Impulse Mark Schene

Q1.

Question number	Answer	Additional guidance	Mark
(i)	substitution (1) (force =) $\frac{8.7}{0.35}$ evaluation (1) 25 (N)	use of force = $\frac{\text{change in momentum}}{\text{time}}$ allow numbers that round to 25 e.g 24 .8571 award full marks for correct answer without working.	**(2)** **AO2**

Question number	Answer	Additional guidance	Mark
(ii)	(magnitude) 25 (N) (1) (direction) down(wards)/ towards floor (1)	ecf from i allow arrow drawn pointing down "south"	**(2)** **AO3**

Q2.

	Answer	Additional guidance	Mark
(i)	conversion of time to s (1) (t =) 0.012 **OR** 12×10^{-3} **OR** 1.2×10^{-2} substitution (1) $(F=)\frac{(0.075 \times -15.0) - (0.075 \times 8.2)}{0.012}$ OR $(F=)\frac{(0.075 \times 15.0) - (0.075 \times -8.2)}{0.012}$ OR $(F=)\frac{0.075 \times (15.0 + 8.2)}{0.012}$ evaluation (1) (-)150 (N)	substitution and conversion in either order ignore signs on velocity accept time to any power of ten for substitution mark $(F=)\frac{(1.125) + (0.615)}{0.012}$ 145 (N) scores 3 marks 145 (N) to any other power of ten scores 2 marks maximum	(3)

		145 (N) scores 3 marks 145 (N) to any other power of ten scores 2 marks maximum 42.5 (N) scores 2 marks maximum 42.5 (N) to any other power of ten scores 1 mark maximum 93.75 (N) or 51.25(N) 1.933 scores 1 mark maximum award full marks for correct answer without working	

	Answer	**Additional guidance**	**Mark**
(ii)	Any two from: (forces are) equal / same size (1) (forces are) opposite (direction) (1) (forces) act on different bodies (1) same type of force (1)	no marks awarded for answers in terms of energy (forces are) one to the left, one to the right one (force) acts on racket, one acts on ball both are contact forces if no other marks awarded, allow action and reaction (acting) for 1 mark	**(2)** **AO1**

Q3.

	Answer	Additional guidance	Mark
	attempt to find momentum change (Δp) (1) (Δp) =± 1.4 substitution in to F = $\frac{\Delta p}{t}$ (1) $\frac{\pm 1.4}{70 \times 10^{-3}}$ evaluation (1) (±) 20 (N)	± 0.8 ± 0.6 allow (Δp) =± 0.2 allow $\frac{\pm 0.2}{70 \times 10^{-3}}$ answers which round to (±) 20 to any other power of 10 score 2 marks answers which round to (±) 2.9 scores 2 marks answers which round to (±) 2.9 to any other power of 10 score 1 mark award full marks for the correct answer without working	**(3)** **AO2**

Q4.

Question Number	Answer	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • momentum = mass × velocity • action and reaction are equal and opposite (N 3) • force of R on Q = -force of Q on R • $\frac{\text{change in momentum of Q}}{\text{time}} = \frac{\text{- change in momentum of R}}{\text{time}}$ • time of collision same for both • change in momentum of Q = - change in momentum of R • no overall change in momentum • R accelerates because of force from Q • transfer of momentum between Q and R	**(6)** AO 1 1

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Q5.

Question	Answer	Additional guidance	Mark
	explanation linking mass/(change of/initial/final) velocity/(change of) momentum (1) with a consistent equation linking chosen factor to force (1)	 accept speed/acceleration do not accept weight second marking point dependent on first marking point relevant equations are: $F = ma$ $F = \frac{mv - mu}{t}$ $F = \frac{\Delta p}{t}$ $F = \frac{m\Delta v}{t}$	**2 AO2.1**

Q6.

Question number	Answer	Additional guidance	Mark
	An explanation that combines up to 3 points of application of knowledge and reasoning/justification • Momentum increased if final velocity can be increased (1) • Distance (while in athlete's hand) is greater (1) • Time whilst subject to force is longer (1) • using the equation F = (mv-mu)/t (1)	Ignore references to shot after it has left the athletes hand accelerating for a longer time use of v = u + at or use of $v^2-u^2 = 2xaxd$	**(3)**

Q7.

		Indicative Content	Mark
QWC	*	An explanation including some of the following ideas • brakes apply a force to the car • this force from brakes makes the car decelerate/ lose velocity • a force also acts on the driver • driver decelerates at same rate as the car • does not move with respect to car/ stays in the driving seat • moves slightly because belt stretches • small/ no horizontal force acts on the shopping bag • shopping bag continues at similar/ same velocity • until shopping bag falls off seat /	**(6)**

		hits dashboard • ideas can be expressed in terms of energy, momentum and/or by reference to Newton's laws	
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation of the difference in decelerations of at least two of the objects Car **(C)**, Shopping **(S)** and Passenger **(P)** mainly describing the effects. E.g. (at start) **C** stops (very quickly) while **P / S** carries on moving (for a longer time) OR **S** carries on at same speed / hits the dashboard while **P** is held back / slowed down (by the seatbelt) • 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 of the difference in decelerations of at least **two** of the objects Car, Shopping and Passenger, including a reason for at least one of the decelerations. E.g.(at start) **C** stops (very quickly) **because of** friction at the brakes and at the road while **P / S** carries on moving (for a longer time) OR **S** carries on moving (at same speed) / hits the dashboard while **P** is held back / slowed down **because of** stretching force from the seatbelt) • 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 of the relative decelerations of **C**, **S and P** including mention of the physical principles involved in any two such as that named forces are needed to change given motions. E.g. (The force of) friction is large for **C** to slow down / stop quickly but is low for **P** and **S**. **So / thus / therefore etc** **P** or **S** carry on at the same speed (initially). **P** decelerates more slowly than **C because / as a result etc** of the stretching (force) of the seatbelt. OR *The idea of* Newton's first law / inertia / need for a force to change motion *and the role of friction and elastic / tension / stretching force in producing the* ***three*** *named decelerations. OR Named force*	

		*needed for a described change in momentum/kinetic energy to stop / slow down each of the **three** objects.* • *the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately* • *spelling, punctuation and grammar are used with few errors*

Q8.

	Answer	***Acceptable answers***	***Mark***
(a)	*Description including 3 of the following:* • *(Gravitational) potential energy (transferred) to KE(1)* • *Idea of energy transfer to heat/sound whilst descending (1)* • *Chemical energy is transferred to heat energy in Andrew (1)* • *Idea of energy dissipated on stopping (1)*	*(G)PE (transferred) to KE Allow gravitational energy for GPE* *Energy transferred to heat because of air resistance/ friction The energy goes to heat as he stops.* *Energy is transferred to the surroundings*	***(3)***
(b)(i)	*substitution (1)* *67 × 31 evaluation (1)* *2077 (kg m/s)*	*2080, 2100 working backwards using 2000* *(v=) 29.85, 30* *(m=) 64.52, 65 67 X 31=2000 scores only one mark*	***(2)***
(b)(ii)	*substitution (1)* *2000 ÷ 2.3* *evaluation (1)* *870 (N)*	*answer to (b)(i)) ÷ 2.3 900, 869.6, 869.5* *903*	***(2)***
(b)(iii)	*an explanation linking two of the following* • *Force on Andrew is quite small (1)* • *Because impact time is long (1)* • *The acceleration/deceleration is quite small (1)* • *Because impact distance is far (1)*	*force is reduced/ less /not as strong slows down/changes momentum gradually acceleration = 1.35 'g' or 13.5 m/s^2 slows down (rate of) change of momentum scores 2 marks*	***(2)***

Total question = 8 marks

Q9.

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that combines identification (1 mark) and reasoning (1 mark) • identify the two forces which are (force of the submarine on the water) and force/push of water on the submarine/propeller (1) • these forces are equal and opposite (1)	states N's 3rd law mentions action and reaction **ignore** balanced forces	**(2)**

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation that combines identification (1 mark) and reasoning (1 mark) • states N's 2nd law (1) $F = \frac{(mv - mu)}{t}$ • The reason that a long time is needed is because of a big change in momentum (1)	large momentum if no other marks scored F = ma scores 1 mark **OR** large mass scores 1 mark	(2)

Q10.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (strand 2) (6 marks)** <u>Determining force</u> • Use of F = (mv - mu)/t or F =ma • mass (of trolley(s)) needed • and times during impact (t) <u>Showing effect of crumple zone</u> • experiment repeated with and without the spring • (note) difference in contact times • use of spring as crumple zone • with spring, time for contact greater, less impact force <u>Precautions or controls</u> • times repeated and average taken • careful controls – same starting position / same angle of slope / release without pushing etc.	**(6)Exp**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

SUMMARY, for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Elements of physics present i.e. isolated knowledge of techniques and procedures – **two** unconnected statements from any section	Possible candidate responses Use F = (mv - mu)/t Use F = ma keep slope the same repeat and average use spring as crumple zone
Level 2	3–4	Additional guidance Some knowledge of techniques and procedures with a logical connection made in one section and statement from one more section	Possible candidate responses Measurements (difference in contact times) with and without the spring Use F = ma in finding the force
Level 3	5–6	Additional guidance Detailed knowledge of techniques and procedures with logical connections made in two sections and statement from one more section	Possible candidate responses Measure the trolley mass(es)/ velocities/ impact time(s) and use F = ma in finding the force Measurements (difference in contact times) with and without the spring Same starting place for trolley each time.