Question Number	Answer	Acceptable answers	Mark
1(a)	stopwatch /stopclock (1) {trundle/measuring} wheel/measuring tape or tape measure (1) ignore speedometer/speed camera/radar	(electronic) timer timing app (on 'phone) clock and watch on their own are insufficient any suitable length measuring device e.g. accept metre {rule(r)/stick} but ruler on its own is insufficient **Answers may be in either order**	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	white (car) (1)	Allow the use of other columns that identify correct car e.g. 5.6(s)	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	substitution (1) 80 ÷ 4.3 evaluation (1) 19 (m/s) Throughout the paper do not penalise answers to many places of decimal e.g. here 18.604651 gets both marks	Allow full marks for correct answer with no working seen. accept 18.6 (m/s) ignore 18 and 18.0 as incorrect rounding accept any power of 10 error for 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(iii)	40 (miles per hour) (1)	accept answers in range 39 – 43 (miles per hour) ecf from b(ii) multiply bii by 2.222 range +/- 2.0	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)	{steady/constant} speed (at first) (1) (then) slows down (1)	accept velocity for speed ignore as time increases distance travelled increases (then) slower/less speed/decelerates/negative acceleration	**(2)**

Total for Question 1 = 8 marks

Question Number	Answer	Acceptable answers	Mark
2(a)	20(m)	value between 18 and 22	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	substitution (1) 100/9.8 evaluation (1) 10 unit (1) m/s	 **Accept** 10.2 give 2 marks for correct answer, no working accept for 1 mark 9.65 or 9.7 mps	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(c)	An explanation linking the following points • speed changes (1) • (because) slower to begin with / faster at the end (1)	 not the same speed throughout slows down after 100 m he speeds up=2	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)(i)	**B** slowing down		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(d)(ii)	speed in a stated direction		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)			**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)	distance travelled = area under graph (1) substitution (1) ½ x 20 x 2 evaluation (1) 20 (m)	distance = average speed x time = 10 × 2 20 (m) allow (distance) = speed × time or 20 x 2 for 1 mark give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation linking the following points • velocity is a vector (1) • (whereas) speed is not (1)	 velocity has magnitude and direction velocity has direction speed is a scalar speed has {no direction}/{magnitude only} allow for 2 marks velocity is speed in a straight line velocity = <u>displacement</u> time NOTE answers in terms of momentum must still refer to vectors or direction to gain credit	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(d)**	An explanation linking some of the following **Forces acting** • weight down • air resistance up (opposing motion) **Forces during fall** • weight constant • air resistance increases • with speed • resultant force = W − R **Effect on shape of graph** • at start, resultant force is large so acceleration large / gradient steep • mid resultant force decreasing so acceleration decreasing / gradient decreasing • terminal velocity, resultant force is zero so acceleration zero / gradient zero	**(6)**
Level	**0**	No rewardable content	
1	**1 -2**	• a limited explanation linking a few facts from the indicative content. E.g. at terminal velocity, forces are equal so constant speed. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 -4**	• a simple explanation linking some of the indicative content to the shape of the graph e.g At the start weight > air resistance so acceleration and at the end weight = air resistance so no acceleration. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 -6**	• a detailed explanation linking most of the indicative content to the complete shape of the graph e.g. At the start weight > air resistance so acceleration. Then air resistance increases (with speed) so acceleration decreases. At the end weight = air resistance so no acceleration. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
4(a)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	12 (m/s) (1)	Range from 11(m/s) to 14 (m/s)	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	Substitution (1) $\frac{20-0}{5}$ evaluation (1) 4 (m/s^2)	$\frac{20}{5}$ Full marks for correct answer with no working Allow answers between 3.6 and 4.7 for 2 marks to reflect readings taken from the graph	**(2)**

Question Number	Answer	Acceptable answers	Mark
4b(iii)	• velocity/ speed (measured in) m/s (1) • <u>divided</u> by time in s (1)	velocity/ speed (measured in) ms^{-1} acceleration is rate of change of velocity m/s/s m per s per s [accept per for divide] do not accept m/s <u>times</u> time	**(2)**

Question Number	Answer	Acceptable answers	Mark

4b(iv)	at constant vel
	• distance = 60 (m) (1)
	
	slowing down
	
	    • distance = ½×2×20 (1)
	
	    • = 20 (m) (1)
		
		correct answer scores 2 marks
			(3)

Total for question 3=10 marks

Question Number	Answer	Acceptable answers	Mark
5 (a) (i)	16 (s) (1)	Sixteen/ sixteen seconds/ 16 s/ 16 seconds	**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (ii)	Downward arrow starting at centre of the block (1)	Mark by eye ie ruler not required. Accept freehand lines and gaps between dot and line less than half the distance between dot and bottom of block by eye. Accept lines that are not quite vertical	**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (iii)	D zero		**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (iv)	Substitution 3 / 2 (1) Evaluation 1.5 (1) Unit m/s^2 (1)	ms^{-2} or m/s/s bald 1.5 x 10^n m/s^2 gains 2 marks eg bald 150 = 1 mark (BOD for correct substitution) 150 m/s^2 gains 2 marks give full marks for correct numerical answer, 1.5 m/s^2 even if no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (v)	An explanation to include two of the following points • (At first/in first 2 seconds Block is) accelerating (1) • Which requires a (resultant) force (1) • In addition to the force needed to balance the weight of the block (1) • (In next 4 seconds) forces are balanced (1) • (Because) velocity is constant (1)	(block is) speeding up/increasing velocity there is an unbalanced force/ forces are not balanced (Because) speed is steady	**(2)**

Question Number	Answer	Acceptable answers	Mark
5 (b)	An explanation to include Information taken from the graph (1) A valid conclusion (1)	Ignore air resistance (Overall) time is less OR velocity/speed is greater OR acceleration is greater OR bigger/faster change in velocity/speed So (same amount of) work is done more quickly/energy is transferred faster	**(2)**