

ALLIANCE

General Certificate of Education

Mathematics 6360

MM1B Mechanics 1B

Mark Scheme

2007 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.

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		MM1B - <i>i</i>	AQA GCE Mark Scheme 2007 June Marks Cloud Con			
Key to m	ark scheme and abbreviations used in n	narking	thscloud.co			
М	mark is for method		CLO CONTRACTOR OF CONTRACTOR O			
m or dM	mark is dependent on one or more M ma	rks and is for r				
А	mark is dependent on M or m marks and	is for accuracy	у			
В	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	МС	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 ÉE	deduct x 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)			

Key to mark scheme and abbreviations used in marking

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.

June 07

MM1B - AQA GCE Mark Scheme 2007 June

Maths

QSolutionMarksTotalComments1(a) $v=0+1.5\times9.8$ M1Use of constant acceleration equation find v $=14.7 \text{ ms}^{-1}$ A12AG Correct v from correct working $1.5\times9.8=14.7$ is not enough on its o(b) $h = \frac{1}{2} \times 9.8 \times 1.5^2$ M1Use of constant acceleration equation $a = 9.8 ext{ to find } h$ $=11.0 \text{ m}$ (to 3 sf)A12Use of constant acceleration equation $a = 9.8 ext{ to find } h$ (c) $5^2 = 0^2 + 2 \times 9.8s$ M1Use of constant acceleration equation $a = 9.8 ext{ to find } h$ $s = \frac{25}{19.6} = 1.28 ext{ m}$ (to 3 sf)A13Correct s Accept 1.27OR $s = \frac{1}{2}(0+5)\frac{5}{9.8} = 1.28 ext{ m}$ A13Correct s Accept 1.27OR $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^2 = 1.28 ext{ m}$ Total7	40
$ \begin{array}{ c c c c c } & \text{find } v \\ & \text{AG Correct } v \text{ from correct working} \\ & 1.5 \times 9.8 = 14.7 \text{ is not enough on its o} \\ & \text{AG Correct } v \text{ from correct working} \\ & 1.5 \times 9.8 = 14.7 \text{ is not enough on its o} \\ & \text{AI } \\ & \text{allow 11 m; ignore negative signs} \\ & \text{(c)} 5^2 = 0^2 + 2 \times 9.8s \\ & \text{(c)} 5^2 = 0^2 + 2 \times 9.8s \\ & \text{AI } \\ & s = \frac{25}{19.6} = 1.28 \text{ m (to 3 sf)} \\ & \text{AI } \\ & s = \frac{25}{9.8} = 0.510 \\ & s = \frac{1}{2}(0+5)\frac{5}{9.8} = 1.28 \text{ m} \\ & \text{OR } \\ & s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^2 = 1.28 \text{ m} \\ \end{array} $	-OUD.COM
(b) $h = \frac{1}{2} \times 9.8 \times 1.5^{2}$ $= 11.0 \text{ m (to 3 sf)}$ (c) $5^{2} = 0^{2} + 2 \times 9.8s$ $s = \frac{25}{19.6} = 1.28 \text{ m (to 3 sf)}$ (c) $s = \frac{25}{9.8} = 0.510$ $s = \frac{1}{2}(0+5)\frac{5}{9.8} = 1.28 \text{ m}$ OR $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^{2} = 1.28 \text{ m}$ (c) $s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{1}{2} \times 9.8 \times $	ю
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$s = 0 + \frac{1}{2} \times 9.8 \times \left(\frac{5}{9.8}\right)^2 = 1.28 \text{ m}$	
Total 7	
2(a) $2\begin{bmatrix} 3\\ -2 \end{bmatrix} + 3\begin{bmatrix} -4\\ 1 \end{bmatrix} = 5\mathbf{v}$ M1 Three term vector equation, with a '+ sign, for conservation of momentum Correct equation.	
$\begin{bmatrix} -2 \end{bmatrix} \begin{bmatrix} 1 \end{bmatrix}$ A1 Correct equation Deduct this first A mark for use of mg	
$\mathbf{v} = \frac{1}{5} \begin{bmatrix} -6\\ -1 \end{bmatrix} = \begin{bmatrix} -1.2\\ -0.2 \end{bmatrix} $ A1 3 Correct velocity	
(b) $v = \sqrt{1.2^2 + 0.2^2} = 1.22 \text{ ms}^{-1}$ M1 Finding speed from their velocity in p (Must include addition of two terms)	rt (a)
A1F 2 Correct speed from their velocity Accept 1.21	
Total 5	

$T = 800 + 480$ = 1280 NA1A1Correct equationA1A13Correct tension Treat calculation of two tensions as two methods unless one selected Treat sum or difference of two tensions as an incorrect methodCorrect tension Treat sum or difference of two tensions as an incorrect method(b) $3000 - 800 - F = 4000 \times 0.4$ M1 A1 A1Four term equation of motion (truck or both) Correct terms Correct signs					. insci
$T_1 = T_2$ OR $T_1 \cos 35^\circ = T_2 \cos 55^\circ$ $T_1 = T_2$ A12(b) $T_1 \cos 35^\circ = T_2 \cos 35^\circ = 2 \times 9.8$ $T_1 \cos 35^\circ = 7_1 \cos 35^\circ = 2 \times 9.8$ $T_1 \cos 35^\circ = 7_1 \cos 35^\circ = 2 \times 9.8$ $T_1 = \frac{2 \times 9.8}{2 \cos 35^\circ} = 12.0 \text{ N (to 3sf)}$ M1 A1Resolving forces to form a three term vertical equation $Correct tension$ Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8 m$ M1 $A1$ Torrect equation $Correct tension$ Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8 m$ M1 $A1$ Forming an equation with two tensions to find m $Correct tension$ Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8 m$ M1 $A1$ Forming an equation with two tensions to find m $Correct tension$ Accept 12 N or 11.9 N(d) $T = 800 - 850$ $= 1280 \times 0.4$ A1 $A1$ A1 $A1$ $T = 800 + 480$ $= 1280 \times 120 \times 0.4$ A1 $A1$ Three term equation of motion for the car Correct equation(b) $3000 - 800 - F = 4000 \times 0.4$ M1 $A1$ A1 $A1$ Correct tension Treat calculation of two tensions as two methods unless on selected Treat sum or difference of two tensions as an incorrect method(b) $3000 - 1280 - F = 2800 \times 0.4$ $F = 600 \times N$ A1 $A1$ 4AG Correct resistance force from correct working(c)Increase, because a greater tension would be needed so that the horizontalB1 B12Greater Reason			Maalaa	T - 4 - 1	Community
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$T_1 = T_2$ OR $T_1 = cos 55^\circ = T_2 \cos 55^\circ$ $T_1 = T_2$ A12string Correct result from correct working(b) $T_1 \cos 35^\circ + T_2 \cos 35^\circ = 2 \times 9.8$ $T_1 \cos 35^\circ = 12.0$ N (to 3sf)M1 A1Resolving forces to form a three term vertical equation $T_1 \circ T_2$ climinated correctly Solving for $T_1 \circ T_2$ Correct tension Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8m$ M1 A1Solving force to quation $T_1 \circ T_2$ eliminated correctly Solving for $T_1 \circ T_2$ Correct equation Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8m$ M1 A1Solving force to form a three term vertical equation Accept 12 N or 11.9 N(c) $2 \times 40 \cos 35^\circ = 9.8m$ M1 A1Solving forming an equation with two tensions to find m $m = \frac{80 \cos 35^\circ}{9.8} = 6.69$ kg(d) $m = \frac{40}{11.96} \times 2$ $= 1280 N$ A1 A1Solving force to form a three term correct equation Correct equation Correct equation Correct equation Correct equation(b) $3000 - 800 - F = 4000 \times 0.4$ M1 A1 A1Solving force to notion for the car Correct tension Treat calculation of two tensions as two methods unless one selected Treat sum or difference of two tensions as an incorrect method(b) $3000 - 800 - F = 2800 \times 0.4$ $F = 5000 N$ A1 A14(c)Increase, because a greater tension would be needed so that the horizontalB1 B1 Correct resistance force from correct working	C (u)	$r_1 \sin 55 - r_2 \sin 55$			equation, with different tensions for each
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$T_1 \cos 55^\circ = T_2 \cos 55^\circ$ $T_1 = T_2$ M1Resolving forces to form a three term vertical equation Correct equation T_1 or T_2 eliminated correctly Solving for T_1 or T_2 eliminated correctly correct equation Correct equation find m correct equation of motion for the car Correct equation of motion for the car Correct equation Treat calculation of two tensions as two methods unless one selected Treat sum or difference of two tensions as an incorrect method(b) $3000 - 800 - F = 4000 \times 0.4$ A1 A1A1 A1A3 Correct terms Correct terms Correct signs(c) $Reson - F$		$T_1 = T_2$	A1	2	Correct result from correct working
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(c)Increase, because a greater tension would be needed so that the horizontalB1 B1Greater Reason					
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Example would be the additional the second of the second			DI	2	

			ſ	MM1B - AQA GCE Mark Scheme 2007 June
B (con				MM1B - AQA GCE Mark Scheme 2007 June Comments Using trigonometry (usually tan or sine
D (COII	Solution	Marks	Total	Comments
<u>z</u> 5(a)	$V = 150 \tan 30^{\circ}$	M1	Ivtai	Using trigonometry (usually tan or sine
Jui	y = 150 tai 150	1411		rule) to find V
	$=86.6 \text{ ms}^{-1}$	A1	2	AG Correct answer from correct working (Division by 2 only acceptable if sin30° or cos60° seen)
	OR			,
	V 150			
	$\overline{\sin 30^\circ} = \overline{\sin 60^\circ}$ AG			
	$V = 86.6 \text{ ms}^{-1}$			
	V = 80.0 ms			
(b)	150	M1		Using trigonometry or Pythagoras to
(~)	$\frac{150}{v} = \cos 30^{\circ}$			find v
	V	A1		Correct expression
	$v = \frac{150}{\cos 30^\circ} = 173 \text{ ms}^{-1}$ (to 3sf)	A1	3	Correct answer
		111		
	Total		5	
(a)(i)	$R ext{ or } N$			
		B1	1	Correct diagram with arrows and labels
		101	1	Collect diagram with arrows and labers
	\checkmark mg or W or 3g			
(ii)	$3a = 3g\sin 30^{\circ}$	M1		Two term equation of motion
	$a = g \sin 30^\circ = 4.9 \text{ ms}^{-2}$	A1	2	AG Correct acceleration from correct
	$u = g \sin 30^{\circ} = 1.7 \sin 30^{\circ}$	A1	4	working (Allow $a = g \sin 30^\circ$)
	1 2			
(b)(i)	$5 = \frac{1}{2}a \times 2^{2}$	M1		Constant acceleration equation with $u = 0$
	$5 = \frac{1}{2}a \times 2^2$ $a = 2.5 \text{ ms}^{-2}$	A 1	n	AC Compation from correct working
	$a = 2.5 \text{ ms}^2$	A1	2	AG Correct answer from correct working. (Use of $y = 5$ must be justified)
(ii)	$3 \times 2.5 = 3g\sin 30^\circ - F$	M1		(Use of $v = 5$ must be justified) Three term equation of motion
(11)	$3 \times 2.5 = 5g \sin 50^{\circ} - 1^{\circ}$	A1		Correct equation
	$F = 3g\sin 30^\circ - 7.5$	111		
	= 7.20 N (to 3 sf)	A1	3	Correct F
	- 1.20 11 (10 5 61)		2	Accept 7.2 N
(iii)	$R = 3g\cos 30^\circ \ (= 25.46)$	M1		Resolving perpendicular to the slope to
	\mathbf{c}			find R
		A1		Correct R
	$7.2 = \mu \times 3g \cos 30^{\circ}$	M1		Use of $F = \mu R$
		A1F		Correct expression
	$\mu = \frac{7.2}{3g\cos 30^\circ} = 0.283$	A1F	5	Correct
	$\mu^{-3} g \cos 30^{\circ}$	AII	3	Correct μ Accept 0.282
				(Follow through from incorrect <i>F</i> from
				above, but not an incorrect R)
(iv)	Reduce <i>a</i> , as the air resistance would	B1		Reduces
(11)	reduce the magnitude of the resultant	B1	2	Explanation
	force or because the air resistance			Second B1 dependent on the first B1 mark
	increases as the velocity increases			
	towards its terminal value			

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Q	Solution	Marks	Total	Comments First assumption
7(a)	A particle or no spin	B1		First assumption
	No air resistance or no wind or only	B1	2	Second assumption
	gravity acting			
				If more than 2 assumptions given, subtract
				one mark for each incorrect additional
				assumption
(b)	$0 = 25\sin 40^{\circ}t - 4.9t^{2}$	M1		Equation for time of flight
		A1		Correct equation
	$0 = t(25\sin 40^\circ - 4.9t)$	dM1		Solving for <i>t</i>
	$25\sin 40^{\circ}$			
	$t = 0$ or $t = \frac{25\sin 40^{\circ}}{4.9}$			
	Time of flight $= 3.28$ s	A1	4	AG Correct final answer from correct
				working
				(Verification method M1A1M1A0)
(c)	$s = 3.28 \times 25 \cos 40^\circ = 62.8 \text{ m}$	M1		Finding range
		A1	2	Correct range
(d)	25 ms ⁻¹ at 40° below the horizontal	B1		Speed
		B1	2	Direction
(e)	$v_{\rm min} = 25 \cos 40^\circ = 19.2 \ {\rm ms}^{-1}$	M1		Horizontal component of velocity
	min 2000000 19.2 ms	A1	2	Correct speed
	OR			Accept 19.1 ms ⁻¹
	$v_{\rm min} = \frac{62.807}{3.2795} = 19.2 {\rm ms}^{-1}$			
	Tot	al	12	

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MM1B (con	t)			Comments Com
Q	Solution	Marks	Total	Comments
8 (a)	$\mathbf{u} = 5\mathbf{i} \text{ or } \begin{bmatrix} 5\\0 \end{bmatrix}$	B1	1	Correct velocity
(b)	v = 5i + (-0.2i + 0.25j)t	M1		Use of constant acceleration equation, with u and a not zero
		A1	2	Correct velocity M1A0 for using 5j or just 5
	$\mathbf{OR} \\ \mathbf{v} = \begin{bmatrix} 5 - 0.2t \\ 0.25t \end{bmatrix}$			
(c)		M1 A1		Easterly component zero Correct equation
	$t = \frac{5}{0.2} = 25 \text{ seconds}$	A1	3	Correct <i>t</i>
(d)	$\mathbf{r} = 5\mathbf{i} \times 25 + \frac{1}{2}(-0.2\mathbf{i} + 0.25\mathbf{j}) \times 25^2$	M1		Use of constant acceleration equation with <i>t</i> from part (c)
	= 62.5i + 78.125j	A1F A1		Correct expression based on <i>t</i> from part (c) Correct simplification CAO
	$\theta = \tan^{-1} \left(\frac{62.5}{78.125} \right)$	dM1 A1F		Using tan to find the angle Correct expression based on <i>t</i> from part (c), with correct two values(either way)
	= 038.7°	A1	6	Correct angle Accept 38.6° or 039°
	OR			1
	$\mathbf{r} = \frac{1}{2}(5\mathbf{i} + 6.25\mathbf{j}) \times 25$	(M1) (A1F) (A1)		
	$\theta = \tan^{-1}\left(\frac{5}{6.25}\right) = 038.7^{\circ}$	(A1) (dM1) (A1F) (A1)		
	Total		12	
	TOTAL		75	