AQA

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme
January 2004

GCE

Mathematics A

Unit MAM1

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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 or F		follow through from previous incorrect result
CAO		correct answer only
AWFW		anything which falls within
AWRT		anything which rounds to
AG		answer given
SC		special case
OE		or equivalent
A2,1		2 or 1 (or 0) accuracy marks
– *x* EE		Deduct *x* marks for each error
NMS		No method shown
PI		Perhaps implied
c		Candidate

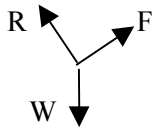
Abbreviations used in marking

MC – *x*	deducted *x* marks for miscopy
MR – *x*	deducted *x* marks for misread
ISW	ignored subsequent working
BOD	gave benefit of doubt
WR	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.

Q	Solution	Marks	Total	Comments
1 (a)	$\mathbf{F} = \begin{pmatrix} 6 \\ -2.5 \end{pmatrix}$ N	B1 B1	 2	B1 each component
(b)	$\lvert\mathbf{F}\rvert = \sqrt{6^2 + (-2.5)^2}$	M1		Must see +
	$= 6.5$ N	A1F	2	ft from vector in (a)
		Total	**4**	
2 (a)		B1	1	Three forces labelled & with arrows, W, *mg* or 35*g* vertical (or 2 components of W), R and F perpendicular (ignore pairs of components of existing forces)
(b)	$R = 35g \times \cos 25°$	M1A1		Component attempted & *g* present for M1
	$R = 311$ N	A1F	3	(R=310.86) accept AWRT 311
(c)	$F = 35g \times \sin 25°$ $(= 144.96)$	M1A1		Component attempted & *g* present for M1 & acceleration zero
	$F = \mu R,\ 144.96 = \mu \times 310.86$	M1		Use of friction law with candidate's values, must have tried to find F
	$\mu = 0.466$	A1F	4	ft R and F, provided $\mu > 0$ M1A0 if $F < \mu R$ used SC accept use of $\mu = \tan\theta$
		Total	**8**	

Q	Solution	Marks	Total	Comments
3 (a)	$v^2 = 5^2 + 2\times(-1.8)\times 2.5$	M1A1		3 terms for M1, accept 1.8; A1 all correct
	$v = \pm 4\ \text{m s}^{-1}$	A1	3	Both required
(b)	$v = u + at, \qquad -4 = 4 - 1.8t$	M1A1F		M1 for full method for finding the two times at B or their difference A1F if one positive & one negative time
	$t = 40/9$ or $t = 4\frac{4}{9}$ or 4.44 sec	A1F	3	A1F for completion, including difference of times Alternatives: $s = ut + \frac{1}{2}at^2$, $2.5 = 5t - \frac{1}{2}\times 1.8t^2$ (M1) $(9t-5)(t-5)$ (A1) time difference $= 4\frac{4}{9}$ (A1F) If time from B to stopping point found, 20/9, M1A1F time × 2, 40/9, A1F
		Total	**6**	
4 (a)(i)	$\lvert\text{retardation}\rvert = \frac{9}{6}$	M1		Accept ±
	$= 1.5\ \text{m s}^{-1}$	A1	2	Positive answer required
(ii)	distance $= \frac{1}{2}\times 6\times 9$	M1		Method for distance
	$= 27\text{m}$	A1F	2	ft if incorrect retardation used provided answer > 0
(b)	distance $= \int\left(9 - \frac{t^2}{4}\right)\text{d}t = 9t - \frac{t^3}{12}(+c)$	M1 A1		integration attempted integration correct, constant not required
	use of limits $t = 6$ and $t = 0$	m1		or evaluation of constant
	distance = 36 m	A1F	4	ft integration SC if $t = 6$ only used, B1
(c)	second model, as distance is greater	B1F	1	Comparison of 2 unequal positive distances
		Total	**9**	

Q	Solution	Marks	Total	Comments
5 (a)	$\mathbf{v} = \left(4t^3 - 4t\right)\mathbf{i} + \left(12t^2 - 4t^3\right)\mathbf{j}$	M1		differentiation
		A1A1	3	each term of vector
(b)	$m\mathbf{v} = \left(t^3 - t\right)\mathbf{i} + \left(3t^2 - t^3\right)\mathbf{j}$	B1F	1	Accept unsimplified vector
(c)	$\frac{\mathrm{d}}{\mathrm{d}t}(m\mathbf{v}) = \left(3t^2 - 1\right)\mathbf{i} + \left(6t - 3t^2\right)\mathbf{j}$	M1		differentiation
		A1FA1F	3	Accept unsimplified vector Alternative: **a** found (M1A1F) $\mathbf{a} = (12t^2 - 4)\mathbf{i} + (24t - 12t^2)\mathbf{j}$ $\mathbf{F}(= m\mathbf{a})$ (A1F)
(d)	$3t^2 - 1 = 0$	M1		
	$t = \frac{1}{\sqrt{3}}$	A1F	2	Exact value required, ignore ±
		Total	**9**	
6 (a)	$\mathrm{T} = 0.4 \times 9.8 = 3.92\mathrm{N}$	B1	1	Accept $0.4g$
(b)(i)	A: $0.6g - \mathrm{T} = 0.6a$	M1A1		M1 either equation, with 3 terms and g
	B: $\mathrm{T} - 0.4g = 0.4a$	A1		SC whole string method, max 3/5, $0.6g - 0.4g = (0.6+0.4)a$, M1A1; a, A1
	$0.2g = a$	m1		m1 for elimination of T
	$a = 1.96\,\mathrm{m\,s^{-2}}$	A1	5	CAO
(ii)	$v = 0 + 1.96 \times 1.5$	M1		
	$v = 2.94\,\mathrm{m\,s^{-1}}$	A1	2	
(c)	clay: $S_1 = 2.94t + \frac{1}{2} \times 9.8t^2$	M1A1F		Must see g term for M1, must use velocity from (b)(ii) for A1, ft velocity
	bucket: $S_2 = 2.94t$	B1F		ft velocity
	difference: $4.9t^2$	B1F	4	$S_1 - S_2$ leading to positive answer
		Total	**12**	

Q	Solution	Marks	Total	Comments
7 (a)	$x = 7t$	B1		
	$y = 0 + \frac{1}{2}gt^2$	M1		Accept ±
	$y = 4.9t^2$	A1	3	Accept ±
(b)	$t = \frac{x}{7}$	M1		Attempt at substitution, or use of equation of trajectory with V = 7 & α = 0
	$y = 4.9\left(\frac{x}{7}\right)^2$			
	$y = \frac{x^2}{10}$	A1	2	CAO
(c)	$8.1 = \frac{x^2}{10}$	M1		Full method for x, accept ±
	$x = 9\text{m}$	A1	2	AWRT 9.0 if two stages used
(d)	vert: $v^2 = 0 + 2 \times 9.8 \times 8.1$	M1A1		For M1 Accept ±, for A1 consistency of signs needed
	$u = 7$	B1		
	$\text{speed}^2 = \left(7^2 + 12.6^2\right)$	M1		
	$\text{speed} = 14.4\,\text{m s}^{-1}$	A1F	5	(14.414)
		Total	**12**	
		Total	**60**	