Question number	Answer	Notes	Marks
1 (a)	B – the horizontal part of the line;		1
(b)	A – the area under the line;		1
(c)	B – the distance moved divided by the time taken;		1

Total 3 marks

Question number	Answer	Notes	Marks
2	Any **5** of 1. determine / measure distance; 2. determine / measure time; 3. Appropriate measuring instrument for distance **OR** time; 4. Use a suitable distance /count laps (of known length); 5. repeat experiment/**calculate** average; 6. Speed = distance / time OR finding the gradient ; 7. Suitable experimental precaution, e.g. reaction time considered, consistent height on track, time from a predetermined consistent point;	Allow idea of published track length use of split times e.g. 1 lap or circuit Ignore 'human error'	5
		Total	**5**

Question number	Answer	Notes	Marks
3 (a) (i)	42 (m/s)	Allow range 42 - 43	1
(ii)	Attempt to calculate slope; Answer; Unit; 42 ÷ 15 2.8 m/s^2	Allow value from (i) e.g. 43 m/s → 2.9 m/s^2 42.5 →2.83 m/s^2 45 → 3 m/s^2 not 42/120 allow 42/20	3
(iii)	Attempt to calculate an area under graph line; Appropriate further working (e.g. adding areas); Answer; (½ x 15 x 42) + (80 x 42) + (½ x 25 x 42) 315 + 3360 + 525 4200 (m)	Allow value from (i) e.g. 43 m/s → 4300 m first 2 MP may be gained using the trapezium method, i.e. 42 x (120+80)/2 Bald correct answer scores 3	3

Question number	Answer	Notes	Marks
(b)	Any **three** from 1. Stopping distance affected by speed or mass; 2. For faster plane, stopping distance greater/ runway too short ; 3. for heavier plane stopping distance greater/ runway too short; 4. Attempt to calculate stopping distance from graph; 5. Data shows most/all of runway already used;	ignore time = 500/40 Allow a momentum argument for MP1, 2, 3	3
		Total	**10**

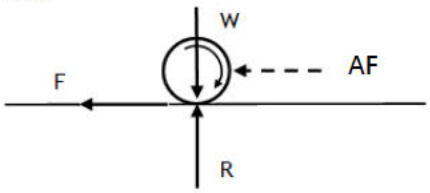
Question number		Answer	Notes	Marks
4 (a) B		constant velocity of 5 m/s	Allow speed is 5 m/s	2
D		Idea that velocity/speed = 0	Allow "stops", "stationary","at rest"	
(b)		Idea of greater slope (for stage E); e.g. the gradient is steeper	Allow reverse argument, provided stage A is identified e.g. "stage A has a shallower slope" Allow attempts to demonstrate through - ca culation of both gradients - qualitative comp rison of data	1
(c)		distance = speed × time OR distance = area under graph; attempt to find any area; attempt to total correct areas (or use trapezium method); evaluation; **e.** distance = area under graph 7 × 7 or ½ × 7 × 3 (7 × 7) + (½ × 7 × 3) = 49 + 10.5 59.5 (m)	The correct relationship can be **implicit** in the working 59.5 (m) with no working = full marks Allow the trapezium method - e.g. 7 × ((7+10) ÷ 2) = 7 × 8.5 = 59.5 (m)	4
(d)		Correct equation shown ; e.g. (average speed) = distance (moved) / time (taken) Substitution of correct distance and suitable time; Correct evaluation ; e.g.106.5/27 3.94 (m/s)	Allow d/t Allow (ecf) max 2 4.26 (m/s) (use of time = 25 s) 3.55 (m/s) (use of time = 30 s) Allow reverse argument max 2 e.g. 106.5 ÷ 4 = 26.6 (s)	3

Question number	Answer	Notes	Marks
5	Any FOUR of Reaction time of driver (inc comment on drink/drugs / driver paying attention / driver distracted /driver tired); Condition of car's brakes/force applied to brakes; Condition of car's tyres; Condition of road surface (inc ice/water/mud /friction ideas); Stopping distance of car; Velocity / speed / behaviour of rabbit (across road); Distance of rabbit from car; Visibility factor (e.g. fog / dirty windscreen); ALLOW MAXIMUM of TWO from these Kinetic energy of car; Momentum of car; Velocity / speed of car; Mass / weight of car / number of passengers;	ACCEPT 'thinking distance / time' as an alternative to these points IGNORE 'condition of driver' ACCEPT 'braking distance (of the car)' as an alternative to these three 'condition' points IGNORE 'condition of car' i.e. momentum of car <u>and</u> velocity of car <u>and</u> mass of car only scores two of the marks available	4

Total 4 Marks

Question number	Answer	Notes	Marks
6 (a) (i)	6.1 (m);		1
(ii)	any two from:- MP1. (on distance-time graph,) flat line means zero speed / eq MP2. (so) count when slope is zero; MP3. 7 (times);	allow flat or horizontal for zero slope	2
(b) (i)	(average) speed = <u>(total) distance moved</u> (total) time taken	allow defined symbols ignore 'triangles'	1
(ii)	Substitution; Calculation; Matching unit; e.g. Average speed = $\frac{6.1}{(7 \times 60)}$ = 0.0145 = 0.015 m/s	allow both substitution and calculation marks for a correct value without working allow 6.1, or ecf for distance 7 for time allow alternatives with compatible unit, e.g. 1.45 cm/s OR 1.5 cm/s 14.5 mm/s OR 15 mm/s 0.87 m/minutes 87 cm/minute 870 mm/minute Allow for 1 mark 6 / 7 or 0.9	3

Total 7 marks

Question number	Answer	Notes	Marks
7 (a) (i)	Any two of - MP1. arrow downwards, labelled weight; MP2. arrow upwards, labelled reaction/contact force; MP3. arrow to the left, labelled air friction / air resistance / drag; MP4. arrow along the surface, labelled friction; e.g.  	In MP1, 2 & 3, position of arrows unimportant, but direction must match label Allow initial letters as shown in example ignore • gravity allow • mg • force of gravity • arrow drawn on left or right Accept arrow in either direction for MP4 N = normal contact force	2
(ii)	Any three of - MP1. friction/resistance /drag (acts); MP2. (there is an) unbalanced force; MP3. (hence) ball decelerates; MP4. reference to $f_{(R)} = ma$; MP5. (kinetic) energy dissipates / fate of energy discussed;	ignore stem allow • resistive forces > {forward/driving} force • there is a resultant force • its momentum changes • accelerates	3
(b) (i)	idea that friction is (much) less in the air;	allow • RA • no contact / ground friction • less energy lost	1

Question number	Answer	Notes	Marks
7 (c) (i)	KE = ½ mv^2;	Words or symbols	1
(ii)	Conversion to kg; Substitution into correct equation; Rearrangement; Evaluation; e.g. 45 g = 0.045 kg (or 1 kg = 1000 g etc) $36 = ½ \times 0.045 \times v^2$ $v^2 = \frac{2 \times 36}{0.045}$ (= 1600) 40 (m/s)	allow • 1000 seen • steps in any order • correct answer with no working for full marks • up to 3 marks for use of 45 kg →1.26 (m/s)- working must be seen	4
(iii)	Any one of- • (Hit the ball transferring) more energy; • (Hit the ball with) more velocity; • (Hit the ball with) more speed; • (Hit the ball with) more force;	Ignore • harder • power Allow • momentum • keep contact for a larger part of the swing • go to a place where g is less (e.g. on the moon) • hit ball at a steeper angle / vertically (e.g. use a more lofted club)	1

Total 12 marks