

Mark Scheme

Q1.

Question Number	Answer	Mark
	The only correct answer is A $\left(\frac{2g}{3}\right)$ B is not correct because the resultant force is not $5g$ as this does not take the weight of the 3 kg mass into account C is not correct because this gives the resultant force on the 3 kg mass in N D is not correct because this gives the upwards force from the spring in N	1

Q2.

Question Number	Answer	Mark
	C is the correct answer This is because $s = \frac{1}{2}gt^2$. So if in one unit of time the sphere has fallen one unit of distance, i.e. from image 1 to image 2, then in 2 units of time it will have fallen 4 units of distance, i.e. from image 1 to R.	(1)

Q3.

Question Number	Answer	Mark
	The only correct answer is C (initial acceleration is same for coin and feather, and time taken to reach the ground is less for coin) A is not correct because both objects have the same initial acceleration B is not correct because both objects have the same initial acceleration and object A has a greater terminal velocity D is not correct because object A has a greater terminal velocity	1

Q4.

Question Number	Answer	Additional Guidance	Mark
	Use of $\Sigma F = ma$ (1) $a = 1.3 \text{ m s}^{-2}$ (1)	<u>Example calculation</u> $a = \frac{6700 \text{ N} - 900 \text{ N}}{4500 \text{ kg}} = 1.29 \text{ m s}^{-2}$	2
	Total for question		2

Q5.

Question Number	Answer	Mark
	The only correct answer is B ($\frac{(0.5 - 0.4) \times 9.81}{0.5 + 0.4}$) A is not correct because the total mass being accelerated is $0.4 \text{ kg} + 0.5 \text{ kg}$ C is not correct because the total mass being accelerated is $0.4 \text{ kg} + 0.5 \text{ kg}$ and the resultant force is $(0.5 \text{ kg} - 0.4 \text{ kg}) \times 9.81 \text{ N kg}^{-1}$ D is not correct because the resultant force is $(0.5 \text{ kg} - 0.4 \text{ kg}) \times 9.81 \text{ N kg}^{-1}$	1

Q6.

Question Number	Answer	Mark
	B is the correct answer A is incorrect because the gradient gives a quarter of the acceleration C is incorrect because the gradient gives the wrong units D is incorrect because the gradient gives the wrong units	1

Q7.

Question Number	Answer	Mark
	The correct answer is B because for a constant resultant force acceleration increases if mass decreases A is incorrect because a constant acceleration for a decreasing mass would require a decreasing resultant force C is incorrect because a decreasing acceleration for a decreasing mass would require a decreasing resultant force D is incorrect because a decreasing acceleration for a decreasing mass would require a decreasing resultant force	1

Q8.

Question Number	Acceptable Answer	Additional Guidance	Mark
	Use of $F = ma$ with $F = 4800 \text{ N}$ (1) Use of $W = mg$ (1) $W = 150\,000 \text{ N}$ (1)	<u>Example calculation</u> $m = \frac{4800 \text{ N}}{0.31 \text{ m s}^{-2}} = 15\,500 \text{ kg}$ $W = 15\,500 \text{ kg} \times 9.81 \text{ N kg}^{-1}$ $= 152\,000 \text{ N}$	3

Q9.

Question Number	Answer	Mark
(a)	Use of $W = mg$ (1) Use of $F = ma$ (1) $a = 4.8 \text{ m s}^{-2}$ (1) <u>Example calculation</u> $W = 5.0 \times 10^6 \text{ kg} \times 9.81 \text{ N kg}^{-1} = 4.91 \times 10^7 \text{ N}$ $\Sigma F = 7.3 \times 10^7 \text{ N} - 4.91 \times 10^7 \text{ N} = 5.0 \times 10^6 \text{ kg} \times a$ $a = \frac{2.39 \times 10^7 \text{ N}}{5.0 \times 10^6 \text{ kg}} = 4.78 \text{ m s}^{-2}$	3
(b)	The mass / weight of the rocket / fuel decreases (because fuel is used up) Or The thrust force increases Or The resultant force increases (1)	1
Total for question		4

Q10.

Question Number	Answer	Additional Guidance	Mark
(a)	(Starting and stopping stopwatch) involves human reaction time (1) (So) there will be (large) <u>random</u> errors (1)	Ignore references to human error	2
(b)(i)	The length of the metal cylinder (1)	Ignore length of the tube	1
(b)(ii)	Use of $v^2 = u^2 + 2as$ (1) $a = 9.62 \text{ m s}^{-2}$ (1)	Allow any valid suvat method to determine acceleration <u>Example calculation</u> $a = \frac{(2.96 \text{ m})^2 - (1.39 \text{ m})^2}{2 \times 0.355 \text{ m}} = 9.619 \text{ m s}^{-2}$	2
Total for question			5

Q11.

Question Number	Answer	Mark
	• Reference to $s = ut + \frac{1}{2} at^2$ with $u = 0$ (1) • Correct variable labels on graph axes to give a straight line through origin. (1) • Reference to time in s and distance in m (this can be taken from the axes labels or a suitable unit conversion) (1) • Straight line through origin. (1) • Correct method to determine g using their graph. (1)	(5)

Q12.

Question Number	Answer	Mark																																						
(a)*	This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning. Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning. The following table shows how the marks should be awarded for indicative content and lines of reasoning. <table><tr><th>IC points</th><th>IC mark</th><th>Max linkage mark available</th><th>Max final mark</th></tr><tr><td>6</td><td>4</td><td>2</td><td>6</td></tr><tr><td>5</td><td>3</td><td>2</td><td>5</td></tr><tr><td>4</td><td>3</td><td>1</td><td>4</td></tr><tr><td>3</td><td>2</td><td>1</td><td>3</td></tr><tr><td>2</td><td>2</td><td>0</td><td>2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr></table> <table><tr><td></td><td>Marks</td></tr><tr><td>Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout.</td><td>2</td></tr><tr><td>Answer is partially structured with some linkages and lines of reasoning</td><td>1</td></tr></table>	IC points	IC mark	Max linkage mark available	Max final mark	6	4	2	6	5	3	2	5	4	3	1	4	3	2	1	3	2	2	0	2	1	1	0	1	0	0	0	0		Marks	Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout.	2	Answer is partially structured with some linkages and lines of reasoning	1	
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	Indicative content: 1. There is a (backward) force/friction on floor from wheels/car 2. Newton's Third Law implies forward/opposite force from floor 3. Compression/deformation of spring reduces (as car moves forward) 4. (Resultant) force is proportional to compression/deformation of spring Or Reference to Hooke's law. 5. Acceleration is proportional to resultant force Or Reference to $F = ma$ 6. Acceleration reduces (as distance travelled increases) Or Acceleration is zero once spring has returned to original state Accept "resultant force" for "acceleration" in IC6	6
Total for question		6

Q13.

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	Indicative content: IC1 The force of the lift/scales on the student is the reading on the scales Or The reaction/contact force is the reading on the scales IC2 At constant speed, the resultant force on the student is zero Or Weight/W = Reaction/R IC3 At constant speed the reading on the scales would be 600 N. Or At rest the reading on the scales would be 600 N IC4 As lift decelerates reaction is less than weight IC5 As the lift decelerates there is a resultant downward force (on the student). IC6 As the lift decelerates the reading on the scales will be less than 600 N (because the upward force on the student is less than his weight)	
	Total for question	6

Q14.

Question Number	Answer	Mark																					
(a)	- Length/height of wooden rod (1) - Distance from the rod to the light gate (1)	2																					
(b)	$v = \frac{\text{length of rod}}{\text{time (to pass through light gate)}}$ (1) - Repeat (at each height) and (calculate) an average (1)	2																					
(c)	- Repeat at different (release) heights (above the light gate and calculate v for each height) (1) - States an appropriate graph to draw (1) - Corresponding description of how to obtain the acceleration from the gradient (1) <table><tr><td>Graph</td><td>$s - v^2$</td><td>$v^2 - s$</td><td>$2s - v^2$</td><td>$v^2 - 2s$</td><td>$v^2/2 - s$</td><td>$s - v^2/2$</td></tr><tr><td>a</td><td>$1/(2 \times \text{gradient})$</td><td>$\text{gradient}/2$</td><td>$1/\text{gradient}$</td><td>$\text{gradient}$</td><td>$\text{gradient}$</td><td>$1/\text{gradient}$</td></tr><tr><td>Gradient</td><td>$1/2a$</td><td>$2a$</td><td>$1/a$</td><td>a</td><td>a</td><td>$1/a$</td></tr></table>	Graph	$s - v^2$	$v^2 - s$	$2s - v^2$	$v^2 - 2s$	$v^2/2 - s$	$s - v^2/2$	a	$1/(2 \times \text{gradient})$	$\text{gradient}/2$	$1/\text{gradient}$	gradient	gradient	$1/\text{gradient}$	Gradient	$1/2a$	$2a$	$1/a$	a	a	$1/a$	3
Graph	$s - v^2$	$v^2 - s$	$2s - v^2$	$v^2 - 2s$	$v^2/2 - s$	$s - v^2/2$																	
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Total for question		7																					