



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

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**Mark scheme  
January 2004**

**GCE**

**Mathematics & Statistics B**

**Unit MBM1**

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## Key to mark scheme

<b>M</b>	mark is for	method
<b>m</b>	mark is dependent on one or more M marks and is for	method
<b>A</b>	mark is dependent on M or m mark and is for	accuracy
<b>B</b>	mark is independent of M or m marks and is for	method and accuracy
<b>E</b>	mark is for	explanation
<b>√ or ft or F</b>		follow through from previous incorrect result
<b>CAO</b>		correct answer only
<b>AWFW</b>		anything which falls within
<b>AWRT</b>		anything which rounds to
<b>AG</b>		answer given
<b>SC</b>		special case
<b>OE</b>		or equivalent
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>– x EE</b>		Deduct $x$ marks for each error
<b>NMS</b>		No method shown
<b>PI</b>		Perhaps implied
<b>c</b>		Candidate

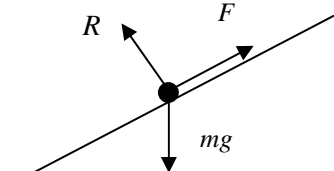
## Abbreviations used in marking

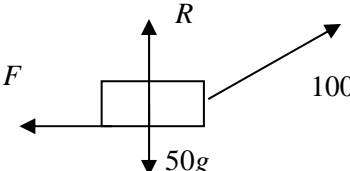
<b>MC – <math>x</math></b>	deducted $x$ marks for miscopy
<b>MR – <math>x</math></b>	deducted $x$ marks for misread
<b>ISW</b>	ignored subsequent working
<b>BOD</b>	gave benefit of doubt
<b>WR</b>	work replaced by candidate

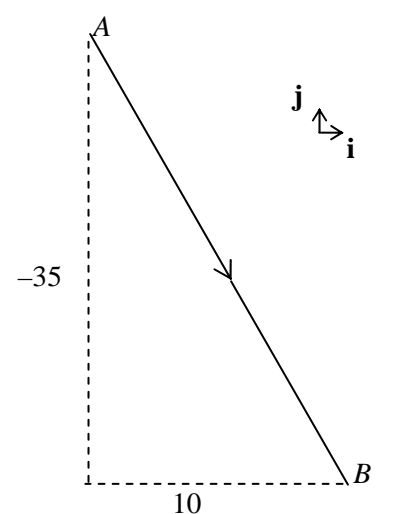
## Application of mark scheme

Correct answer without working	mark as in scheme
Incorrect answer without working	zero marks unless specified otherwise

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

Question Number and Part	Solution	Marks	Total	Comments
1(a)	$9 = 3 + 1.2t$	M1	2	Forming constant acceleration equation
	$t = \frac{9-3}{1.2} = 5 \text{ seconds}$	A1		Correct result from correct working
(b)	$s = \frac{1}{2}(3+9) \times 5 = 30 \text{ metres}$	M1	2	Forming constant acceleration equation
(c)	$F = 1200 \times 1.2 = 1440 \text{ N}$	A1 M1		Correct distance Applying Newton's second law with $a = 1.2$
		A1	2	Correct $F$
	<b>Total</b>		<b>6</b>	
2(a)	$0.1 \times 5 + 0.4 \times 3 = 0.5v$	M1	3	Using conservation of momentum
	$v = \frac{1.7}{0.5} = 3.4 \text{ ms}^{-1}$	A1		Correct equation
		A1		Correct $v$
(b)	$0.1 \times 5 + 0.4 \times 3 = 0.1v + 0.4 \times 3.5$	M1	4	Using conservation of momentum
		A1		Correct equation
	$v = \frac{1.7-1.4}{0.1} = 3 \text{ ms}^{-1}$	m1 A1		Solving for $v$ Correct $v$
	<b>Total</b>		<b>7</b>	
3(a)				
(b)	$R = 5 \times 9.8 \cos 40^\circ = 37.5 \text{ N}$	B1 M1	1	Correct force diagram Resolving perpendicular to slope
(c)	$F = 0.2R = 7.51 \text{ N}$	A1 M1	2	Correct $R$ Using $F = \mu R$
(d)	$5 \times 9.8 \sin 40^\circ - F = 5a$	A1 M1	2	Correct $F$ from correct working Resolving parallel to slope to give 3 term equation of motion
		A1	4	Correct equation
	$a = \frac{5 \times 9.8 \sin 40^\circ - F}{5} = 4.80 \text{ ms}^{-2}$	m1 A1		Solving for $a$
(e)	$10^2 = 2^2 + 2 \times 4.80s$	M1	3	Correct $a$ from correct working Forming constant acceleration equation
	$s = \frac{100-4}{9.6} = 10.0 \text{ m}$	A1		Correct equation Correct $s$
	<b>Total</b>		<b>12</b>	

Question Number and Part	Solution	Marks	Total	Comments
4(a)	$14a = 14g \sin 45^\circ - T$ $6a = T - 6g$ $14a = 14g \sin 45^\circ - (6a + 6g)$ $a = \frac{14g \sin 45^\circ - 6g}{20} = 1.91 \text{ ms}^{-2}$	M1 A1 M1 A1 M1 A1	6	Equation of motion for one particle Correct equation Equation of motion for other particle Correct equation Solving for $a$ Correct $a$ from correct working
(b)	$T = mg$ $T = 14g \cos 45^\circ$ $m = 14 \cos 45^\circ = 9.90 \text{ kg}$	M1 M1 A1 A1	4	Equation for one particle Equation for other particle Correct $m$
<b>Total</b>			<b>10</b>	
5(a)		B1	1	Correct force diagram
(b)	$50 \times 9.8 = R + 100 \sin 30^\circ$ $R = 440 \text{ N}$	M1 A1 A1	3	Resolving vertically Correct equation Correct $R$ from correct working
(c)	$100 \cos 30^\circ \leq \mu \times 440$ $\mu \geq 0.197$ $\therefore k = 0.197$	M1 A1 A1	3	Use of $F \leq \mu R$ or $F = \mu R$ Correct equation Correct $k$ from correct working
(d)	$50a = 100 \cos 30^\circ - 0.1 \times 440$ $a = 0.852 \text{ ms}^{-2}$	M1 A1 m1 A1	4	Resolving horizontally to obtain a 3 term equation of motion Correct equation Solving for $a$ Correct $a$ Allow 0.680 or 0.681
<b>Total</b>			<b>11</b>	
6(a)(i)	$10 \times 9.8 \times 0.5 = 2T$ $T = 24.5$	M1 A1 A1	3	Moments about pivot with 2 terms Correct moment equation Correct tension from correct working
(ii)	$10 \times 9.8 \times 0.5 + 40 \times 9.8 \times 3 = 2T$ $T = 613$ (to 3 sf)	M1 A1 A1	3	Moments about pivot with 3 terms Correct moment equation Correct tension from correct working
(b)	No change, as the ratios of the distances from the pivot would be the same.	B1 B1	2	No Reason
<b>Total</b>			<b>8</b>	

Question Number and Part	Solution	Marks	Total	Comments
7(a)	$0 = 10 \sin 70^\circ t - 4.9t^2$ $t = 0$ or $t = \frac{10 \sin 70^\circ}{4.9} = 1.918 \text{ s}$ $R = 10 \cos 70^\circ \times 1.918 = 6.56 \text{ m}$	M1 M1 A1 M1 A1	5	Equation for height equal to zero Solving for $t$ Correct $t$ Calculating range Correct range
(b)	$-2 = 10 \sin 70^\circ t - 4.9t^2$  $4.9t^2 - 10 \sin 70^\circ t - 2 = 0$ $t = 2.11$ or $-0.193$ $R = 10 \cos 70^\circ \times 2.11 = 7.22 \text{ m}$	M1 A1 A1  M1 A1 M1 A1		
<b>Total</b>			<b>12</b>	
8(a)	$19\mathbf{i} - 25\mathbf{j} = \frac{1}{2}\mathbf{a} \times 10^2 + 9\mathbf{i} + 10\mathbf{j}$ $50\mathbf{a} = 10\mathbf{i} - 35\mathbf{j}$ $\mathbf{a} = 0.2\mathbf{i} - 0.7\mathbf{j}$	M1  A1 M1 A1	4	Using both position vectors to form a constant acceleration equation Correct equation Solving for $\mathbf{a}$ Correct $\mathbf{a}$ Use of $\mathbf{v} = \mathbf{a}t$ Correct velocity
(b)	$\mathbf{v} = 10(0.2\mathbf{i} - 0.7\mathbf{j})$ $= 2\mathbf{i} - 7\mathbf{j}$ $v = \sqrt{2^2 + 7^2} = 7.28 \text{ ms}^{-1}$	M1 A1		
(c)	$15.4 = \frac{1}{2} \times 0.2 \times t^2 + 9$ $t = 8$ $\frac{1}{2} \times (-0.7) \times 8^2 + 10 = -12.4$	M1  A1		Finding $t$ from one component  Correct $t$
(d)		B1 B1	2	Straight line Correct direction
<b>Total</b>			<b>14</b>	
<b>TOTAL</b>			<b>80</b>	