GCE 2004
November Series

AQA

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.

Key to Mark Scheme

M	mark is for	method
m	mark is dependent on one or more M marks and is for	method
A	mark is dependent on M or m mark and is for	accuracy
B	mark is independent of M or m marks and is for	method and accuracy
E	mark is for	explanation
√or ft		follow through from previous incorrect result
cao		correct answer only
cso		correct solution only
awfw		anything which falls within
awrt		anything which rounds to
acf		any correct form
ag		answer given
sc		special case
oe		or equivalent
sf		significant figure(s)
dp		decimal place(s)
A2,1		2 or 1 (or 0) accuracy marks
–x ee		deduct x marks for each error
PI		possibly implied
sca		substantially correct approach

Abbreviations used in Marking

MC –x	deducted x marks for mis-copy
MR –x	deducted x marks for mis-read
isw	ignored subsequent working
bod	gave benefit of doubt
wr	work replaced by candidate
fb	formulae book

Application of Mark Scheme

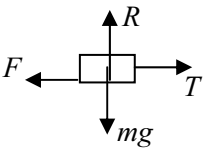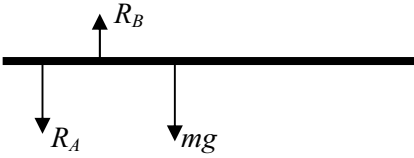|	
Correct answer without working	**mark as in scheme**
Incorrect answer without working	**zero marks unless specified otherwise**

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

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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
	$a = \dfrac{256}{800} = 0.32 \, \text{m s}^{-2}$	A1	2	**ag** Correct a from correct working
(ii)	$16 = 0 + 0.32t$	M1		Using constant acceleration equation to find t
	$t = \dfrac{16}{0.32} = 50 \, \text{seconds}$	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)	$644 = \dfrac{1}{2}(16 + 30)t$	M1		Using constant acceleration equation to find t
	$t = \dfrac{644}{23} = 28 \, \text{s}$	A1		Correct t
	Total time $= 28 + 50 = 78 \, \text{s}$	A1✓	3	Adding 50 to give total time
	Total		**9**	
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
		A1		Correct equation
	$T = 23.7 \, \text{N (to 3sf)}$	A1	3	Correct T
(d)	$20 - 0.4 \times 39.2 = 4a$	M1		
	$a = 1.08 \, \text{m s}^{-2}$	A1	2	
	Total		**7**	
3(a)	$12g - T = 12a$	M1		Equation of motion for one particle
		A1		Correct equation
	$T - 8g = 8a$	M1		Equation of motion for other particle
		A1		Correct equation
	$8a + 8g = 12g - 12a$			
	$20a = 4g$			
	$a = \dfrac{4g}{20} = 1.96 \, \text{m s}^{-2}$	A1	5	**ag** 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
	$\quad = 94.1 \, \text{N}$	A1	2	Correct T
(c)	$7 = 0 + 1.96t$	M1		Using constant acceleration to find t
	$t = \dfrac{7}{1.96} = 3.57 \, \text{s (to 3 sf)}$	A1	2	Correct t
	Total		**9**	

MBM1 (cont)

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

MBM1 (cont)

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