EDEXCEL - LONDON EXAMINATIONS

Stewart House 32 Russell Square London WC1B 5DN

June 2001

Advanced Supplementary/Advanced Level

General Certificate of Education

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

Question number	Scheme	Marks
1. (a)	$v = \int \frac{1}{2} e^{-\frac{1}{6}t} dt$	M1
	$= -3e^{-\frac{1}{6}t} (+c)$	A1
	use of limits or $t=0, v=10$	M1
	$v = 13 - 3e^{-\frac{1}{6}t}$	A1 (4)
(b)	$t=3, \quad v = 11.2 \text{ ms}^{-1}$	M1 A1 (2)
(c)	13 (ft. if $v = a \pm be^{-\frac{1}{6}t}$)	B1 ft (1) (7)
2. (a)	$\cos\theta = 3/4$, 0.75, 6/8	B1 (1)
(b)	$mg\cos\theta (-R) = \frac{mv^2}{0.8}$	M1 A1
	$v^2 = 5.88$ *	A1 (3)
(c)	$\frac{1}{2}m.5.88 - \frac{1}{2}mu^2 = mg \times 0.2$	M1 A1
	$u = 1.4$	A1 (3) (7)
3. (a)	$\frac{1}{2} \times 1.5v^2 = \frac{52 \times .05^2}{2 \times 0.25}$	M1 A1 A1
	$v = 0.589 \text{ ms}^{-1}$ (3SF)	M1 A1 (5)
(b)	$F = 0.6 \times 1.5g$	M1
	$\frac{52x}{0.25}$ or $\frac{52x}{25}$	B1
	$T = F \Rightarrow x = 0.0424\text{m}$ or 4.24cm	M1 A1
	Min distance = 0.208m or 20.8cm	A1 ft (5) (10)

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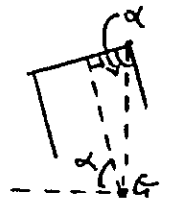
4.(a)	$g = k/R^2 \Rightarrow k = R^2g$	B1
	$a = \frac{k}{x^2}$	M1
	$v\frac{dv}{dx} = -\frac{R^2g}{x^2}$ *	M1 A1 c.s.o. (4)
(b)	$\int v\,dv = -\int \frac{R^2g}{x^2}\,dx$	M1
	$\frac{v^2}{2} = \frac{R^2g}{x}$ (+ c)	A1
	$x = R, v = u$ (correct use of limits)	M1
	$\frac{v^2}{2} = \frac{R^2g}{x} + \frac{u^2}{2} - Rg$ (correct)	A1
	use of $v = 0$	M1
	$X = \frac{2gR^2}{2gR - u^2}$	A1 (6) (10)
5(a)	$\pi r^2 h$ (6) $\quad \frac{1}{6}\pi r^2 h$ (1) $\quad \frac{5}{6}\pi r^2 h$ (5)	B2 -1 e.e.o.o.
	$\frac{1}{2}h \quad \frac{7h}{8} \quad \bar{x}$	B2 -1 e.e.o.o.
	$6.\frac{1}{2}h - \frac{7h}{8} = 5\bar{x}$	M1 A1
	$\bar{x} = \frac{17h}{40}$ *	A1 (7)
(b)		M1 A1
	$\tan\alpha = \frac{h - \bar{x}}{r}$	M1
	use of $h = 4r$ to obtain expression in h or r only	A1 (4) (11)
	$\alpha = 66.5°$ (1DP)	

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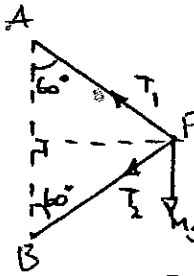
6.(a)	$r = \frac{1}{2}h\tan 60° = \frac{\sqrt{3}}{2}h$ *	M1 A1 (2)
(b)	 $R(\uparrow)$, $T_1\cos 60° - T_2\cos 60° = mg$ $R(\leftarrow)$, $T_1\sin 60° + T_2\sin 60° = m\frac{\sqrt{3}}{2}h\omega^2$ Use of $\cos 60° = \frac{1}{2}$ and $\sin 60° = \frac{\sqrt{3}}{2}$ solving for T_1 or T_2 $T_1 = \frac{1}{2}m(h\omega^2 + 2g)$; $T_2 = \frac{1}{2}m(h\omega^2 - 2g)$	→M1 A1 →M1 A1 B1 M1 A1; A1 – (8)
(c)	$T_2 > 0 \Rightarrow \omega > \sqrt{\frac{2g}{h}}$ $T = \frac{2\pi}{\omega} \Rightarrow T < 2\pi\sqrt{\frac{h}{2g}} = \pi\sqrt{\frac{2h}{g}}$ *	M1 A1√ M1 A1 c.s.o. (4) (14)
7.(a)	In equil^m, $T = mg\sin 30°$ $\lambda\frac{\frac{1}{8}a}{a} = mg\sin 30° \Rightarrow \lambda = 4mg$ *	B1 M1 A1 (3)
(b)	$m\ddot{x} = mg\sin 30° - \frac{4mg}{a}(\frac{1}{8}a + x)$ $\ddot{x} = -\frac{4g}{a}x \Rightarrow$ SHM Period $= 2\pi\sqrt{\frac{a}{4g}} = \pi\sqrt{\frac{a}{g}}$ *	→M1 A2 M1 A1 A1 (6)
(c)	Max accel^n $= \omega^2 a = \frac{4g}{a}\cdot\frac{a}{4} = g$	M1 A1 (2)
(d)	$x = \frac{a}{4}\sin\omega t$; (+)$\frac{a}{8} = \frac{a}{4}\sin\omega t$ $\omega t = \sin^{-1}\frac{1}{2} = \pi/6$ $t = \pi/12\sqrt{\frac{a}{g}}$	→M1 A1 M1 A1 A1√ (5)
OR:	Circle approach: $\theta = \frac{\pi}{2} - \cos^{-1}\frac{1}{2} = \frac{\pi}{2} - \frac{\pi}{3} = \frac{\pi}{6}$ $\omega t = \pi/6$ $t = \pi/12\sqrt{\frac{a}{g}}$	OR →M1 A1 M1 A1 A1√ (5)
OR:	$\cos^{-1}(-\frac{1}{2}) - \cos^{-1}(0) = \frac{2\pi}{3} - \frac{\pi}{2} = \frac{\pi}{6}$ $\omega t = \pi/6$ $t = \pi/12\sqrt{\frac{a}{g}}$	OR →M1 A1 M1 A1 A1√ (5) (16)

ALTERNATIVES

Question	Solution	Markscheme
7.(d)	$\theta = \frac{\pi}{2} - \cos^{-1}\frac{1}{2} = \frac{\pi}{6}$ $\omega t = \frac{\pi}{6}$ $t = \frac{\pi}{6}\sqrt{\frac{a}{49}} = \frac{\pi}{12}\sqrt{\frac{a}{5}}$	M1 A1 M1 A1 A1 f.t.
OR:	$\cos^{-1}\left(-\frac{1}{2}\right) - \cos^{-1}(0) = \frac{2\pi}{3} - \frac{\pi}{2} = \frac{\pi}{6}$ $\omega t = \frac{\pi}{6}$ $t = \frac{\pi}{6}\sqrt{\frac{a}{45}} = \frac{\pi}{12}\sqrt{\frac{a}{5}}$	M1 A1 M1 A1 A1 f.t.