

## **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

М	mark is for method				
m or dM	mark is dependent on one or more M marks and is for method				
А	mark is dependent on M or m marks and is for accuracy				
В	mark is independent of M or m marks and is for method and accuracy				
Е	mark is for explanation				
$\sqrt{100}$ 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 <i>x</i> marks for each error	G	graph		
NMS	no method shown	с	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

I(a) $s = 0 + \frac{1}{2} \times 9.8 \times 4^2$ M1 A1Full method Correct subs, accept $\pm 9.8$ (b)Average speed $= \frac{78.4}{4}$ M1Also accept full method with use of velocities at $t = 0$ and 4, or at $t = 2$ (c)Only force acting is weightB11Acc resistance forces negligible or ignored, (not friction, or air friction)(c)Only force acting is weightB11Acc resistance forces negligible or ignored, (not friction, or air friction)(c)Only force acting is weightM1Both relevant forces, component of 8N attempted(d) $P = 5 + 8\cos 60^\circ$ M1Both relevant forces, component of 8N attempted $P = 9$ A13CAO(b) $Q = 8\cos 30^\circ$ M1Component of 8N attempted A1 $Q = 6.93$ or $4\sqrt{3}$ A12AWRT 6.933(a) $v = u + at$ $0 - 10 + (-0.8) \times t$ $t = 12.5$ secA12(b) $v = \frac{1}{2} \times 10 \times (4 + 22.5)$ $= 132.5$ metresB1 A1FA1(c)distance $= \frac{1}{2} \times 10 \times (4 + 22.5)$ $= 132.5$ metresM1 A1FFull correct subs, B1, repeated errors no further penalty axes labelled v, t(d)Acceleration unlikely to: change so abruptly or be constant or velocity unlikely to be constantTatel10	Q	Solution	Marks	Total	Comments
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be constant or velocity unlikely to be constant B1 1	(d)	Acceleration unlikely to:			
or velocity unlikely to be constant B1 1	, í	change so abruptly or			
			D1	1	
		or velocity unlikely to be constant <b>Total</b>	BI	1 10	

Q	Solution	Marks	Total	Comments
4(a)				
-()		B1	1	Accept <i>W</i> or <i>mg</i> (or 6.86) for weight Arrows and labels needed (can replace <i>W</i> with 2 correct components
	0.7g			
(b)	$R = 0.7g\cos 22^\circ$	M1		component of weight attempted
	R = 6.36  N	A1 A1	3	all correct, including signs CAO
(c)	$F = 0.25 \times 6.36$	M1		
	F = 1.59N	A1	2	CAO
(d)	$5.6 - 0.7g\sin 22^\circ - 1.59 = 0.7a$	M1		4 terms with weight component attempte
	$a = 2.06 \text{ms}^{-2}$	A2 A1F	4	A marks -1 each error, accept $\pm 0.7a$ FT one error, accept $\pm$
	Total		10	
5(a)(i)	R	B1	1	Accept <i>mg</i> , 0.4g or 3.92 for weight
	$F \longleftarrow T$ $W$			Arrows and labels needed
(ii)	$F = 0.5 \times (0.4 \times 9.8)$	M1		Need to see $0.4 \times 9.8$ or 3.92 used
	F = 1.96N	A1	2	
(b)	T - 1.96 = 0.4a	M1A1		Consistent reversal of signs in both
	0.3g - T = 0.3a	M1A1		equations 4 marks; reversal of signs in one equation, M1 A1 M1 A0
	$a = 1.4 \text{ms}^{-2}$	A1	5	Sign change needs justification (whole string: equation, $0.3g - 1.96 = 0.7a$ M14 a = 1.4 A1) max 3/5
(c)	$v = 1.4 \times 3$	M1		Full method
	$v = 4.2 \text{ms}^{-2}$	A1	2	САО
(d)	<i>P</i> : Friction will cause	M1		
	speed to decrease Q : Gravity will cause	A1 M1		Accept decelerate or comes to rest
	speed to increase	A1	4	Accept accelerate
	Total	1	14	· ·

MM1B (cont)

Q MMTB (cont	Solution	Marks	Total	Comments
6(a)	$\mathbf{d} = 3\mathbf{i} - 6\mathbf{j}$	B1		Accept $\pm \mathbf{d}$ or displacements of 3, 6
	$3\mathbf{i} - 6\mathbf{j} = (\mathbf{i} - 2\mathbf{j})t$	M1		shown on a diagram Or equivalent method for <i>t</i> Accept ratio of vectors leading directly to
	<i>t</i> = 3	A1	3	±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 4i + 8j)
	+6i - 4j	M1		
	$=10\mathbf{i}+4\mathbf{j}$	A1F	4	FT slip provided obtain vector expression $(\mathbf{u} = 0 \text{ gives } 6\mathbf{i} + 12\mathbf{j})$
(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 <i>C</i>
	$ \mathbf{d}  = \sqrt{7^2 + 2^2}$ $AC = \sqrt{53} = 7.28$			
	$AC = \sqrt{53} = 7.28$	A1F	2	FT <b>d</b> provided two non-zero components Accept $\sqrt{53}$
	Total		9	
7(a)	$57 = 24\cos 40^\circ \times t$	M1		Component attempted and acceleration $= 0$
	t = 3.10  sec	A1 A1	3	All correct CAO
	l = 5.10 sec	AI	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 = $9.8$
	h = 0.734  m	A1 A1F	3	All correct FT one slip e.g. +9.8 used Accept 2 s.f. answer, AWRT 0.71-0.74
(c)(i)	horizontal, $u = 24 \cos 40^\circ = 18.39 \text{ ms}^{-1}$	B1		Seen anywhere in (c) accept 18.4
	vertical, $v = 24 \sin 40^\circ - 9.8 \times 3.1$	M1		Component attempted & acceleration = $9.8$
	$v = -14.95 \text{ ms}^{-1}$	A1		(Accept -15.0)
	$V = \sqrt{(18.39)^2 + (-14.95)^2}$	M1		Use of candidate's $u$ and new $v$ (when $t = 3.1$ )
	$V = 23.7 \mathrm{ms}^{-1}$	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
	$ \begin{array}{c} \theta = 39.1^{\circ} \text{ or } 39.2^{\circ} \\ \text{Also } 140.8^{\circ} \text{ or } 140.9^{\circ} \end{array} \right\}  \text{accept } \pm $	A1F	2	FT use of candidates $u$ and $v$ and $V$
	Total		13	

<b>MM1B</b> (	cont)
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Q	Solution	Marks	Total	Comments
<b>8(a)</b>	m(5i - 3j) + 0.2(2i + 3j)	M1		Momentum terms added
		A1	2	All correct
(b)(i)	$(0.2+m)(k\mathbf{i}+\mathbf{j})$	B1		Seen or used to find <i>m</i>
	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		
	<i>k</i> = 3	A1	3	
	Total		8	
	TOTAL		75	