EDEXCEL

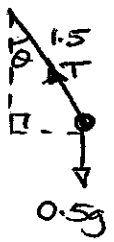
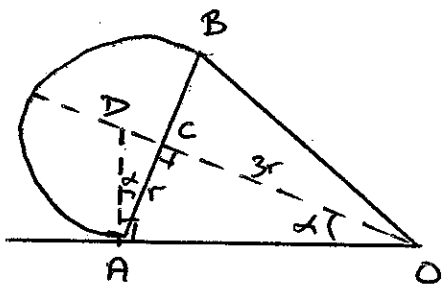
190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

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

Question Number	Scheme	Marks
1.(a)	 $r = 1.5\sin\theta$ $T\sin\theta = mr\omega^2$ $T\sin\theta = 0.5 \times 1.5\sin\theta \times 2.7^2$ $T = 5.4675\ N$	B1 M1 A1 A1 (4)
(b)	$T\cos\theta = 0.5g$ $\cos\theta = \frac{0.5g}{5.4675}$ $\theta = 26°$ (nearest degree)	M1 A1 A1 (3) (7)
2.(a)	$\frac{3r}{4}$; $\frac{3r}{8}$ $-m\cdot\frac{3r}{4} + M\cdot\frac{3r}{8} = (m+M)\bar{x}$ $\frac{3r(M-2m)}{8(M+m)} = \bar{x}$ *	B1 ; B1 M1 A1 A1 (5)
(b)	 $CD = r\tan\alpha$ $= r \times \left(\frac{r}{3r}\right)$ $= \frac{1}{3}r$	M1 A1
	No equ^{n} $\Rightarrow$ $\bar{x} > CD$ $\frac{3r(M-2m)}{8(M+m)} > \frac{r}{3}$ $9(M-2m) > 8(M+m)$ $M > 26m$ *	M1 A1 (4) (9)

EDEXCEL

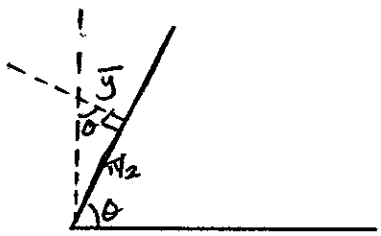
190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

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

Question Number	Scheme	Marks
3.(a)	$\int_0^{\pi} \frac{1}{2}y^2\,dx = \int_0^{\pi} \frac{1}{2}\sin^2 x\,dx$	M1
	$= \frac{1}{4}\int_0^{\pi}(1-\cos 2x)\,dx$	M1
	$= \frac{1}{4}\left[x - \frac{1}{2}\sin 2x\right]_0^{\pi}$	A1
	$= \pi/4$	A1
	$\bar{y} = \frac{\pi/4}{\int_0^{\pi}\sin x\,dx} = \frac{\frac{\pi}{4}}{2}$	M1
	$= \pi/8$	A1 (6)
(b)	 $\tan\theta = \frac{\pi/2}{\bar{y}}$	M1
	$= 4$	A1√
	$\theta = 75.96°$	A1 (3)
		(9)

EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

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

Question Number	Scheme	Marks
4. (a)	$6 = 2\pi/\omega \Rightarrow \omega = \pi/3$	M1
	$a = 2L$	B1
	$x = 2L\cos\omega t$	M1
	$2L - b = 2L\cos\left(\frac{\pi}{3}\cdot\frac{3}{4}\right)$	A1 √
	$\underline{b = L(2-\sqrt{2})}$ *	A1 cso. (5)
(b)	$\dot{x} = -2L\omega\sin\omega t$	M1
	$= -2L\frac{\pi}{3}\sin\frac{\pi}{4}$	
	Speed $= \frac{\sqrt{2}L\pi}{3}$	A1 (2)
(c)	$\frac{1}{2}(2-\sqrt{2})L = 2L\sin\omega t$	M1 A1
	$t = 0.1469..$	
	$\therefore$ Total time $= 2\times 0.14$	
	$= \underline{0.28}$ (2dp)	A1 (3) (10)
5. (a)	$\frac{dv}{dt} = -\frac{3}{\sqrt{t+4}}$	M1
	$v = -3\int (t+4)^{-\frac{1}{2}}\,dt$	
	$v = -6(t+4)^{\frac{1}{2}} + C$	M1 A1
	$t=0, v=18$: $18 = -6\times 2 + C \Rightarrow C = 30$	M1
	$\underline{v = 30 - 6\sqrt{t+4}}$ *	A1 cso. (5)
(b)	$x = \int 30 - 6(t+4)^{\frac{1}{2}}\,dt$	M1
	$= 30t - 4(t+4)^{3/2} + D$	A1
	$t=0, x=0$: $0 = 0 - 4\times 8 + D \Rightarrow D = 32$	M1
	$v=0 \Rightarrow 30 - 6\sqrt{t+4} = 0 \Rightarrow t = 21$	M1 A1
	When $t=21$, $x = 30\times 21 - 4\times 5^2 + 32$	M1
	$= \underline{\underline{162}}$ (m)	A1 (7) (12)

EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

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

Question Number	Scheme	Marks
6.(a)	KE Loss + PE Loss = EPE Gain $\frac{1}{2}\cdot m2gL + mg3L = \frac{\lambda(3L)^2}{2L}$ $\Rightarrow \frac{8mg}{9} = \lambda$	M1 A2 (-1e.e.) A1 (4)
(b)	$mg - T = m\ddot{x}$ $mg - \frac{8mg}{9L}(x+e) = m\ddot{x}$ $-\frac{8g}{9L}x = \ddot{x}$ Hence SHM about D	M1 A1 M1 A1 A1 c.s.o. (5)
(c)	(i) Period $= \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{9L}{8g}} = 3\pi\sqrt{\frac{L}{2g}}$ (ii) $mg = \frac{8mg}{9L}e \Rightarrow e = 9L/8$ $a = 3L - 9L/8 = 15L/8$ $v_{MAX} = a\omega = \frac{15L}{8}\sqrt{\frac{8g}{9L}}$ $= \frac{5}{4}\sqrt{2gL}$	M1 A1 B1 M1 A1 (5) (14)

EDEXCEL

190 High Holborn London WC1V 7BH

January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

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

Question Number	Scheme	Marks
7.(a)	$\frac{1}{2}m(v^2-15) = mg5(1-\cos 60°)$	M1 A1 A1
	$v = 8\,ms^{-1}$	A1 (4)
(b)	$\frac{1}{2}mw^2 = mg5(1-\cos 60°)$	M1 A1
	$w = 7\,ms^{-1}$	A1
	CLM: $60\times 8 - 3m = (60+m)7$	M1 A1✓ A1✓
	$480 - 3m = 420 + 7m$	
	$60 = 10m$	
	$6 = m$	A1 (7)
(c)	$T - 66g = \frac{66\times 7^2}{5}$	M1 A1✓
	$T = 132g$	
	$= 1290\ (1294)\ N$	A1 (3)
		(14)