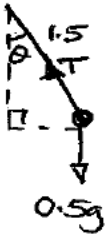
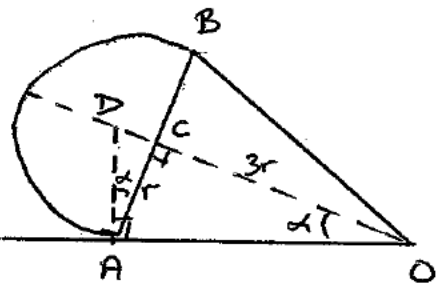
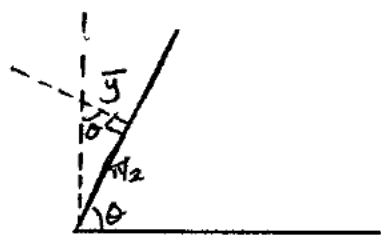


Question Number	Scheme	Marks
1.(a)	 $r = 1.5 \sin \theta$ $T \sin \theta = m r \omega^2$ $T \sin \theta = 0.5 \times 1.5 \sin \theta \times 2.7^2$ $T = \underline{5.4675 \text{ N}}$	<p>B1 M1 A1 A1 (4)</p>
(b)	$T \cos \theta = 0.5g$ $\cos \theta = \frac{0.5g}{5.4675}$ $\theta = \underline{26^\circ} \text{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

Question Number	Scheme	Marks
3.(c)	$\int_0^{\pi} \frac{1}{2} y^2 dx = \int_0^{\pi} \frac{1}{2} \sin^2 x dx$ $= \frac{1}{4} \int_0^{\pi} (1 - \cos 2x) dx$ $= \frac{1}{4} [x - \frac{1}{2} \sin 2x]_0^{\pi}$ $= \frac{\pi}{4}$ $\bar{y} = \frac{\frac{\pi}{4}}{\int_0^{\pi} \sin x dx} = \frac{\frac{\pi}{4}}{2} = \frac{\pi}{8}$	<p>M1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>(6)</p>
(b)	 $\tan \theta = \frac{\pi/2}{3}$ $= 4$ $\theta = 75.96^\circ$	<p>M1</p> <p>A1 ✓</p> <p>A1</p> <p>(3)</p> <p>(9)</p>

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

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January 2005

Advanced Subsidiary/Advanced Level

General Certificate of Education

Subject: **Mechanics**

Paper: **M3**

Question Number	Scheme	Marks
6.(a)	$KE_{Loss} + PE_{Loss} = EPE_{Gain}$ $\frac{1}{2} \cdot m2gL + m3L = \frac{\lambda(3L)^2}{2L}$ $\times \frac{8m\cancel{g}}{\cancel{9}} = \lambda$	M1 A2 (1.e.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) $mg = \frac{8mg}{9L}e \Rightarrow e = \frac{9L}{8}$ $a = 3L - \frac{9L}{8} = \frac{15L}{8}$ $v_{max} = a\omega = \frac{15L}{8}\sqrt{\frac{8g}{9L}}$ $= \frac{5}{4}\sqrt{29L}$	M1 A1 B1 M1 A1 (5) (14)

Subject: **Mechanics**

Paper: **M3**

Question Number	Scheme	Marks
7.(a)	$\frac{1}{2}mv^2 - 15 = mg \cdot 5(1 - \cos 60^\circ)$ $v = 8 \text{ms}^{-1}$	M1 A1 A1 A1 (4)
(b)	$\frac{1}{2}mv^2 = mg \cdot 5(1 - \cos 60^\circ)$ $v = 7 \text{ms}^{-1}$ <u>CM:</u> $60 \times 8 - 3m = (60+m) \cdot 7$ $480 - 3m = 420 + 7m$ $60 = 10m$ $6 = m$	M1 A1 A1 M1 A1✓ A1✓ A1 (7)
(c)	$T - 66g = \frac{66 \times 7^2}{5}$ $T = 132g$ $= \underline{1290 \text{ (1294) N}}$	M1 A1✓ A1 (3)
		(4)