Newton's Laws - Revision question answers -Higher Tier

Duel award – physics 2018 Q2

(a)	(i)		To ensure that the cake case has reached terminal [top / maximum….] speed / has stopped accelerating
	(ii)		To check repeatability / identify anomalies (1) [Not: to ensure there are no anomalies] To improve the mean / give a more accurate mean / to reduce the effect of random errors / to allow anomalies to be removed before calculating the mean (1) Reference to 'reliability' → no credit
(b)	(i)		Substitution into $s = \frac{d}{t}$ i.e. $2.88 = \frac{1.50}{t}$ (1) t = 0.52 [s] (1) [accept 0.5, 0.521]
	(ii)		Appropriate scales on both axes 0.5 g and 0.5 m/s per 2 cm square (1) 5 points plotted correctly (ignore (0,0) to within <1 small square division (2) 4 points plotted correctly (ignore (0,0) to within <1 small square division (1) 3 points plotted correctly (ignore (0,0) to within <1 small square division (0) Smooth curve of best fit to (0,0) < 1 small square division (1)
	(iii)		Correct pair of values of speed taken from graph or table for 1.0 g and 2.0 g or 1.5 g and 3.0 g (1) Calculation of ratio for at least 1 other pair of masses e.g. ~2.8 / 1.60 = ~1.75 or 2.94 / 2.54 = 1.16 (1) Conclusion [must include a valid comparison of ratio to 1.4] – so not always true (1) **Alternative route** Correct pair of values of speed taken from graph or table for 1.0 g and 2.0 g or 1.5 g and 3.0 g (1) [can be implied by method] Calculation of expected speed, i.e. 2.54 × 1.4 = 3.56 or 2.24 × 1.4 = 3.14 (1) Valid comparison of speeds, e.g. 3.56 ≠ 2.94, or 3.14 ≠ 2.8 so not always true (1)

(c)			Valid improvement and justification e.g. Drop the cake cases from a greater height (1) So that the random errors due to timing are a smaller fraction of the value measured (1) **Alternative:** Use light gates / record with a camera or phone (1) to give a more accurate time measurement / reduce reaction time errors (1) **Alternative:** Measure the mass of the stack / each case (1) to give a more <u>accurate</u> mass / mass closer to the true value(1) Not: extra data collected
(d)			**Use** of weight = mg (1) [allow even if mass not converted] air resistance = 0.025 [N] [on answer line] (1) **cao** air resistance = weight (1)

Duel award – physics 2019 Q2

(a)			If object A exerts a force on object B, then B exerts an equal and opposite force on A (1) Accept action and reaction are equal and opposite The wall applies a force on the car in the collision (1) Therefore the car applies an equal <u>and opposite</u> force on the wall (1)
(b)	(i)		Use of $a = \frac{v-u}{t}$ and $F = ma$ (1) $a = \frac{(0-15)}{0.028}$ = (–)535.7 [m s^{-2}] (1) [ignore sign] Accept 536 [m s^{-2}] F = 85 × 535.7 **ecf** = 46 000 [N] (1)
	(ii)		Gradient / slope of the graph isn't constant / acceleration is changing or increasing (1) Don't accept acceleration is decreasing Which shows that the <u>force increases</u> through the stopping process (1) Don't accept that the force changes
(c)			The crumple zone increases the distance or time to stop (1) So the <u>force</u> is smaller [on the driver] (1) N.B. Award only 1 mark if a fully correct answer is accompanied with an incorrect statement about work done changing

Duel award -physics 2022 Q5

(a)	(i)		$\frac{0.036+0.032+0.033+0.034+0.030}{5} = \frac{0.165}{5} = 0.033$ [N] Don't accept 0.03 N
	(ii)		$\frac{0.036-0.030}{2} = 0.003$ [N]
	(iii)		$\frac{0.003\ \textbf{ecf}}{0.033\ \textbf{ecf}}$ (1) ×100 % = 9 [%] [this is less than 10 %] so the data is repeatable (1) Accept 9.09 [%] or 9.1 [%]
(b)	(i)		Light gates are more accurate measurement **or** no human reaction time when using light gates Accept no human error Don't accept to make it more repeatable
	(ii)		Selection of 0.55 **and** 1.1 (1) $0.5 \times 3.3 \times 10^{-3} \times 0.55^2 = 4.99125 \times 10^{-4}$ [J] **OR** $0.5 \times 3.3 \times 10^{-3} \times 1.1^2 = 1.9965 \times 10^{-3}$ (1) [J] **accept** 5×10^{-4} [J] **or** 2×10^{-3} [J] $\frac{1.9965 \times 10^{-3}}{4.99125 \times 10^{-4}} = 4$ **or** $4.99125 \times 10^{-4} \times 4 = 1.9965 \times 10^{-3}$ so the student is correct (1) N.B. No penalty if $\times 10^{-3}$ is omitted throughout **Alternative:** $\frac{1.1^2(1)}{0.55^2(1)} = 4$ so the student is correct (1) **or** 0.3025 (1) × 4 (1) = 1.21 so the student is correct (1)

(c)	(i)		[As the drop height increases] the mean speed increases (1) at a decreasing rate (1) Don't accept speed accelerates or speed increase slows down
	(ii)		1.1 [m/s]
	(iii)	I	Weight / <u>force of</u> gravity **and** air resistance / drag
		II	Forces are balanced / equal

(a)	(i)		Gravitational (1) Earth (1)
	(ii)		Equal **and** opposite Accept they are balanced
	(iii)		Substitution: $1.5 = m \times 10$ (1) Mass = 0.15 [kg] (1)
(b)	(i)		10 [m/s^2] accept 9.8 [m/s^2]
	(ii)		1.25 [N]
	(iii)		Substitution into: $F = ma$ i.e. 1.25 **ecf** = 0.15 **ecf** $\times a$ (1) Rearrangement: $a = \frac{1.25}{0.15}$ (1) = 8[.3] [m/s^2] (1)
(c)			No air resistance [on the moon] (1) Accept drag So acceleration is same so agree (1) Accept speeds up the same

Separate Physics 2022 Q7 part a

(a)			**Indicative content:** Initially, only weight acts, there is a resultant force downwards and the skydiver accelerates described by Newton's second law, $F = ma$. As the skydiver speeds up air resistance increases until the forces balance. Newton's first law states that if the forces acting on a body are balanced then it will remain in a constant state of motion, so the skydiver travels at terminal speed. Newton's third law states that if a body A exerts a force on body B, then body B exerts an equal and opposite force on body A. As the skydiver exerts a force on the air, the air exerts an equal and opposite force on the skydiver which is air resistance. **5–6 marks** Correctly states all 3 laws and correctly applies them to the motion. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** Correctly states and applies 2 laws or does 3 partially. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks** Correctly states and applies 1 law or a partial treatment of 1 or 2. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.* *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*