EDEXCEL FOUNDATION

Stewart House 32 Russell Square London WC1B 5DN

January 2002

Advanced Supplementary/Advanced Level

General Certificate of Education

Subject **MECHANICS 6679**

* indicates printed answer

Paper No. M3

Question number	Scheme	Marks
1.	$0.2a = \frac{5}{x+1}$ $0.2v\frac{dv}{dx} = \frac{5}{x+1}$ $\int v\,dv = \int \frac{25}{x+1}\,dx$ $\frac{1}{2}v^2 = 25\ln(x+1)\ (+C)$ $x=0,\ v=5 \Rightarrow C = 12.5$ $\frac{225}{2} = 25\ln(x+1) + 12.5$ $x = 53.6$ (3SF)	M1 M1 M1 A1 A1 A1 M1 A1 (8)
2.(a)	PE Loss $= 0.5g(2+x)$; EPE at C $= \frac{19.6x^2}{4}$ $0.5g(2+x) = \frac{19.6x^2}{4}$ $k(x^2-x-2)=0$ solving $AC = 4m$	B1; B1 M1 A1 M1 A1✓ (6)
(b)	$T_c = \frac{19.6\times 2}{2} = 19.6$ $19.6 - 0.5g = 0.5a$ $a = 29.4\ ms^{-2}$	B1✓ M1 A1 (3) (9)
3.(a)	Line of action of weight must pass through C which is not above centre of rod (or equivalent)	B1 (1)
(b)	Method A: R(along AC): $T_1 = 2mg\sin\alpha = \frac{6mg}{5}$ R(along BC): $T_2 = 2mg\cos\alpha = \frac{8mg}{5}$ * [Equiv. to moments about A, B respectively] OR Method B: R(↑), $T_1\sin\alpha + T_2\cos\alpha = 2mg$ →(→), $T_1\cos\alpha = T_2\sin\alpha$ solving to find T_1 or T_2 $T_1 = \frac{6mg}{5}$; $T_2 = \frac{8mg}{5}$ *	M1 M1 A1 M1 A1 M1 M1 M1 A1; A1 (5)
(c)	$\frac{8mg}{5} = \frac{kmg(BC-a)}{a}$ $BC = 2a\sin\alpha$ $k = 8$	M1 A1 B1 A1 (4) (10)

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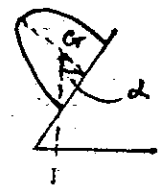
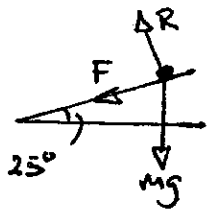
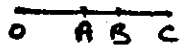
4.(a)	$\int_0^r (\pi) y^2 x\,dx = \bar{x}\int_0^r (\pi) y^2\,dx$ $\int_0^r rx^2\,dx = \bar{x}\int_0^r rx\,dx$ $\left[(r)\frac{x^3}{3}\right]_0^r = \bar{x}\left[(r)\frac{x^2}{2}\right]_0^r$ $\bar{x} = 2r/3$ *	M1 A1 M1 A1 A1 A1 (6)
(b)	 Vertical thro' CM and lowest point of plane face $\tan\alpha = r/r/3$ $\alpha = 72°$ (nearest degree)	M1 M1 A1 A1 (4) (10)
5.	 R(↑) $R\cos 25° - F\sin 25° = mg$ R(←) $R\sin 25° + F\cos 25° = \frac{mv^2}{40}$ $F = 0.6R$ used Eliminating R Solving for v $v = 24.1 ms^{-1}, 24 ms^{-1}$	→ M1 A2 → M1 A2 M1 → M1 ↑ M1 A1 (10)
6.(a)	 If S.H.M., $a = 1.2$ Using $v^2 = \omega^2(a^2 - x^2)$ $0.27 = \omega^2(1.2^2 - 0.6^2)$ or $0.2 = \omega^2(1.2^2 - 0.8^2)$ Solve for ω ($= 0.5$) and use in other equ^n Shown to be correct	B1 → M1 A1 M1 A1 c.s.o. (5)
(b)	$v = a\omega = 1.2 \times 0.5 = 0.6$ *	M1 A1 (2)
(c)	$\lvert\ddot{x}\rvert = \omega^2 \times 0.6 = 0.15 ms^{-2}$	M1 A1√ (2)
(d)	$0.6 = a\sin\omega t$ or $0.8 = a\sin\omega t$ $t = \frac{1}{\omega}\left(\sin^{-1}\frac{0.8}{a} - \sin^{-1}\frac{0.6}{a}\right)$ $= 0.412s$ (3SF)	M1 M1 A1√ A1 (4) (13)

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7. (a)	$\frac{1}{2}m\frac{7ag}{2} - \frac{1}{2}mV^2 = mga$	M1 A1
	$(\leftarrow)$, $R = \frac{mV^2}{a} = \frac{3mg}{2}$	M1 A1 (4)
(b)	$\frac{1}{2}m.\frac{7ag}{2} - \frac{1}{2}mV^2 = mga(1+\cos\theta)$	→ M1 A1
	$(\nearrow)$, $mg\cos\theta = \frac{mV^2}{a}$	→ M1 A1
	Eliminating V^2	→ M1
	Solving to give $\cos\theta = k$, $\theta = 60°$ *	M1 A1 (7)
(c)	$V\cos 60° t = a\sin 60°$	→ M1
	$V^2 = ag\cos 60°$	B1
	Making t explicit	M1
	$t = \sqrt{\frac{6a}{5}}$	A1 (4)
		(15)

H.J.J. 17.6.02