

GCE 2005

January Series



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Mark Scheme

Mathematics

MM1B

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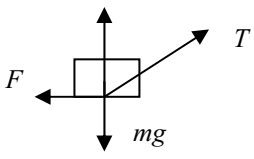
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Dr Michael Cresswell Director G

MM1B

Q	Solution	Marks	Total	Comments
1(a)(i)	$40 = 12 + 100a$	M1	2	Use of a constant acceleration equation to form equation for a AG; correct answer from correct working
	$a = \frac{40 - 12}{100} = 0.28 \text{ ms}^{-2}$ AG	A1		
	(ii)	$s = \frac{1}{2}(12 + 40) \times 100$ $= 2600 \text{ m}$	M1 A1	2
(c)	$F - 40000 = 200 \times 1000 \times 0.28$ $F = 40000 + 56000 = 96000 \text{ N}$	M1 A1 A1	3	Three term equation of motion Correct equation Correct force
Total			7	
2(a)	$12 \begin{bmatrix} 4 \\ 7 \end{bmatrix} + 4 \begin{bmatrix} 2 \\ 3 \end{bmatrix} = 16\mathbf{v}$	M1 A1	4	Three term momentum equation Correct equation Solving for \mathbf{v} Correct velocity
	$\mathbf{v} = \frac{1}{16} \begin{bmatrix} 56 \\ 96 \end{bmatrix} = \begin{bmatrix} 3.5 \\ 6.0 \end{bmatrix} \text{ ms}^{-1}$	m1 A1		
(b)	$12 \begin{bmatrix} 4 \\ 7 \end{bmatrix} + 4\mathbf{u} = 16 \begin{bmatrix} 1 \\ 4 \end{bmatrix}$	M1 A1	3	Three term momentum equation Correct equation Correct velocity
	$\mathbf{u} = \frac{1}{4} \begin{bmatrix} -32 \\ -20 \end{bmatrix} = \begin{bmatrix} -8 \\ -5 \end{bmatrix} \text{ ms}^{-1}$	A1		
Total			7	
3 (a)		B1	1	Correct diagram
(b)	$40 \cos 30^\circ - F = 25 \times 0.1$ $F = 40 \cos 30^\circ - 2.5 = 32.1 \text{ N}$	M1 A1 A1	3	Three term equation of motion Correct equation AG; correct force from correct working
	(c)	$R + 40 \sin 30^\circ = 25 \times 9.8$ $R = 225 \text{ N}$	M1 A1 A1	3
(d)	$32.1 = 225\mu$ $\mu = \frac{32.1}{225} = 0.143$	M1 A1	2	use of $F = \mu R$ Correct μ
	(e)	Friction will decrease as normal reaction decreases	B1 B1	2
Total			11	

MM1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	Light or smooth	B1	1	Acceptable assumption
(b)	$5g - T = 5a$ $T - 2g = 2a$ $3g = 7a$ $a = \frac{3g}{7} = 4.2 \text{ ms}^{-2}$	M1 A1 M1 A1 A1	5	Three term equation of motion for one particle Correct equation Three term equation of motion for other particle Correct equation AG; correct acceleration from correct working
(c)	$T = 2 \times 4.2 + 2 \times 9.8 = 28 \text{ N}$	M1 A1	2	Substitute $a = 4.2$ into one equation of motion Correct tension
Total			8	
5(a)	$200 \sin 30^\circ = T \sin 45^\circ$ $T = \frac{200 \sin 30^\circ}{\sin 45^\circ} = 141 \text{ N}$	M1 A1 A1	3	Resolving horizontally Correct equation AG; correct T from correct working
(b)	$200 \cos 30^\circ + 141 \cos 45^\circ + R = 500 \times 9.8$ $R = 4630 \text{ N}$	M1 A1 A1 A1	4	Resolving vertically with four terms Correct values Correct signs Correct R
Total			7	
6(a)	$\frac{\sin 60^\circ}{6} = \frac{\sin \alpha}{2}$ $\alpha = 16.8^\circ$	M1 A1 A1 A1	4	Use of sine rule Correct LHS Correct RHS AG; correct α from correct working
(b)	$\frac{v}{\sin(180 - 60 - 16.8)} = \frac{6}{\sin 60^\circ}$ $v = 6.74 \text{ or } 6.75 \text{ ms}^{-1}$	M1 A1 A1	3	use of sine rule to find v Correct equation Correct v
Total			7	

MM1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)	$-\mathbf{i} + \mathbf{j} = 2\mathbf{i} - \mathbf{j} + 10\mathbf{a}$ $\mathbf{a} = -0.3\mathbf{i} + 0.2\mathbf{j}$	M1 A1 A1	3	Use of velocity equation Correct equation Correct \mathbf{a}
(b)	$\mathbf{r} = (2\mathbf{i} - \mathbf{j})t + \frac{1}{2}(-0.3\mathbf{i} + 0.2\mathbf{j})t^2 + 20\mathbf{i}$ $= (2t - 0.15t^2 + 20)\mathbf{i} + (-t + 0.1t^2)\mathbf{j}$	M1 A1 A1 ft	3	Use of constant acceleration equation for position Correct \mathbf{i} component Correct \mathbf{j} component ft incorrect acceleration
(c) (i)	$\mathbf{r}(20) = (2 \times 20 - 0.15 \times 20^2 + 20)\mathbf{i} + (-20 + 0.1 \times 20^2)\mathbf{j}$ $= 0\mathbf{i} + 20\mathbf{j}$ so due north of origin	M1 A1	2	Substituting $t = 20$ into their expression for \mathbf{r} Correct conclusion from correct working
(c)(ii)	$\mathbf{v}(20) = 2\mathbf{i} - \mathbf{j} + 20(-0.3\mathbf{i} + 0.2\mathbf{j})$ $= -4\mathbf{i} + 3\mathbf{j}$ $v(20) = \sqrt{4^2 + 3^2} = 5 \text{ ms}^{-1}$	M1 A1 m1 A1ft	4	Finding velocity at $t = 20$ Correct velocity Finding magnitude Correct speed ft incorrect acceleration
Total			12	
8(a)	Ball is a particle No air resistance	B1 B1	2	One appropriate assumption Second appropriate assumption
(b)(i)	$0 = 12 \sin 40^\circ - 9.8t$ $t = \frac{12 \sin 40^\circ}{9.8} = 0.787 \text{ s}$	M1 A1 M1 A1	4	Equation to find time at maximum height Correct equation Solving for t Correct time
(ii)	$h = 12 \sin 40^\circ \times 0.7871 - 4.9 \times 0.7871^2$ $= 3.04 \text{ m}$	M1 A1 A1	3	Substituting time from previous into expression for height Correct expression AG; correct height from correct working
(c)	$2.44 = 12 \sin 40^\circ t - 4.9t^2$ $4.9t^2 - 12 \sin 40^\circ t + 2.44 = 0$ $t = 0.4385 \text{ or } 1.136$ $s = 12 \cos 40^\circ \times 1.136 = 10.4 \text{ m}$	M1 A1 A1 m1 A1 M1 A1	7	Equation for time to get to the bar, based on height being 2.44 Correct LHS Correct RHS Solving quadratic Correct time / times Substituting their larger time into an expression for the horizontal displacement Correct distance
Total			16	
TOTAL			75	