Mark Scheme (Results)

Summer 2010

GCE

GCE Mechanics M3 (6679/01)

Edexcel Limited. Registered in England and Wales No. 4496750
Registered Office: One90 High Holborn, London WC1V 7BH

A PEARSON COMPANY

If you have any subject specific questions about the content of this Mark Scheme that require the help of a subject specialist, you may find our Ask The Expert email service helpful.

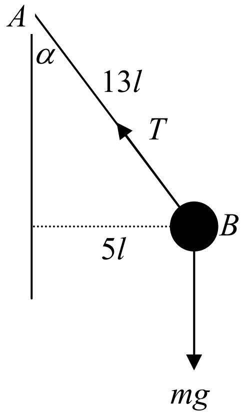
Ask The Expert can be accessed online at the following link:

http://www.edexcel.com/Aboutus/contact-us/

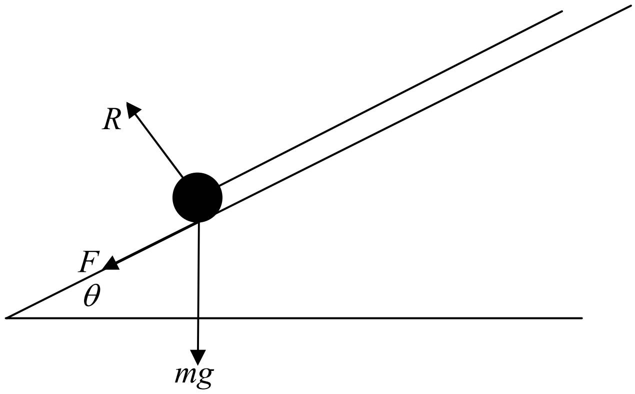
Summer 2010

Publications Code UA024475

Summer 2010
Mechanics M3 6679
Mark Scheme

Question Number	Scheme	Marks
Q1		
(a)	$\cos\alpha = \frac{12}{13}$	B1
	R(↑) $T\cos\alpha = mg$	M1
	$T \times \frac{12}{13} = mg$	
	$T = \frac{13}{12}mg$ oe	A1 (3)
(b)	Eqn of motion $T\sin\alpha = m\frac{v^2}{5l}$	M1 A1
	$\frac{13mg}{12} \times \frac{5}{13} = m\frac{v^2}{5l}$	M1 dep
	$v^2 = \frac{25gl}{12}$	
	$v = \frac{5}{2}\sqrt{\frac{gl}{3}}$ $\left(\text{accept } 5\sqrt{\frac{gl}{12}} \text{ or } \sqrt{\frac{25gl}{12}} \text{ or any other equiv}\right)$	A1 (4)
		[7]

Question Number	Scheme	Marks
Q2 (a)	$F = (-)\dfrac{k}{x^2}$	M1
	$mg = (-)\dfrac{k}{R^2}$	M1
	$F = \dfrac{mgR^2}{x^2}$ *	A1 (3)
(b)	$m\ddot{x} = -\dfrac{mgR^2}{x^2}$	M1
	$v\dfrac{\mathrm{d}v}{\mathrm{d}x} = -\dfrac{gR^2}{x^2}$	M1
	$\dfrac{1}{2}v^2 = \int\left(-\dfrac{gR^2}{x^2}\right)\mathrm{d}x$	M1 dep on 1st M mark
	$\dfrac{1}{2}v^2 = \dfrac{gR^2}{x} \quad (+c)$	A1
	$x = R,\ \ v = 3U \qquad \dfrac{9U^2}{2} = gR + c$	M1 dep on 3rd M mark
	$\dfrac{1}{2}v^2 = \dfrac{gR^2}{x} + \dfrac{9U^2}{2} - gR$	
	$x = 2R,\ v = U \qquad \dfrac{1}{2}U^2 = \dfrac{gR^2}{2R} + \dfrac{9U^2}{2} - gR$	M1 dep on 3rd M mark
	$U^2 = \dfrac{gR}{8}$	
	$U = \sqrt{\dfrac{gR}{8}}$	A1 (7)
		[10]

Question Number	Scheme	Marks
Q3		
	EPE lost $=\frac{\lambda \times 0.6^2}{2\times 0.9}-\frac{\lambda\times 0.1^2}{2\times 0.9}\left(=\frac{7}{36}\lambda\right)$	M1 A1
	R$(\uparrow)$ $R = mg\cos\theta$	M1
	$= 0.5g\times\frac{4}{5} = 0.4g$	
	$F = \mu R = 0.15\times 0.4g$	M1 A1
	P.E. gained = E.P.E. lost − work done against friction	
	$0.5\text{g}\times 0.7\sin\theta = \frac{\lambda\times 0.6^2}{2\times 0.9}-\frac{\lambda\times 0.1^2}{2\times 0.9}-0.15\times 0.4g\times 0.7$	M1 A1 A1
	$0.1944\lambda = 0.5\times 9.8\times 0.7\times\frac{3}{5}+0.15\times 0.4\times 9.8\times 0.7$	
	$\lambda = 12.70......$	
	$\lambda = 13$ N or 12.7	A1
		[9]

Question Number	Scheme	Marks
Q4 (a)		

	cone	container	cylinder
mass ratio	$\frac{4\pi l^3}{3}$	$\frac{68\pi l^3}{3}$	$24\pi l^3$
	4	68	72
dist from O	l	$\bar{x}$	$3l$

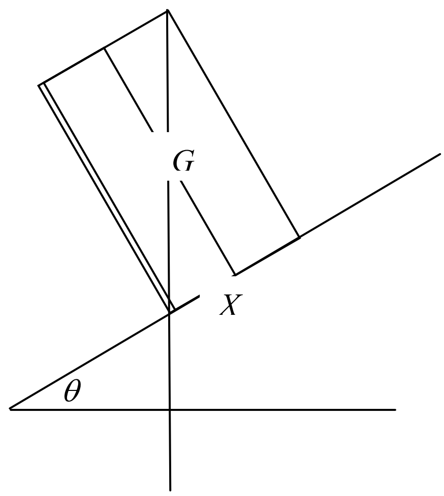
M1 A1

B1

Moments: $4l + 68\bar{x} = 72 \times 3l$ — M1 A1ft

$$\bar{x} = \frac{212l}{68} = \frac{53}{17}l \quad \text{accept } 3.12l$$ — A1 (6)

(b)



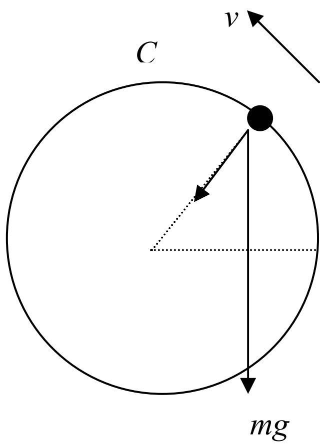
$GX = 6l - \bar{x}$ seen — M1

$$\tan\theta = \frac{2l}{6l - \bar{x}}$$ — M1 A1

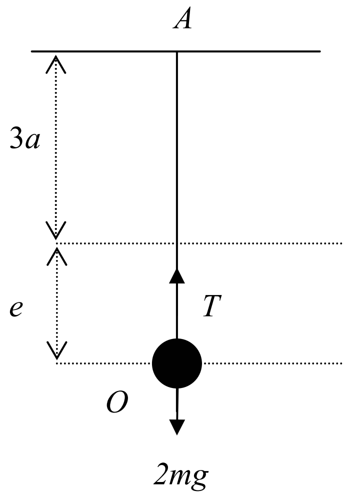
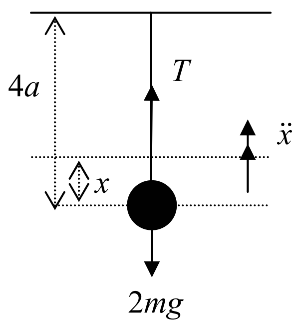
$$= \frac{2 \times 17}{49}$$

$\theta = 34.75... = 34.8$ or 35 — A1 (4)

[10]

Question Number	Scheme	Marks
Q5		
(a)	Energy: $mga\sin\theta = \frac{1}{2}m \times 5ag - \frac{1}{2}mv^2$	M1 A1
	$v^2 = 5ag - 2ag\sin\theta$	A1 (3)
(b)	Eqn of motion along radius:	
	$T + mg\sin\theta = \frac{mv^2}{a}$	M1 A1
	$T = \frac{m}{a}(5ag - 2ag\sin\theta) - mg\sin\theta$	M1
	$T = mg(5 - 3\sin\theta)$	A1 (4)
(c)	At C, $\theta = 90°$	
	$T = mg(5-3) = 2mg$	M1 A1
	$T > 0 \quad \therefore P$ reaches C	A1 (3)
(d)	Max speed at lowest point	
	($\theta = 270°$; $v^2 = 5ag - 2ag\sin 270$)	M1
	$v^2 = 5ag + 2ag$	
	$v = \sqrt{(7ag)}$	A1 (2)
		[12]

Question Number	Scheme	Marks
Q6 (a)	$\frac{d^2x}{dt^2} = -\frac{3}{(t+1)^2}$	M1
	$\frac{dx}{dt} = \int -3(t+1)^{-2}\,dt$	
	$= 3(t+1)^{-1}\ (+c)$	M1 A1
	$t=0,\ v=2 \quad 2=3+c \quad c=-1$	M1
	$\frac{dx}{dt} = \frac{3}{t+1} - 1$ *	A1 (5)
(b)	$x = \int\left(\frac{3}{t+1}-1\right)dt$	M1
	$= 3\ln(t+1) - t \quad (+c')$	A1
	$t=0,\ x=0 \quad \Rightarrow c'=0$	B1
	$x = 3\ln(t+1) - t$	
	$v=0 \Rightarrow \frac{3}{t+1} = 1$	M1
	$t=2$	A1
	$x = 3\ln 3 - 2$	M1
	$= 1.295...$	
	$= 1.30$ m (Allow 1.3)	A1 (7) **[12]**

Question Number	Scheme	Marks
Q7		
(a)	$R(\uparrow) \quad T = 2mg$	B1
	Hooke's law: $T = \dfrac{6mge}{3a}$	
	$2mg = \dfrac{6mge}{3a}$	M!
	$e = a$	
	$AO = 4a$	A1 (3)
(b)		
	H.L. $\quad T = \dfrac{6mg(a-x)}{3a} = \dfrac{2mg(a-x)}{a}$	B1ft
	Eqn. of motion $\quad -2mg + T = 2m\ddot{x}$	M1
	$-2mg + \dfrac{2mg(a-x)}{a} = 2m\ddot{x}$	M1
	$-\dfrac{2mgx}{a} = 2m\ddot{x}$	
	$\ddot{x} = -\dfrac{g}{a}x$	A1
	period $\quad 2\pi\sqrt{\dfrac{a}{g}}$ *	A1 (5)

Question Number	Scheme	Marks
(c)	$v^2 = \omega^2\left(a^2 - x^2\right)$ $v_{\max}{}^2 = \frac{g}{a}\left(\left(\frac{a}{4}\right)^2 - 0\right)$ $v_{\max} = \frac{1}{4}\sqrt{(ga)}$	 M1 A1 A1 (3)
(d)	$x = -\frac{a}{8}$ $\quad v^2 = \frac{g}{a}\left(\frac{a^2}{16} - \frac{a^2}{64}\right)$ $= \frac{3ag}{64}$ $v^2 = u^2 + 2as$ $0 = \frac{3ag}{64} - 2gh$ $h = \frac{3a}{128}$ Total height above $O = \frac{a}{8} + \frac{3a}{128} = \frac{19a}{128}$	M1 M1 A1 A1 (4) **[15]**

Further copies of this publication are available from
Edexcel Publications, Adamsway, Mansfield, Notts, NG18 4FN

Telephone 01623 467467
Fax 01623 450481

Email publications@linneydirect.com

Order Code UA024475 Summer 2010

For more information on Edexcel qualifications, please visit www.edexcel.com/quals

Edexcel Limited. Registered in England and Wales no.4496750
Registered Office: One90 High Holborn, London, WC1V 7BH