OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education

MATHEMATICS 4729

Mechanics 2

MARK SCHEME

Specimen Paper

MAXIMUM MARK	72

This mark scheme consists of 4 printed pages.

Registered Charity Number: 1066969
[Turn over

1	**(i)**	Work done is $500\cos 15° \times 400 \approx 193\,000$ J	M1	For attempt to use Force × distance
			A1	For correct unsimplified product
			A1 **3**	For correct answer 193 000
	(ii)	Power applied is $\frac{193185}{600} \approx 322$ W	M1	For relevant use of $\frac{\text{work}}{\text{time}}$ or force × velocity
			A1 **2**	For correct answer 322
			5	
2	**(i)**	CM is vertically above lowest point of base	B1	For stating or implying correct geometry
		Hence $\tan\alpha = \frac{6}{7.5} \Rightarrow \alpha = 38.7°$	M1	For appropriate trig calculation
			A1 **3**	For correct answer 38.7
	(ii)	Cylinder slides when $\tan\theta = \frac{3}{4}$	B1	For stating or implying limiting friction case
		But $\frac{3}{4} < 0.8$, so $\theta < \alpha$	M1	For comparing $\tan\alpha$ to $\tan\theta$, or equivalent
			A1	For correct comparison of the angles
		Hence it slides first (at inclination $36.9°$)	A1 **4**	For correct conclusion of sliding first
			7	
3	**(i)**	CG of triangle is $\frac{2}{3}a$ horizontally from A	B1	
		Moments: $\frac{1}{3}W \times \frac{2}{3}a + \frac{2}{3}W \times \frac{3}{2}a = W \times \bar{x}$	M1	For equating moments about A, or equivalent
			A1	For a correct unsimplified equation
		Hence $\bar{x} = \frac{11}{9}a$	A1 **4**	Given answer correctly shown
	(ii)	$R_A \times 2a = W \times \frac{7}{9}a \Rightarrow R_A = \frac{7}{18}W$	M1	For one moments equation
			A1	For one correct answer
		$R_A + R_D = W \Rightarrow R_D = \frac{11}{18}W$	M1	For resolving, or a second moments equation
			A1√ **4**	For a second correct answer
			8	
4		Horiz distances of B from A and C are 5 cm and 16 cm	M1	For appropriate use of Pythagoras
			A1	For both distances correct
		$21T_A = 13 \times 18.5 + 20 \times 8$	M1	For any moments equation for the system
			A1√	For any one relevant term correct
			A1√	For a completely correct equation
		$T_A + T_C = 33$	M1	For resolving, or using another moments eqn
		Hence $T_A = 19.1$ N and $T_C = 13.9$ N	A1	For correct answer 19.1
			A1 **8**	For correct answer 13.9
			8	
5	**(i)**	Gain in KE is $\frac{1}{2} \times 80 \times 5^2 = 1000$ J	M1	For use of formula $\frac{1}{2}mv^2$
		Gain in PE is $80 \times 9.8 \times 4 = 3136$ J	M1	For use of formula mgh
			A1 **3**	For both answers 1000 and 3136 correct
	(ii)	$8000 = 1000 + 3136 + 70d$	M1	For equating work done to energy change
			M1	For relevant use of force × distance
		Hence distance AB is 55.2 m	A1 **3**	For correct answer 55.2
	(iii)	$\frac{720}{5} - 70 = 80a$	B1	For driving force $\frac{720}{5}$
			M1	For use of Newton II with 3-term equation
			A1	For a completely correct equation
		Hence acceleration is 0.925 m s^{-2}	A1 **4**	For correct answer 0.925
			10	

6	**(i)**	$0 = (19\sin 11°)^2 - 2gh$	M1	For use of relevant const acc equation for h
			B1	For correct vertical component $19\sin 11°$
		Hence max height is $\dfrac{(19\sin 11°)^2}{19.6} + 1.53 = 2.20$ m	A1	For correct expression for h (≈ 0.67)
			A1 **4**	For correct answer 2.20
	(ii)	*EITHER*: Time to top point is $\dfrac{19\sin 11°}{g} \approx 0.3699$	M1	For use of relevant const acc equation for t_{up}
		Time to fall is $\sqrt{\dfrac{2\times 2.20}{9.8}} \approx 0.6701$	M1	For use of relevant const acc eqn for t_{down}
			A1	For a correct expression for t_{down}
		Total time of flight is 1.04	A1	For correct value (or expression)
		Horiz dist is $19\cos 11° \times 1.04 \approx 19.4$ m	M1	For any use of $x = (19\cos 11°)t$
			A1	For correct answer 19.4
				[Alternative approaches for the first four marks are equally acceptable; e.g. the use of $s = ut - \frac{1}{2}gt^2$ to find $t = 1.04$]
		OR: $-1.53 = x\tan 11° - \dfrac{gx^2}{2\times(19\cos 11°)^2}$	M1	For relevant use of trajectory equation
			B1	For $y = -1.53$ correctly substituted
			A1	For completely correct equation for x
		Hence $x = 19.4$	M1	For attempt to solve relevant quadratic
			A2 **6**	For correct answer 19.4
			10	
7	**(i)**	$T_1 \times \frac{7}{25} = 0.08g$	M1	For resolving vertically
			B1	For $\frac{7}{25}$ or $\sin 16.3°$ or equivalent
		Hence tension in upper string is 2.8 N	A1	For correct value 2.8
		$T_1 \times \frac{24}{25} + T_2 = 0.08 \times \dfrac{10.5^2}{2.4}$	M1	For correct use of Newton II horizontally
			B1	For any use of $\dfrac{10.5^2}{2.4}$, or equivalent
			A1	For correct horizontal equation
		Hence tension in horizontal string is 0.987 N	A1 **7**	For correct value 0.987
	(ii)	$2.8 \times \dfrac{2.4}{2.5} = 0.08 \times \dfrac{v^2}{2.4}$	M1	For new horizontal equation with $T_2 = 0$
			A1√	For correct equation for v
		Hence $v = 8.98$	M1	For solving for v correctly
			A1 **4**	For correct value 8.98
			11	

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8	**(i)**	Change of momentum of A is 0.24×2	M1		For considering momentum of A
			A1		For correct expression for change in mom
		Hence magnitude of impulse is 0.48 N s	A1	**3**	For correct answer 0.48
	(ii)	$mv_B = 0.48$	M1		For considering momentum of B
		$v_B \geqslant 6$	M1		For using the inequality $v_B \geqslant v_A$
		Hence $m \leqslant \dfrac{0.48}{6} = 0.08$	A1	**3**	For showing given answer correctly
	(iii)	$m = 0.06 \Rightarrow v_B = 8$	B1		For correct speed of B
		Hence $8 - 6 = e(8 - 0)$	M1		For correct use of Newton's law
		i.e. $e = \frac{1}{4}$	A1	**3**	For correct answer $\frac{1}{4}$ or equivalent
	(iv)	$0.24\times 4 - 0.06\times 4 = 0.24a + 0.06b$	B1		For a correct momentum equation
		$b - a = \frac{1}{4}(4 + 4)$	B1√		For a correct restitution equation
		Hence speeds of A and B are $2\ \text{m s}^{-1}$ and $4\ \text{m s}^{-1}$	M1		For solution of relevant simultaneous equns
			A1	**4**	For both answers correct
				13	