GCE 2005

January Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Mathematics

MM1B

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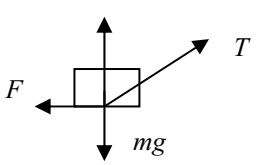
MM1B

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

MM1B (cont)

Q	Solution	Marks	Total	Comments
4(a)	Light or smooth	B1	1	Acceptable assumption
(b)	$5g - T = 5a$	M1		Three term equation of motion for one particle
		A1		Correct equation
	$T - 2g = 2a$	M1		Three term equation of motion for other particle
	$3g = 7a$	A1		Correct equation
	$a = \frac{3g}{7} = 4.2 \text{ ms}^{-2}$	A1	5	AG; correct acceleration from correct working
(c)	$T = 2\times4.2 + 2\times9.8 = 28 \text{ N}$	M1		Substitute a = 4.2 into one equation of motion
		A1	2	Correct tension
	Total		**8**	
5(a)	$200\sin 30° = T\sin 45°$	M1		Resolving horizontally
		A1		Correct equation
	$T = \frac{200\sin 30°}{\sin 45°} = 141 \text{ N}$	A1	3	AG; correct T from correct working
(b)	$200\cos 30° + 141\cos 45° + R = 500\times9.8$	M1		Resolving vertically with four terms
		A1		Correct values
		A1		Correct signs
	$R = 4630 \text{ N}$	A1	4	Correct R
	Total		**7**	
6(a)	$\frac{\sin 60°}{6} = \frac{\sin\alpha}{2}$	M1		Use of sine rule
		A1		Correct LHS
		A1		Correct RHS
	$\alpha = 16.8°$	A1	4	AG; correct α from correct working
(b)	$\frac{v}{\sin(180-60-16.8)} = \frac{6}{\sin 60°}$	M1		use of sine rule to find v
		A1		Correct equation
	$v = 6.74$ or 6.75 ms^{-1}	A1	3	Correct v
	Total		**7**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
7 (a)	$-\mathbf{i}+\mathbf{j}=2\mathbf{i}-\mathbf{j}+10\mathbf{a}$	M1		Use of velocity equation
		A1		Correct equation
	$\mathbf{a}=-0.3\mathbf{i}+0.2\mathbf{j}$	A1	3	Correct **a**
(b)	$\mathbf{r}=(2\mathbf{i}-\mathbf{j})t+\frac{1}{2}(-0.3\mathbf{i}+0.2\mathbf{j})t^2+20\mathbf{i}$	M1		Use of constant acceleration equation for position
	$=\left(2t-0.15t^2+20\right)\mathbf{i}+\left(-t+0.1t^2\right)\mathbf{j}$	A1		Correct **i** component
		A1 ft	3	Correct **j** component ft incorrect acceleration
(c) (i)	$\mathbf{r}(20)=(2\times20-0.15\times20^2+20)\mathbf{i}+(-20+0.1\times20^2)\mathbf{j}$	M1		Substituting $t = 20$ into their expression for **r**
	$=0\mathbf{i}+20\mathbf{j}$			
	so due north of origin	A1	2	Correct conclusion from correct working
(c)(ii)	$\mathbf{v}(20)=2\mathbf{i}-\mathbf{j}+20(-0.3\mathbf{i}+0.2\mathbf{j})$	M1		Finding velocity at $t = 20$
	$=-4\mathbf{i}+3\mathbf{j}$	A1		Correct velocity
		m1		Finding magnitude
	$\mathbf{v}(20)=\sqrt{4^2+3^2}=5\ \text{ms}^{-1}$	A1ft	4	Correct speed ft incorrect acceleration
	Total		**12**	
8(a)	Ball is a particle	B1		One appropriate assumption
	No air resistance	B1	2	Second appropriate assumption
(b)(i)	$0=12\sin40°-9.8t$	M1		Equation to find time at maximum height
		A1		Correct equation
	$t=\frac{12\sin40°}{9.8}=0.787\ \text{s}$	M1		Solving for t
		A1	4	Correct time
(ii)	$h=12\sin40°\times0.7871-4.9\times0.7871^2$	M1		Substituting time from previous into expression for height
	$=3.04\ \text{m}$	A1		Correct expression
		A1	3	AG; correct height from correct working
(c)	$2.44=12\sin40°t-4.9t^2$	M1		Equation for time to get to the bar, based on height being 2.44
		A1		Correct LHS
	$4.9t^2-12\sin40°t+2.44=0$	A1		Correct RHS
	$t=0.4385\text{ or }1.136$	m1		Solving quadratic
		A1		Correct time / times
		M1		Substituting their larger time into an expression for the horizontal displacement
	$s=12\cos40°\times1.136=10.4\ \text{m}$	A1	7	Correct distance
	Total		**16**	
	TOTAL		**75**	