OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

WS1.2 EXPERIMENTAL SKILLS AND STRATEGIES

SCORE	PERCENTAGE
/141	%

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.

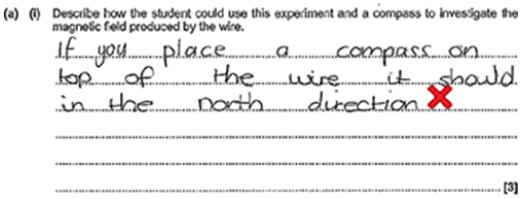
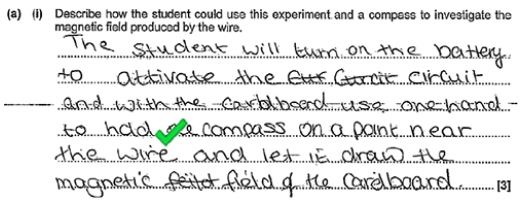
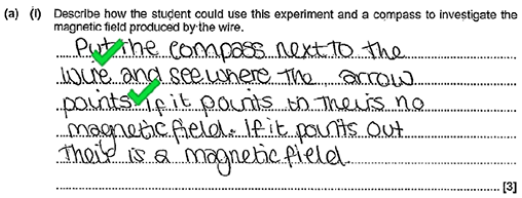
Where to find the originals

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			any two from: enables data to be checked / challenged/developed/shared (1) inform the public (1) peer review (1) scientists get credit for work / prevents plagiarism (1)	2	
			Total	2	
2		i	variable resistor ✓	1 (AO1.2)	ALLOW rheostat IGNORE potentiometer Examiner's Comments Q22 is an overlap question with J249/03. Very few candidates recognised that this was a variable resistor. Many thought it was a thermistor.
		ii	Control / change / vary / increase / decrease / AW the resistance / current in the circuit ✓	1 (AO1.2)	DO NOT ALLOW merely 'changes the voltage or changes p.d.' BUT ALLOW: changes the potential difference or voltage across (component) X ✓ Examiner's Comments Candidates who misidentified the variable resistor in Q22(a)(i) were not able to answer this question.
			Total	2	

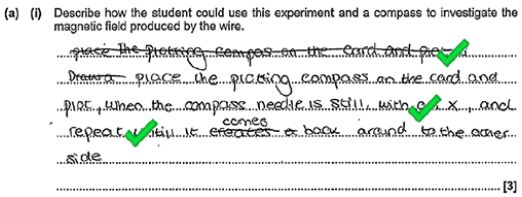
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
3		i	Any three from: place the compass onto the card or near to the wire (and turn on the current) ✓ plot / observe the direction of the compass / needle ✓ repeat idea of tip-to-tail / plotting onto the card ✓ repeat at different distances from the centre ✓	3 (AO3 × 1.2)	<u>Examiner's Comments</u> Q23 is an overlap question with J249/03. Identifying the command word 'describe' was key to candidates successfully answering this question. Those that did were able to apply their experience of practical activities supporting P4.1 and wrote down what they could do with a plotting compass in this experiment. Exemplar 14  (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. If you place a compass on top of the wire it should in the north direction ✗ [3] This candidate has not understood the question and is answering a different one about predicting how the compass will behave. Exemplar 15  (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. The student will turn on the battery to activate the circuit and with the cardboard use one hand to hold ✓ a compass on a point near the wire, and let it draw the magnetic field of the cardboard. [3] The candidate has not thought out what they were going to say, so they have only made one relevant point before running out of space. Exemplar 16  (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. Put the compass next to the wire ✓ and see where the arrow points ✓ if it points to the is no magnetic field. If it points out there is a magnetic field. [3]

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					If the candidate had written their answer as bullet points it would have helped them to identify that after the first two clear descriptions they were no longer describing how to investigate a magnetic field. Exemplar 17  (a) (i) Describe how the student could use this experiment and a compass to investigate the magnetic field produced by the wire. place the plotting compass on the card and put a dot Draw a place the plotting compass on the card and put a dot when the compass needle is still with a x and repeat this it creates comes back around to the other side [3] This candidate's response is a good example of the effective use of short clear instructions when describing experimental procedures . It is much easier to follow this type of scientific writing rather than continuous descriptive prose in longer sentences. **AfL** Give the students the instructions for a practical activity as a single descriptive paragraph and ask them to summarise the instructions a fixed number of short bullet points. Alternatively ask them to write down the procedure after they have completed the activity, but keeping to a word limit.
		ii	one or more circles around wire ✓ clockwise arrow(s) ✓	2 (AO2 × 2.2)	**DO NOT ALLOW** a spiral BUT **ALLOW** if clockwise direction shown by an arrow on the spiral then ✓ Examiner's Comments Some good answers were drawn by candidates. However, the annotated field direction on the drawings were not always correct. The question explicitly asks for the shape of the field around **this** wire. A common misconception was to draw the field around a bar magnet.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			Total	5	
4			A ✓	1 (AO1.2)	Examiner's Comments About two thirds of candidates gave the correct answer A.
			Total	1	
5		i	variable resistor ✓	1 (AO1.2)	ALLOW rheostat IGNORE potentiometer Examiner's Comments Most named this correctly as a variable resistor for 1 mark. 'LDR' or 'resistor' and 'thermistor' were common incorrect answers.
		ii	Control / change / vary / increase / decrease / AW the resistance / current in the circuit ✓	1 (AO1.2)	DO NOT ALLOW merely 'changes the voltage or changes p.d.' BUT ALLOW: changes the potential difference or voltage across (component) X Examiner's Comments About half of candidates referred correctly to changing, varying or controlling the current or resistance for 1 mark. Incorrect answers varied but frequently seen were a device to measure current or resistance.
			Total	2	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
6		i	Any three from: place the compass onto the card or near to the wire (and turn on the current) ✓ plot / observe the direction of the compass / needle ✓ repeat idea of tip-to-tail / plotting onto the card ✓ repeat at different distances from the centre ✓	3 (AO3 × 1.2)	Examiner's Comments Some candidate did not attempt to describe the experiment here. Most got the idea of placing the compass on the card or near the wire. Rather fewer described the plotting or observing using the compass. Fewer still suggested the idea of repeating at different distances or places. About a quarter of candidates gained all 3 marks here and about a quarter did not gain credit.
		ii	one or more circles around wire ✓ clockwise arrow(s) ✓	2 (AO2 × 2.2)	DO NOT ALLOW a spiral BUT ALLOW if clockwise direction shown by an arrow on the spiral Examiner's Comments This was well answered with about half of the candidates drawing a circular field [1] with arrows showing a clockwise direction [1]. Some candidates drew a circular field [1] but either got the direction wrong or did not indicate a direction at all. Some labelled it with both clockwise and anticlockwise arrows so the direction mark could not be given.
			Total	5	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
7		i	**Any two from:** (extra resistance due to) connecting leads too long / too thin ✓ (extra) resistance of the croc clips / connections ✓ croc clip is not at 0cm / the end of the ruler / length of resistance wire **longer** than intended / AW ✓ Heating effect of wires ✓	2 (AO2 × 3.1b)	**DO NOT ALLOW** idea of less resistance Eg. Crocodile clips rusted / poor conductor / bad or loose connections **IGNORE** crocodile clips in wrong place unless qualified correctly. Eg. croc clips too far apart **ALLOW** Parallax error on meter (if it is analogue) / meter not calibrated (so resistance higher) Examiner's Comments Answers her were often vague here and examiners were seeking to award marks for clearly described errors. About a third gained one mark for either the idea of the crocodile clip not being at zero or the meter not being zeroed or calibrated.
		ii	**Any one from:** make the connecting wires as short as possible ✓ keep croc clips clean / solder connections ✓ place croc clip exactly at the end of the ruler / at 0cm / AW✓	1 (AO3.3b)	Solution needs to be consistent with an error identified in part i. OR a new specified error **ALLOW**: use **thicker** connecting wires **ALLOW** let wire(s) cool between readings / Securely fix croc clip / calibrate meter / avoid parallax error Examiner's Comments About a quarter gained one mark here for taking an error from part (i) and providing a solution.
			Total	3	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

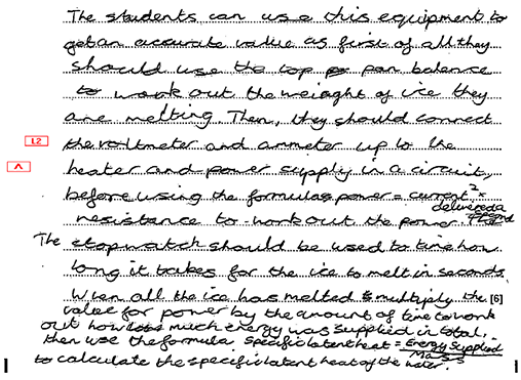
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
8			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 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.*	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 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 <u>Examiner's Comments</u> 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,

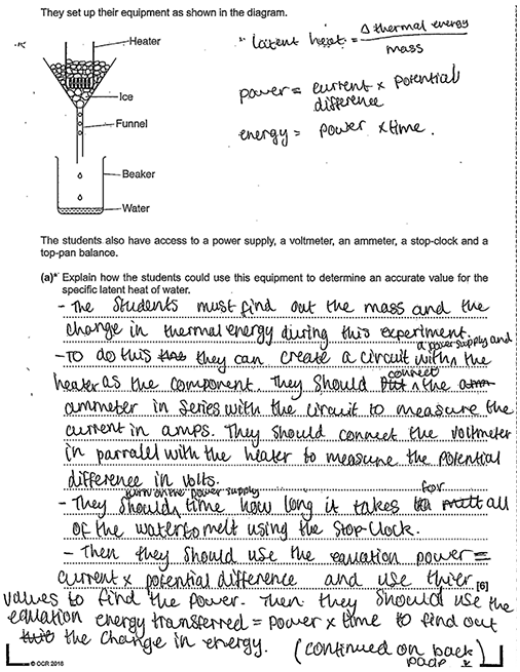
© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			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 formula power = current² × 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. L2 A [6] This answer has some idea of the method 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.

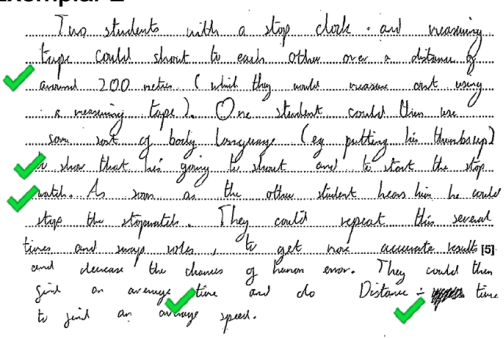
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					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 heater as the component. They should connect a power supply and 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 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 page 4) [6] © OCR 2016 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.
			Total	6	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
9			C ✓	1 (AO2.1)	Examiner's Comments Many candidates chose distractor B as they had the misconception that beta radiation will not pass through aluminium foil. While an aluminium plate will stop beta radiation, thin aluminium foil will not be an effective screen for all the beta radiation.
			Total	1	

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
10			(Idea of) action to produce sound and seen by observer / received by receiver ✓ Measure an appropriate distance eg between source and observer or between microphone(s) / speaker ✓ Measure an appropriate time eg between seeing action and hearing sound or on CRO / or frequency from signal generator ✓ (Idea of) calculating speed = distance / time or velocity = frequency x wavelength ✓ (Idea of) improvements to experiment eg repeat **and** average readings / retake readings if they are anomalous / use a different method / use different equipment / use longer distances ✓	**5** (AO1.1) (AO2.2) (AO2.2) (AO3.2b) (AO3.3b)	**ALLOW** marks to be awarded from a clear diagram **ALLOW** higher level methods eg using standing waves **ALLOW** equation in any form Examiner's Comments This question assessed AO1, AO2 and AO3 and discriminated well between the lower and higher ability candidates. Many correct experiments were suggested, for example practical improvements to the ball being hit by a bat making use of echoes, microphones and oscilloscope, as well as less practical suggestions in a school setting involving the use of fireworks and explosions. Some candidates made vague references to 'using a computer' that could not be credited. Most candidates realised that it was necessary to measure a time, but did not clearly specify what time they should measure. Almost every candidate gained some credit, many for stating the correct equation to calculate speed or for the idea of taking multiple readings and then using the average value. Exemplar 2 

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					This candidate gained full credit. The response included: • a suitable experiment • an appropriate time and distance measured • an equation to calculate the speed • the improvement of repeating and averaging the readings in order to improve accuracy and reduce the effect of operator error on their observations.
			Total	5	
11			C ✓	1 (AO 2.2)	Examiner's Comments Almost half of the candidates correctly recalled that an alpha particle had 2 protons and 2 neutrons and were able to show that they understood standard nuclear notation (conventional representation for nuclei).
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
12	a		Any two from: Keeping a safe distance (from source) ✓ Use tongs ✓ Point sources away from people ✓ Keep sources in sealed containers ✓ Keep exposure time as short as possible ✓	2 (AO 2 x 1.2)	ALLOW behind (lead) screen IGNORE gloves/goggles ALLOW lead box Examiner's Comments Many candidates answered this question in general terms suggesting general laboratory rules rather than specific safety precautions relevant to the experiment. A large number of candidates suggested keeping a safe distance from the source. Some candidates were confused about whether the barrier was part of the experiment or a safety device. Higher ability candidates gave relevant precautions including the use of tongs to hold the source (in effect adding some distance), using the sources for a short period of time (to minimise exposure) and storing the sources in lead lined boxes.
	b	i	(Source) A ✓ (Source) A because (idea that) count rate unaffected by paper and aluminium OR only lead reduces / stops gamma ✓	2 (AO 3.2) (AO 2.1)	ALLOW cannot travel through lead Examiner's Comments Candidates were expected to the interpret information from the table. The first mark was credited for identifying the correct source. Candidates then needed to apply their understanding to explain why source A could be the only correct answer for part I (because there was no change in the count rate through paper and aluminium, but the radiation was absorbed by the lead). The most common misconception was to choose source D because it had the largest count rate. For part (ii), half of the candidates correctly identified source B but fewer explained their choice in terms of paper absorbing the radiation.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

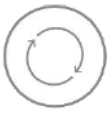
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	(Source) **B** ✓ (Source) **B** because count rate is reduced by paper ✓	2 (AO 3.2a) (AO 2.1)	<u>Examiner's Comments</u> Candidates were expected to the interpret information from the table. The first mark was credited for identifying the correct source. Candidates then needed to apply their understanding to explain why source A could be the only correct answer for part I (because there was no change in the count rate through paper and aluminium, but the radiation was absorbed by the lead). The most common misconception was to choose source D because it had the largest count rate. For part (ii), half of the candidates correctly identified source B but fewer explained their choice in terms of paper absorbing the radiation.
		iii	(Source) **D**✓ (Source) **D** because (idea that) count rate decreases after aluminium (beta) <u>and</u> after lead (gamma) ✓	2 (AO 3.2a) (AO 2.1)	**ALLOW** not absorbed by paper <u>Examiner's Comments</u> One in four candidates identified the source correctly as D, but few justified their choice in terms of the count rate decreasing though the aluminium and then further decreasing after the lead.
	c		**Any two from:** Radioactive decay is random ✓ Variations are more pronounced at low count rates ✓ Background radiation ✓	2 (AO 2 x 3.1a)	<u>Examiner's Comments</u> Candidates found this question very challenging and fewer than 5% were credited with any marks. Many candidates responded in terms of the thickness of the lead barrier. It was expected that candidates would state that there was a range of results because of the random nature of radioactivity and that what was being measured was the background radiation.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	d		Any two from: Larger number of counts ✓ Less variation in count rate ✓ Gives an average count rate ✓ Gives more repeatable results ✓ Makes it easier to decide what the source is ✓	2 (AO 2 x 3.2b)	 ALLOW more radiation detected ALLOW idea of smoothing out variations ALLOW more reliable IGNORE accurate <u>Examiner's Comments</u> A large number of candidates responded by repeated the stem of the question in their own words, many just stated that the time should be increased. A number of candidates stated that the experiment would be "more accurate" without any explanation and so did not gain any. This was a practical skills question, which also assessed candidates' understanding of Working Scientifically (Appendix 5e). Candidates were expected to understand that the longer recording time would give a larger number of counts and thus there would be less variation in count rate, or it would enable an average count rate to de determined. There were also marks available for stating that the teacher's observations would give more repeatable results.  AfL Candidates should be encouraged to interpret the question paper as to the expected length of their answers. In this question there were three answer lines and two marks available, which indicated that at least two improvements needed to be explained and that a short three-word answer was unlikely to gain both marks.
			Total	12	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

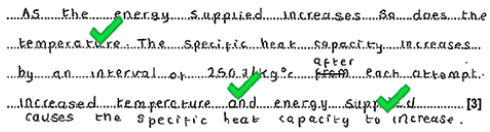
Question			Answer/Indicative content	Marks	Guidance
13	a		Distance (between source and observer) ✓ Time (for sound to travel between source and observer) ✓	2 (AO 2 x 1.1)	Do not accept distance / time the ball travels Do not accept metres / seconds Examiner's Comments Some candidates wrote a list of quantities that could be measured with no description: speed, distance, time, frequency and wavelength. These candidates could not be credited with any marks as they had not answered the question. Candidates were expected to describe how the distance that the sound would travel and the time for the sound to travel were needed to calculate the speed. Many candidates ignored the context for the question and referred to measuring the distance the ball travels.
	b		Speed = distance ÷ time ✓	1 (AO 1.1)	ALLOW distance ÷ time Examiner's Comments This question was answered well by candidates. Some candidates quoted the wave equation which was not appropriate to the experiment. A significant number of candidates incorrectly gave the correct equation as *speed = distance × time*..
	c		Takes several readings / take averages / increase distance ✓	1 (AO 3.3a)	ALLOW no wind IGNORE increase time Examiner's Comments Most candidates suggesting repeating the experiment and calculating an average. Some candidates suggested using different distances and then plotting a graph. Other candidates suggested increasing the distance to the observer.
			Total	4	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
14	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
15		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 <u>Examiner's Comments</u> 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 <u>for a set time</u>. 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 <u>Examiner's Comments</u> 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	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
16	a	i	LED / cells connected the wrong way around OR ✓ Voltmeter is across the battery/cells OR voltmeter should be across the LED ✓	2 (AO2x3 .2a)	ALLOW diode IGNORE voltmeter in wrong place Examiner's Comments The majority of the candidates gained at least one mark. Vague answers such as "voltmeter is in the wrong place" did not gain credit. Higher ability candidates stated for one of the errors that the LED (or cells) were connected the wrong way around or the LED (or cells) needed to be reversed. For the other error, it was expected that the candidates would indicate that the voltmeter was not measuring the potential difference across just the LED, but across the battery. Candidates gained a mark for this error by suggesting connecting the voltmeter across the LED. Incorrect answers given by many candidates included the ammeter being in the wrong place or the variable resistor being in the wrong place. Often candidates incorrectly suggested that the order of the components mattered.
		ii	Any one from: Control/change/alter the current (in the circuit) ✓ Control/change/alter the potential difference/voltage (across the LED) ✓	1 (AO1.2)	DO NOT ALLOW to vary the resistan Examiner's Comments A large number of candidates answered this question by stating that the component was a variable resistor or to vary the resistance of the circuit. Few candidates answered the question in term of the purpose of the variable resistor was to vary the potential difference across the LED or vary the current through the LED (by varying the resistance in the circuit).

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	b	i	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 100 (Ω) award 3 marks** Resistance = potential difference ÷ current / R = V ÷ I ✓ R = 3.0 ÷ 0.03 ✓ R = 100 (Ω) ✓	3 (AO1.2) (AO2.1) (AO2.1)	<u>Examiner's Comments</u> The majority of the candidates were able to rearrange the given equation and substitute into the rearranged equation the correct values to give an answer of 100 Ω. A very small minority of candidates used 0.3 A rather than 0.03 A. Candidates often underline the quantities in the question, which was good practice.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 4.5 (C) award 4 marks** Charge flow = current × time / Q = I × t ✓ t = 2.5 minutes = 150 seconds ✓ Q = 0.03 x 150 ✓ Q = 4.5 (C) ✓	4 (AO1.2) (AO1.2) (AO2.1) (AO2.1)	**ALLOW** 3 marks for an answer of 0.075 (C) (time not converted to seconds) ✓✓✓ <u>Examiner's Comments</u> In this question, higher ability candidates who did not obtain the correct answer, but showed their working, could still gain marks from their working. In this case, the equation for charge flow needed to be recalled and the time of 2.5 minutes needs to be changed to 150 seconds, before the answer could be calculated.
		iii	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 13.5 (J) award 2 marks** E = 4.5 x 3.0 ✓ E = 13.5 (J) ✓	2 (AO2.1) (AO2.1)	**ECF** from **(ii)** **ALLOW** 14(J) <u>Examiner's Comments</u> Most candidates were able to multiply their answer to (ii) by 3.0 to gain the correct answer.
			Total	**12**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
17	a	i	50 (m) ✓	1 (AO2.2)	Examiner's Comments 16(a) was a gentle introduction to the structured questions in Section B and almost all candidates were awarded all three marks.
		ii	60 (s) ✓	1 (AO2.2)	Examiner's Comments 16(a) was a gentle introduction to the structured questions in Section B and almost all candidates were awarded all three marks.
		iii	Any one from: Tape measure/ Measuring tape ✓ Trundle wheel ✓	1 (AO1.1)	ALLOW Metre ruler / metre stick / metre wheel / surveyors' wheel DO NOT ALLOW ruler ALLOW Fitbit/smartphone app Examiner's Comments 16(a) was a gentle introduction to the structured questions in Section B and almost all candidates were awarded all three marks.
	b	i	C ✓ It has the steepest line/gradient/slope / greatest change in distance per second / AW ✓	2 (AO 2.2) (AO 1.1)	ALLOW calculation of all 4 speeds NOT 'highest distance change in shortest amount of time' Examiner's Comments 16(b) provided the first questions where more than one mark was available, and this helped a number who could identify the important factor but had selected the wrong option A – D. In (i) a number calculated all four speeds (including 0) in order to identify C. Most candidates appreciated that it was the section with the highest gradient/steepness which they needed to identify.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	B ✓ The line is horizontal/flat /distance does **not** change/AW ✓	2 (AO 2.2) (AO 1.1)	Examiner's Comments 16(b) provided the first questions where more than one mark was available, and this helped a number who could identify the important factor but had selected the wrong option A – D. In (i) a number calculated all four speeds (including 0) in order to identify C. Most candidates appreciated that it was the section with the highest gradient/steepness which they needed to identify.
			Total	7	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

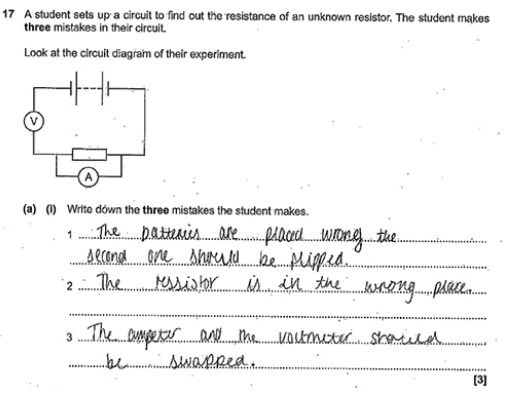
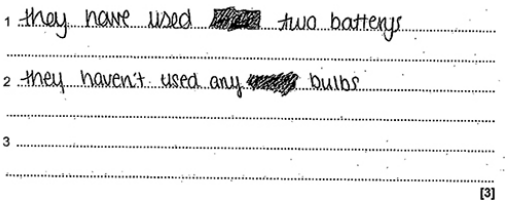
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
18		i	The voltmeter is in series ✓ The ammeter is in parallel ✓ One of the cells is connected the wrong way round / AW ✓	3 (AO3.2b) (AO3.2b) (AO3.2b)	**ALLOW** reverse arguments: E.g. voltmeter should be in parallel ✓ E.g. ammeter should be in series ✓ **ALLOW** The cells/batteries are incorrectly connected / facing each other <u>Examiner's Comments</u> Many candidates had problems with this circuit that were not relevant to the question. Some expected to see components (such as a filament bulb) which did not feature and others were unfamiliar with the symbol for a battery (two or more cells in series/two cells joined by a dotted line). Exemplar 1 shows a candidate who identified the problems with the battery and the voltmeter and ammeter. Although the candidate has stated two separate points were on the same line for the third mistake, as what the candidate wrote made it clear exactly what they intended the second identified mistake was allowed by the examiner to gain full marks. Exemplar 2 is typical of many candidate responses seen by examiners and gained no marks.  Misconception Remember it is the apparatus and techniques in Topic P9 (Practical skills) that candidates are examined on not the specific practical activity that they experienced in their science classroom.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 1  17 A student sets up a circuit to find out the resistance of an unknown resistor. The student makes **three** mistakes in their circuit. Look at the circuit diagram of their experiment. (a) (i) Write down the **three** mistakes the student makes. 1 The batteries are placed wrong the second one should be flipped. 2 The resistor is in the wrong place. 3 The ampeter and the voltmeter should be swapped. [3] Exemplar 2  1 they have used two batterys 2 they haven't used any bulbs 3 [3]
		ii	**Any one from:** Put the voltmeter in parallel with the resistor ✓ Put the ammeter in series ✓ Turn around one of the cells/AW ✓	1 (AO3.3b)	**ALLOW** swap the meters over or AW <u>Examiner's Comments</u> Many candidates who had gained some marks in 17(a)(i) also answered this question successfully. Typical responses that were given the mark included 'turn one of the two batteries round' or 'swap the voltmeter and ammeter over'.
			Total	**4**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

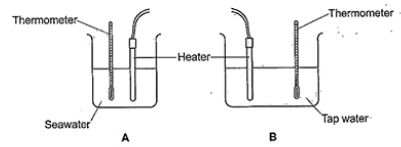
Question			Answer/Indicative content	Marks	Guidance
19			**Any three from:** Measure original length (using the ruler) ✓ Add the 2N weight ✓ Measure the extended length and use Extension = extended length – original length ✓ Use $k = F \div x$ to determine k ✓	3 (AO1.2 x3)	**ALLOW** measure the extension/how far it stretched Examiner's Comments Only a few candidates stated how the spring constant should be calculated by referring to *spring constant = force exerted by the spring ÷ extension*. However as the mark scheme allowed for any of the four marking points to count towards the total many candidates gained all 3 marks without reference to the spring constant equation. Exemplar 3 was a typical response and gained two marks. This candidate did realise a calculation was needed but decided it should be $E = ½ k x^2$. This energy equation (which was on the data sheet) was given in more candidate answers than the expected force = *extension x spring constant* Exemplar 3 18 A student has a spring, a ruler and a 2.0 N weight. (a) Describe how the student can use this equipment to determine the **spring constant** of the spring. the student can attach the spring to a stand and a clip, then put the weight on the end of the spring, measuring how far it extends. Then use the equation energy transferred in stretching = 0.5 × spring constant × (extension)² [3]
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
20		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 <u>Examiner's Comments</u> 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 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**

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					(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.  (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]
		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 <u>Examiner's Comments</u> 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)	<u>Examiner's Comments</u> 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	**6**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
21			Change the thickness of the cardboard (and repeat) ✓ Any 2 from: (Control variable) Same volume of water / same starting temperature of water ✓ Measure temperature with thermometer / time with stopwatch ✓ Calculate the rate using change in temperature / time ✓ Repeat results (and calculate the mean) ✓	3 (AO3 × 3.3a)	ALLOW use different boxes with different thicknesses / line the box with an insulator ALLOW same beaker / both beakers (don't) have a lid / same room temperature ALLOW a specified amount of water in the beaker / a specified starting temperature
			Total	3	
22			Tape measure / metre rule(r)/stick AND Stop clock/watch✓	1 (AO1.2)	IGNORE just ruler ALLOW light gates
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
23		i	**Any two from:** (more current means) ions vibrate **more** / AW✓ (more current means) **more** electrons collide with ions (in the lattice) / AW ✓ (more collisions mean) hard**er** for electrons to pass (through wire/lamp) / AW ✓ (which) increases temperature (and therefore resistance) / AW ✓	2 (AO2x1.1)	**ALLOW** atoms/particles/molecules for ions **ALLOW** (lamp) heats up / high(er) temperature
		ii	Lamp, cell, ammeter and variable resistor in series ✓ Voltmeter in parallel with the lamp ✓	2 (AO2x2.2)	**IGNORE** voltmeter in series for this mark **ALLOW** voltmeter in parallel with ammeter and lamp but not variable resistor
		iii	Measure current **and** potential difference/voltage ✓ **Any two from:** Change current/variable resistor/pd (value) ✓ Take at least 3 sets of different V and I readings ✓ Calculate the resistance using V/I or using the current and pd values / plot a graph of V against I ✓	3 (AO3x1.2)	**ALLOW** take readings on ammeter **and** voltmeter **IGNORE** repeating same V and I readings **ALLOW** graph of I against V / graph of I against R
			Total	**7**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
24			Change the thickness of the cardboard (and repeat) ✓ Any 2 from: (Control variable) Same volume of water / same starting temperature of water ✓ Measure temperature with thermometer / time with stopwatch ✓ Calculate the rate using change in temperature / time ✓ Repeat results (and calculate the mean) ✓	3 (AO3 × 3.3a)	**ALLOW** use different boxes with different thicknesses / line the box with an insulator **ALLOW** same beaker / both beakers (don't) have a lid / same room temperature **ALLOW** a specified amount of water in the beaker / a specified starting temperature
			Total	3	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
25	a	i	Correct symbol for a voltmeter ✓ Voltmeter is in parallel with the lamp ✓	2 (AO1.1) (AO2.2)	**ALLOW** voltmeter in parallel with lamp and ammeter
		ii	Mistake: Units for current are missing ✓ Correction: Add A/amps/amperes/mA (for the unit) ✓ Mistake: Current is not recorded to correct number of decimal places / 1d.p. Correction: Current should be recorded to 1 d.p./1.0A ✓	4 (AO3.2a) (AO3.2b) (AO3.2a) (AO3.2b)	**ALLOW** Current at 1.0 V is recorded to 4 significant figures **ALLOW** current should be recorded to 2 sig figs
		iii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 1.25 (Ω) award 3 marks** Rearrange to give resistance = potential difference ÷ current ✓ 4(.0) ÷ 3.2 ✓ = 1.25 (Ω) ✓	3 (AO1.2) (AO2.1) (AO2.1)	**ALLOW** 1.3 (Ω) ✓✓✓ (**ALLOW** *R*) = *V* ÷ *I* Choice of *V*, I for wrong data point loses this mark but can get mp1 for equation and mp3 for evaluation ecf. Mp3 may depend on units chosen for current in (ii).
	b	i	Point 1,1 correctly plotted within ½ small square ✓ Suitable curved line of best-fit drawn ✓	2 (AO2.2 x 2)	Should be within 1 small square of each point. May not be extrapolated to (0,0,)
		ii	Current increases as potential difference increases/AW ✓ Rate of increase reduces/current increases more slowly with potential difference/AW ✓	2 (AO3.1a) (AO3.1a)	**IGNORE** it is a straight line **ALLOW** (they are) not proportional / not linear **ALLOW** resistance increases as current goes up/filament gets hotter
		iii	Change lamp for a (fixed) resistor ✓ Measure current for different potential differences/AW ✓	2 (AO1.2 x 2)	**ALLOW** repeat the experiment
		iv	Straight line (through the origin)/ current is (directly) proportional to voltage ✓ Resistance is constant./not changing/ fixed✓	2 (AO1.2 x 2)	**ALLOW** obeys Ohm's Law
			Total	**17**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
26			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)** Circuit A identified as a parallel circuit and having the brightest lamps **AND** Detailed explanation of why A has the brightest lamps **AND** Identification of control variables *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)** Circuit A identified as a parallel circuit and having the brightest lamps **AND** An explanation of why A has the brightest lamps **OR** Identification of control variables *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)** Circuit A identified as having the brightest lamps. **OR** Identification that circuit A is in parallel. **OR** Identification of control variables *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 (AO1.2 x 2) (AO2.2 x 2) (AO3.2b x 1) (AO3.3a x 1)	**AO1.2 Demonstrate knowledge and understanding of series and parallel circuits** For example: • circuit A is parallel • circuit B is series • both circuits have one cell **AO2.2 Apply knowledge and understanding of series and parallel circuits** For example: • resistance is lower in circuit A / ORA • more current flows in circuit A / ORA **AO3.2b Analyse information and ideas to draw conclusions** For example: • lamps in circuit A are brighter / ORA **AO3.3a Analyse information to develop experimental procedure by identifying control variables** • same (number of) lamps • same (number of) cells
			Total	**6**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
27	a		Tape measure / metre rule(r)/stick **AND** Stop clock/watch✓	1 (AO1.2)	**IGNORE** just ruler **ALLOW** light gates
	b	i	Mean = 2(.00) ✓ Median = 2.02 ✓ Mode = 2.08 ✓	3 (AO1.2 x 3)	**ALLOW** 2.04 for mean (for ignoring 1.84) **ALLOW** 2.06 for median if 2.04 calculated for the mean
		ii	(They have a) wide spread/range / AW ✓	1 (AO3.2a)	**ALLOW** (they are) not all close together / don't have a small difference / not similar / AW **ALLOW** they are too different / have a big gap / not concordant / 0.24 gap **IGNORE** not consistent
		iii	Improvement must be linked to error Error: Reaction time / difficulty in starting/stopping timer at exact time / AW ✓ Improvement: Video/record the drop (and replay using timings from the recording) / use an electronic timing method / light gates / A/W ✓ **OR** Error: Not dropping ball from exact height / AW Improvement: Indication of marking the point from where it should be dropped / A/W	2 (AO3.3b) (AO3.3a)	Marks can be awarded for errors/improvements in either section **IGNORE** difficulty in timing without reason **IGNORE** human error unless qualified **ALLOW** use larger distances (so that % error in time is reduced)
			Total	**7**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK