Standardisation Markscheme
M.J.J. 27.5.04

EDEXCEL

Stewart house 32 Russell Square London WC1B 5DN

June 2004

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **6679 Mechanics** Paper: **M3**

Question number	Scheme	Marks
1.	1000 r.p.m. $= \frac{1000\text{x}2\pi}{60}$ rad /s $v = 0.035\text{x}\frac{1000\text{x}2\pi}{60} = 3.67\text{ms}^{-1}$ (3 SF) *M1 their r x their ω*	B1 M1 A1 (3)
2.	Extn at bottom $= \frac{a}{\cos\alpha} - a = \frac{2a}{3}$ (0.67a or better) Energy: $mga\tan\alpha = \frac{2\lambda\left(\frac{2a}{3}\right)^2}{2a}$ $3mg = \lambda$ *Second M0 if treated as equilibrium.* *Third M1 for solving for λ.*	M1 A1 M1 A1 A1 f.t. dep. M1 A1 (7)
3.(a)	$mg\sin30^o - mx^2 = ma$ $\frac{g}{2} - x^2 = v\frac{dv}{dx}$ or $\frac{d(\frac{1}{2}v^2)}{dx}$ $\frac{gx}{2} - \frac{x^3}{3}(+C) = \frac{v^2}{2}$ $x = 2:g - \frac{8}{3} = \frac{v^2}{2}$ $v = 3.8\text{ms}^{-1}$ (3.78) *Third M1 for attempting to integrate*	M1 A1 M1 dep. M1A1 dep. M1 A1 (7)
(b)	$v = 0: \frac{gx}{2} - \frac{x^3}{3} = 0$ $x^2 = \frac{3g}{2} \Rightarrow x = 3.8$, (3.83), $\sqrt{\frac{3g}{2}}$ *Must have integrated for first M1*	M1 dep. M1 A1 c.s.o. (3) (10)

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4.(a)	$(\uparrow), R=mg$	B1
	$m\frac{4a}{3}\omega^2$ seen and used.	B1
	$m\frac{4a}{3}\omega^2 \leq \frac{3}{5}mg$	M1
	$\Rightarrow \omega^2 \leq \frac{9g}{20a}$ *	A1 c.s.o. (4)
(b)	$T=\frac{2mg}{a}\frac{a}{3}=\frac{2mg}{3}$	B1
	$(\rightarrow), \frac{3}{5}mg+\frac{2mg}{3}=m\frac{4a}{3}\omega_{max}^2$	M1 A1 **f.t.**
	$\frac{19g}{20a}=\omega_{max}^2$	A1
	$(\rightarrow), -\frac{3}{5}mg+\frac{2mg}{3}=m\frac{4a}{3}\omega_{min}^2$	M1 A1 **f.t.**
	$\frac{g}{20a}=\omega_{min}^2$	A1 (7)
		(11)
	If only one answer, must be clear whether max or min for final A1	

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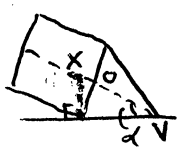
5. (a)	cylinder ($36\pi r^3$) cone ($12\pi r^3$) toy ($48\pi r^3$) mass ratio 3 1 4 — B1 dist. from O $2r$ (-) r $\bar{x}$ — B1 $(3 \times 2r) - r = 4\bar{x}$ — M1 A1 $\frac{5r}{4} = \bar{x}$ — A1 **(5)** *M1 for clear attempt at $\Sigma mx = \bar{x}\Sigma m$ - correct no. of terms.* *If distances not measured from O, B1B1M1A1 available.*	
(b)  *AG* vertical, seen or implied — M1 $\tan\theta = \frac{3r}{4r - \bar{x}}$ — M1 A1 $\theta = 47.5^{\circ}$ (1 d.p.) — A1 **(4)** *Second M1 for use of tan*	
(c)  sim Δ's : $\frac{OX}{3r} = \frac{3r}{4r} (=\tan\alpha)$ — M1 $\Rightarrow OX = \frac{9r}{4}$ — A1 (This is √ on alternatives) $\bar{x} < OX$ — M1 $\Rightarrow$won't topple — A1 c.s.o. **(4)** *Note that second M1 is independent, for the general idea.*	
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	All M marks require correct number of terms with appropriate terms resolved.	
6.(a)	B to C : $\frac{1}{2}mv^2 - \frac{1}{2}m20^2 = mg.50(1-\sin 30^o)$	M1 A1
	$v = 30\text{ms}^{-1}(29.8)$	A1 **(3)**
(b)	(↑) at C, $R - mg = m\frac{890}{50}$	M1 A1 **ft**
	$R = 1900$ N (1930N)	A1 **(3)**
(c)	C to D : $\frac{1}{2}m890 - \frac{1}{2}mw^2 = mg.50(1-\cos 30^o)$	M1 A1 **ft**
	$w = 28\text{ms}^{-1}(27.5)$	A1 **(3)**
(d)	Before: $R = mg\cos\theta$	B1
	After : $R = mg\cos\theta + m\frac{20^2}{50}$	M1 A1
	Change = $70.\frac{20^2}{50} = 560$ N	A1 c.s.o **(4)**
(e)	lower speed at $C \Rightarrow R$ reduced	M1 A1 **(2)**
		(15)

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7.(a)	$(\rightarrow) -\frac{21.6x}{2} = 0.3\ddot{x}$	M1 A1
	$-36x = \ddot{x}$	M1
	S.H.M., period $= \frac{2\pi}{\sqrt{36}} = \frac{\pi}{3}$	A1 c.s.o. **(4)**
(b)	At A: $v = a\omega = 1.5 \times 6 = 9\ \text{ms}^{-1}$	M1 A1 **(2)**
(c)	$x = a\cos\omega t$	general.
	$0.75 = 1.5\cos 6t$	→ M1
	$\frac{\pi}{3} = 6t \Rightarrow t = \frac{\pi}{18}$ (no decimals)	dep M1 A1 **(3)**
(d)	$(\rightarrow) -\frac{21.6x}{2} = 0.5\ddot{x}$	M1 A1
	$-21.6x = \ddot{x} \Rightarrow$ S.H.M., $\omega = \sqrt{21.6}$	A1
	At collision: CLM: $0.3 \times 9 = 0.5v \Rightarrow v = 5.4$	→ M1 A1 f.t.
	$a \times \sqrt{21.6} = 5.4$	M1
	$a = 1.16$ m (3SF)	A1 **(7)**
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HJJ. 26.5.04