EDEXCEL - LONDON EXAMINATIONS

Stewart House 32 Russell Square London WC1B 5DN

FINAL

4MK

17-01-01

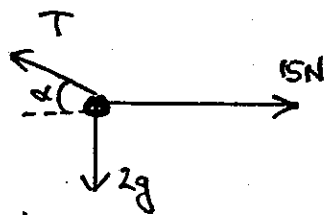
January 2001

Advanced Supplementary/Advanced Level

General Certificate of Education

Subject **MECHANICS 6677**

Paper No. **M1**

Question number	Scheme	Marks
1. (a)	Resolving vertically e.g. $R_P + R_Q = 70$ $R_P = 20 \Rightarrow R_Q = 50$	M1 A1 (2)
(b)	A valid moments equation e.g. $R_P \times 0.5 + R_Q \times x = 70 \times \frac{3}{2}$ $20 \times 0.5 + 50 \times x = 70 \times \frac{3}{2}$ Completing method to find AQ AQ = 1.9	M1 A1ft DM1 A1 cao (4)
2		
(a)	ONE resolution equation e.g. $T\cos\alpha = 15$ OR $T\sin\alpha = 2g$ are most likely but $T = 15\cos\alpha + 2g\sin\alpha$, $2g\cos\alpha = 15\sin\alpha$ also possible as is also Lami's theorem. One equation correct; second independent eqn. correct (omission of g loses A1 only) $\tan\alpha = \frac{2g}{15}$ or $\frac{2}{15}$ [$\tan\alpha = \frac{15}{2g}$ scores M1 A0] Answer for α as 53° OR 52.6°	M1 A1 + A1 M1 A1ft A1 (6)
(b)	Using valid equation (their 1 M1 required) to extract value of T (or eliminating α from valid eqns) T = 24.7 or 25	M1 A1 (2)

("Over accurate" answers in (a) or (b) or both which round to correct answer receive a penalty of −1 once overall)

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3.(a)	For particle A $T - 3mg = 3ma$	M_1
	[Note $T - mg = ma$ or $T - m = ma$ etc scores M_1]	
	$T - 3mg = 3m\left(\frac{2}{5}g\right) \rightarrow T = \frac{21}{5}mg$	$A_1 \rightarrow A_1$ (3)
(b)	String is inextensible	B_1 (1)
(c)	For particle B $kmg - T = kma$	M_1
	[(or system) $kmg - 3mg = (km + 3m)a$]	
	$kg - \frac{21}{5}g = \frac{2}{5}kg$ (or equivalent equation in k only)	A_1 f.t.
	Solving DM1 dependent on first M1 in (c)	DM1
	$k = 7$	A_1 cao (4)
(d)	Tension is of same magnitude throughout the string	B_1 (1)
4.(a)	At $t = 0$ $\underset{\sim}{r}_P = 2\underset{\sim}{i} - \underset{\sim}{j}$; At $t = 2$, $\underset{\sim}{r}_P = 6\underset{\sim}{i} + \underset{\sim}{j}$	
	Velocity of P constant $\Rightarrow \underset{\sim}{v}_P = \frac{(6\underset{\sim}{i} + \underset{\sim}{j}) - (2\underset{\sim}{i} - \underset{\sim}{j})}{2}$	M_1A_1
	$\underset{\sim}{v}_P = 2\underset{\sim}{i} + \underset{\sim}{j}$ (one slip in $\underset{\sim}{i}$ or $\underset{\sim}{j}$ only)	A_1 f.t. (3)
(b)	$\arctan\frac{1}{2}$ (or $\arctan 2$ allowed for M_1)	M_1
	$26.6°$ only	A_1 (2)
(c)	$\vec{OC} = 2\underset{\sim}{i} - \underset{\sim}{j} + 5(2\underset{\sim}{i} + \underset{\sim}{j})$ OR $6\underset{\sim}{i} + \underset{\sim}{j} + 3(2\underset{\sim}{i} + \underset{\sim}{j})$	M_1
	$\vec{OC} = 12\underset{\sim}{i} + 4\underset{\sim}{j}$	A_1 ft
	$\lvert\vec{OC}\rvert = \sqrt{(12^2 + 4^2)}$	M_1
	$OC = 12.6$ only or equivalent f.t. answer given to 1 decimal place also depends on M1+M1	A_1 ft. (4)

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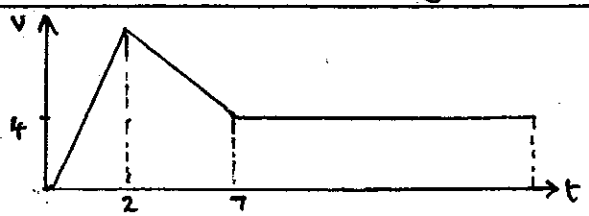
5.(a)	Before $\rightarrow 4.5$ A (0.6) $\leftarrow 3$ (0.2) B; After $\frac{v}{2}\rightarrow$ $v\rightarrow$ Momentum conserved on system $0.6\times4.5-0.2\times3=0.6\times\frac{v}{2}+0.2\times v$ Solving for $v \rightarrow v=4.2$	M1 A1 M1 A1 (4)
(b)	Change in momentum of A or B attempted $0.2(3+4.2)$ OR $0.6(4.5-2.1)\rightarrow$ 1.44 units NS	M1 A1ft B1 (3)
(c)	$R=mg$ $\mu R=\mu mg=$ retarding force or deceleration μg $v^2=u^2+2as$ applied (or equivalent work) $0=4.2^2-2\mu g\times2$ $\mu=\frac{4.2^2}{4g}=0.45$ (DM1 depends on M1+1)	B1 M1 M1 A1ft DM1 A1 (6)
6 (a)	 G1 2 stages ✓ shape G2 3 stages ✓ shape +G1 for 2, 7, 4 on axes.	G3, 2, 1, 0 (3)
(b)	Using $v=u+at \rightarrow v=9.8\times2=19.6$	M1 A1 (2)
(c)	Stage 1 distance $\frac{1}{2}\times9.8\times4$ or $\frac{1}{2}\times2\times19.6=19.6$ Stage 2 distance $\frac{1}{2}(19.6+4)\times5$ (or equivalent two stage method) $=59$ (acceleration = 3.12 M1A1; 59 A1) Minimum height for H = 59 + 19.6 = 78.6 m	B1 ft M1 A1ft A1 cao A1 f.t. (5)
(d)	From a height of 125 m, there are 46.4 m to fall at 4 ms^{-1} Time for stage 3 $=\frac{46.4}{4}$ s $\rightarrow$ (11.6 s) Total time $= 2+5+\frac{4}{4}(11.6)\rightarrow 18.6$ s	M1 M1 A1ft A1 cao (4)
(e)	Air resistance in (a) or equivalent sound reason	B1 (1)

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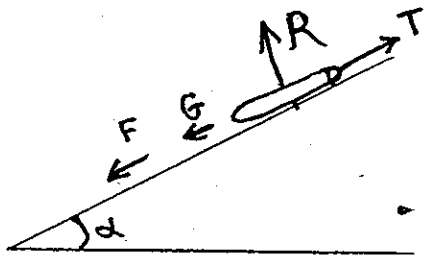
7. (a)	$\alpha = \arctan \frac{5}{12}$	
	$\cos\alpha = \frac{12}{13}$, $\sin\alpha = \frac{5}{13}$	M1 A1
	α 22.6° ; cos α 0.923 , sin α $\frac{4}{5}$, 0.384	
	$R = 78g\cos\alpha$	B1
	$F = 78g\cos\alpha\,(0.25)$	M1 A1 f.t.
	$G = 78g\sin\alpha$	B1
		
	Newton II along slope attempted with T, F, G included	
	$T - F - G = 78(0.5)$	M1
	Solving for T (dependent on M1)	dM1
	$T = 509.4$ (accept this or 510 as 2 s.f. or 509 as 3 s.f. result only)	A1 (9)
(b)	Accelerating force down slope is $G - F$ (or Friction reversed and T no longer included)	M1
	Newton II $G - F = 78a$	M1
		A1
	$a = g\sin\alpha - \mu g\cos\alpha$	M1
	$= 9.8\left(\frac{5}{13} - \frac{3}{13}\right)$ or $\frac{2}{13}g$	
	$= 1.5, 1.50, 1.51$ // Score A2	A2;1;0 (6)
	other answers which round to 1.5 Score A1	

H.M.K 16:9:01