OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

P2.1 MOTION

SCORE	PERCENTAGE
/253	%

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			[Level 3] Describes changes in KE over whole journey AND Correctly calculates KE at B Quality of written communication does not impede communication of the science at this level. (5–6 marks) [Level 2] Describes changes in KE over whole journey. OR Calculates KE of car at B Quality of written communication partly impedes communication of the science at this level. (3–4 marks) [Level 1] Realises that the KE depends on speed OR gives an indication of what is happening to KE over part of the journey. Quality of written communication impedes communication of the science at this level. (1–2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points at levels 2 and 3 may include: • KE increases between **A** and **B** • KE decreases between **B** and **C** • KE increases between **C** and **D** • KE at **B** is greater than the KE at **D** • At **B** KE = 1/2 × 400 × 8 × 8 • KE at **B** = 12800 J Indicative scientific points at level 1 may include: • KE increases as speed increases • KE increases between **A** and **B** • KE decreases between **B** and **C** • KE increases between **C** and **D** • KE greatest at **B** • KE zero at **A** • KE equation involving speed (correct or not) Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This was a six-mark question about a roller-coaster. A common mistake by candidates was to think that the graph showed a height distance graph. Examiners had taken care in setting the question to emphasize speed in the first sentence of the question. Weaker candidates managed level 1 by showing that kinetic energy depended on speed. The better candidates were able to calculate KE at B correctly and gained level 2. Only a few candidates answered the question in full by describing the change in KE throughout the full journey and calculating the KE at B.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			Total	6	
2		i	B (1)	1	**mark answer on line first** **allow** answer ringed, underlined or ticked if no answer on the answer line Examiner's Comments Candidates correctly identified B as the part of the graph showing an increase in speed.
		ii	C (1)	1	**mark answer on line first** **allow** answer ringed, underlined or ticked if no answer on the answer line Examiner's Comments Candidates correctly identified C as the part of the graph showing constant speed.
			Total	2	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
3	a		**any two from** idea of two cameras used [1] cameras are set / known distance apart (1) time measured between two pictures / over fixed distance (1) speed = $\frac{\text{(fixed) distance}}{\text{time}}$ (1)	2	Eg. Two photos taken [1] Eg distance between lines known [1] **allow** measure time between start and end of journey (1) Examiner's Comments Candidates were asked to explain how average speed cameras work. The majority of candidates explained how ordinary speed cameras work. The candidates were able to score marks because they were credited with statements such as 'two photos taken' and speed = distance travelled/time taken. Centres should ensure that candidates understand the difference between a momentary speed cameral and an average speed one.
	b		32(m/s) (2) **but If incorrect** $\frac{800}{25}$ (1)	2	Examiner's Comments The majority of candidates correctly calculated speed of the car.
			Total	4	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
4	a		2 (m/s^2) [1]	1	NOT 2m/s Examiner's Comments This motion, acceleration and power question gave the opportunity for candidates to give some good answers. Most correctly calculated the acceleration from the graph.
	b		280000 (J) [3] but if incorrect 2800 x 100 [2] but if incorrect distance = 100(m) OR 2800 x distance OR evidence of **using** work done = force x distance [1]	3	Eg 2800 x 200 or 560000 [1] Examiner's Comments This was generally poorly done as many did not obtain the correct distance from graph and simply read off a speed. Most candidates identified the correct formula (work done = force x distance) to use but were unable to calculate an appropriate distance to gain one mark for a reasonable substitution into the correct formula.
	c		56000 (W) [2] but if answer incorrect 2800 x 20 [1]	2	The power was correctly calculated by many.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
5			[Level 3] Answer describes correctly what happens in all 4 sections **AND** calculates / states one (average) speed from section A or B or C or over whole journey. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Answer describes correctly what happens in all 4 sections **OR** describes correctly 2 sections **and** calculates / states one (average) speed from section A or B or C or over whole journey. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Answer describes correctly what happens in 2 sections / times **OR** calculates /states one (average) speed from any section or over whole journey. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A Section A • accelerates / speeding up • (average) speed = 10m/s Section B • constant speed / zero acceleration • (average) speed = 20m/s Section C • deceleration / negative acceleration / slowing down • (average) speed = 10m/s Section D • Stationary or (average) speed = 0m/s **Whole journey** (average) speed = 13.3m/s **Use the L1, L2, L3 annotations when useful. Do not use ticks.** Examiner's Comments This was a 6-mark level of response question using a distance – time graph. Many scored well but the quality of communication was often poor. Many were confused by the graph and often answers clearly showed that candidates were answering as if it was a velocity / time graph. Common was ‘accelerating at a steady speed’. For a simple graph, this was not answered as carefully as it should. Many candidates had the wrong descriptions for each section, or and a large number kept attempting to calculate the acceleration for each section. Basically greater initial thought from candidates about the axes would have clarified subsequent answers. This question however, was a very good discriminator at grade C and grade A. Good answers

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					described A as accelerating, B as steady speed, C as decelerating and D as stationary. This alone gained level 2 with [4] marks. Often in addition, the average speeds for at least one of the sections was calculated correctly to gain all [6] marks. Even at this level there were some uncertainties in the communication such as 'part B – accelerating at a steady speed'.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
6			**Level 3: (5 – 6 marks)** Answer explains that there is no horizontal acceleration but there is vertical acceleration **AND** shows a successful calculation for the time taken. Quality of written communication does not impede communication of the science at this level. **Level 2: (3 – 4 marks)** Answer describes **EITHER** that there is no horizontal acceleration but there is vertical acceleration AND shows partial success at calculating the time taken **OR** gives the correct calculation. Quality of written communication partly impedes communication of the science at this level. **Level 1: (1 – 2 marks)** Answer describes **EITHER** that the path has vertical acceleration **OR** has no horizontal acceleration **OR** a simple attempt at a relevant calculation with numbers 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 may include:** **Level 3:** • constant speed / no horizontal acceleration BUT there is vertical acceleration BECAUSE gravity acts vertically • t = 0.447 / 0.4 / 0.45 (s) • t = ?0.2 or $t = \frac{1}{\sqrt{5}}$ or $t = \frac{\sqrt{5}}{3}$ **Level 2:** • constant (horizontal) speed / no horizontal acceleration AND vertical acceleration / increasing speed • $t^2 = 0.2$ • $1 = ½ \times 10 \times t^2$ • appreciation that ut = 0 • correct substitution into equation $s = ut + ½ at^2$ **Level 1:** • no horizontal acceleration / constant (horizontal) speed • vertical acceleration / increasing speed • quote an equation of motion with values. **Use the L1, L2, L3 annotations if needed; do not use ticks.** **Examiner's Comments** This 6-mark level of response question on projectiles was challenging for many as it was targeted at up to grade A*. It did discriminate clearly at these higher grades. Candidates were asked to explain the horizontal and vertical accelerations and do a calculation of time. Often candidates interchanged or confused speed or velocity with acceleration. They

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					said constant horizontal acceleration when they perhaps really meant velocity. Vertical acceleration was more often given credit. Higher grade answers referred to the force of gravity. Some candidates did not appreciate that the vertical acceleration was constant. Many thought that acceleration increased (or did they mean speed increased) the nearer you got to the ground. Four marks for calculating t was the saving grace for a large number. (Calculations were generally good all through this paper). Weaker candidates on this challenging question went for speed = distance / time, often using the value of g as speed. About a fifth of candidates could explain it well enough with a correct calculation to get 5 or 6 marks.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
7		i	speed is scalar / velocity is vector [1] **or** velocity gives direction / speed does not have direction / AW [1]	1	**allow** one is scalar and the other is vector [1] **allow** speed **only** has size / magnitude [1] **Examiner's Comments** This part of the question was common with the foundation paper (B752-01). It asked candidates to describe the difference between velocity and speed. Three quarters of candidates could correctly describe velocity as being a vector quantity or having direction [1]. Weaker answers thought that speed was on land and velocity was in water. Other confusions were about 'speed is speed but velocity has force too'.
		ii	**Y** [1] Maximum of one mark for the (idea that): - same direction so add velocities [1] - opposite direction so subtract velocities [1] - (resultant is) **6m/s** [1]	2	more than one letter = 0 marks if V, W or X is chosen then [0] (see advice below) if no letter is chosen one mark is still available _ In the unusual circumstances that a candidate misinterprets the information such that boat velocity is taken as the resultant velocity then award a maximum of [1] mark for W **and** X. **Examiner's Comments** This part of the question was also common with the foundation paper (B752-01). About two thirds of answers gained both marks for 'Y' and '6m/s'. X was often given incorrectly. Other answers were fewer and often missed the idea of the same direction (so velocities are added).

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			Total	3	
8			7 (s) [2] but if answer is incorrect or incomplete then either $\frac{28}{4}$ **or** $\frac{28 \times 2}{2+6}$ [1]	2	**allow** correct substitution into an appropriate equation of motion eg. 28 = 4 × t [1] **Examiner's Comments** About two thirds of candidates calculated this correctly to get 7 [2].
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
9	a	i	speed is scalar / velocity is vector [1] **or** velocity gives direction / speed does not have direction / AW [1]	1	**allow** one is scalar and the other is vector [1] **allow** speed **only** has size / magnitude [1] **Examiner's Comments** This question was describing and interpreting uniform motion in two different contexts Few candidates knew the difference between velocity and speed
		ii	**Y** [1] Maximum of one mark for the (idea that): - same direction so add velocities [1] - opposite direction so subtract velocities [1] - (resultant is) **6m/s** [1]	2	**more than one letter = 0 marks** **if V, W or X is chosen then [0]** (see advice below) if no letter is chosen one mark is still available _ In the unusual circumstances that a candidate misinterprets the information such that boat velocity is taken as the resultant velocity then award a maximum of [1] mark for W **and** X. **Examiner's Comments** This question was describing and interpreting uniform motion in two different contexts Unsurprisingly this question on interpreting the addition of velocities of a boat and river from the perspective of the bank proved to be challenge across the full range.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
	b		28 (m) scores [2] but if answer is incorrect or incomplete then either 4×7 or $\frac{8x7}{2}$ or $\frac{2+6}{2}\times7$ [1]	2	**allow** alternative approach using $s=ut+1/2at^2$ **Examiner's Comments** This question calculating distance travelled for an object increasing speed uniformly discriminated very well and higher ability candidates on the whole successfully chose used the equation accurately
			Total	**5**	
10			Nick [1]	1	**Examiner's Comments** Only about one third of the candidates identified Nick as having the greatest kinetic energy. There was evidence that candidates were in some way confusing this with potential energy and multiplied the person's height by their mass.
			Total	**1**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
11			[Level 3] Describes the correct trend in speed AND acceleration using numerical figures from the graph. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks) [Level 2] Describes the correct trend in speed using numerical figures from the graph. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks) [Level 1] Describes the correct trend in the speed. Quality of written communication impedes communication of the science at this level. (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C Indicative scientific points at level 3 may include: • acceleration for 10 seconds • steady speed / no change in acceleration for 60 seconds • deceleration for 10 seconds • acceleration is same as deceleration • acceleration = 1.5 m/s^2 allow higher level calculations of acceleration Indicative scientific points at level 2 may include: • speeds up (steadily) for 10 seconds • steady speed for 60 seconds • slows down (steadily) for 10 seconds Indicative scientific points at level 1 may include: • speeds up • steady speed • slows down Use the L1, L2, L3 annotations; do not use ticks. Examiner's Comments Most candidates were able to score marks on this question by giving a simple description in terms of speeding up and slowing down. More able candidates used the figures on the graph to give a more detailed description. The most able candidates calculated the acceleration and deceleration and some attempted to calculate the distance travelled and the average speed.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
12	a		8.3 (m/s) [2] **but if incorrect** $\frac{100}{12}$ [1]	2	**allow** 8.333 (m/s) [1] Examiner's Comments Most candidate calculated average speed correctly to two significant figures. Very few candidates did not follow the instruction and used more than two figures.
	b	i	2.5 [2] **but if incorrect** $\frac{10}{4}$ [1] m/s^2 [1]	3	**allow** m/s/s [1] Examiner's Comments Whilst the majority of candidates correctly calculated the acceleration as 2.5 few gave the correct units of ms^{-2}.
		ii	150 (N) [2] **but if incorrect** 60 x 2.5 [1]	2	**allow** ecf answer to b x 60 correctly calculated [2] **allow** ecf answer to b x 60 uncalculated [1] Examiner's Comments Candidates had no problem with calculating the force as 150N.
			Total	7	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
13	a		120 [2] But if answer is incorrect or incomplete: $\frac{13+27}{2} \times 6$ scores [1]	2	Examiner's Comments Few candidates could calculate average speed and therefore distance travelled. The majority simply multiplied one of the two given speeds by the time taken
	b		30 (m/s) **and** yes [2] But if answer is incorrect or incomplete up to 1 mark from: 30 **OR** 0 + 3×10 **OR** 3 × 10	2	**allow** higher level answers e.g. 'she has gone 3m/s over the speed limit'. [2] '3×10 and yes' [1] Examiner's Comments Many scored [2] on this calculation of final speed.
			Total	4	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
14	a		**7** minutes scores [3] **but if answer incorrect or incomplete then:** $\frac{1{,}680{,}000 \times 2}{8{,}000}$ or 420 scores [2] **but if no marks scored then:** either use of correct average speed, 4000 or 210 or 3.5 minutes scores [1]	3	**7 seconds** scores [2] **Ignore** units Examiner's Comments This was a complex calculation involving a change of units. It discriminated well with high-grade candidates (about a fifth) giving 7 [3] as the answer. Two marks were awarded for 420 (failed to cover to minutes) or 3.5 minutes or 210s [1].
	b	i	**lower speed** (than 8000 m/s) then: –centripetal / gravitational force too high (to stay in this orbit) [1] –rocket may fall / move or spiral to Earth [1] **higher speed** (than 8000 m/s) then: –centripetal / gravitational force too low (to stay in this orbit) [1] –rocket may move away from Earth / spiral out of orbit [1] (idea of) higher stable orbits experience lower gravitational force or lower speed / ORA [1]	3	**Eg**. rocket may fall as centripetal / gravitational force is too big [2] **Eg**. rocket may move away as centripetal / gravitational force is too small [2] **allow** any idea that correct speed needed to allow correct angle of re-entry to avoid overheating [1] Examiner's Comments This was an intentionally challenging question, which required both confidence in the physics and some skill in its communication. Few referred correctly in terms of the forces. The idea that lower speeds would cause the satellite to spiral to Earth was reasonably common. Less common was the idea that at higher speeds the satellites would spiral into space.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	(+/?) 4 (m/s^2) scores [3] **but if answer is incorrect then:** $(+/-)\ \frac{(120^2 - 2000^2)}{2 \times 5 \times 10^5}$ [2] **Or if no other marks scored then** evidence of correct substitution into $v^2 = u^2 + 2as$ **or** evidence of **rearranged** formula: $\frac{v^2 - u^2}{2s}$ [1]	3	**allow** 3.99 / 3.9856 (m/s^2) [3] Examiner's Comments The calculation of deceleration was challenging but it discriminated well with about a quarter gaining full marks.
			Total	9	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
15			(average speed) 3000 (m/s) (1) (distance travelled) 900000 (2) OR correct calculation of ecf average speed × 300 (2) **BUT** if distance answer incorrect 5 minutes converted to 300 seconds (1)	3	Allow 3000 × 5 (= 15000) OR ecf average speed × 5 (1) Examiner's Comments ??Most candidates were not able to work out the average speed when given the final speed of an object accelerating steadily from rest. Most scored one mark for calculating the distance travelled by multiplying average speed by the time in minutes and higher ability candidates scored two marks for doing the same calculation but correctly converting the time taken to seconds.
			Total	3	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
16			[Level 3] Describes how KE changes in both sections AND describes how GPE changes in both sections AND calculates the maximum KE or difference in height. Quality of written communication does not impede communication of the science at this level. (5–6 marks) [Level 2] Describes how KE AND how GPE changes for both sections OR describes correctly how KE changes over both sections and calculates maximum KE OR describes correctly how GPE changes over both sections and calculates maximum KE OR calculates difference in height. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) [Level 1] Realises that KE depends on speed and describes changes over part of journey OR describes how GPE changes over part of journey OR attempts to calculate maximum KE / height OR loss in KE = gain in PE (on either section) ORA Quality of written communication impedes communication of the science at this level. (1–2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A* Ignore points after C Indicative scientific points at all levels may include: • KE increases from A to B • KE decreases from B to C • GPE decreases from A to B • GPE increases from B to C • loss in GPE = gain in KE • KE = 1/2 mv^2 • maximum KE = 51200J • GPE = mgh • 51200 = mgh = 400 × 10 × h • height = 12.8m Use the L1, L2, L3 annotations in Scoris; do not use ticks. Examiner's Comments This six-mark level of response question proved to be the most challenging of the three on the paper. It did involve a data-handling element to the question. The graph, for many looked like a roller coaster track, so about a third of students described the motion along this track. A sizeable minority scored low marks for having the whole thing the wrong way round. Many thought that A to B was climbing and B to C was falling. The more able calculated the height correctly. Again this question discriminated well at the higher grades with approximately 10% scoring five or six marks. About 10% also failed to attempt this question at all.
			Total	6	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
17	a		9.8 (m) or $\frac{1}{2}$ x 14 x 1.4 (2) **but if incorrect allow** attempt at calculating area under the graph (1)	2	**E.g.** shown on graph by shading / AW [1] **If no other marks scored then allow** 14 × 1.4 or 19.6 [1] Examiner's Comments This question was set in the context of diving into water from a diving board. Most answers showed the over-simplistic idea of distance = speed x time. So 19.6 gained one mark. Better candidates realising that the speed changed either worked out the area under the graph or used a calculation to get the correct answer of 9.8 [2]. Less than 20% gained both marks here showing that this calculation discriminated effectively at the highest grades.
	b	i	instantaneous deceleration at point P is (more representative of) when diver enters water [1] idea of ignoring anomalous results / point Q is not on the line / (1) Elaine's method covers more data / more appropriate data / AW [1] (gradient gives a more) accurate result (1)	2	**allow** Q is (some time) after diver enters water [1] allow deceleration / acceleration changes (after P) [1] **eg** point Q is anomalous [1] Examiner's Comments This question was set in the context of diving into water from a diving board. In part (i), there were a few good answers described in terms of Elaine and these discriminated well. Usually the idea of more data or gradient showing the real or more accurate deceleration gave candidates a route into successful answers. It was a challenging question, which gave a good range of responses.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	1200 (N) (1)	1	**Allow** ? 1200 (N) [1] Examiner's Comments This question was set in the context of diving into water from a diving board. In part (ii), most gave 1200N as the correctly calculated answer.
			Total	**5**	
18		i	Golf (1)	1	
		ii	7.7 (s)(1) Skoda (because it takes less than 7.7 seconds) (1)	2	**allow** 7.69..... (1) **allow** 'Skoda' [1] (even if working incomplete or incorrect) Examiner's Comments The first question on section C module P1 was about speed and has 10 marks in total. Perhaps pre-conceived ideas tempted some to assume that the Jaguar was the fastest. About 40% said Jaguar and 60% the correct answer of Golf. It discriminated well for a one-mark question. Also rather more candidates thought that the times of 8s then 9s indicated an increase in speed rather than a decrease. This misconception was also evident in part (ii) where the speed was usually calculated correctly [1] by most with the Golf, Fiat and Jaguar incorrectly accused of speeding by many. The lowly but guilty Skoda often escaped identification and candidates gave away a mark as a result. This two-mark question also discriminated well.
			Total	**3**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
19			**Level 3: 5–6 marks** **Explains fully the changes in KE and GPE between A and B or B and C.** Quality of written communication does not impede communication of science at this level. **Level 2: 3–4 marks** **Gives a partial explanation of the changes in GPE and KE between A and B or B and C** Quality of written communication partly impedes communication of science at this level. **Level 1: 1–2 marks** **Simple statement about KE and GPE.** Quality of written communication impedes the communication of science at this level **Level 0: 0 marks** Insufficient or irrelevant science. Not worthy of credit.	6	**This question is targeted up to grade C** **Indicative scientific points may include (but are not limited to) the following:** **KE Statements** at **A** kinetic energy is zero / a minimum at **B** kinetic energy is a maximum at **C** kinetic energy is zero / a minimum **allow** correct changes e.g. KE increases from zero to a maximum between **A** and **B** / decreases from maximum to zero between B and C **GPE Statements (allow PE for GPE)** at **A** gravitational potential energy is a maximum at **B** gravitational potential energy is a minimum / zero at **C** gravitational potential energy is a maximum **allow** correct changes e.g. GPE decreases from maximum to minimum between **A** and B / increases from minimum to maximum between B and C **allow** GPE for gravitational potential energy allow just potential energy for GPE as this is in the question **allow** KE for kinetic energy allow PE at C is less than PE at A **simple statements include:** car has KE at B Car has PE at A or C KE depends on speed PE depends on / increases with height
			Total	**6**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
20	a		**B and C** (1)	1	Both required in either order for the mark
	b		**D** (1)	1	
	c		**A** (1)	1	
			Total	**3**	
21			20 or –20 (m/s) (2) **if incorrect or incomplete then**: v=√2gh **or** 400 (1)	2	Allow answers using other valid equations of motion: Eg. $v^2 = u^2 + 2as$ v=√2as (1)
			Total	**2**	
22	a		Direction is **not** important when measuring speed. ✓ Relative speed does **not** depend on the direction of movement. Speed and velocity are vector quantities. Speed is a scalar quantity. ✓ Velocity is always higher than speed. (2)	2	
	b		5 (m/s) (2) **but if answer is incorrect or incomplete then** 11 – 6 (1) **or** 11 – (0.6 × 10) (1) **or** 11 = u + (0.6 × 10) (1)	2	**Ignore all units**
			Total	**4**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
23	a		vector has size and direction / scalar has size only / scalar has no direction / ORA (1)	1	**Allow** (difference is that) vector (also) has direction (1)
	b		5 (m / s) (2) **but if answer is incorrect or incomplete then** 11 – 6 (1) **or** 11 – (0.6 × 10) (1) **or** 11 = u + (0.6 × 10) (1)	2	
			Total	**3**	
24		i	2 (2) **if incorrect allow** 26/13 (1) m/s^2 (1)	3	**allow** 2.0 mark units independently **allow** m/s/s **or** ms^{-2} (1)
		ii	**any two from:** avoid bias / AW (1) to allow (accurate) comparisons (1) level playing field (1)	2	Eg so that the manufacturer does not influence the outcome. **Idea of** reliable data Eg all manufacturers / tests are treated / performed in the same way. **Idea of** fair testing
			Total	**5**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

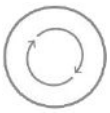
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
25	a		kinetic energy / KE increases as speed increases (1) **but** kinetic energy / KE quadruples when speed doubles / AW (2)	2	
	b		mass (1)	1	**ignore** weight
	c		**any three from:** take 2 images (1) a set distance apart (1) measure the time between the images (1) calculate average speed using distance / time (1)	3	If not average speed camera max 2 marks.
			Total	**6**	
26			**B ✓**	1 (AO2.1)	<u>Examiner's Comments</u> This proved to be the easiest question in Section A, with about 85% of all candidates getting it right. The commonest wrong answer was D.
			Total	**1**	
27			**D ✓**	1 (AO1.2)	
			Total	**1**	
28			**C ✓**	1 (AO2.1)	
			Total	**1**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
29			C ✓	1 (AO1.2)	Examiner's Comments Nearly half of the candidates did get the right answer. However most of the other candidates appeared to have been just guessed which response was correct.  **AfL** Standard form is tricky for Foundation Tier candidates. Try using low stakes pop quizzes and starter exercises to embed concepts of standard form and the metric prefixes. See also the Mathematical Skills Handbook http://www.ocr.org.uk/Images/310651-mathematicalskills-handbook.pdf
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
30			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 and comparison of the motion of all four students in terms of distance and time relating speed to distance run **AND** Calculates the speed of all four students. *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)** Description and comparison of the motion of three students of distance and time **OR** Calculates the speed of at least three students. *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 description of the motion of at least three students. **OR** Calculates the speed of at least one student. *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 × 1.1) (AO2 × 2.2) (AO1 × 3.1a) (AO1 × 3.2b)	**AO1.1 Demonstrate knowledge and understanding of the correct formulae** • speed = distance ÷ time • v = s ÷ t • evidence of calculation **AO2.2 Apply knowledge and understanding of the motion of the four students** • Race B is a longer distance than race A • Race B and C are the same distance • Students B & C take different amounts of time • Student D takes the longest time • Race D is the longest distance • Race A is the shortest distance • Student A speed = 15÷6 = 8.3m/s • Student B speed = 100÷15 = 6.7m/s • Student C speed = 100÷14 = 7.1m/s • Student D speed = 200÷31 = 6.5m/s **AO3.1a & AO3.2b Analyse information to interpret and draw conclusions about the motion of the four students** • Race B is twice the length of race A, but time is more than twice that of race A • C is faster than B as the time is shorter (for the same distance) • As race length increases, average speed decreases Examiner's Comments There were many excellent answers, with the mean speeds of all four runners calculated with comments about how they had run different races (apart from B and C). Many candidates helped themselves by annotating the calculated speeds next to

© OCR 2022. You may photocopy this page.

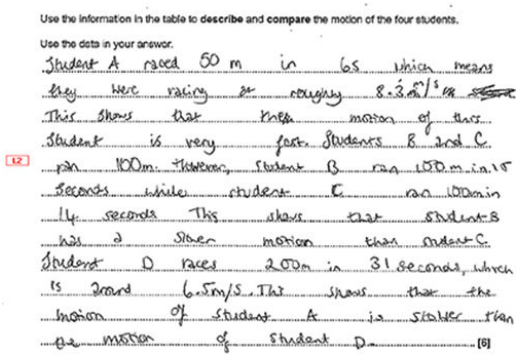
Created in ExamBuilder

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			the table). The most able candidates discussed the effect of running a longer race on the mean speed of the runner (see Exemplar 7 below). Less able candidates compared the times of each runner but did not calculate speeds (see Exemplar 5 below). **OCR support** About one in ten candidate did not attempt to answer this question. Level of Response (LoR) questions are designed to open up the potential answers so that candidates at all levels of ability have an opportunity to show their scientific understanding. Every candidate should be encouraged to answer LoR questions as even a weak but relevant answer will be credited. The 'How to answer 6 mark LoR questions' resource can be used to help candidates prepare for this style of question http://www.ocr.org.uk/Images/374902-how-to-answer-6-mark-lor-activity.doc Exemplar 5 Use the information in the table to **describe** and **compare** the motion of the four students. Use the data in your answer. The less motion the student had compleated the race quicker as to student A the race distance is 50m then did the race in 6s about student D the race resistance was 200 and did the race in 8ls however student B and C race resistance was the same 100m and student B did the race in 15s and C did the race in 14s. [6] A Level 1 candidate response. They describe the data in the table with no attempt to process data and calculate the speed of each runner. The information is relevant to the question but there is no real attempt to compare the motion of the four students.

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			Exemplar 6



Use the information in the table to **describe** and **compare** the motion of the four students.

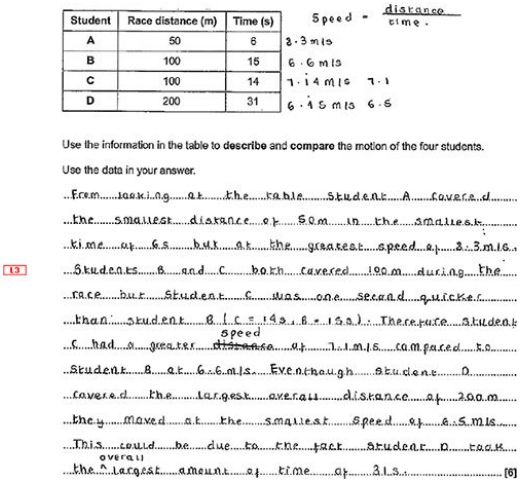
Use the data in your answer.

Student A raced 50 m in 6s which means they were racing at roughly 8.3̇m/s in this shows that their motion of this Student is very fast. Students B and C ran 100m. However, student B ran 100m in 15 seconds while student C ran 100m in 14 seconds This shows that student B was a slower motion than student C. Student D races 200m in 31 seconds, which is around 6.5m/s. This shows that the motion of student A is faster than the motion of student D. [6]

L2

A Level 2 candidate response. They have calculated and compared the speeds of A and D, but only compared the relative motions of B and C. There is a structured line of reasoning and the reporting of data is linked by sentences that offer some interpretation of the facts.

Exemplar 7



Student	Race distance (m)	Time (s)	Speed = distance / time
A	50	6	8.3 m/s
B	100	15	6.6 m/s
C	100	14	7.14 m/s 7.1
D	200	31	6.45 m/s 6.5

Use the information in the table to **describe** and **compare** the motion of the four students.

Use the data in your answer.

From looking at the table Student A covered the smallest distance of 50m in the smallest time of 6s but at the greatest speed of 8.3m/s. Students B and C both covered 100m during the race but Student C was one second quicker than student B (15 - 14 = 1s). Therefore student C had a greater speed distance of 7.1m/s compared to Student B at 6.6m/s. Even though student D covered the largest overall distance of 200m they moved at the smallest speed of 6.5m/s. This could be due to the fact student D took the overall largest amount of time of 31s. [6]

L3

A Level 3 candidate response. They first calculated the speed of each student and then annotated the data table. This allowed them to be more focused and precise in their response. They have offered some explanation of the relative motions of the students. This answer is logical and all the content is relevant. The word counts for all

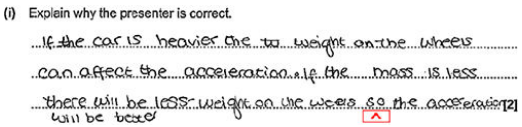
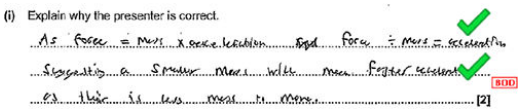
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					three exemplars are similar and demonstrating that a well thought out answer is better than a very long answer.
			Total	6	

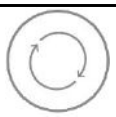
© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
31		i	*F = ma* / force equals mass times acceleration ✓ so reducing mass means the same engine force will cause greater acceleration ✓	2 (AO1.2) (AO2.2)	Must start with Newton II NOT less force for same acceleration <u>Examiner's Comments</u> Few candidates identified that this question was about the implications of the equation F = ma. Candidates did not recognise that the force would be the same for both the heaver and the lighter model of car. Most candidates discussed the effects of friction on the car. For the order of magnitude for changes in mass between different models of a car frictional forces would have no measurable effect on acceleration. Exemplar 12  (i) Explain why the presenter is correct. If the car is heavier the to weight on the wheels can affect the acceleration, if the mass is less there will be less weight on the wheels so the acceleration will be best [2] This answer only considers the marginal changes in friction caused by a very small increase in the contact area of the tyres but ignores the more significant effect that the same force applied to a smaller mass will have on acceleration. Exemplar 13  (i) Explain why the presenter is correct. As force = mass x acceleration and force ÷ mass = acceleration therefore a smaller mass with same force greater acceleration as this is less mass in more. [2] This candidate's answer shows very clearly why using a more mathematical approach in physics saves time and increases understanding. They have identified the appropriate equation (F=ma), changed the subject to acceleration and then drawn the correct conclusion. Using this approach their answer was shorter, clearer and more relevant than exemplar 12. **AfL**

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					 As a starter exercise show students the question and ask them to select the equation that will answer the question. Helping students to be more comfortable using equations will help them overcome their reluctance to answer physics questions using maths.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 5 (m/s^2) award 3 marks change in speed = 25–5 = 20 (m/s) ✓ acceleration = 20 ÷ 4 (m/s^2) ✓ = 5 (m/s^2) ✓	3 (AO2.1) (AO2.1) (AO2.1)	e.c.f. incorrect change in speed if subtraction attempted <u>Examiner's Comments</u> This calculation was well done with most candidates being credited with all three marks.
			Total	5	
32			C ✓	1 (AO2.2)	<u>Examiner's Comments</u> About half of the candidates could correctly calculate the distance travelled from the graph (by area or calculation) and gave C as the answer. Working out was often seen on this question and answer D was a frequently chosen distractor (velocity × time, 8 × 5 = 40m).
			Total	1	
33			D ✓	1 (AO2.1)	<u>Examiner's Comments</u> About 40% of candidates gave the correct answer D. A common incorrect response (the differences in speeds rather than velocities with direction) was 'A'.
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

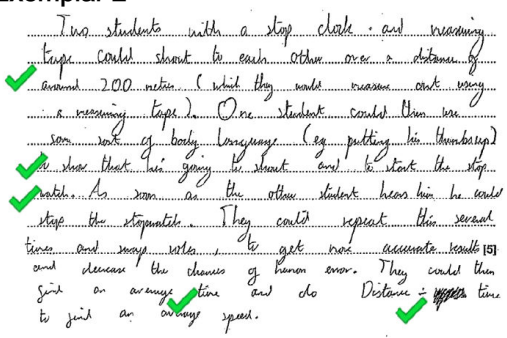
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
34			B ✓	1 (AO2.1)	Examiner's Comments This was and intentionally challenging question AO2 question and about a quarter of candidates gave the correct answer B. A common incorrect response was 'D'.
			Total	1	
35		i	initial speed is zero **and** • either acceleration due to gravity = 10 • or g = 10 ✓ use a = (v-u) ÷ t to find the final speed / v ✓ use $v^2 - u^2 = 2as$ to find s ✓	3 (AO 3 × 1.1)	**IGNORE** the idea of echoes and speed of sound **ALLOW** answers using g = 9.8 or 9.81 **ALLOW** v = u + at ✓ **ALLOW** credit for higher level answers: Eg. three marks for answer in terms of $s = ut + ½at^2$ Examiner's Comments This was an intentionally challenging question where less than 10% did not score at all. Most of these wrote about g = 10 and the initial velocity was 0 and gained 1 mark. Very few successfully continued further.
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 22 (m/s) award 2 marks** 10 = v (- 0) / 2.2 OR uses idea that stone gains 10m/s each second ✓ V = 22 (m/s) ✓	2 (AO 2 × 2.1)	**ALLOW** 21.56 or 21.58 or 21.6 (if g=9.8 or 9.81) ✓✓ Examiner's Comments Again this challenging calculation saw about $1/5^{th}$ gaining both marks with 22 (m/s). A few correctly used g = 9.8 or 9.81 and still scored full marks. Many used speed = distance ÷ time and did not score.
			Total	5	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
36			(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  Two students with a stop clock and measuring tape could stand to each other over a distance of around 200 metres (what they would measure out using a measuring tape). One student could then use some sort of body language (eg putting his thumbs up) to show that he's going to start and to start the stop watch. As soon as the other student hears him he could stop the stopwatch. They could repeat this several times and many more, to get more accurate results and decrease the chances of human error. They could then find an average time and do Distance ÷ time to find an average speed. [5]

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	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
37	a		E ✓ FIRST CHECK THE ANSWER ON THE ANSWER LINE If answer = 0.6 (s) award 2 marks 5 ÷ 8 ✓ = 0.6 (s) ✓	3 (AO3.1a) (AO1.2) (AO2.2)	ALLOW 0.625 or 0.63 (s) Examiner's Comments Most candidates were able to identify that driver E had the quickest reaction time. Only the higher ability candidates were then able to correctly calculate the reaction time. Calculations were sometimes shown and a common error made by candidates when calculating the reaction time was to use (*thinking distance + braking distance) ÷ speed*.
	b		Any two from: A, C or D ✓ Thinking distance / reaction time is proportional to speed / AW ✓	2 (AO3.2b) (AO3.2b)	ALLOW as speed doubles, thinking distance doubles / ratio of speed:distance or distance:speed is the same / both have reaction time of 0.75 (s) Examiner's Comments This question required candidates to identify two drivers from A, C and D and explain why their reaction times are the same. Over half of the candidates correctly identified two of the drivers. Most of these candidates proceeded to explain why, usually by calculating the reaction time of 0.75 s. A significant number of candidates did not gain any credit. A common error candidates made was to choose drivers A and E or B and D due to their braking distances being almost the same.
	c	i	AWARD ALL CANDIDATES 2 MARKS	2 (AO1 × 2.1) (AO1 × 1.2)	Examiner's Comments We have adjusted the mark scheme to allow for a typo within this question.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	KE transferred to thermal energy / heat in brakes / surroundings / AW ✓✓ OR (KE of car) is reduced / transferred ✓ Brakes gain / absorb thermal energy / heat ✓	2 (AO1.1) (AO1.2)	ALLOW surroundings gain thermal energy / heat dissipated to surroundings IGNORE just brakes get hot <u>Examiner's Comments</u> The majority of candidates knew that the kinetic energy store would decrease or be transferred and so were credited with one mark. Fewer candidates gained the second mark as although they referred to heat or thermal energy they did not specify that the energy was transferred to the brakes or surroundings (i.e. into a thermal energy store).
		iii	AWARD ALL CANDIDATES 3 MARKS	3 (AO2 × 2.1) (AO1.2)	
			Total	12	
38			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> Candidates were required to carry out a simple substitution into a given equation were generally answered well. The most common error was not squaring the speed and choosing distractor B.
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
39	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
40			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.75 (s) award 3 marks Recall: (Reaction) time = (Thinking) distance ÷ Speed ✓ 6÷8 or 12÷16 or 24÷32 ✓ = 0.75 (s) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	IGNORE correct substitutions if NOT rearranged Examiner's Comments 10% of candidates recalled the speed equation and rearrange it as *reaction time = thinking distance ÷ speed*. The majority of the candidates were unable to interpret the data from the table and very few realised that the reaction time depended on the thinking distance before calculating the answer.
			Total	3	
41			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 12 (m/s) award 2 marks Rearrange formula - 4 × 3 ✓ 12 (m/s) ✓	2 (AO 2.1) (AO 2.1)	Examiner's Comments Higher ability candidates wrote out in a recognisable form that *change in velocity = acceleration × time = 3 × 4 = 12 (m/s)*. A common misconception was to divide the acceleration by time taken (i.e. 3 × 4 = 0.75). Candidates should be encouraged to put the numbers into the given equation which will help them to identify if they will need to rearrange the formula.
			Total	2	
42			C ✓	1 (AO 1.1)	Examiner's Comments This question assessed candidates' knowledge of how the force of gravity can change the velocity of a planet but its speed stays the same. Most candidates correctly chose option C.
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
43		i	16 (m) ✓	1 (AO 3.1a)	
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 0.67 (s) award 3 marks** Rearrangement to give Time = distance / speed ✓ Time = 16 / 24 #x2713; Time = 0.67 (s) (2 decimal places) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	**ALLOW** ECF from **(b)(i)** **ALLOW** 0.6 or 0.7 or 0.66(6…) (s) for 2 marks **ALLOW** one mark for any calculated answer to 2dp Examiner's Comments There were many excellent responses for this question with the majority of candidates gaining full credit. A few candidates could not rearrange the equation correctly and therefore did not score any marks. About one fifth of candidates did not give their answers to 2 decimal places as requested. **AfL** A number of candidates gave two possible versions of rearranging the equation leading to two different answers. Candidates should be aware that marks cannot be awarded when they do this, even if one of the versions is correct. **Exemplar 1** (ii) Calculate the **thinking time** at 24 m/s. Use your answer to **(b)(i)** and the equation: distance travelled = speed × time Give your answer to 2 decimal places. thinking time = distance / speed = 16 m / 24 m/s = 0.666... = 0.67 Thinking time = 0.67 s [3] This is an excellent example of how the response should be set out. The candidate has clearly rearranged the equation, before substituting the correct values for distance and speed and writing down the answer. This would allow compensatory marks to be awarded if the candidate had then

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

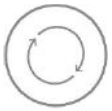
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					made an error such as mis-entered numbers into the calculator. Finally, the candidate has underlined the instruction to give their answer to 2 decimal places so that they do not forget to do this.
			Total	**4**	
44		i	Area (under line) for thinking (distance) is same as for braking (distance) / area under horizontal line = area under diagonal line / area of rectangle = area of triangle / AW ✓	1 (AO 3.1a)	**ALLOW** both areas show 4(m) Examiner's Comments This question was a good discriminator as only the more able candidates recognised that the braking distance and thinking distance could be calculated from the area under the graph and that both had the same value.
		ii	A line starting at (0.75, 8) ✓ Diagonal line drawn parallel to original line and finishing at the x axis ✓	2 (AO 2×1.2)	Mark independently
			Total	**3**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
45		i	Mean = (0.28 + 0.32) = 0.30 (s) ✓	1 (AO 1.2)	ALLOW 0.3 (s) DO NOT ALLOW answers with all 3 readings used giving a mean of (0.28+0.32+0.54) / 3 = 0.38 (s) Examiner's Comments  AfL Candidates need to be aware that anomalous readings in a set of results, due to a mistake or lack of attention, are not included in calculations of the mean.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 333 (m/s) award 4 marks Use of distance = 100 m ✓ Recall (s =) d / t ✓ 100 / 0.3 ✓ (s =) 333 (m/s) (3 sig. figs.)✓	4 (AO 2.1) (AO 1.2) (AO 2.1) (AO 2.1)	ALLOW ECF from 24(a)(i) ALLOW 100 ÷ 0.38 ✓✓✓ ALLOW 263 (m/s) ✓✓✓✓ ALLOW ECF for 3rd and 4th marking points if incorrect distance is used ALLOW 50 ÷ 0.3 or 166.7 ✓✓ ALLOW 50 ÷ 0.38 or 131.6 ✓✓ ALLOW 132 ✓✓✓ ALLOW 167 ✓✓✓ Examiner's Comments The majority of candidates could rearrange the equation provided, substitute values and give their answer to 3 significant figures. However, many candidates did not take into account that the sound travelled 100m to the wall and back again so used 50m in their calculations instead. AfL A number of candidates gave two possible versions of rearranging the equation leading to two different answers. Candidates should be aware that marks cannot be awarded when they do this, even if one of the versions is correct.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

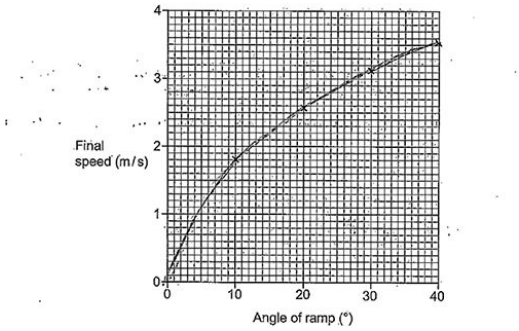
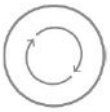
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		iii	Any two from: Inconsistent results should be repeated ✓ More readings of time should be done and the mean calculated ✓ (Explanation of) clap-echo method ✓ Larger/different distances used ✓	2 (AO 2×3.3b)	Clap-echo method effectively may gain 2 marks as it also uses the idea of multiple readings. Examiner's Comments This Assessment Objective 3 question required candidates to analyse information in order to develop the experimental procedure of the students (in Question 24(a)). There is evidence that over half of the candidates did not read the question carefully as they suggested improvements relating to other methods such as videoing, using microphones etc. Many candidates suggested taking more readings but did not mention calculating the mean and therefore could not score the mark.
			Total	7	
46			B ✓	1 (AO2.1)	Examiner's Comments A very large number of candidates incorrectly chose A. Higher ability candidates worked out the area for each graph. Candidates should be encouraged to check each of the four responses.
			Total	1	
47			C ✓	1 (AO2.1)	Examiner's Comments This question was well answered. Candidates should be encouraged to consider each letter of the diagram, adding a small cross to the ones that are eliminated.
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
48	a	i	Both points correctly plotted ✓ Smooth curve correctly drawn ✓	2 (AO1.2)	**ALLOW** within ½ small square for plotting **DO NOT ALLOW** straight lines between data points **IGNORE** any line drawn for <10° <u>Examiner's Comments</u> Candidates needed to plot the last two data points before drawing the best fit line. Many candidates incorrectly drew a straight line through plots that appeared to lie on a curved trend. Other candidates did not draw smooth curves, or had many lines. **Exemplar 5**  This candidate has clearly indicated the correct positions of the two missing plots using two small crosses. The smooth line was not considered good enough in that there appeared to be more than one line in several places. This candidate has correctly assumed that the graph starts from the origin.  **AfL** Candidates should be encouraged to plot graphs using a sharp pencil. The points should be indicated with a small cross. It may help candidates to draw smooth curves by rotating the paper so that the

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

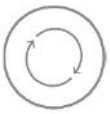
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					curve can be drawn naturally with the arc of the candidates' arm. Candidates should be encouraged to check the plotting of their data points - particularly points which do not appear to fit a pattern. The line of best fit may not pass through every data point. There should be a balance of data points about the line of best fit.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	Increase in angle of ramp increases speed (at bottom ramp) ORA✓ Increase is not linear/doubling angle does not double final speed / AW ✓ Reference to quantitative data for two calculations, for example, increase from 10˚ to 20˚ the speed increases by 0.76 whilst 20˚ to 30˚ the speed increases by 0.54 ✓	3 (AO3.1a) (AO3.1a) (AO3.1b)	IGNORE correlation ALLOW Not directly proportional / Not constant increase NOTE comparison of two increases required NOTE Speed increase from 0˚ to 10˚ is 1.81 and speed increase from 30˚ to 40˚ is 0.40 Examiner's Comments Most candidates correctly stated that the as the angle of the ramp increased the speed increased. It was essential that candidates included a comparison between the angle of the ramp and the speed. The next two marks were more challenging and required candidates to state that the angle of the ramp and the speed were not directly proportional or linear since there was not a constant increase in speed for the same increase in angle. Candidates were expected to demonstrate this by carrying out two calculations using data from the table or graph.  AfL Understand how to test from a graph whether two quantities are directly proportional. 1 Take the quantity on the x-axis and double it and read off the y-axis values and see whether they double as well 2 See whether there is a straight line through the origin.

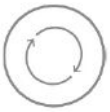
STEMUP.CO.UK

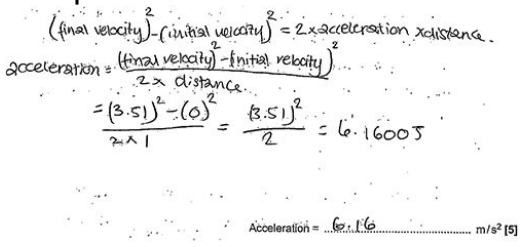
Question			Answer/Indicative content	Marks	Guidance
		iii	(Increase in angle) increases potential energy of the trolley/more work is done raising trolley to that point on the ramp ✓ This **increases** the / **more** kinetic energy at the bottom of the ramp ✓	2 (AO1.1 x2)	**ALLOW more** PE is transferred to KE Examiner's Comments Most candidates found this question challenging to gain two marks due to some vague answers relating to the transfer energy from the PE store to the KE store without specifically referring to the greater energy in the PE store being transferred so that there more energy in the KE store.
		iv	Attempt 1 at 30˚ (is only recorded to 1 decimal place)/ 3.1 ✓ Student should record data to a consistent number of decimal places or 2 dp / the reading should by recorded as 3.10 / AW ✓	2 (AO3.3a) (AO3.3b)	**ALLOW** only recorded to 2 significant figures **ALLOW** should be recorded to 3 significant figures **NOT** same accuracy Examiner's Comments Many candidates correctly identified that the first attempt (3.1) at an angle of 30° was only recorded to one decimal place. Most candidates then suggested that that the raw data should have been recorded to the same number of decimal places and the reading should have been recorded as 3.10. Some candidates referred to significant figures, which was allowed this year. Candidates need to understand that raw data should be recorded to the same number of decimal places while calculated data is recorded to a number of significant figures which is dependent on the number of significant figures in the raw data.

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		v	**Any two from:** Reproducible means that the results can be reproduced by someone else ✓ Only one student has collected this data ✓ The experiment is repeatable (as the repeated readings are close together) ✓	2 (AO2.2 x2)	**NOT** experiment can be repeated Examiner's Comments Most candidates discussed apparatus details such as not indicating what sort of surface was used, etc. Few candidates realised that reproducible results would need to be reproduced by someone else. A few candidates did state that the experiment is repeatable since the repeated reading are close to each other.  AfL Understand the terms used in the language of measurement. See the Glossary of terms on the OCR website at: https://www.ocr.org.uk/Images/467774-glossary-of-terms.doc
	b	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 6.16 (m/s^2) award 5 marks** $v^2 - u^2 = 2as$ (no mark – on formula sheet) u = 0 ✓ a = $v^2 \div 2s$ ✓ a = $3.51^2 \div (2x1.0)$ ✓ a = 6.16005 (m/s^2) ✓ a = 6.16 (m/s^2) (2 decimal places) ✓	5 (AO2.1) (AO1.2) (AO2.1) (AO2.1) (AO1.2)	NOTE must be rearranged **ALLOW** Any number which rounds to 6.16 **ALLOW** one mark for any calculated answer to 2dp Examiner's Comments About half the candidates gained full marks for this question. It was expected that candidates would

Question			Answer/Indicative content	Marks	Guidance
					select an appropriate equation from the data sheet, rearrange the equation and substitute in the numbers from the question before calculating the answer. It was expected that the initial speed of zero would be shown in any calculation. Many candidates who did not gain full marks attempted to gain the answer by using the definition of acceleration and the equation linking average speed with distance and time without realising the importance of the word “average”. Candidates using this method often arrived with an incorrect answer of 12.32 m / s^2. **Exemplar 6**  This candidate has correctly selected the equation from data sheet. The candidate has then rearranged the equation before substituting in the values form the question. Helpfully the candidate has indicated that the initial velocity was zero. The candidate then correctly calculates the answer as 6.16005 before correctly rounding the answer to two decimal places.
		ii	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 9 (J) award 3 marks** kinetic energy (J) = 0.5 x mass (kg) x (speed (m/s))^2 / KE = ½ mv^2 / KE = 0.5mv^2 ✓ KE = 0.5 x 2.0 x 3.0^2 ✓ KE = 9 (J) ✓	3 (AO1.2) (AO2.1) (AO2.1)	<u>Examiner’s Comments</u> Candidates who were able to recall the equation for kinetic energy scored well on this question. Candidates should be encouraged to show their working.
			Total	**19**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
49			B ✓	1 (AO2.1)	
			Total	1	
50			B ✓	1 (AO1.2)	Examiner's Comments This involves two different unit conversions, km to m and h to s. Many successful candidates used the space to set out step-by-step intermediate calculations..
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
51	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.
	c		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 0.5 (m/s^2) award 2 marks $v = 20 \div 40$ ✓ $v = 0.5$ (m/s^2) ✓	2 (AO2.1) (AO2.1)	Mp2 dependent on correct substitution for mp1 Examiner's Comments The equation for acceleration was given and it required no rearrangement. Most candidates were credited with both marks here.
			Total	9	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

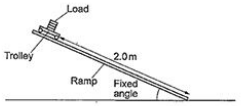
STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
52	a		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)** States that there is no clear trend. **AND** Detailed identification of at least two problems with the experiment with suggestions of detailed improvements. *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)** Recognises that the average speeds are similar. **AND** Identifies at least one problem with the experiment with a suggested improvement. *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)** Refers to data from the table. **AND** Suggests an improvement to the experiment or identifies one problem with the experiment. *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 (AO2×3.1a) (AO2×3.2a) (AO2×3.3b)	**AO3.1a Analyse information and ideas to describe trend in results** For example: • No obvious/discernible trend • As loads increased time ≈ the same • As loads increased speeds ≈ the same • 20N and 60N mean speeds the same • 20N and 60N times the same • 40N and 80N mean speeds the same • 40N and 80N times the same **AO3.2a Analyse information and ideas to make judgements and identify problems with the experiment** For example: • Only 4 loads tested • Ramp distance too short • No repeated readings • Mass/weight of trolley ignored • Reaction times an issue for short times **AO3.3b Analyse information and ideas to improve experimental procedures** For example: • Test more loads • Include mass/weight of the trolley • Use a longer ramp • Have a smaller angle of ramp • Start higher up the ramp • Electronic timing method • Repeat readings and take a mean Examiner's Comments Because there was no systematic pattern in the data this was a demanding level of response question for a foundation tier candidates. Exemplar 5 is a candidate who scored Level 3, 6 marks for clearly identifying the absence of a trend and suggesting improvement to the experiment. Exemplar 6 is a Level 2 response, gaining 4 marks as the candidate has identified

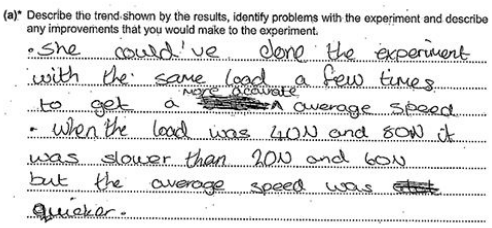
© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question	Answer/Indicative content	Marks	Guidance
			that the times and speeds are essentially similar and suggested improvements to the procedure. Exemplar 7 is a Level 1 response. The candidate makes reference to the data and makes a suggestion for doing a better experiment. This was judged to fit the Level 1 criteria exactly and was given 2 marks. **Exemplar 5** 21 A student investigates the average speed at which a trolley with different loads travels down a ramp. Look at the diagram of her experiment.  She releases the trolley from a distance of 2.0 m from the bottom of the ramp. The student uses a stop-clock to measure the time it takes to reach the bottom of the ramp. She calculates the average speed. Look at her results. Load (N) / Time taken (s) / Average speed (m/s) 20 / 2.3 / 0.87 40 / 2.4 / 0.83 60 / 2.3 / 0.87 80 / 2.4 / 0.83 (a)* Describe the trend shown by the results, identify problems with the experiment and describe any improvements that you would make to the experiment. There is no clear trend. When the speed is higher it takes less time to cover the distance. The problem is that the ramp is too short so time is not allowed for it to accelerate meaning that all speeds are extremely similar and a correlation is not shown between the load and speed. To improve she could make the ramp longer. She could experiment with different fixed angles in order to have a larger collection of results. If there was a bigger difference in the load, the may be more to see a clear trend. they are all too close in range. [6] **Exemplar 6** (a)* Describe the trend shown by the results, identify problems with the experiment and describe any improvements that you would make to the experiment. Firstly, the table shows a trend, that the time taken of a similar average speed for example all the 2.3s have an average speed of 0.87m/s and 2.4s has also 0.83m/s. The student could lean something up against the ramp to make sure it stays in a fix angle, the student could also instead use a light gate and not a stop watch to reduce human error and timing. [6]

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 7  (a)* Describe the trend shown by the results, identify problems with the experiment and describe any improvements that you would make to the experiment. • She could've done the experiment with the same load a few times to get a more accurate average speed • When the load was 40N and 80N it was slower than 20N and 60N but the average speed was ~~fast~~ quicker.
	b		EITHER $v^2 - u^2 = 2as$ (no mark – on formula sheet) $u = 0$ ✓ $a = v^2 \div 2s$ ✓ $a = 2^2 \div (2 \times 2.0)$ ✓ $a = 1.0/1$ (m/s^2) ✓ OR mean v = ½ (0 + 2 m/s) = 1 m/s ✓ $t = s$/mean v = 2 m / 1 m/s = 2 s ✓ $a = \Delta v/t$ ✓ = (2 m/s - 0)/2 s = 1 (m/s^2) ✓	4 (AO2.1) (AO2.1) (AO2.1) (AO2.1)	If no working shown and answer = 1 (m/s^2), award all 4 marks. If wrong physics used, then award marks as appropriate for either approach. <u>Examiner's Comments</u> There were different possible approaches to the calculation: use of $v^2 = u^2 + 2as$ or finding the mean speed and hence t and using a = (v-u)/t. Both were seen. Many candidates just randomly multiplied or divided the numbers given, and two of these operations gave a response of 1 m/s^2. Where candidates used incorrect physics in their response (e.g. acceleration = speed/distance = 2/2 = 1) then they only gained marks for those parts of their workings that were appropriate. For fairness candidates who only wrote '1' on the answer line with no workings shown were given the benefit of the doubt and awarded all 4 marks.
			Total	10	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
53			D ✓	1 (AO1.2)	Examiner's Comments The majority of candidates correctly identified that a ruler and a stopwatch should be used to measure the speed of water waves. A common incorrect response was an ammeter and stopwatch.
			Total	1	
54		i	(Driver under influence of) alcohol / drugs / tired / (named) distraction / ill / old-age / intoxication / high(er) speed ✓	1 (AO 1.1)	IGNORE just age ALLOW increase in driver's reaction time Examiner's Comments Many candidates correctly answered this question. The common factors were alcohol, drugs and tiredness. Some candidates did not score the mark for factors related to braking distances. Other candidates did not give an appropriate direction for the change, e.g. 'speed' was not credited but 'increasing speed' was credited.
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 26 (m) award 2 marks (Stopping distance =) braking (distance) + thinking (distance) OR 16 OR 10 ✓ (sd =) 26 (m) ✓	2 (AO 2×2.2)	Examiner's Comments The majority of the candidates gained one mark for correctly reading off either the thinking distance or the braking distance. Many candidates did not read the question carefully to realise it was the stopping distance that was required. Higher ability candidates clearly showed both the values from the graph and the addition.
			Total	3	
55			C ✓	1 (AO2.1)	
			Total	1	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
56			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 explanation about why speed and velocity are different from each other **AND** Calculations of speed **and** velocity completed and are correct *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 explanation about why speed and velocity are different from each other **AND** Calculation of speed **OR** velocity completed and is correct **OR** both equations stated/implied **OR** Explanation about why speed and velocity are different from each other **AND** Calculations of speed **and** velocity completed and are correct *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)** Explanation about why speed and velocity are different from each other. **OR** Calculation of speed **or** velocity completed and is correct **OR** Both equations stated/implied *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.*	6 (AO1.1x4) (AO2.1x2)	**AO1.1 Demonstrate knowledge and understanding of the difference between speed and velocity** For example: • speed is a scalar • velocity is a vector • speed has magnitude only • velocity has magnitude and direction • speed depends on distance • velocity depends on displacement • speed is rate of change of distance • velocity is rate of change of displacement **AO1.2 Recall of speed and velocity equations** • speed = distance / time • velocity = displacement / time **AO2.1 Apply knowledge and understanding of calculating speed and velocity** For example: • speed = 3.0 / (0.5x60) • speed = 0.10 (m/s) • velocity = 0.6 / (0.5x60) • velocity = 0.02 (m/s)

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
			0 marks No response or no response worthy of credit.		
			Total	6	
57			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 8 (m/s) award 4 marks u = 0 or $v^2 = (u^2 +) 2as$ ✓ $v^2 = 2 \times 10 \times 3.2$ or $v = \sqrt{(2 \times 10 \times 3.2)}$ ✓ $v^2 = 64$ ✓ v = 8 (m/s) ✓ OR alternative method: $mgh = ½ mv^2$ ✓ $(70 x) 10 \times 3.2 = ½ (x 70) \times v^2$ ✓ $64 = v^2$ ✓ v = 8 (m/s) ✓	4 (AO1.2) (AO2.1) (AO2.1) (AO2.1)	$v^2 – u^2 = 2as$ does not score a mark
			Total	4	
58			C ✓	1 (AO2.1)	
			Total	1	
59			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
60	a		(All galaxies) showed <u>red-shift</u> ✓ (Hubble measured the) wavelength/frequency of <u>light</u> (from the galaxy) ✓	2 (AO2 × 1.1)	**ALLOW** (all galaxies) showed <u>light</u> with a longer wavelength/lower frequency for 2 marks
	b	i	Readings of speed taken for two different values of distance ✓ Working to show that the factor increase in speed is the same as distance ✓	2 (AO2 × 3.1a)	**ALLOW** +/- ½ a small square **ALLOW** a statement for the second mark e.g. as the distance doubles so does the speed. <u>Example:</u> At 20 Mpc, speed = 1400 km/s At 40 Mpc, speed = 2800 km/s 40/20 = 2 = 2800/1400 **ALLOW** 1 mark maximum for it is a (straight) line of best fit through the origin (therefore it is proportional)
		ii	**Any one from:** The more distant galaxies are travelling faster ✓ The evidence suggests the universe is expanding ✓ The universe was smaller in the past ✓	1 (AO1.1)	**ALLOW** galaxies are moving away from each other
	c		To ensure results are reproducible / check the work is of high enough quality / claims are not false / for new theories to be accepted / to develop theories / AW ✓	1 (AO1.1)	**ALLOW** check validity / for mistakes/anomalies / AW **ALLOW** check that it's not biased / AW
	d	i	**FIRST CHECK THE ANSWER ON ANSWER LINE** **If answer = 5 800 000 (m/s) award 2 marks** (Reads off speed from graph =) 5800 (km/s) ✓ Speed = 5800 × 1000 = 5 800 000 (m/s) ✓	2 (AO2.2) (AO1.2)	**ALLOW** 5.8×10^6 (m/s) **ALLOW** ecf for their speed from graph x 1000

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
		ii	FIRST CHECK THE ANSWER ON ANSWER LINE **If answer = 4.36 × 10^{17} (s) award 3 marks** time = distance / speed ✓ (time =) 2.53 × 10^{24} / 5 800 000 ✓ (time =) 4.36 × 10^{17} (s) ✓	3 (AO1.2) (AO2.1) (AO2.1)	**ALLOW** ecf from **(i)** **ALLOW** 4.4 x 10^{17} (s) **ALLOW** equation in any form
			Total	**11**	
61			A	1 (AO2.1)	
			Total	**1**	
62			B	1 (AO2.1)	
			Total	**1**	
63			A	1 (AO1.1)	
			Total	**1**	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK

Question			Answer/Indicative content	Marks	Guidance
64			**Any two from:** Speed is a scalar ✓ Velocity is a vector ✓ Speed does not take direction into account / AW ✓ Velocity does take direction into account / AW ✓ Speed is calculated using distance ✓ Velocity is calculated using displacement ✓ Displacement depends on direction from start point / displacement takes into account direction ✓ Distance does not depend on direction from start point / distance does not take into account direction ✓	2 (AO1.1 x 2)	
			Total	2	

© OCR 2022. You may photocopy this page.

Created in ExamBuilder

STEMUP.CO.UK