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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MM1B Mechanics 1B

Mark Scheme

2006 examination – June series

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 And Abbreviations Used In Marking

M	mark is for method
m or dM	mark is dependent on one or more M marks and is for method
A	mark is dependent on M or m marks 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	MC	mis-copy
CAO	correct answer only	MR	mis-read
CSO	correct solution only	RA	required accuracy
AWFW	anything which falls within	FW	further work
AWRT	anything which rounds to	ISW	ignore subsequent work
ACF	any correct form	FIW	from incorrect work
AG	answer given	BOD	given benefit of doubt
SC	special case	WR	work replaced by candidate
OE	or equivalent	FB	formulae book
A2,1	2 or 1 (or 0) accuracy marks	NOS	not on scheme
–*x* EE	deduct *x* marks for each error	G	graph
NMS	no method shown	c	candidate
PI	possibly implied	sf	significant figure(s)
SCA	substantially correct approach	dp	decimal place(s)

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

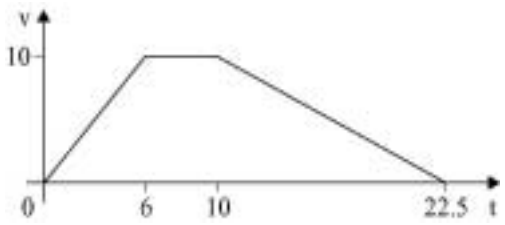
Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

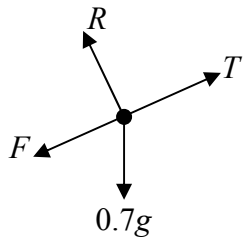
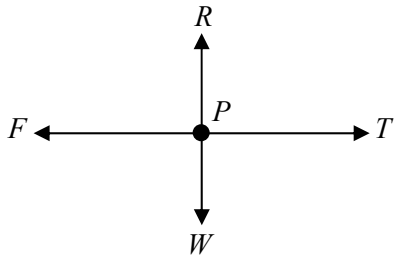
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

MM1B

Q	Solution	Marks	Total	Comments
1(a)	$s = 0 + \frac{1}{2} \times 9.8 \times 4^2$	M1 A1		Full method Correct subs, accept ± 9.8
	$s = 78.4$ metres	A1	3	CAO (need positive)
(b)	Average speed $= \frac{78.4}{4}$	M1		Also accept full method with use of velocities at $t = 0$ and 4, or at $t = 2$
	$= 19.6$ ms^{-1}	A1F	2	FT distance
(c)	Only force acting is weight	B1	1	Acc resistance forces negligible or ignored, (not friction, or air friction)
	Total		**6**	
2(a)	$P = 5 + 8\cos 60^\circ$	M1		Both relevant forces, component of 8N attempted
		A1		All correct
	$P = 9$	A1	3	CAO
(b)	$Q = 8\cos 30^\circ$	M1		Component of 8N attempted
	$Q = 6.93$ or $4\sqrt{3}$	A1	2	AWRT 6.93
	Total		**5**	
3(a)	$v = u + at$ $0 = 10 + (-0.8) \times t$	M1		Full method with u, v used correctly Accept ± 0.8
	$t = 12.5$ sec	A1	2	CAO (correct subs and answer)
(b)		B1 B1 B1		each line, straight and correct end points SC: B1 for 3 lines giving correct shape but no values shown SC: first error in labelling times loses B1, repeated errors no further penalty
		B1	4	axes labelled v, t
(c)	distance $= \frac{1}{2} \times 10 \times (4 + 22.5)$	M1		Full correct method
		A1F		Correct subs, FT graph if final $t = 12.5$
	$= 132.5$ metres	A1F	3	FT one slip, AWRT 133
(d)	Acceleration unlikely to: change so abruptly or be constant or velocity unlikely to be constant	B1	1	
	Total		**10**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
4(a)		B1	1	Accept W or mg (or 6.86) for weight Arrows and labels needed (can replace W with 2 correct components)
(b)	$R = 0.7g\cos 22^\circ$	M1		component of weight attempted
		A1		all correct, including signs
	$R = 6.36$ N	A1	3	CAO
(c)	$F = 0.25 \times 6.36$	M1		
	$F = 1.59$N	A1	2	CAO
(d)	$5.6 - 0.7g\sin 22^\circ - 1.59 = 0.7a$	M1		4 terms with weight component attempted
		A2		A marks -1 each error, accept $\pm 0.7a$
	$a = 2.06\text{ms}^{-2}$	A1F	4	FT one error, accept $\pm$
	Total		**10**	
5(a)(i)		B1	1	Accept mg, $0.4g$ or 3.92 for weight Arrows and labels needed
(ii)	$F = 0.5 \times (0.4 \times 9.8)$	M1		Need to see 0.4×9.8 or 3.92 used
	$F = 1.96$N	A1	2	
(b)	$T - 1.96 = 0.4a$	M1A1		Consistent reversal of signs in both equations 4 marks; reversal of signs in one equation, M1 A1 M1 A0
	$0.3g - T = 0.3a$	M1A1		
	$a = 1.4\text{ms}^{-2}$	A1	5	Sign change needs justification (whole string: equation, $0.3g - 1.96 = 0.7a$ M1A1 $a = 1.4$ A1) max 3/5
(c)	$v = 1.4 \times 3$	M1		Full method
	$v = 4.2\text{ms}^{-2}$	A1	2	CAO
(d)	P : Friction will cause	M1		
	speed to decrease	A1		Accept decelerate or comes to rest
	Q : Gravity will cause	M1		
	speed to increase	A1	4	Accept accelerate
	Total		**14**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
6(a)	$\mathbf{d} = 3\mathbf{i} - 6\mathbf{j}$	B1		Accept $\pm\mathbf{d}$ or displacements of 3, 6 shown on a diagram
	$3\mathbf{i} - 6\mathbf{j} = (\mathbf{i} - 2\mathbf{j})t$	M1		Or equivalent method for t Accept ratio of vectors leading directly to ± 3
	$t = 3$	A1	3	CAO
(b)(i)	$\mathbf{r} = (\mathbf{i} - 2\mathbf{j}) \times 4 + \frac{1}{2} \times 2\mathbf{j} \times 16$	M1		Full method for vector expression giving change in position
		A1		For correct subs (gives $4\mathbf{i} + 8\mathbf{j}$)
	$+6\mathbf{i} - 4\mathbf{j}$	M1		
	$= 10\mathbf{i} + 4\mathbf{j}$	A1F	4	FT slip provided obtain vector expression $(\mathbf{u} = 0$ gives $6\mathbf{i} + 12\mathbf{j})$
(ii)	$A(3,2)$ $C(10,4)$			
	$\mathbf{d} = 7\mathbf{i} + 2\mathbf{j}$	M1		Attempt to find vector $\overrightarrow{AC}$ or $\overrightarrow{CA}$ (using candidate's C
	$\lvert\mathbf{d}\rvert = \sqrt{7^2 + 2^2}$			
	$AC = \sqrt{53} = 7.28$	A1F	2	FT $\mathbf{d}$ provided two non-zero components Accept $\sqrt{53}$
	Total		**9**	
7(a)	$57 = 24\cos 40^\circ \times t$	M1		Component attempted and acceleration $= 0$
		A1		All correct
	$t = 3.10$ sec	A1	3	CAO
(b)	$h = 24\sin 40^\circ \times 3.1 - \frac{1}{2} \times 9.8 \times 3.1^2$	M1		Component attempted & acceleration = 9.8
		A1		All correct
	$h = 0.734$ m	A1F	3	FT one slip e.g. +9.8 used Accept 2 s.f. answer, AWRT $0.71 - 0.74$
(c)(i)	horizontal, $u = 24\cos 40^\circ = 18.39$ ms^{-1}	B1		Seen anywhere in (c) accept 18.4
	vertical, $v = 24\sin 40^\circ - 9.8 \times 3.1$	M1		Component attempted & acceleration = 9.8
	$v = -14.95$ ms^{-1}	A1		(Accept -15.0)
	$V = \sqrt{(18.39)^2 + (-14.95)^2}$	M1		Use of candidate's u and new v (when $t = 3.1$)
	$V = 23.7$ ms^{-1}	A1F	5	FT use of candidate's u and v and new v when $t = 3.1$
(ii)	$\tan\theta = \frac{14.95}{18.39}$	M1		Use of candidate's u and v Accept inverted ratio
	$\theta = 39.1^\circ$ or 39.2° Also 140.8° or 140.9° } accept $\pm$	A1F	2	FT use of candidates u and v and V
	Total		**13**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
8(a)	$m(5\mathbf{i} - 3\mathbf{j}) + 0.2(2\mathbf{i} + 3\mathbf{j})$	M1		Momentum terms added
		A1	2	All correct
(b)(i)	$(0.2 + m)(k\mathbf{i} + \mathbf{j})$	B1		Seen or used to find m
	use of conservation of momentum	M1		Used with candidate's expressions in 2D equation or used to give one of the 1D equations below
	$-3m + 0.6 = 0.2 + m$			
	$m = 0.1$	A1	3	Full verification accepted, CAO
(ii)	$5m + 0.4 = 0.2k + mk$	A1		
	substitute m	m1		
	$k = 3$	A1	3	
	Total		**8**	
	TOTAL		**75**	