Question number	Ans	Mark
1(a)(i)	D	(1)

Question number	Answer	Additional guidance	Mark
1(a)(ii)	16.0 (m/s) read from graph (1) Substitution (1) (distance travelled =) 16 × 0.5 Answer (1) 8.0 (m) (1)	award full marks for correct numerical answer without working ecf for substitution and answer using wrong speed value	(3)

Question number	Answer	Mark
1(a)(iii)	A	(1)

Question number	Answer	Additional guidance	Mark
1(a)(iv)	Obtain readings from graph (1) Substitution (1) $\frac{16}{2.0}$ Answer (1) 8.0 (m/s^2)	award full marks for correct numerical answer without working	(3)

Question number	Answer	Additional guidance	Mark
1(b)	Any three improvements from: • suitable instrument to measure distance (1) • using a greater distance (to reduce effect of reaction times) (1) • suitable instrument to measure time (1) • use of one student at the {first/second} lamp post to signal when to {start/stop} timing (1)	allow tape measure, trundle wheel allow stop watch/clock or timing app. on phone	(3)

	• two of three sets of students taking readings for the same car (1)		

Question number	Answer	Additional guidance	Mark
1(a)	Rearrangement (1) $m = \frac{f}{a}$ Substitution and conversion (1) $m = \frac{1870}{1.83}$ Answer and rounding to 3 s.f. (1) 1020 (kg)	maximum 2 marks if kN not converted to N award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
1(b)	Rearrangement of $\frac{(v-u)}{t} = a$ (1) $v = u + at$ Substitution (1) $v = 0 + 1.83 \times 16$ Answer (1) 29.3 (m/s)	award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
1(c)	Correctly identifies data points from the graph to calculate areas (1) Calculates area under AB (1) 240 m Calculates area under CD (1) 135 m distance travelled at constant speed = 240 m is greater than distance travelled when slowing down = 135 m (1)	**(4)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	force (1)	If than one word given then 0 marks.	**(1)**

Question Number	Answer	Acceptable answers	Mark
2 (a)(ii)	B 0.07kg		**(1)**

Question Number	Answer	Acceptable answers	Mark
2 (a)(iii)	Arrow pointing (vertically) upwards (1) Value of 1.2 (N) (written near to arrow) (1)	 Marks are independent of each other	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	Substitution $\frac{90}{1000} \times 3.3$ (1) evaluation 0.30 (N) (1)	 A value which rounds to 0.30 eg 0.297 Give full marks for correct answer with no working Ignore power of ten error until evaluation Allow 1 mark for 297 even with no working shown	**(2)**

Question Number		Indicative Content	Mark
QWC	***2(b)(ii)**	An explanation demonstrating some of the following: Descriptions of the graph • Accelerates upwards during stage1 • Maximum velocity is reached at the end of stage 1 • Accelerates downwards / decelerates during stage 2 • Accelerates during stage 3 • Comes to rest during stage 4. Interpretations of the shape of the graph • Fuel is burnt creating thrust in stage • Thrust is upwards in stage 1/ • Gravity/weight (is always) a downward force • Fuel runs out at end of stage 1/ has ran out by stage 2 • Still going up during/ max height at end of stage 2 • Starts to fall at start of stage 3 • Negative velocity during stage 3 because it is falling. • Rapid deceleration / collision with the ground during stage 4/end of stage 3 Explanations for changes in velocity • Resultant force upwards/ thrust greater than gravity force during stage 1 • Acceleration non-linear because mass is decreasing / resultant force is increasing • Linear deceleration in stage 2/3 because force of gravity is constant • Resultant downward force/only gravity/ weight is acting during stage 2 and 3 • Large resultant force of impact during stage 4	**(6)**

Level	0	No rewardable content
1	**1 - 2**	• A limited explanation involving descriptions of the graph. • E.g. The rocket gets faster as it goes up during stage 1. The rocket slows down during stage 2 • 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 involving interpretations of the shape of the graph e.g. The rocket's velocity increases during stage 1 because the burning fuel provides a force. The rocket accelerates downwards during stage 3 • 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 which includes descriptions and interpretations for the shape of the graph including an explanation. E.g. The rocket's acceleration during stage 1 is increasing because it is losing mass as the fuel is burnt. It then slows down until it reaches maximum height at the end of stage 2 • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for Question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
3(ai)	**D** 150 m **(1)**		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(aii)	**B** at 7 s **(1)**		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(aiii)	6 (s) **(1)**		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(aiv)	Substitution: 15 ÷ 6 (1) Evaluation 2.5 (m/s^2) (1)	Allow ecf from 4(aiii) Must be 15 divided by their 4(aiii) ECF allowed from first marking point ie evaluation of 15 divided by their answer from 4(aiii) Award 2 marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(bi)	100 - 30 (1) 70 (N) (1)	100 + 30 or 130 gains 1 mark Award 2 marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(bii)	550 (N) (1)	539 (N) allow use of g = 9.8 N/kg 539.55 (N) for use of g = 9.81N/kg Award mark for correct answer, no working	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)	An explanation linking (combined) mass is less (1) smaller force required for same acceleration OR more acceleration from same force (1)	ignore references to weight, friction or backwards force ignore "easier to accelerate" as in stem less force needed (to accelerate)	**(2)**

(Total for Question 4 =10 marks)