

Mark Scheme (Results)

June 2011

GCE Mechanics M2 (6678) Paper 1

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 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/>

June 2011

Publications Code UA028440

All the material in this publication is copyright

© Edexcel Ltd 2011

EDEXCEL GCE MATHEMATICS

General Instructions for Marking

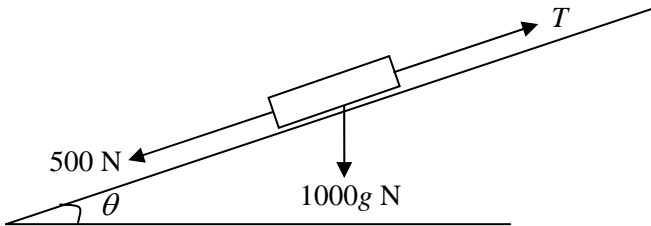
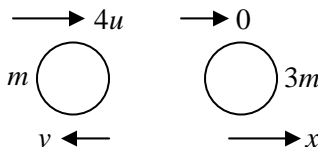
1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
 - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
 - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
 - **B** marks are unconditional accuracy marks (independent of M marks)
 - Marks should not be subdivided.

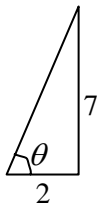
3. Abbreviations

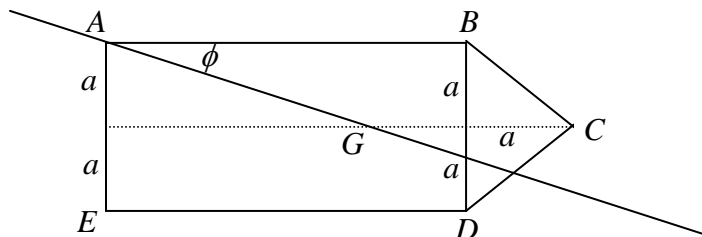
These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN.

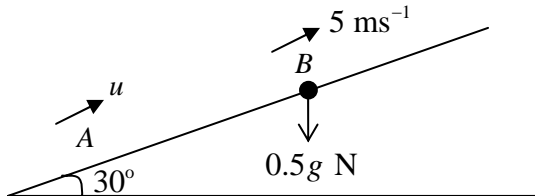
- bod – benefit of doubt
- ft – follow through
- the symbol $\hat{=}$ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- * The answer is printed on the paper
- \square The second mark is dependent on gaining the first mark

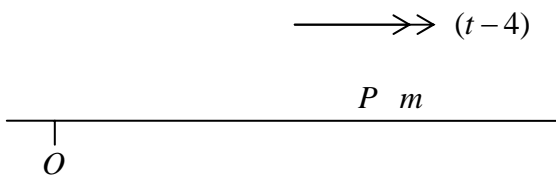
June 2011
6678 Mechanics M2
Mark Scheme

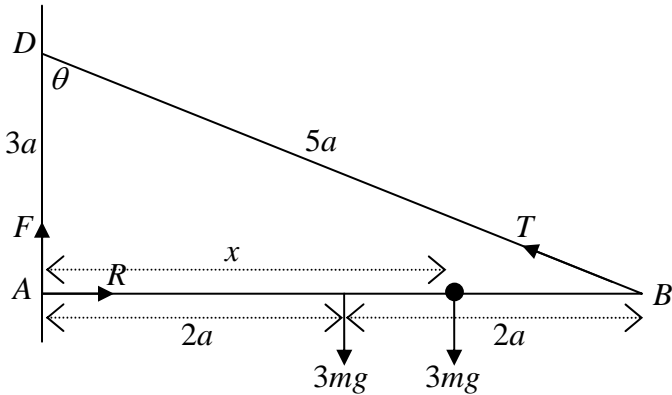
Question Number	Scheme	Marks
1.	 <p> $12000 = TV$ $T - 500 - 1000g \sin \theta = 0$ $V = \frac{12000}{500 + 1000 \times 9.8 \times \frac{1}{30}}$ $V = 15 \quad (\text{accept } 14.5)$ </p>	<p>M1 M1 A1 DM1 A1</p> <p>(5) 5</p>
2.	 <p> $4mu = 3mx - mv$ $4ue = x + v$ $4u = 3(4ue - v) - v$ $4u = 12ue - 4v$ $v = (3e - 1)u$ $v > 0 \Rightarrow 3e > 1$ $\therefore e > \frac{1}{3} \quad **$ </p>	<p>M1 A1 M1 A1 DM1 A1 DM1 A1</p> <p>(8) 8</p>

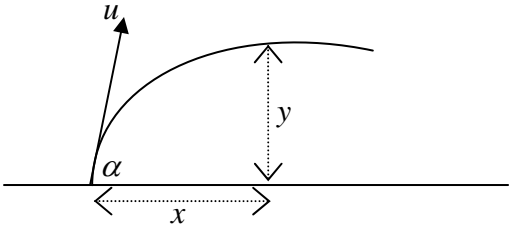
Question Number	Scheme	Marks
3. (a)	$\mathbf{I} = m\mathbf{v} - m\mathbf{u}$ $-4\mathbf{i} + 7\mathbf{j} = 0.5(\mathbf{v} - 12\mathbf{i})$ $4\mathbf{i} + 14\mathbf{j} = \mathbf{v}$ Speed = $\sqrt{16 + 196} = \sqrt{212} \text{ m s}^{-1}$ (14.6 or better)	M1 A1 M1 A1 (4)
(b)	 $\tan \theta = \frac{7}{2}$ $\theta = 74.0\dots$ $\theta = 74^\circ$	M1 A1ft (2)
(c)	Gain in K.E. = $\frac{1}{2} \times 0.5(212 - 12^2)$, = 17 J	M1 A1 (2) 8

Question Number	Scheme	Marks																
4. (a)	<div></div> <table><tr><td></td><td><i>ABDE</i></td><td><i>BCD</i></td><td>Lamina</td></tr><tr><td>Mass ratio</td><td>$8a^2\rho$</td><td>$a^2\rho$</td><td>$9a^2\rho$</td></tr><tr><td></td><td>8</td><td>1</td><td>9</td></tr><tr><td>Dist of C of M From AE</td><td>2a</td><td>$4\frac{1}{3}a$</td><td>\bar{x}</td></tr></table> <div>$8 \times 2a + 1 \times \frac{13}{3}a = 9\bar{x}$$\bar{x} = \frac{61}{27}a \quad (2.26a)$</div>		<i>ABDE</i>	<i>BCD</i>	Lamina	Mass ratio	$8a^2\rho$	$a^2\rho$	$9a^2\rho$		8	1	9	Dist of C of M From AE	2a	$4\frac{1}{3}a$	\bar{x}	<div>B1</div> <div>B1</div> <div>M1</div> <div>A1</div> <div>(4)</div>
	<i>ABDE</i>	<i>BCD</i>	Lamina															
Mass ratio	$8a^2\rho$	$a^2\rho$	$9a^2\rho$															
	8	1	9															
Dist of C of M From AE	2a	$4\frac{1}{3}a$	\bar{x}															
(b)	<div>$\tan \phi = \frac{a}{\frac{61}{27}a} = \frac{27}{61}$$\phi = 23.87... = 24^\circ \quad (\text{accept } 23.9), 0.417 \text{ radians}$</div>	<div>M1 A1 ft</div> <div>A1</div> <div>(3)</div> <div>7</div>																

Question Number	Scheme	Marks
5. (a)	 $0.5g \times 2 \sin 30 = \frac{1}{2} \times 0.5u^2 - \frac{1}{2} \times 0.5 \times 5^2$ $\frac{1}{4}u^2 = 0.5g + \frac{1}{2} \times 0.5 \times 5^2$ $u = 6.7 \text{ m s}^{-1} \quad (\text{accept } 6.68)$	<p>M1 A1</p> <p>DM1 A1</p> <p>(4)</p>
(b)	$R = 0.5g \cos 30$ $F = 0.5g \cos 30 \times \mu$ <p>Work done by friction = $1.5F$</p> $\frac{1}{2} \times 0.5 \times 5^2 = 1.5F + 0.5g \times 1.5 \sin 30$ $\mu = \frac{\frac{1}{2} \times 0.5 \times 5^2 - 0.5g \times 1.5 \sin 30}{0.5g \cos 30 \times 1.5}$ $\mu = 0.40 \quad (\text{accept } 0.4 \text{ or } 0.405)$	<p>B1</p> <p>M1</p> <p>M1 A1 A1</p> <p>A1</p> <p>(6)</p> <p>10</p>

Question Number	Scheme	Marks
6. (a)	 $\frac{dv}{dt} = t - 4$ $v = \frac{1}{2}t^2 - 4t (+c)$ $t = 0 \quad v = 6 \quad \Rightarrow c = 6$ $\therefore v = \frac{1}{2}t^2 - 4t + 6$	M1 A1 M1 A1 (4)
(b)	$v = 0 \quad 0 = t^2 - 8t + 12$ $(t - 6)(t - 2) = 0$ $t = 6 \quad t = 2$	M1 DM1 A1 (3)
(c)	$x = \frac{t^3}{6} - 2t^2 + 6t + k$ $x_6 - x_2 = \frac{6^3}{6} - 2 \times 6^2 + 6 \times 6 + k$ $- \left(\frac{2^3}{6} - 2 \times 2^2 + 6 \times 2 + k \right)$ $= -5\frac{1}{3}$ $\therefore \text{Distance is } 5\frac{1}{3} \text{ m}$	M1 A1 ft DM1 A1 (4) 11

Question Number	Scheme	Marks
7. (a)	 <p> $M(A) \quad 3mg \times 2a + 3mgx = T \cos \theta \times 4a$ $\quad \quad \quad = \frac{12}{5}aT$ $\frac{12}{5}aT = 6mga + 3mgx$ $T = \frac{25}{4}mg \quad \frac{12}{5}a \times \frac{25}{4}mg = 6mga + 3mgx$ $15a = 6a + 3x$ $x = 3a \quad **$ </p>	<p>M1 A2,1,0</p> <p>M1</p> <p>A1</p> <p>(5)</p>
(b)	<p> $R(\rightarrow) \quad R = T \sin \theta$ $\quad \quad \quad = \frac{25}{4}mg \times \frac{4}{5}$ $\quad \quad \quad = 5mg \quad **$ </p>	<p>M1</p> <p>A1</p> <p>A1</p> <p>(3)</p>
(c)	<p> $R(\uparrow) \quad F + \frac{25}{4}mg \times \frac{3}{5} = 3mg + 3mg$ $F = 6mg - \frac{15}{4}mg = \frac{9}{4}mg$ $\mu = \frac{F}{R} = \frac{\frac{9}{4}mg}{5mg} = \frac{9}{20}$ </p>	<p>M1 A2,1,0</p> <p>DM1 A1</p> <p>(5)</p> <p>13</p>

Question Number	Scheme	Marks
8. (a)	 <p> Horiz: $x = u \cos \alpha t$ Vert: $y = u \sin \alpha t - \frac{1}{2} g t^2$ $y = u \sin \alpha \times \frac{x}{u \cos \alpha} - \frac{1}{2} g \times \frac{x^2}{u^2 \cos^2 \alpha}$ $y = x \tan \alpha - \frac{g x^2}{2 u^2 \cos^2 \alpha} \quad **$ </p>	B1 M1 DM1 A1 (4)
(b)	$y = -7: \quad -7 = \tan 45x - \frac{g x^2}{2 \times 7^2 \cos^2 45}$ $-7 = x - \frac{9.8 x^2}{7^2}$ $-7 = x - \frac{x^2}{5}$ $x^2 - 5x - 35 = 0$ $x = \frac{5 \pm \sqrt{25 + 4 \times 35}}{2}$ $x = 8.92 \text{ or } 8.9$	M1 A1 M1 M1 A1 (5)
(c)	Time to travel 8.922 m horizontally $= \frac{8.922}{7 \cos 45} = 1.802...s$ $v = \frac{8.922}{1.402}$ $= 6.36 \text{ or } 6.4 \text{ (m s}^{-1}\text{)}$	M1 M1 A1 ft A1 (4) 13

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

Telephone 01623 467467

Fax 01623 450481

Email publication.orders@edexcel.com

Order Code UA028440 June 2011

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

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Ofqual



Llywodraeth Cynulliad Cymru
Welsh Assembly Government

