Version 1.0: 0107

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Mathematics 6360

MM1B Mechanics 1B

Mark Scheme

2007 examination - January 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.

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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**.

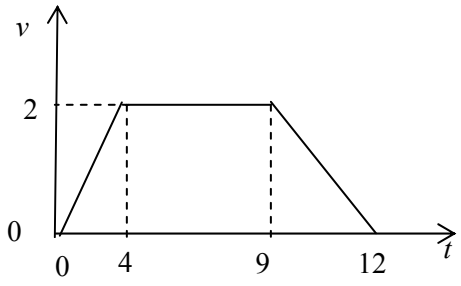
Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

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.

Jan 07

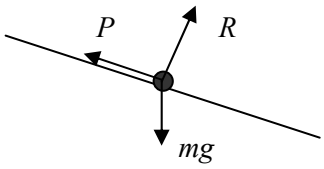
MM1B

Q	Solution	Marks	Total	Comments
1(a)	$3\times4+2\times(-4)=5v$	M1 A1		Three term equation for conservation of momentum. Correct equation
	$4=5v$			
	$v=\frac{4}{5}=0.8$	A1	3	Correct speed (for use of *mg* instead of *m* deduct the first A1)
(b)	$3\times4+2\times(-4)=3\times0.4+2v$	M1 A1		Four term equation for conservation of momentum. Correct equation
	$4=1.2+2v$			
	$v=\frac{4-1.2}{2}=1.4$	A1	3	Correct speed (for use of *mg* instead of *m* deduct the first A1)
			6	
2(a)		B1 B1 B1 B1	4	Starts and finishes at rest Correct shape Correct values on *t*-axis Correct values on *v*-axis Condone omission of the origin
(b)	$s=\frac{1}{2}(5+12)\times2$	M1		Use of the area under the graph (or equivalent) to find *s*
	or $s=\frac{1}{2}\times2\times4+5\times2+\frac{1}{2}\times2\times3=17$			
	$=17$	A1	2	Correct distance **SC** When 21 used instead of 12 allow full marks for $s=26$
(c)	$\max a=\frac{2}{4}=0.5$	B1		Maximum acceleration
	$300\times0.5=T-300\times9.8$	M1		Three term equation of motion using their *a*
		A1		Correct equation using $a=0.5$
	$T=2940+150=3090$	A1	4	Correct tension
			10	

MM1B (cont)

Q	Solution	Marks	Total	Comments
3(a)	$F = \sqrt{6^2 + 5^2}$	M1A1		Obtaining an equation for F with square or root. Correct equation
	$= \sqrt{61} = 7.81$	A1	3	Correct force
	Alt			
	$\alpha = \tan^{-1}\left(\frac{5}{6}\right) = 39.8°$			
	$F = \frac{6}{\cos 39.8} = 7.81$ or	(M1A1)		Equation for F with a value for α. Correct equation
	$F = \frac{5}{\sin 39.8} = 7.81$	(A1)		Correct force
(b)	$\alpha = \tan^{-1}\left(\frac{5}{6}\right)$ or $\cos^{-1}\left(\frac{6}{7.81}\right)$ or $\sin^{-1}\left(\frac{6}{7.81}\right)$	M1 A1		Obtaining an equation for α using trigonometry. Correct equation (using their F)
	$= 39.8°$	A1	3	Correct angle
	Alt			Accept values between 39.7 and 39.9
	$\frac{\sin\alpha}{5} = \frac{\sin 90°}{\sqrt{61}}$			
	$\alpha = 39.8°$			
	Total		**6**	
4(a)	The string is light and inextensible or inelastic or taut	B1 B1	2	First assumption Second assumption
(b)	$6 = 0 + 4a$	M1		Finding a using a CA equation
	$a = \frac{6}{4} = 1.5$	A1	2	Correct a from correct working
(c)	$7 \times 9.8 - T = 7 \times 1.5$	M1A1		Three term equation of motion with F for the 7 kg particle. Correct equation
	$T = 68.6 - 10.5 = 58.1$	A1	3	Correct tension
(d)	$58.1 - F = 13 \times 1.5$	M1A1		Three term equation of motion with F for the 13 kg particle. Correct equation
	$F = 58.1 - 19.5 = 38.6$	A1		Correct F
	$R = 13.98 = 127.4$	B1		Correct R
	$38.6 = \mu \times 127.4$	dM1		Use of $F = \mu R$
	$\mu = \frac{38.6}{127.4} = 0.303$	A1	6	Correct coefficient of friction
			13	

MM1B (cont)

Q	Solution	Marks	Total	Comments
5(a)	$v = \sqrt{0.3^2 + 0.1^2} = \sqrt{0.1} = 0.316 \text{ ms}^{-1}$	M1A1	2	Use of Pythagoras to find *v*. Correct *v*
(b)	$\alpha = \tan^{-1}\left(\frac{0.3}{0.1}\right) = 71.6°$	M1A1 A1	3	Use of trigonometry with reasonable choice of sides to find α. Correct expression Correct angle **CAO**
(i)	$t = \frac{15}{0.3} = 50\text{s}$	M1 A1	2	Use of *s/v* to find *t* with *s* and *t* consistent Correct *t*
(ii)	$s = 50 \times \sqrt{0.1} = 15.8\text{m}$	M1A1	2	Use of their *t* in $t \times v$ to find *s* or the use of trigonometry. Correct distance **CAO**
	Total		**9**	
6(a)		B1	1	Correct diagram with arrows and labels Must not use *F* instead of *P* Condone resistance instead of *P*
(b)	$P = 100 \times 9.8 \sin 4°$ $= 68.4$	M1 M1 A1	3	Resolving weight (must see 100) Using $\sin 4°$ or $\cos 86°$ **AG** Correct *P* from correct working
(c)	$100a = 100 \times 9.8 \sin 5° - 100 \times 9.8 \sin 4°$ $a = \frac{100 \times 9.8 \sin 5° - 100 \times 9.8 \sin 4°}{100}$ $= 0.171$	M1 A1 A1 A1	4	Three term equation of motion Weight resolved correctly Correct equation Correct *a*. (Accept 0.170 or 0.17)
(d)	You would expect *P* to vary with the speed of the car.	B1	1	Correct explanation
			9	

MM1B (cont)

Q	Solution	Marks	Total	Comments
7(a)	$0^2 = (50\sin 40°)^2 + 2\times(-9.8)h$	M1A1		Equation for h with $v = 0$ and a component of velocity. Correct equation
	$h = \dfrac{(50\sin 40°)^2}{2\times 9.8} = 52.7$	dM1 A1		Solving for h Correct h
	Alt			
	$0 = 50\sin 40° - 9.8t$	(M1)		Equation for t with $v = 0$ and a component of velocity
	$t = \dfrac{50\sin 40°}{9.8} = 3.280$	(A1)		Correct t
	$h = 50\sin 40°\times 3.280 - \dfrac{1}{2}\times 9.8\times 3.280^2$	(dM1)		Expression for h with a component of velocity
	$= 52.7$ ALLOW 52.6	(A1)	4	Correct h
(b)	$6 = 50\sin 40°t - 4.9t^2$	M1A1		Forming a quadratic in t. Correct terms with any signs
	$0 = 4.9t^2 - 50\sin 40°t + 6$	A1		Correct equation
	$t = \dfrac{50\sin 40° \pm \sqrt{(50\sin 40°)^2 - 4\times 4.9\times 6}}{2\times 4.9}$	dM1		Solving quadratic
	$= 0.192$ or 6.37 $t = 6.37$	A2	6	Correct solution selected
	Alt			
	$46.7 = 4.9t_1^2$	(M1) (dM1)		Finding two times Equation for time to go down
	$t_1 = 3.087$	(A1)		Correct time
	$t_2 = 3.280$	(A1)		Time to go up
	$t = 3.087 + 3.280 = 6.37$	(A2)		Correct total
	Total		**10**	

MM1B (cont)

Q	Solution	Marks	Total	Comments
8(a)	$75\mathbf{i} = (5\mathbf{i} - 2\mathbf{j}) \times 10 + \frac{1}{2}\mathbf{a} \times 10^2$	M1		Equation to find **a** from $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$
		A1		Correct expression
	$\mathbf{a} = \frac{75\mathbf{i} - 50\mathbf{i} + 20\mathbf{j}}{50} = 0.5\mathbf{i} + 0.4\mathbf{j}$	A1	3	**AG** Correct **a** from correct working
(b)	$\mathbf{r} = (5\mathbf{i} - 2\mathbf{j}) \times 8 + \frac{1}{2}(0.5\mathbf{i} + 0.4\mathbf{j}) \times 8^2$	M1		Expression for **r** using $t = 8$ with no extra terms
		A1		Correct expressions
	$= 56\mathbf{i} - 3.2\mathbf{j}$	A1	3	Correct position vector
(c)	$\mathbf{v} = (5 + 0.5t)\mathbf{i} + (0.4t - 2)\mathbf{j}$	M1A1		Expression for **v**. Correct expression
	$0.4t - 2 = 0$	dM1		**j** component equal to zero
	$t = \frac{2}{0.4} = 5$	A1		Correct t
	$\mathbf{r} = (5\mathbf{i} - 2\mathbf{j}) \times 5 + \frac{1}{2}(0.5\mathbf{i} + 0.4\mathbf{j}) \times 5^2$	dM1		Expression for **r** using t from **j** component equal to zero
	$= 31.25\mathbf{i} - 5\mathbf{j}$			
	$= 31.3\mathbf{i} - 5\mathbf{j}$	A1	6	Correct position vector
	Total		**12**	
	TOTAL		**75**	