OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

P8.1 PHYSICS ON THE MOVE

SCORE	PERCENTAGE
/110	%

STEMUP

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Question			Answer/Indicative content	Marks	Guidance
1			Correct reference or attempt to use area under sloping part of graph (1) $\frac{8 \times 1.5}{2} = 6$ (1)	2	**ALLOW** full marks for correct calculation as this implies correct use of area under sloping part of graph.
			Total	2	
2			**A** (1)	1	**mark answer on line first** **allow** answer ringed, underlined or ticked if no answer on the answer line Examiner's Comments The majority of candidates correctly identified A as the situation with the best fuel consumption.
			Total	1	
3			<table><tr><td></td><td></td><td></td><td></td></tr><tr><td>(32)</td><td>24</td><td>**96** (1)</td><td>**120** (1)</td></tr></table>	2	
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
4			Jo (no mark) idea that Jo will have the longest thinking time / distance (1) Chris (no mark) largest braking distance / less friction, **grip or traction** (1)	2	answer must be Jo to score the mark for the explanation allow slowest reaction [1] Not slowest time or slowest reaction time answer must be Chris to score the mark for the explanation **if no marks scored** allow Jo (for tired) and Chris (for icy) (1) Examiner's Comments This question was answered well by the majority of candidates who realised that tiredness would increase the thinking distance and that slippery conditions would increase the braking distance.
			Total	**2**	
5			**any two from** **risks** could cause bruising / break ribs / friction burn / cut (1) could trap passenger (1) **benefits** holds passenger in seat / AW (1) reduces injury or named injury (1)	2	**not** just causes injury, injury must be stated eg. whiplash / choking Examiner's Comments About 90% of candidates gave correct answers as to the benefits and risks of using seat belts.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
6				2	
			Maximum of one for: compare injuries from (a variety of) crashes / compare effects on crash dummies / measure force / acceleration / stretch / momentum [1]		
			for different materials / seatbelts [1]		eg. different types of seatbelt [1] old design of belt compared with new designs [1] lap belt compared to 3-point belt [1]
			for different people [1]		**eg.** sizes
			for different speeds [1]		**Examiner's Comments**
			for seat positions [1]		This question was about car safety features. This question was common with the foundation paper (B751-01). Poor communication and use of English prevented many from scoring 2. Many said 'look at' accidents / tests but did not say what to do. Also common was 'with and without' seatbelts rather than different types of belt – e.g. Shoulder belt v lap belt or different materials for belts [1].
			Total	2	

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Question			Answer/Indicative content	Marks	Guidance
7	a		crumple zones **and** air bags [1]	1	**Allow** collapsible steering column / collapsible bumpers **Examiner's Comments** Many correct, but ABS was also seen many times. Crumple zone / air-bag / collapsible steering wheel were the most common correct responses. Bumpers, safety cages, seatbelts and good tyres were often given as answers [0].
	b		they change shape / stretch / get longer [1] (and therefore) absorb energy [1]	2	**allow** reduce pressure by spreading force over a larger area [1] **allow** the KE of driver is converted into elastic (potential) energy in the seat belt [1] **allow** higher level answers referring to eg. increased time / distance [1] eg. reduced force / acceleration [1] eg. decreased rate of change of momentum [2] **allow** prevents impact with steering wheel, windscreen or dashboard [1] **Examiner's Comments** Only more able candidates tended to score [2] marks here. Many failed to say that seatbelts stretch. Common to see though was the belt preventing passengers hitting part of car — e.g. Windscreen or dashboard [1]. Often higher level answers such as seatbelts stretch giving a longer time or distance to stop [1] and a reduced acceleration and force [1] were also seen quite often.
	c	i	(no) (no mark) doubling speed increases stopping distance [1] **but**	2	If yes answered [0] marks

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Question			Answer/Indicative content	Marks	Guidance
		i	doubling speed more than doubles the braking / stopping distance [2]		**Allow** anything more than double the affect **Eg.** doubling speed triples / quadruples braking or stopping distance [2] **Allow** correct calculation and comparison of two stopping distances, e.g. at 32km/h, stopping distance = 12m & at 64km/h it is 36m [2] **Examiner's Comments** In this question candidates had to use the data in the chart to comment. It was quite well answered and the 'quadrupling' of breaking distance was often seen and understood. Most realised at least that the braking distance would increase [1]. Most however went on the gain the second mark also for more than doubling.
		ii		1	
		ii	bald tyres / smooth tyres / faulty brakes		**Allow** worn tyres / worn brakes
		ii	wet road / ice on road		**Allow** reduced friction surface / slippy road [1] **Ignore** bad weather / tyre condition / road conditions
		ii	more load in car		**Ignore** merely mass / weight / number of passengers **But allow** more mass / weight / passengers
		ii	increased gradient / downhill [1]		**Examiner's Comments** In this question many failed to score because they did not specify the condition clearly. Commonly seen was 'the road condition' or 'the tyre condition' but did not say for example 'wet road' or 'bald tyres'. Often answers did not achieve the mark for this as they did not answer the question correctly by referring to things that *affected* the braking distance rather than things that *increased* it. As both answers were needed for the single mark this tended to reduce success on this simple recall question.
			Total	6	

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Question			Answer/Indicative content	Marks	Guidance
8			**Maximum of one for:** compare injuries from (a variety of) crashes / compare effects on crash dummies / measure force / acceleration / stretch / momentum [1] **and maximum of one from** for different materials / seatbelts [1] for different people [1] for different speeds [1] for seat positions [1]	2	**Marking points are independent** eg. different types of seatbelt [1] old design of belt compared with new designs [1] lap belt compared to 3-point belt [1] **eg.** sizes Examiner's Comments Most candidates correctly suggested dummies being used in crashes with different types of seat belts, which scored full marks.
			Total	**2**	
9	a		**any two from** crumple zones [1] air bags [1] collapsible steering wheel [1] side impact bars [1]	2	Examiner's Comments There were 2 marks for this question, but a large proportion of candidates were happy to give only one answer. To score full marks any two from crumple zones (often described as crumble zones – which was accepted), air bags or collapsible steering columns were needed.
	b		D [1]	1	**allow** correct answer circled, ticked or underlined if no answer on the answer line Examiner's Comments Tested the idea of force = rate of change in momentum. About half the candidates answered the question successfully.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
10			Jo (no mark) idea that Jo will have the longest thinking time / distance (1) Chris (no mark) largest braking distance / less friction, **grip or traction** (1)	2	answer must be Jo to score the mark for the explanation **allow** slowest reaction [1] **NOT** slowest time / slowest reaction time answer must be Chris to score the mark for the explanation **if no marks scored** allow Jo (for tired) and Chris (for icy) (1) Examiner's Comments The first question on section C module P1 was about speed and has 10 marks in total. This question on stopping distances was answered well with most gaining the 2 marks.
			Total	2	

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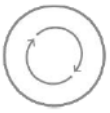
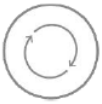
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Question			Answer/Indicative content	Marks	Guidance
11	a	i	**any one from:** driver tiredness (1) influence of alcohol / drugs (1) **greater** speed (1) distractions (1) lack of concentration (1)	1	 **not** just speed **allow** named distractions, e.g. radio / talking / mobile phone
		ii	**any one from:** wet / icy / slippery road conditions (1) **worn** brakes (1) **worn / poor** tyres (1) **greater** speed (1)	1	 **Not** merely 'road conditions' **Allow** poor road conditions (1) **allow** poor brakes (1) **not** merely 'condition of brakes' **not** merely quality / condition of tyre **not** just speed **Allow** high speed (1) **Allow** more mass / heavier car (1)
	b		(Idea that) there is not enough **reaction time** or enough **thinking distance** to stop the car / AW (1)	1	**Allow** you will crash before you have reacted (1) **Allow** not (even) enough time to start braking (1) **Ignore** there is not enough time to think **ignore** 'you will crash' / 'you are too close'
			Total	3	
12			B ✓	1 (AO1.1)	Examiner's Comments This question required candidates to recall and apply the equation: *acceleration = change in velocity ÷ time* as well as use the relationship provided to convert m/s into mph. Most candidates were able to do this successfully.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
13			D ✓	1 (AO1.2)	
			Total	1	
14			C ✓	1 (AO2.2)	Examiner's Comments  Many candidates struggled to estimate the force of the brakes, often incorrectly choosing distractor B. Those candidates who correctly choose distractor C were often seen to write down their estimated values of the mass and acceleration.  **AfL** Candidates would benefit from being provided with opportunities to estimate, the speed, accelerations and forces involved for everyday road transport.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
15	a		F ✓	1 (AO3.3a)	<u>Examiner's Comments</u> Almost all candidates were able to answer this correctly.
	b		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) <u>Examiner's Comments</u> 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*.
	c		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) <u>Examiner's Comments</u> 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.

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Question			Answer/Indicative content	Marks	Guidance
	d		(The **thinking** distance will) **stay the same** (The **braking** distance will) **decrease** (The **stopping** distance will) **decrease** **All three** correct ✓✓ **Two** correct ✓	2 (AO3.2b) (AO3.2b)	<u>Examiner's Comments</u> Higher ability candidates generally were credited with full marks for this question. However a third of the candidates did not provide any creditable response. . **AfL** These 'thought experiment' type questions can be used as short starter activities to help students develop the habit of thinking about science. Candidates can also be encouraged to quickly sketch out the question. This can help candidates to visualise how the forces acting on the car have changed from moving along the flat road to moving uphill at a constant speed.
			Total	8	
16			**B**	1 (AO 1.1)	<u>Examiner's Comments</u> This question assessed P8.1a which includes the abilities to recall typical speeds of other transportation systems. Many candidates chose 2500 m/s (equivalent to 9000km/h), rather than 250 m/s, equivalent to 900 km/h (or about 560 mph). Candidates should have an idea of typical speeds of wind, sound as well as walking, running, cycling and other transportation systems such as trains.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
17			C ✓	1 (AO 2.2)	<u>Examiner's Comments</u> Higher ability candidates added an extra column to the table to calculate the change in temperature. These candidates were also more likely to write down their workings, even for multiple choice questions. See exemplar 1 **Exemplar 1** 6 A student wants to find out which heater produces the largest temperature rise. Look at the results she collects and the calculations she makes. Heater / Starting temperature (°C) / Finishing temperature (°C) / Change in temperature (°C) A / 18 / 28 / 20 10 B / 18 / 36 / 16 18 C / 18 / 44 / 26 26 D / 18 / 51 / 23 33 Which heater has results that are correctly calculated? Your answer C ✓
			Total	1	
18			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 <u>Examiner's Comments</u> 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	

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Question			Answer/Indicative content	Marks	Guidance
19		i	Reduces <u>pressure</u> / spreads the <u>force</u> / AW ✓	1 (AO 1.1)	<u>Examiner's Comments</u> Many candidates found it difficult to use appropriate technical language in their answers to this question (for example, force and pressure). Many candidates wrote vague responses such as 'it would cover more of the body' without explaining why this was important. Higher ability candidates used specific technical language such as 'reducing the pressure' or 'spreading the force'. AfL The parts of a question form a story that develops a central theme. In part (a) looks at the pressure the car applies to the road, part (b) looks at the pressure that the force resulting from breaking applies to passengers, and part (c) applies this knowledge to the specific context of child safety seats. Where candidates follow these story lines, it helps them to improve the quality of their answers. However in (i) and (c) most candidates did not make the connection after they were asked to calculate pressure in (a).
		ii	Absorb energy (in a crash) ✓	1 (AO 1.1)	ALLOW higher level answers: eg. Reduces force / acceleration E.g. Increases time / distance to stop <u>Examiner's Comments</u> Higher ability candidates realised that the material was stretchy to absorb energy in a crash. Other responses referred to more generalised reasons such as allowing seatbelts 'to fit around different sized people.' Some candidates described the seat belt material as 'having a little give' or 'movement' without explicitly explain how this would increase time, reducing the rate of deceleration and thus the force exerted on the passenger.

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Question			Answer/Indicative content	Marks	Guidance
			Total	2	
20			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	
21			Mass / inertia of child is lower ✓ Less force is needed (for the same deceleration)✓	2 (AO 2.1) (AO 1.1)	ALLOW weight of child is lower/child is smaller Examiner's Comments Many candidates suggested that the narrower belts were needed because of child car seats are smaller.
			Total	2	
22			FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 800 (kg) award 3 marks Recall: force = mass × acceleration ✓ 4000 ÷ 5 ✓ 800 (kg) ✓	3 (AO 1.2) (AO 2.1) (AO 2.1)	ALLOW 0.8 for two marks Examiner's Comments Some candidates divided their calculated answer by 1000 so that there answer was actually in tonnes rather than kilograms. Because the equation uses force in N and acceleration in m/s^2 the computed mass will be kilograms. Other candidates divided 4000 by 5^2 perhaps thinking that 5 m/s^2 implied it needed to be squared.
			Total	3	

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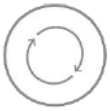
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Question			Answer/Indicative content	Marks	Guidance
23		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 2.8 (kW) award 4 marks	4	ALLOW 2.78 kW or 2.783 kW ✓✓✓✓
			(P =) $I^2 \times R$ ✓	(AO 1.2)	ALLOW equation in any form
			11 × 11 × 23 or 112 × 23 or 121 × 23 ✓	(AO 2.1)	
			= 2783 ✓	(AO 2.1)	
			Conversion to kW = 2.8 (kW) ✓	(AO 2.1)	ALLOW ecf candidates answer to 3rd marking point converted to kW Examiner's Comments Q23 is an overlap question with J249/04 and candidates found it very challenging with only a small number of the most able candidates being credited with any marks. From the stem of the question candidates knew that their answer needed to be between 1.0 kW and 3.0 kW. There were compensatory marks available where candidates wrote down the equation they were using and the different stages of their calculations. The most common workings shown were 11 × 23 or 23 ÷ 11, rather than 112 × 23 = 2.78kW. .
		ii	Wind speed varies / AW ✓	1 (AO 2.1)	ALLOW it depends on the strength of the wind / how windy it is / AW IGNORE there might not be any wind / wind changes direction / AW Examiner's Comments Many candidates realised that the wind speed would vary, but most responses were vague statements about the 'weather'.

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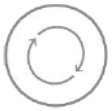
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Question			Answer/Indicative content	Marks	Guidance
		iii	(Idea of) not always enough wind / demand may exceed supply / AW ✓	1 (AO 2.1)	ALLOW (it) may not generate enough power / energy / AW Examiner's Comments Two thirds of the candidates reasoned that there may not be enough wind of the required speed or that a 3.0 kW wind turbine would not be sufficient to power a household.  AfL It is very important to show candidates how to focus their answers on the question that they are being asked. For example, this question was about whether 'just one wind turbine' could be a reliable source of power a house. However, many candidates answered a question about the impact of a domestic electrical supply failure, which would apply to any source of power to a house.
			Total	6	
24			B ✓	1 (AO 1.1)	Examiner's Comments Candidates are expected to be able to recall typical speeds such as cycling, wind and sound. Most candidates were able to do this successfully.
			Total	1	

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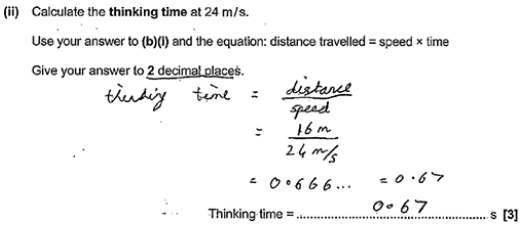
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Question			Answer/Indicative content	Marks	Guidance
25	a		As speed increases, (thinking) distance increases / ORA ✓ BUT (thinking) distance is (directly) proportional to speed / as speed doubles, (thinking) distance doubles / linear relationship through the origin ✓✓	2 (AO 3.1a) (AO 3.2b)	ALLOW numerical values from graph, e.g. at 15 (m/s), td = 10m but at 30 (m/s) td = 20(m). ALLOW numerical values from graph, e.g. at 15 (m/s), td = 10 (m) but at 30 (m/s) td = 2×10 = 20 (m) for 2 marks Examiner's Comments This AO3 question assessed candidates' ability to interpret the distance-speed graph and draw conclusions about how thinking distance varies with increasing speed. The question discriminated well. Most candidates were able to give a basic description that as speed increases, thinking distance increases but only the more able candidates were able to give a more detailed relationship, e.g. speed is proportional to thinking distance, for 2 marks.
	b	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

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Question			Answer/Indicative content	Marks	Guidance
					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 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.
	c	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 Although the majority of candidates answered this question correctly, candidates should be aware that vague answers such as 'speed' or 'age' without any qualification will not gain credit.

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Question			Answer/Indicative content	Marks	Guidance
		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)	<u>Examiner's Comments</u> This question assessed candidates' ability to read the values of thinking distance and braking distance from the distance-speed graph. Most candidates scored 1 mark for reading at least 1 value correctly but many did not calculate the stopping distance by adding the thinking distance and braking distance together, with some multiplying or subtracting the values instead.
	d		Maximum 2 marks from: Higher speed increases braking distance ✓ BUT Double speed quadruples braking distance / braking distance is (directly) proportional to the speed squared AW ✓✓ Maximum 2 marks from: (Idea that) higher speed (car has) more KE ✓ BUT Double speed quadruples KE / KE is (directly) proportional to the speed squared / AW ✓✓	3 (AO 2.1) (AO 3.1ax2) (AO 2.1) (AO 3.1ax2)	ALLOW numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 30 (m). ALLOW numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 4×7.5 (= 30m) for 2 marks <u>Examiner's Comments</u> This question covered Assessment Objectives 2 and 3 and assessed candidates' ability to apply their knowledge of kinetic energy and braking distance as well as to interpret the graph. The majority of candidates scored 2 marks for linking a higher speed to increased kinetic energy and braking distance. Although some candidates recognised that the relationships were linked to a 'square factor' they could not express it clearly and therefore only the more able candidates gained full credit for recognising that speed is directly proportional to kinetic energy and/or braking distance.
			Total	12	

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Question			Answer/Indicative content	Marks	Guidance
26	a	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
	b	i	(Idea of measuring) a length/distance on the ruler ✓	1 (AO 1.2)	Examiner's Comments The majority of candidates gave a correct response but it was also common to see incorrect explanations referring to using a stopwatch to time how long it took driver Q to catch the ruler.
		ii	Any one from: drop ruler from same height above hand ✓ (idea of) change the time taken before dropping the ruler each time ✓ make sure hand of catcher not moving / fingers are the same distance apart ✓	1 (AO 1.2)	ALLOW suitable answers that refer to reducing named random or systematic errors e.g. measure from same place on the ruler (relative to hand) ALLOW (idea of driver Q being) unaware of when ruler is being dropped ALLOW repeat and calculate mean
	c	i	(Store of) KE (in moving car) ✓ (transferred thermally) to (store of) thermal energy / heat (in brakes/pads/discs/tyres) ✓	2 (AO 2×2.1)	Examiner's Comments This question assessed candidates' ability to apply their knowledge of energy stores. Most candidates scored at least 1 mark for identifying either kinetic energy or thermal energy but it was generally only the more able candidates that identified both energy stores correctly.

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Question			Answer/Indicative content	Marks	Guidance
		ii	**Any one from:** (Idea of) heat dissipated/transferred (to air) more quickly ✓ KE is reduced more quickly ✓	1 (AO 2.1)	IGNORE to thermal energy of road/surroundings <u>Examiner's Comments</u> It was evident that most candidates found this question very challenging, with usually only the most able gaining 1 mark.
			Total	8	

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Question			Answer/Indicative content	Marks	Guidance
27	a	i	16 (m) ✓	1 (AO 3.1a)	Examiner's Comments This question was generally answered well.
		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 ✓ Time = 0.67 (s) (2 decimal places) ✓	1 (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 Higher ability candidates rearranged the equation, substituted the numbers and wrote the answer as 0.66667 before rounding the answer to 0.67. A number of candidates wrote their answer exactly from the calculator as 0.66 which was not acceptable for two decimal places.
	b	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.

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Question			Answer/Indicative content	Marks	Guidance
		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)	<u>Examiner's Comments</u> 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.
	c		**Maximum 2 marks from:** Higher speed increases braking distance ✓ **BUT** Double speed quadruples braking distance / braking distance is (directly) proportional to the speed squared AW ✓✓ **Maximum 2 marks from:** (Idea that) higher speed (car has) more KE ✓ **BUT** Double speed quadruples KE / KE is (directly) proportional to the speed squared / AW ✓	3 (AO 2.1) (AO 3.1a x2) (AO 2.1) (AO 3.1a x2)	**ALLOW** numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 30 (m). **ALLOW** numerical values from graph, e.g. at 10 (m/s), bd = 7.5 (m) but at 20 (m/s) bd = 4×7.5 (= 30m) for 2 marks <u>Examiner's Comments</u> Many answers to this question were vague. This question again required candidates to indicate the direction of the change in speed, e.g. as the speed increases. A small minority of candidates realised that both the kinetic energy and the braking distance increased with increasing speed. Very few used their graph to show that as the speed doubled the braking distance and kinetic energy quadrupled.
			Total	**10**	
28			**C** ✓	1 (AO1.2)	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
29	a	i	**Any two from:** First student drops the ruler and second student catches as quick as possible ✓ Measure the distance on the ruler where it was caught ✓ Use look-up table/equation to find time to travel this distance ✓	2 (AO2 × 1.2)	1
		ii	**Any one from:** To check the precision or repeatability of the readings ✓ to find the uncertainty in the measurement ✓ to find an average or mean ✓	1 (AO3.3a)	
		iii	Student B's reaction times will be longer / increases ✓	1 (AO3.2a)	**ALLOW** B will be slower
	b	i	(9 + 14) = 23 (m) ✓	1 (AO2.2)	
		ii	Stopping distance at 50 mph = 53 m ✓ Stopping distance is greater than 40 m / Car hits the barrier ✓	2 (AO3.1a) (AO3.2a)	**ALLOW** 52-54m

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Question			Answer/Indicative content	Marks	Guidance
		iii	Factor: larger mass (of car) ✓ Reason: Braking distance is increased ✓ because deceleration is less / larger KE to dissipate ✓ OR Factor: Poor quality brakes / tyres ✓ Reason: Braking distance is increased ✓ Less friction / smaller deceleration ✓ OR Factor: Icy / wet / slippery road ✓ Reason: Braking distance is increased ✓ Less friction / smaller deceleration ✓ OR Factor: Going uphill ✓ Reason: Braking distance is decreased ✓ Weight of car increases deceleration ✓ OR Factor: Going downhill ✓ Reason: Braking distance is decreased ✓ Weight of car decreases deceleration ✓	3 (AO1.1) (AO2 × 2.1) (AO1.1) (AO2 × 2.1) (AO1.1) (AO2 × 2.1) (AO1.1) (AO2 × 2.1) (AO1.1) (AO2 × 2.1)	DO NOT ALLOW distance for braking/thinking distance DO NOT ALLOW stopping distance
	c	i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 3.25/3.3 (m/s^2) award 2 marks 13 ÷ 4 ✓ = 3.3 (m/s^2) ✓	2 (AO2 × 2.1)	 ALLOW 3.25 (m/s^2)
		ii	Any two from: Yes / No (no mark) (agree with driver) stopping distance is shorter ✓ Less likely to hit obstacles / safer ✓ Attempt to quantify, e.g. 4 s / 0.4 s = 10 ✓ OR (disagree with driver) (*F* = *ma* / so) the force (acting on the people in the car) is 10x greater ✓ This can lead to injury / 10× more dangerous ✓ Other factors involved (so cannot quantify) ✓	2 (AO2.1) (AO2 ×3.1b) (AO2.1) (AO2 ×3.1b)	 1

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Question			Answer/Indicative content	Marks	Guidance
		iii	Seat belt / airbag / crumple zone ✓	1 (AO1.1)	
			Total	**18**	
30			**B ✓**	1 (AO1.2)	
			Total	**1**	

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