STRAIGHT LINE MOTION MECHANICS ANSWERS OCR ALEVEL YEAR 1

1.

Question		Expected Answers	Marks	Additional Guidance
(a)		A quantity that has (both) magnitude / size and direction	B1	**Not** 'A quantity that has direction'
(b)		Circled /underlined quantities are: acceleration, displacement and weight	B1	**Note**: All three need to be identified for a mark
(c)	(i)	Constant / steady / uniform acceleration (up to 4 s) Or Velocity increases at a steady / constant / uniform rate Or Has acceleration of 3.5 (m s^{-2}) Constant / steady / uniform velocity (after 4 s) Or Zero acceleration Or Travels at a velocity of 24 (m s^{-1})	B1 B1	**Not** Accelerates up to 4 s / 'uniform motion' for the first B1 mark **Not** 'Accelerates at a constant rate'. **Allow**: 'speed' instead of velocity **Allow**: 2 mark for 'Constant acceleration and then constant speed / velocity'
	(ii)	distance = area (under graph) distance = 68 (m)	C1 A1	**Allow**: The C1 mark is for … distance = $\frac{1}{2}(10+24)\times 4.0$ **Allow**: Bald 68 (m) scores 2 marks Bald $\frac{1}{2}(4\times 14)$ or 28 (m) scores 1 mark for 'area of triangle'
	(iii) 1	Answer in the range: 1.1 to 1.2 (s)	B1	
	(iii) 2	Same areas under graphs $14t = 10t + (0.5\times 3.5\times t^2)$ t = 2.28 (s) ≈ 2.3 (s)	 C1 A1	 **Note**: The C1 mark is for substitution **Allow**: Bald 2.3 (s) scores 2 marks **Allow:** Bald 't = 2 × **(iii)1**.' Scores 2 marks
		Total	**9**	

2.

a	The distance travelled (by the car) from when the driver sees a problem and the brakes are applied	B1	**Note**: There must be reference to 'stimulus' and brakes. **Not**: 'speed × reaction time'
b	Distance / displacement	B1	
c(i)	distance = 20 × 0.5 distance = 10 (m)	B1	
c(ii)	distance = area under graph distance = ½ × 20 × 3.5 distance = 35 (m)	 C1 A1	 **Allow** 1 mark if stopping distance of 45 m quoted No marks for an answer of '20 × 3.5 = 70 (m)'
d(i)	gradient = 'acceleration' / $a = \frac{v-u}{t}$ / $a = \frac{\Delta v}{\Delta t}$ $a = (-)\frac{20}{3.5}$ deceleration = 5.71(4) ≈ 5.7 (m s^2)	C1 A1	The first mark is for selecting correct equation or stating a = gradient **Note**: Ignore negative sign
d(ii)	force = 910 × 5.71 force ≈ 5200 (N)	C1 A1	 Possible ecf from **(d)(i)**
e	Increases by a factor of 4 Braking distance ∝ speed^2 / '$Fx = ½ mv^2$' / speed doubles and time doubles	B1 B1	

3.

Question		Expected Answers	Marks	Additional Guidance
(a)		stopping distance = thinking distance + braking distance	**B1**	
(b)		Any two factors from: speed, mass, condition of tyres, condition of brakes, condition of road, gradient of road For each factor, correct description of how braking distance is affected E.g: • Greater speed means greater distance Or distance ∝ speed^2 (ora) • Greater mass means greater distance Or distance ∝ mass (ora) • Worn tyres / brakes implies less friction therefore greater distance (ora) • Wet / slippery / icy road means less friction therefore greater distance (ora) • Uphill means shorter distance (ora)	**B1×2** **B1×2**	**Allow**: KE if neither mass nor speed is mentioned. For description marks, reference to 'distance' instead of 'braking distance' is fine For 1st bullet point allow reference to kinetic energy **Allow**: 'more' or 'longer' instead of 'greater' when referring to distance Do not allow 'grip' for friction for 3rd and 4th bullet points

4.

Question			Answers	Marks	Guidance
	(a)		acceleration = rate of change of velocity	B1	**Allow**: $a = \frac{v-u}{t}$ where v = final velocity, u = initial velocity and t = time **Allow**: 'acceleration = change in velocity over time' **Not**: 'acceleration = rate of change of speed' **Not**: mixture of quantity and unit, e.g. 'change of velocity per second'
	(b)	(i)	$a = \frac{v-u}{t}$ (Any subject) $a = \frac{0-6.0}{2400}$ a = (-) 2.5 × 10^{-3} (m s^{-2})	C1 C1 A1	 **Allow**: $a = 6.0/2400$ Ignore sign
		(ii)	distance = av speed × time or $v^2 = u^2 + 2as$ distance = 3.0 × 2400 or $0 = 6.0^2 - (2 \times 2.5 \times 10^{-3} \times s)$ distance = 7200 (m)	C1 A1	Possible ecf. from **(b)(i)** **Allow**: $v^2 = u^2 + 2as$ with v = 6.0, u = 0 and a = 0.0025 **Allow**: Full credit for correct use of $s = ut + ½ at^2$ **Note**: Bald 7200 (m) scores 2 marks **Allow**: 1 mark for 's = (6 × 2400) + ½ × 0.0025 × 2400^2 = 21600 (m)'
		(iii)	Correct shape of curve of decreasing gradient starting from 0,0 Graph passes through 40, 7.2	M1 A1	 Possible e.c.f. from **(b)(ii)** **Allow** the A1 mark if x is between 5-10 km at 40 min
	(c)	(i)	It has (constant) acceleration / It accelerates (down the ramp)	B1	**Allow**: Its velocity / speed increases
		(ii)	The time taken by ball to travel between (successive) bells is the same / 'same as first trolley' / 'there is no change' (AW) Acceleration is independent of mass / acceleration is the same (for the heavier trolley) (AW)	B1 B1	
			Total	**11**	

5.

Question			Answers	Marks	Guidance
	(a)		A straight line through the origin	B1	**Ignore** graph after 0.5 s.
	(b)		The speed (of the car) is constant	B1	**Note**: This can only be scored if **(a)** is correct
	(c)		The distance travelled by the car after the brakes are applied until the car stops	B1	**Note**: Must have reference to car 'stopping' to score the mark
	(d)		Mass (of car) (½ mv^2 = Fx, hence braking) distance ∝ mass Speed / velocity (of car) (½ mv^2 = Fx, hence braking) distance ∝ speed^2	**Must use tick or cross on Scoris to show if the mark is awarded** M1 A1 M1 A1	**Allow**: weight (of car) **Not**: 'distance increases with mass' **Allow**: distance ∝ m **Not**: 'distance increases with speed' **Allow**: distance ∝ v^2
	(e)		Increases time (of impact / to slow down) / increases the distance (travelled by the driver) Smaller deceleration / acceleration Force is smaller because $F = ma$ and a is smaller or force is smaller because $F = E_k/x$ and x is bigger or force is smaller because $F = \frac{\Delta p}{\Delta t}$ and Δt is bigger	**Must use tick or cross on Scoris to show if the mark is awarded** B1 B1 B1	 **Not**: 'slow down acceleration' **Allow**: $E_k = Fx$ and x is bigger **Not**: Prevent crashing into windscreen / steering wheel
			Total	**10**	

6.

Question			Answer	Marks	Guidance
(a)			Difference: Velocity / vector has direction (and speed does not) or speed / scalar does not have direction (velocity has) Similarity: Both have the same unit / both have m s^{-1} (as the unit) / both have magnitudes	B1 B1	**Not** 'velocity is a vector / speed is a scalar' since it is stated in the question
(b)	(i)		distance = $2 \times \pi \times 0.60$ (= 3.77 m) / speed = $\frac{3.77}{12}$ speed = 0.31 (m s^{-1})	C1 A1	 **Note**: Answer to 3 sf is 0.314 (m s^{-1})
	(ii)		$s^2 = 0.60^2 + 0.60^2$ s = 0.85 (m)	C1 A1	 **Note**: Answer to 3 sf is 0.849 (m) **Note**: 0.72 scores 1 mark (square root omitted)
	(iii)		The (change in) displacement is zero	B1	
	(iv)		The direction changes (even though the magnitude is the same)	B1	
			Total	**8**	

7.

Question			Answer	Marks	Guidance
(a)			acceleration = rate of change of velocity (or acceleration = change in velocity / time)	B1	**Allow** '$a = (v - u)/t$' or $\Delta v/t$ if v, u and t or Δv and t are defined
(b)			Mass and (net) force	B1	
(c)	(i)		**1** acceleration **2** deceleration / negative acceleration Detail mark: Constant used in either 1 or 2 or reaches maximum height at 25 (s) or stops at 25 (s)	B1 B1 B1	**Allow**: velocity / speed increases **Allow**: velocity / speed decreases **Allow**: 'uniform / same' for 'constant'
	(ii)		height = area under graph from 0 to 25 (s) height = ½ × 25 × 200 height = 2500 (m)	C1 C1 A1	 **Allow** 1 mark for either 500 (m) or 2000 (m)
	(iii)		A sensible suggestion, for example: • $v^2 = 2 \times g \times 2500$, v = 220 (m s^{-1}) – allow g = 10 (m s^{-2}) • For 200 (m s^{-1}) at ground, the (maximum) height would only be 2040 (m) (with g = 9.81 m s^{-2}) or 2000 (m) (with g = 10 m s^{-2}) • (Burning) rocket fuel does work on the rocket (AW)	B1	
			Total	**9**	