible while a chemical change was not (easily) reversible. Some candidates confused their answers in terms of products.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	c	i	**Any three from:** Measure start/initial temperatures ✓ Turn on the heaters / heat water ✓ Measurements to determine energy or mass of water ✓ For a set time✓ Measure the final/end temperatures ✓	3 (AO2.2 x3)	**IGNORE** put thermometer or heater in beaker Initial can be implied **ALLOW** for a fixed temperature change **ALLOW** for a fixed temperature change, measure time Examiner's Comments Many candidates did not gain full marks on this question by repeating the question, e.g. place heater and thermometer in the beakers. Ideally candidates were expected to measure the temperature of both beakers at the start of the experiment before switching on the heaters for a set time. It was then expected that candidates would measure the temperature at the end. Other workable alternatives were allowed. Credit was also given for appropriate methods to measure the mass of the water or to determine the energy.
		ii	**Any one from:** Beakers are different sizes OR different volumes /mass of liquid in A and B ✓ Beakers are not insulated / no lids✓	1 (AO3.3a)	**ALLOW** Heater is not fully in the water Examiner's Comments Most candidates identified that the beakers were different sizes. Credit was also allowed for identifying that the beakers were not insulated or did not have a lid. Some candidates correctly referred to the heaters not being totally submerged.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		iii	Any two from: Use beakers of the same size / same volume✓ Use same mass or volume of liquid✓ Stir water / keep distance from thermometer to heater fixed✓ Insulate the beakers or put the beakers on an insulating material ✓ Put a lid on the beakers ✓ Make sure the heater is fully inserted into the liquid ✓	2 (AO3.3b)	Examiner's Comments The majority of the candidates gained at least one mark for this question. One easy improvement was linked to the previous question. Examiners did not allow same amounts of water. Candidates need to use specific terms such as mass, or volume.
			Total	10	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

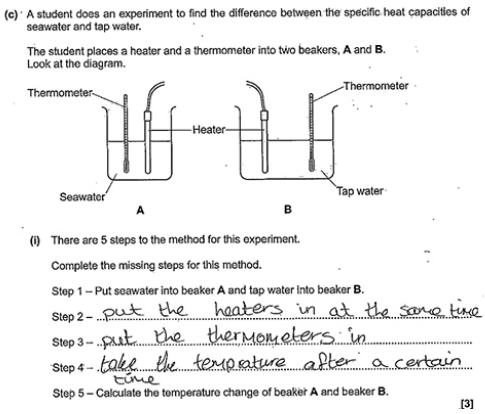
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
17	a	i	40 (g) ✓	1 (AO3.2b)	
		ii	Mass before = mass after / Mass is conserved AW ✓ Explanation in terms of particle rearrangement / conservation of numbers of particles✓	2 (AO1.1x2)	ALLOW no mass is lost ALLOW matter for mass ALLOW atoms/molecules for particles
	b		Any one from: Original properties return if change is reversed for physical changes ✓ Chemical change can't be reversed (easily) OR physical change easily reversible✓ The substance after the change is the same as the substance before the change for physical changes ORA ✓	1 (AO1.1)	 ALLOW in a chemical change particles join together in a different way Examiner's Comments Question (a)(i) was correctly done by most candidates. Around half the candidates gained 2/2 in (a)(ii) where an explanation on the mass conservation in terms of particles was needed for the second mark (e.g. 'the same molecules are present'). . The most common misconception was that physical changes were hard to reverse but chemical changes were easy to reverse.
	c	i	Any three from: Measure start/initial temperatures ✓ Turn on the heaters / heat water ✓ Measurements to determine energy or mass of water ✓ For a set time✓ Measure the final/end temperatures ✓	3 (AO2.2x3)	IGNORE put thermometer or heater in beaker Initial can be implied ALLOW for a fixed temperature change ALLOW for a fixed temperature change, measure time Examiner's Comments Many candidates did not read the stem to (c)(i) carefully. Exemplar 8 is a response where the quoted steps 2 and 3 are actually in the stems has having been done already. Fortunately, there were two

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					reasonable suggestions on the 'Sep 4' answer line, so the candidate gained 2 marks. **Misconception** In practical skills questions many candidates want to describe the practical activity they did in the classroom rather than answering the question they have been given. It is important to read the stem to the question carefully, including any diagrams. In Exemplar 8 the candidate responses for Step 2 and Step 3of their method had already been done. Fortunately Step 4 contained two reasonable suggestions so the candidate was given 2 marks. **Exemplar 8**  (c) A student does an experiment to find the difference between the specific heat capacities of seawater and tap water. The student places a heater and a thermometer into two beakers, **A** and **B**. Look at the diagram. Thermometer Thermometer Heater Seawater Tap water A B (i) There are 5 steps to the method for this experiment. Complete the missing steps for this method. Step 1 – Put seawater into beaker **A** and tap water into beaker **B**. Step 2 – put the heaters in at the same time Step 3 – put the thermometers in Step 4 – take the temperature after a certain time Step 5 – Calculate the temperature change of beaker **A** and beaker **B**. [3]

Question			Answer/Indicative content	Marks	Guidance
		ii	**Any one from:** Beakers are different sizes OR different volumes /mass of liquid in A and B ✓ Beakers are not insulated / no lids✓	1 (AO3.3a)	**ALLOW** Heater is not fully in the water Examiner's Comments Many candidate answers to (c)(ii) and (c)(iii) were linked, with the response to (c)(iii) correcting one of the errors in (c)(ii), and this appeared to be a good approach. Acceptable answers to (c)(iii) had to be related to the process in (c)(i), and not just a generic 'how to do a better experiment' comment.
		iii	**Any two from:** Use beakers of the same size / same volume✓ Use same mass or volume of liquid✓ Stir water / keep distance from thermometer to heater fixed✓ Insulate the beakers or put the beakers on an insulating material ✓ Put a lid on the beakers ✓ Make sure the heater is fully inserted into the liquid ✓	2 (AO3.3b)	Examiner's Comments Many candidate answers to (c)(ii) and (c)(iii) were linked, with the response to (c)(iii) correcting one of the errors in (c)(ii), and this appeared to be a good approach. Acceptable answers to (c)(iii) had to be related to the process in (c)(i), and not just a generic 'how to do a better experiment' comment.
			Total	**10**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

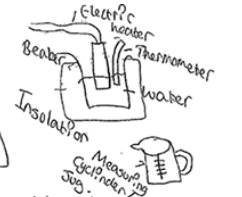
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
18			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed description of the procedure and the measurements (including a labelled diagram). **AND** Correct calculation of the change in thermal energy. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Detailed description of the procedure and the measurements (with a diagram). **OR** Description of the procedure and the measurements (with a diagram). **AND** Correct calculation of the change in thermal energy. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Basic description of the procedure and the measurements. **OR** Correct calculation of the change in thermal energy. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6 (AO2×3.3a) (AO2×2.2) (AO2×2.1)	**AO3.3a Analyse information and ideas to develop experimental procedures** • liquid placed in beaker • heater immersed in liquid • heater connected to power supply • insulation arranged to reduce heat loss • thermometer • instrument(s) to determine energy e.g. stopwatch, circuit **AO2.2 Apply knowledge and understanding of scientific enquiry, techniques and procedures - measurements** • Explanation of obtaining mass of 200 g • Initial temperature measured • Temperature rise / change / temperature after measured • Method to determine the energy e.g. use of joule meter / E = ItV method / power of heater and time. **AO2.1 Apply knowledge and understanding of scientific ideas to calculate change in thermal energy** • use of E = m x c x t • E = 0.2 × 4 200 × 20 • E = 16 800 J **Examiner's Comments** This question gave candidates the opportunity to apply their knowledge and understanding of practical procedures related to specific heat capacity. The question is open ended so that candidates have the opportunity of demonstrating their knowledge as well as having the opportunity to structure their answers logically. This question stated "You may include a diagram in your answer." A diagram of the experimental arrangement would have been very helpful. Many candidates did not include a diagram. The advantage of

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			drawing a diagram is that it will also assist candidates in their procedures. Diagrams should be labelled. Several candidates drew diagrams with a beaker, heater and thermometer. Some candidates incorrectly drew diagrams of Bunsen burners heating water. The question also required candidates to calculate the change in internal energy for the water. Higher ability candidates stated the equation from the data sheet and then clearly substituted the numbers from the question before calculating the answer. Candidates who did not calculate the change in internal energy correctly often did not include an equation. The question gave candidates the opportunity to discuss practical procedures. Again, several candidates used insulation and adding a lid. Some discussed stirring the water. A circuit diagram showing how the electrical heater was connected would have been useful. For the highest marks, it was expected that candidates would explain how a mass of 0.2 kg was measured and how the energy could be measured experimentally. Some candidates did mention the use of a stopwatch. **Exemplar 3** You may include a diagram in your answer. Change in internal energy = mass x SHC x change in temp. 0.2 x 4200 x 20 = 16800 J  The student should accurately measure out the water, then pour into beaker. Then put the heater into the water and the thermometer, making sure they don't touch otherwise it will affect making the test inaccurate. Then time the experiment and find out how much the energy heater gives out a second. Then heater the water 20°c and stop the time and turn off heater. Make sure to read thermometer on eye level for most accuracy. [6]

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					This candidate has drawn a diagram showing the container is insulated with a heater and thermometer. The calculation is clearly shown using an appropriate equation. The candidate then describes the experiment; this could have included much more detail such as explaining how the water would be measured. This candidate hints at an energy determination when the energy per second of the heater is mentioned. The candidate also gives some extra detail when suggesting that the heater and thermometer should not touch. The description of the procedure lacked appropriate detail but the calculation was correct. The information given by the candidate was relevant and was presented with some structure. Overall this response was assessed as being a Level 2 response worth four marks.
			Total	6	
19			A	1 (AO2.1)	
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
20	a		FIRST CHECK THE ANSWERS ON ANSWER LINES If answer = 385 (J/kg˚C) AND material = zinc award 5 marks	5	ALLOW ecf for missing or incorrect unit conversion e.g. 0.385 (J/kg°C) for 3 marks
			c = (E / mθ) ✓ (θ = 900 – 420 =) 480 (°C) ✓ (c =) 462000 / (2.5) x 480) ✓ (c =) 385 (J/kg°C) ✓	(AO1.2) (AO2.2) (AO2.2) (AO2.2)	(E = mcθ does not score a mark)
			(substance is) zinc ✓	(AO3.2b)	ALLOW ecf for closest material to the answer calculated for shc if answer is incorrect. IGNORE another material quoted with its value from the table given as the answer unless workings shown
	b		Any two from: Not all substances are shown in the table / it could be a substance not in the table ✓ Named uncertainties/errors in the experiment ✓ It assumes all of the energy went to heat the material ✓ The value is (very) close to other values ✓ It assumes the substance is pure/not a mixture ✓	2 (AO2x3.1 b)	ALLOW there could be more than one substance with the same shc ALLOW assumes no energy transferred to other stores / no energy/heat loss ALLOW ecf from the part above ALLOW maximum of 1 mark for idea of results not repeated/reproduced
			Total	7	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
21		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 72 (%) award 5 marks Select from data sheet: change in thermal energy = mass × specific heat capacity × change in temperature (no mark) (change in thermal energy =) 1.2 × 4200 × 75 ✓ (change in thermal energy =) 378 000 (J) ✓ (Recall: efficiency =) useful output energy transfer / input energy transfer OR (Efficiency =) 378 000 / 525 000 ✓ (Efficiency =) 0.72 ✓ (Efficiency =) 72 (%) ✓	5 (AO1.2) (AO2.1) (AO1.2) (AO2.1) (AO1.2)	ALLOW ecf for incorrect thermal energy calculated ALLOW 4 marks for answer of 0.72 (%)
		ii	some energy is transferred to the (thermal energy store of the) kettle/surroundings/air ✓	1 (AO2.1)	IGNORE sound
			Total	6	
22			C	1 (AO2.1)	
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK