

# GCE 2004

## *November Series*



## Mark Scheme

### Mathematics and Statistics B

#### *MBM1*

---

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA  
Tel: 0161 953 1170

or

download from the AQA website: [www.aqa.org.uk](http://www.aqa.org.uk)

Copyright © 2004 AQA and its licensors

#### COPYRIGHT

AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX.

*Dr Michael Cresswell Director General*

## 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</b>		follow through from previous incorrect result
<b>cao</b>		correct answer only
<b>cso</b>		correct solution only
<b>awfw</b>		anything which falls within
<b>awrt</b>		anything which rounds to
<b>acf</b>		any correct form
<b>ag</b>		answer given
<b>sc</b>		special case
<b>oe</b>		or equivalent
<b>sf</b>		significant figure(s)
<b>dp</b>		decimal place(s)
<b>A2,1</b>		2 or 1 (or 0) accuracy marks
<b>-x ee</b>		deduct $x$ marks for each error
<b>PI</b>		possibly implied
<b>sca</b>		substantially correct approach

## Abbreviations used in Marking

<b>MC -<math>x</math></b>	deducted $x$ marks for mis-copy
<b>MR -<math>x</math></b>	deducted $x$ marks for mis-read
<b>isw</b>	ignored subsequent working
<b>bod</b>	gave benefit of doubt
<b>wr</b>	work replaced by candidate
<b>fb</b>	formulae book

## Application of Mark Scheme

**Correct answer without working**

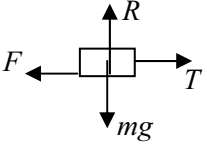
**mark as in scheme**

**Incorrect answer without working**

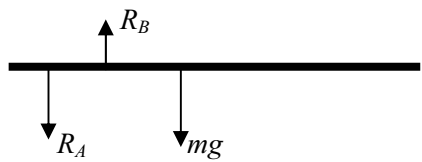
**zero marks unless specified otherwise**

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

**Mathematics and Statistics B Mechanics 1 MBM1 November 2004**

Question Number and Part	Solution	Marks	Total	Comments
1(a)(i)	$16^2 = 0^2 + 2 \times a \times 400$	M1		Using constant acceleration equation to find $a$
	$a = \frac{256}{800} = 0.32 \text{ m s}^{-2}$	A1	2	<b>ag</b> Correct $a$ from correct working
(ii)	$16 = 0 + 0.32t$	M1		Using constant acceleration equation to find $t$
	$t = \frac{16}{0.32} = 50 \text{ seconds}$	A1	2	Correct $t$
(b)(i)	$30^2 = 16^2 + 2 \times 0.5s$	M1		Using constant acceleration equation to find $s$
	$s = 30^2 - 16^2 = 644 \text{ m}$	A1	2	Correct $s$
(ii)	$644 = \frac{1}{2}(16 + 30)t$	M1		Using constant acceleration equation to find $t$
	$t = \frac{644}{23} = 28 \text{ s}$	A1		Correct $t$
	Total time = $28 + 50 = 78 \text{ s}$	A1✓	3	Adding 50 to give total time
<b>Total</b>			<b>9</b>	
2(a)		B1	1	Correct diagram
(b)	$R = 4 \times 9.8 = 39.2 \text{ N}$	B1	1	Correct normal reaction
(c)	$T - 0.4 \times 39.2 = 4 \times 2$	M1		Three term equation of motion
	$T = 23.7 \text{ N (to 3sf)}$	A1	3	Correct $T$
(d)	$20 - 0.4 \times 39.2 = 4a$	M1		
	$a = 1.08 \text{ m s}^{-2}$	A1	2	
<b>Total</b>			<b>7</b>	
3(a)	$12g - T = 12a$	M1		Equation of motion for one particle
	$T - 8g = 8a$	A1		Correct equation
	$8a + 8g = 12g - 12a$	M1		Equation of motion for other particle
	$20a = 4g$	A1		Correct equation
	$a = \frac{4g}{20} = 1.96 \text{ m s}^{-2}$	A1	5	<b>ag</b> Correct $a$ from correct working
(b)	$T = 8 \times 1.96 + 8 \times 9.8$	M1		Substituting value for $a$ into equation of motion to find $T$
	$= 94.1 \text{ N}$	A1	2	Correct $T$
(c)	$7 = 0 + 1.96t$	M1		Using constant acceleration to find $t$
	$t = \frac{7}{1.96} = 3.57 \text{ s (to 3 sf)}$	A1	2	Correct $t$
<b>Total</b>			<b>9</b>	

**MBM1 (cont)**

Question Number and Part	Solution	Marks	Total	Comments
4(a)	$2 \times 5 = 40v$ $v = \frac{10}{40} = 0.25 \text{ m s}^{-1}$	M1 A1	2	Three term conservation of momentum equation Correct v
(b)	$2 \times 6 + 40 \times 0.25 = 42v$ $v = \frac{22}{42} = \frac{11}{21} = 0.524 \text{ m s}^{-1}$ (to 3sf)	M1 A1 A1		
<b>Total</b>			<b>5</b>	
5(a)	$T_1 = 4 \times 9.8 = 39.2 \text{ N}$ $T_2 = 3 \times 9.8 = 29.4 \text{ N}$	B1 B1	2	Correct tension in left string Correct tension in right string
(b)	$39.2 \sin 43^\circ = 29.4 \sin \theta$ $\sin \theta = \frac{39.2 \sin 43^\circ}{29.4} = 0.9093$ $\theta = 65.4^\circ$	M1 A1 A1 M1		
(c)	$9.8m = 39.2 \cos 43^\circ + 29.4 \cos \theta$ $m = \frac{39.2 \cos 43^\circ + 29.4 \cos \theta}{9.8} = 4.17 \text{ kg}$	M1 A1 M1 A1	4	Resolving vertically Correct equation Finding $m$ Correct $m$
<b>Total</b>			<b>11</b>	
6(a)		B1	1	Correct force diagram
(b)	$0.8R_A = 0.5 \times 40 \times 9.8$ $R_A = \frac{0.5 \times 40 \times 9.8}{0.8} = 245 \text{ N}$	M1 A1 A1	3	Moment equation to find $R_A$ Correct equation <b>ag</b> Correct reaction from correct working
(c)	$R_B = 245 + 40 \times 9.8 = 637 \text{ N}$	M1 A1		
(d)	$0.8R_A = 0.5 \times 40 \times 9.8 + 3 \times 5 \times 9.8$ $R_A = \frac{0.5 \times 40 \times 9.8 + 3 \times 5 \times 9.8}{0.8}$ $= 429 \text{ N}$ (to 3sf) $R_B = 429 + 40 \times 9.8 + 5 \times 9.8$ $= 870 \text{ N}$ (to sf)	M1 A1 M1 A1	6	Four term moment equation Correct equation Finding reaction Correct reaction Equation to find other reaction Correct reaction
<b>Total</b>			<b>12</b>	

**MBM1 (cont)**

Question Number and Part	Solution	Marks	Total	Comments
7(a)	$19\mathbf{i} + 13\mathbf{j} = 35\mathbf{i} + 45\mathbf{j} + 8\mathbf{a}$ $\mathbf{a} = \frac{19-35}{8}\mathbf{i} + \frac{13-45}{8}\mathbf{j} = -2\mathbf{i} - 4\mathbf{j}$	M1 A1 A1	3	Constant acceleration equation to find <b>a</b> Correct equation <b>ag</b> Correct <b>a</b> from correct working
(b)	$\mathbf{r} = (35\mathbf{i} + 45\mathbf{j})t + \frac{1}{2}(-2\mathbf{i} - 4\mathbf{j})t^2$	M1 A1 A1	3	Use of constant acceleration equation Correct <b>i</b> component Correct <b>j</b> component
(c)	$\mathbf{r} = (35t - t^2)\mathbf{i} + (45t - 2t^2)\mathbf{j}$ $35t - t^2 = 300$ $t^2 - 35t + 300 = 0$ $t = 15$ or $t = 20$ $4t - 2t^2 = 225$ $2t^2 - 45t + 225 = 0$ $t = 7.5$ or $t = 15$ $t = 15$ seconds	B1 M1 M1 A1 B1 M1 A1	7	Splitting into components correctly Forming equation for one component Solving quadratic Two correct solutions Forming correct second quadratic Solving quadratic for two solutions Correct final solution
	<b>Total</b>		<b>13</b>	
8(a)(i)	$20 \sin 30^\circ t - 4.9t^2 = 0$ $t = 0$ or $t = \frac{20 \sin 30^\circ}{4.9} = 2.04$ (to 3 sf)	M1 A1 M1 A1	4	Forming equation for time of flight Correct equation Solving quadratic equation <b>ag</b> Correct solution from correct working
(ii)	$R = 20 \cos 30^\circ \times 2.04 = 35.3$ m	M1 A1	2	Calculation of range Correct range
(b)	$20 \sin 30^\circ t - 4.9t^2 = 2$ $4.9t^2 - 10t + 2 = 0$ $t = 0.2248$ or $t = 1.82$ $v_y = 20 \sin 30^\circ - 9.8 \times 0.2248 = 7.797$ $v_x = 20 \cos 30^\circ = 17.32$ $v = \sqrt{v_x^2 + v_y^2} = 19.0 \text{ m s}^{-1}$ (to 3 sf)	M1 A1 A1 M1 A1 B1 M1 A1	8	Equation to find $t$ at height of 2 Correct equation Correct times Calculating vertical component Correct vertical component Finding horizontal component Finding speed from components Correct speed
	<b>Total</b>		<b>14</b>	
	<b>TOTAL</b>		<b>80</b>	