EDEXCEL FOUNDATION

Stewart House 32 Russell Square London WC1B 5DN

January 2002

Advanced Supplementary/Advanced Level

General Certificate of Education

Subject **MECHANICS 6679** Paper No. **M3**

* indicates printed answer

Question number	Scheme	Marks
1.	$0.2a = \frac{5}{x+1}$	M1
	$0.2v\frac{dv}{dx} = \frac{5}{x+1}$	M1
	$\int v\,dv = \int \frac{25}{x+1}\,dx$	M1
	$\frac{1}{2}v^2 = 25\ln(x+1)\ (+C)$	A1 A1
	$x=0,\ v=5 \Rightarrow C = 12.5$	A1
	$\frac{225}{2} = 25\ln(x+1) + 12.5$	M1
	$x = 53.6$ (3SF)	A1 (8)
2. (a)	PE Loss $= 0.5g(2+x)$; EPE at C $= \frac{19.6x^2}{4}$	B1; B1
	$0.5g(2+x) = \frac{19.6x^2}{4}$	M1
	$k(x^2 - x - 2) = 0$	A1
	solving	M1
	$AC = 4m$	A1 ✓ (6)
(b)	$T_c = \frac{19.6 \times 2}{2} = 19.6$	B1 ✓
	$19.6 - 0.5g = 0.5a$	M1
	$a = 29.4\ ms^{-2}$	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) : $T_1 = 2mg\sin\alpha = 6mg/5$	M1 M1 A1
	R(along BC) : $T_2 = 2mg\cos\alpha = 8mg/5$ *	M1 A1
	[Equiv. to moments about A, B respectively]	
OR	Method B: R(↑), $T_1\sin\alpha + T_2\cos\alpha = 2mg$	M1
	R(→), $T_1\cos\alpha = T_2\sin\alpha$	M1
	solving to find T_1 or T_2	M1
	$T_1 = 6mg/5$; $T_2 = 8mg/5$ *	A1; A1 (5)
(c)	$\frac{8mg}{5} = \frac{kmg(BC - a)}{a}$	M1 A1
	$BC = 2a\sin\alpha$	B1
	$k = 8$	A1 (4) (10)

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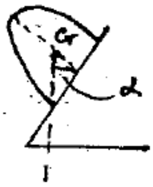
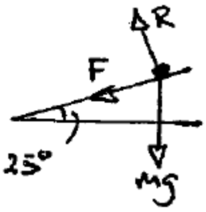
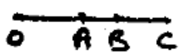
4.(a)	$\int_0^r (\pi) y^2 x\,dx = \bar{x}\int_0^r (\pi) y^2\,dx$	M1 A1
	$\int_0^r r x^2\,dx = \bar{x}\int_0^r rx\,dx$	M1
	$\left[(r)\frac{x^3}{3}\right]_0^r = \bar{x}\left[(r)\frac{x^2}{2}\right]_0^r$	A1 A1
	$\bar{x} = 2r/3$ *	A1 (6)
(b)	 vertical thro' CM and lowest point of plane face	M1
	$\tan\alpha = r / \frac{r}{3}$	M1 A1
	$\alpha = 72°$ (nearest degree)	A1 (4) (10)
5.	 R(↑), $R\cos 25° - F\sin 25° = mg$	M1 A2
	R(←), $R\sin 25° + F\cos 25° = \frac{mv^2}{40}$	M1 A2
	$F = 0.6R$ used	M1
	Eliminating R	M1
	Solving for v	M1
	$v = 24.1\ \text{ms}^{-1}$, $24\ \text{ms}^{-1}$	A1 (10)
6.(a)	 If S.H.M., $a = 1.2$	B1
	Using $v^2 = \omega^2(a^2 - x^2)$	M1
	$0.27 = \omega^2(1.2^2 - 0.6^2)$ or $0.2 = \omega^2(1.2^2 - 0.8^2)$	A1
	Solve for ω ($= 0.5$) and use in other equ^n	M1
	Shown to be correct	A1 c.s.o. (5)
(b)	$v = a\omega = 1.2 \times 0.5 = 0.6$ *	M1 A1 (2)
(c)	$\lvert\ddot{x}\rvert = \omega^2 \times 0.6 = 0.15\ \text{ms}^{-2}$	M1 A1√ (2)
(d)	$0.6 = a\sin\omega t$ or $0.8 = a\sin\omega t$	M1
	$t = \frac{1}{\omega}\left(\sin^{-1}\frac{0.8}{a} - \sin^{-1}\frac{0.6}{a}\right)$	M1 A1√
	$= 0.412\ \text{s}$ (3SF)	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
	$R\downarrow$, $mg\cos\theta = \frac{mv^2}{a}$	M1 A1
	Eliminating v^2	M1
	Solving to give $\cos\theta = k$, $\underline{\theta = 60°}$ *	M1 A1 (7)
(c)	$v\cos 60°\, t = a\sin 60°$	M1
	$v^2 = ag\cos 60°$	B1
	Making t explicit	M1
	$\underline{t = \sqrt{\frac{6a}{5}}}$	A1 (4)
		(15)

H.J.J. 17.1.02