

Mark Scheme (Results) Summer 2010

GCE

GCE Mechanics M3 (6679/01)

Edexcel is one of the leading examining and awarding bodies in the UK and throughout the world. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers.

Through a network of UK and overseas offices, Edexcel's centres receive the support they need to help them deliver their education and training programmes to learners.

For further information, please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our website at www.edexcel.com.

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/>

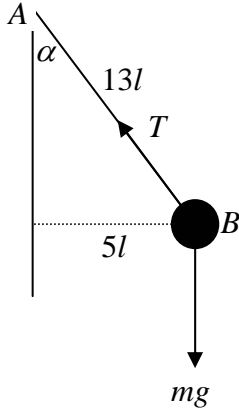
Summer 2010

Publications Code UA024475

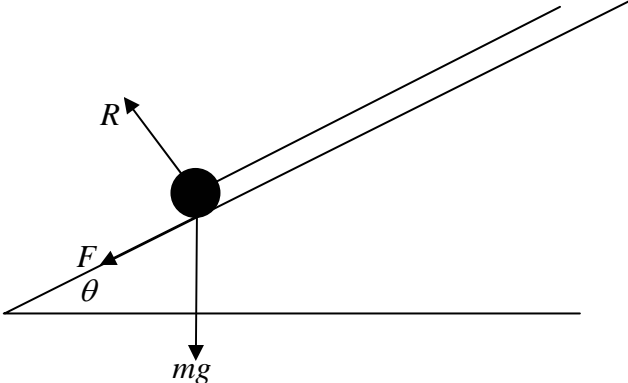
All the material in this publication is copyright

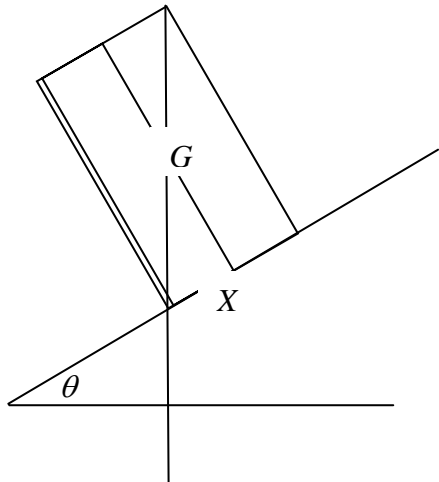
© Edexcel Ltd 2010

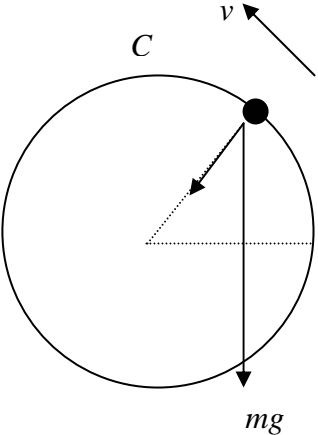
Summer 2010
Mechanics M3 6679
Mark Scheme

Question Number	Scheme	Marks
Q1	<div style="text-align: center;">  </div> <p>(a)</p> $\cos \alpha = \frac{12}{13}$ $R(\uparrow) \quad T \cos \alpha = mg$ $T \times \frac{12}{13} = mg$ $T = \frac{13}{12} mg \quad \text{oe}$	<p>B1</p> <p>M1</p> <p>A1 (3)</p>
(b)	<p>Eqn of motion $T \sin \alpha = m \frac{v^2}{5l}$</p> $\frac{13mg}{12} \times \frac{5}{13} = m \frac{v^2}{5l}$ $v^2 = \frac{25gl}{12}$ $v = \frac{5}{2} \sqrt{\frac{gl}{3}} \quad \left(\text{accept } 5\sqrt{\frac{gl}{12}} \text{ or } \sqrt{\frac{25gl}{12}} \text{ or any other equiv} \right)$	<p>M1 A1</p> <p>M1 dep</p> <p>A1 (4)</p> <p>[7]</p>

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

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

Question Number	Scheme	Marks																
Q4 (a)	<table border="1"> <thead> <tr> <th></th> <th>cone</th> <th>container</th> <th>cylinder</th> </tr> </thead> <tbody> <tr> <td>mass ratio</td> <td>$\frac{4\pi l^3}{3}$</td> <td>$\frac{68\pi l^3}{3}$</td> <td>$24\pi l^3$</td> </tr> <tr> <td></td> <td>4</td> <td>68</td> <td>72</td> </tr> <tr> <td>dist from O</td> <td>l</td> <td>\bar{x}</td> <td>$3l$</td> </tr> </tbody> </table>		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 M1 A1ft A1 (6)
		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}	$3l$															
Moments:	$4l + 68\bar{x} = 72 \times 3l$ $\bar{x} = \frac{212l}{68} = \frac{53}{17}l \quad \text{accept } 3.12l$																	
(b)	 <p> $GX = 6l - \bar{x}$ seen $\tan \theta = \frac{2l}{6l - \bar{x}}$ $= \frac{2 \times 17}{49}$ $\theta = 34.75\dots = 34.8 \quad \text{or } 35$ </p>	M1 M1 A1 A1 (4) [10]																

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

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

Question Number	Scheme	Marks
<p>Q7</p> <p>(a)</p>	<div style="text-align: center;"> </div> <p>R(↑) $T = 2mg$</p> <p>Hooke's law: $T = \frac{6mge}{3a}$</p> <p>$2mg = \frac{6mge}{3a}$</p> <p>$e = a$</p> <p>$AO = 4a$</p>	<p>B1</p> <p>M!</p> <p>A1 (3)</p>
<p>(b)</p>	<div style="text-align: center;"> </div> <p>H.L.</p> <p>Eqn. of motion</p> <p>$T = \frac{6mg(a-x)}{3a} = \frac{2mg(a-x)}{a}$</p> <p>$-2mg + T = 2m\ddot{x}$</p> <p>$-2mg + \frac{2mg(a-x)}{a} = 2m\ddot{x}$</p> <p>$-\frac{2mgx}{a} = 2m\ddot{x}$</p> <p>$\ddot{x} = -\frac{g}{a}x$</p> <p>period $2\pi\sqrt{\frac{a}{g}}$ *</p>	<p>B1ft</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1 (5)</p>

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