Question number	Answer	Additional guidance	Mark
1(a)	An answer that combines the following points of understanding to provide a logical description: • measurement of time between(or at) two positions using suitable timing equipment (1) • measurement of suitable distance along the runway with metre rule (1) • measurement of vertical height to starting position (1) • repeats AND averages AND use of a correct equation (1)	allow stopwatch, light gates minimum is 0.5 m metal tape measure average speed = distance/time OR average speed = (speed at A − speed at B)/2	**(4)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	Substitution of correct data from graph and mass conversion (1) $0.5 \times 0.65 \times (0.61)^2$ Answer (1) 0.12 (J)	maximum of 1 mark if mass in g used allow tolerance of ±0.2 for speed	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(ii)	• Tangent to the graph at h = 0.1 (1) • Answer in the region 3.5 to 3.6	either seen on graph or suitable pairs of values of Δv and Δh	**(2)**

Question number	Answer	Mark
1(b)(iii)	An answer that combines points of interpretation/evaluation to provide a logical description: • for each change in height, as the height increases the speed of the trolley increases • the greatest change in speed is between the change in height from 0.04 m to 0.9 m	(2)

Question number	Answer	Additional guidance	Mark
1(c)	An answer that combines the following points to provide a logical description of the plan/method/experiment: • identifies control variables (1) • uses at least 3 different surfaces (1) • calculates average speed for each surface and repeats (1)	constant height, constant slope, constant starting points **and same length of surface**	(3)

Question Number	Answer	Acceptable answers	Mark
2(a)	**A**		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(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
2(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 = $\frac{\text{displacement}}{\text{time}}$ NOTE answers in terms of momentum must still refer to vectors or direction to gain credit	**(2)**

Question Number		Indicative Content	Mark
QWC	***2(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
3 (a) (i)	16 (s) (1)	Sixteen/ sixteen seconds/ 16 s/ 16 seconds	**(1)**

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

Question Number	Answer	Acceptable answers	Mark
3 (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 $\underline{m/s^2}$ even if no working	**(3)**

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