Question	Answer	Marks	Guidance
1	**Level 3: (5 – 6 marks)** Answer shows qualitative understanding in terms of forces and momentum **AND** a full mathematical understanding of the 'explosion' idea. Quality of written communication does not impede communication of the science at this level. **Level 2: (3 – 4 marks)** Answer shows a qualitative understanding in terms of **either** forces or momentum. **OR** A correct mathematical answer showing both have equal momentum. Quality of written communication partly impedes communication of the science at this level. **Level 1: (1 – 2 marks)** Answer indicates a simple idea of equal and opposite forces **OR** momentum. Quality of written communication impedes communication of the science at this level. **Level 0: (0 marks)** Insufficient or irrelevant science. Answer not worthyof credit.	6	This question is targeted up grade A* **Indicative scientific points may include:** **Qualitative understanding** • Both have same momentum • Same force produces higher acceleration on Nina but less on Matt because he has more mass • Nina has less mass so more speed and Matt has more mass and less speed (level 3) • Force produces different speeds on different masses (level 2) • Momentum before and after is the same **Mathematical understanding** • Momentum before and after is zero (level 3) • 60 x -5 + 100 x 3 = 0 (level 3) • 0 = (60 x -5) + (100 x 3) (level 3) • 0 = -300 + 300 (level 3) • 60 x 5 = 100 x 3 (level 2) • 300 = 300 (level 2) **Level 1:** • Forces are equal and opposite • Momentum is conserved Use the L1, L2, L3 annotations in Scoris; do not use ticks.
	Total	**6**	

Question			Answer	Marks	Guidance
2	(a)		**vector** **scalar** velocity mass weight speed momentum (1) (1)	2	all three needed both needed if no marks scored 2 scalar **and** 2 vector correct scores (1) eg. **vector** **scalar** **velocity** **mass** **weight** **speed** *momentum* **X** scores (1)

Question			Answer	Marks	Guidance
	(b)		56 (m / s) (1)	1	
	(c)		180 (m) (2) **but if answer is incorrect** {(56 + 4) / 2} x 6 scores (1)	2	Allow 178 to 182. (2) **allow** e.c.f. from (b) eg. 57 (m), 96(m) or 102(m) scores (2)
			Total	**5**	

Question			Answer	Marks	Guidance
3	(a		**A – (acceleration section)** acceleration because weight is greater than drag (1) OR acceleration reduces because drag increases (1) **B – (terminal speed section)** terminal speed because weight = drag (1) OR forces are equal and opposite/balanced (1) **C - (deceleration section)** decelerating as drag increases (greatly) (1) OR decelerating as drag now greater than weight (1) **D – (**(lower) **terminal speed section)** drag = weight (1) **OR** forces are equal and opposite/balanced (1)	4	for max marks (4) the links must be there on all four points e.g. part A – acceleration **because** weight is greater than drag (1) without links max (2) for correctly describing the motion OR the forces in the 4 sections without links max (1) for correctly describing the motion OR the forces in 2 or 3 sections **ignore** gravity (rather than weight) **ignore** upthrust **ignore** GPE and KE **allow** air resistance / friction (rather than drag) **allow** for terminal speed – steady / constant speed **allow** for acceleration – increasing speed **allow** for deceleration – decreasing speed **allow** negative acceleration (for deceleration) **Three links plus one description scores 3** **Two links and two descriptions scores 3** **Two links and one description scores 2** **One link and two or three descriptions scores 2** **One link and one description scores 1** **The links and the descriptions must be from different sections.**

<table>
<tr><th colspan="3">Question</th><th>answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><td>At A all of Susie’s energy is GPE.</td><td>(✓)</td></tr>
<tr><td>Between A and B Susie gains both GPE and KE.</td><td>✖</td></tr>
<tr><td>Between A and B Susie gains only KE.</td><td>✓</td></tr>
<tr><td>At B her KE is exactly half her GPE at A.</td><td>✖</td></tr>
<tr><td>Just before touching the ground at C Susie has her maximum KE.</td><td>✓</td></tr>
<tr><td>On the ground at C Susie has zero KE.</td><td>✓</td></tr>
<tr><td>On the ground at C Susie has her maximum GPE.</td><td>✖</td></tr>
</table>
</td><td>3</td><td>Use marking tool on scoris to identify the crosses

all 6 correct (3)

4 or 5 correct (2)

2 or 3 correct (1)

only 1 correct (0)

ignore blank boxes</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>7</td><td></td></tr>
</table>

Question			answer	Marks	Guidance
4	(a)		drag less than weight (1)	1	**allow** air resistance or friction for drag **allow upward** force less than **downward** force (1) forces unbalanced (0) **but** unbalanced (resultant) force downwards (1) **ignore** gravity but **allow** gravitational force eg gravity more than drag (0)
	(b)		drag = weight (1)	1	**allow** (upward and downward) forces balanced (1) **allow** no resultant force / AW (1) **ignore** gravity but **allow** gravitational force eg Gravity = drag (0)
	(c)		drag (much) greater than weight (1)	1	**allow** upward force is (much) greater than the downward force **but** not merely forces are unbalanced **allow** surface area increases drag (1)
	(d)		**any two from:** large surface area / more particles hit (per sec) = more drag (1) surface area to weight ratio has increased (1) drag = weight **at a lower speed** (1) as speed reduces drag reduces until it equals the weight (1)	2	 eg 'larger area parachute has drag = weight at a lower speed' (2) **allow** forces balanced at a lower speed (1)
	(e)		more drag needed to balance higher weight / AW (1) the drag (needed for balance) reached at a higher speed (than before) / AW (1)	2	heavier person will need a larger air resistance (1) **ignore** references to energy
			Total	**7**	

Question			answer	Marks	Guidance
5			<table><tr><th>Statement</th><th></th></tr><tr><td>all sheets..</td><td></td></tr><tr><td>the weight of..</td><td>✓</td></tr><tr><td>the time to...</td><td></td></tr><tr><td>the drag on A >…</td><td>✓</td></tr><tr><td>at terminal speed….</td><td>✓</td></tr></table>	2	three correct = [2] one or two correct = [1] any additional tick over three: minus one to minimum of zero
			Total	**2**	

Question	Answer	Marks	Guidance
6 a	9.8 (m) or $\frac{1}{2}$ x 14 x 1.4 (2) **but if incorrect allow** attempt at calculating area under the graph (1)	2	 **Eg** shown on graph by shading / AW [1] **If no other marks scored then allow** 14 x 1.4 or 19.6 [1]
b i	instantaneous deceleration at point P is (more representative of) when diver enters water [1] idea of ignoring anomalous results / point Q is not on the line / (1) Elaine's method covers more data / more appropriate data / AW [1] (gradient gives a more) accurate result (1)	2	**allow** Q is (some time) after diver enters water [1] allow deceleration / acceleration changes (after P) [1] **eg** point Q is anomalous [1]
b ii	1200 (N) (1)	1	**Allow** -1200 (N) [1]
	Total	**5**	

Question	Answer	Marks	Guidance
7 a	11.25 m (3) **but if incorrect** 56.25 = 5 x h (2) **but if incorrect** KE = ½ x 0.5 x 15 x 15 (1) **or** m g h = ½ m v^2 / PE = KE (1)	3	 **allow** 56 = 5h (2) 11.25 (3) **if incorrect** time = 1.5 (seconds)(1) average speed = 7.5 (1) **allow** other correct calculations using equations of motion
b	**any one from** (idea that the) mass cancels out on the equation (1) (idea that without air resistance) both masses have the same acceleration (and so reach the same speed in the same time) (1)	1	
	Total	**4**	

Question			Answer	Marks	Guidance
8	(a)	(	**any one from:** fewer pedestrians / cyclists killed compared to car occupants (1) fewer pedestrians / cyclists killed compared to previous year(s) (1)	1	**allow** ratio or proportion going down **ignore** descriptions of graph eg trend or graph is down / negative correlation **ignore** answers which simply reword the question **ignore** references to pedestrian : cyclist ratio
		(ii)	**any two from:** data does not distinguish pedestrians from cyclists (1) total numbers of deaths for cars not shown (1) total numbers of deaths for pedestrians not shown (1) total numbers of deaths for cyclists not shown (1)	2	 **allow** 'ratio of cyclist deaths compared to pedestrian deaths not known' (2) **allow** 'total number of deaths for each group unknown' (2)
	(b)		**any two from:** longer time (to stop) (1) less acceleration (1) less force produced (1) **but** lower rate of change of momentum produced (2)	2	 eg 'Slow down the speed of the passengers more slowly' (1) **allow** slow down = longer time unless answer shows otherwise eg slow down the change of momentum (1) eg the change in momentum takes longer (1) **but** slow down the rate of change of momentum (0) (as you cannot 'slow down a rate') **allow** reduce the rate of change of momentum (2) **ignore** references to energy **but** energy absorbed (0) over a longer time (1)
			Total	**5**	