Marking Scheme

#1

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	*(a)*		The point through which the whole of the weight of the object can be considered to act	1			1		
	(b)	(i)	Principle of moments used i.e. 30 F = 40 × 150 (1) F = 200 [N] (1)	1	1		2	2	
		(ii)	Moments taken about the front wheel, which is further from the handles (1) 100 F = 30 × 150 (1) F = 45 [N] (1)			3	3	3	
		(iii)	Increase the size of the base / distance between the wheels (1) Lower cog of the buggy / increase the weight of the base / lower the centre of gravity (1)	2			2		
			Question 6 total	**4**	**1**	**3**	**8**	**5**	**0**

#2

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
	(a)	(i)	[lantern moment] 0.9 × 9.81 × 0.8 [= 7.06] [N m] or by implication (1) [bar moment] 1.8 × 9.81 × 0.55 [= 9.70] [N m] or by implication (1) Total = 17 N m **UNIT** (1) accept 16.8 and 16.7 Give 1 mark if g omitted and answer given as 1.7 with or without any unit.	1 1	1		3	3	
		(ii)	[Anticlockwise] torque due to wire = T × 1.1 m × sin 35° or by implic (1) T = 27 [N] **ecf on (a)(i)** (1)			2	2	2	
		(iii)	Tension must increase (1) Convincing brief explanation e.g. reducing angle decreases [perpendicular] distance **or** reduces component of tension perpendicular to bar (vertical component **or** tension must increase to compensate **or** so that [total] clockwise moment is still balanced (1) **Accept** numerical demonstration using a specific angle smaller than 35° for both marks (First mark for demonstration, second for conclusion)			2	2		
	(b)		1.4 [m s^{-1}]		1		1		
			Question total	**2**	**2**	**4**	**8**	**5**	**0**

#3

Question		Marking details	Marks available AO1	AO2	AO3	Total	Maths	Prac
6	(a)	It equates [opposing] moments of [weights of] m and M (1) when multiplied each side by g [or equivalent]. (1) 0.150 m is distance of rule's C of G from pivot – could be shown on diagram (1) [Absence of g penalised by 1 only] Or (Derivation of equation using PoM) Distance of C of G from pivot = [0.500 – 0.350] = 0.150 m (1) ACM of mg about the pivot = mgz And CM of Mg about pivot = $Mg \times 0.150$ (1) ∴ By PoM $mgz = Mg \times 0.150$ followed by simplification (1)	1	1 1		3		3
	(b)	Reasonable **best fit** line drawn (1) Gradient 0.0175 [±0.005] [kg m] or equivalent (point chosen on line of best fit) (1) [i.e. 0.017(0) – 0.018(0)] Gradient = $M \times 0.150$ [m] or equivalent used (1) M = 0.117 kg ecf from gradient [0.11 – 0.120]. Answer given to 2 or 3 s.f (1) [Give max of 2 marks for method (1) and answer (1) based on a single ***plotted*** data point.]			4	4	4	4
	(c)	From graph (or equation) 0.050 kg has to be at about z = 0.34 m. [Accept 0.32 m based on plotted point.] (1) Lower values of m would need larger z, but $z < 0.350$ m so significantly lower values of m not possible (1) or for largest possible value of z (0.35 m), m = 0.049 kg (1) So values of m significantly lower than 0.050 kg not pos. (1)			2	2	1	2
		Question 6 total	**1**	**2**	**6**	**9**	**5**	**9**

#4

Question				Marking details	Marks available AO1	AO2	AO3	Total	Maths	Prac
	(a)			Diagram showing force and perpendicular distance to pivot clearly labelled (1) Moment = force × perpendicular distance to pivot (1)	2			2		
	(b)	(i)		Distances correct 85 cm and 40 cm (1) Weight = 1.7 [N] / correct use of principle of moments (1) Mass = 0.17 / 0.2 [kg] (1)		3		3	2	3
		(ii)	I	Measure at both ends to ensure same height / spirit level / any suitable method			1	1		1
			II	Application of principle of moments (1) F = 4.26 [N] / accept 4.25 N or 4.3 N (1)		2		2	2	2
	(c)			[Clockwise] moments increase [with larger mass] (1) Mass needs to be moved towards the pivot / newton meter moved away from pivot (1) **Alternative (1)** Raise the clamp holding the newton meter / lower the pivot (1) this is because a greater upward force is needed so the extension of the newton meter spring would be greater (1) **Alternative (2)** Move the pivot towards the centre of mass (1) So this will decrease the moment (1)			2	2		2
				Question total	**2**	**5**	**3**	**10**	**4**	**8**

#5

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		**Calculate the mass of the ruler, *R*** Put known mass on the 0 to 30 cm side of the ruler Adjust the mass until the ruler is level / balances Apply principle of moments to find mass of ruler / accept diagram **Finding unknown mass, *M*** Put unknown mass on 0 - 30 cm side of ruler Put known mass on 30 – 100 cm side Adjust until it balances **Calculating unknown mass, *C*** Apply principle of moments Unknown mass × distance to pivot Equals mass of ruler × 20 + known mass × distance to pivot **5-6 marks** Comprehensive description of how to calculate the mass of the ruler and how to find and calculate the unknown mass. *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured.* **3-4 marks** Limited description of how to calculate the mass of the ruler and how to find and calculate the unknown mass OR comprehensive description of how to calculate the mass of the ruler OR comprehensive description of how to find and calculate the unknown mass. *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure.* **1-2 marks** Limited description of how to calculate the mass of the ruler OR how to find and calculate the unknown mass. *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure.* **0 marks** No attempt made or no response worthy of credit.	6			6		6
	(b)		All force acts at 90° to wall (1) $R \times 3 \sin 70°$ (1) $= 30 \times 9.8 \times 1.5 \cos 70°$ (1) $R = 53.6$ [N] (1) N3 used to give direction horizontally to the left (1)		1 1 1	1 1	5	3	
			Question 5 total	**6**	**3**	**2**	**11**	**3**	**6**