OCR
Oxford Cambridge and RSA

GCE

Mathematics (MEI)

Unit **4761**: Mechanics 1

Advanced Subsidiary GCE

Mark Scheme for June 2018

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations and abbreviations

Annotation in scoris	**Meaning**
✓and ✗	
BOD	Benefit of doubt
FT	Follow through
ISW	Ignore subsequent working
M0, M1	Method mark awarded 0, 1
A0, A1	Accuracy mark awarded 0, 1
B0, B1	Independent mark awarded 0, 1
SC	Special case
^	Omission sign
MR	Misread
Highlighting	
Other abbreviations in mark scheme	**Meaning**
E1	Mark for explaining
U1	Mark for correct units
G1	Mark for a correct feature on a graph
M1 dep*	Method mark dependent on a previous mark, indicated by *
cao	Correct answer only
oe	Or equivalent
rot	Rounded or truncated
soi	Seen or implied
www	Without wrong working

Subject-specific Marking Instructions for GCE Mathematics (MEI) Mechanics strand

a Annotations should be used whenever appropriate during your marking.

The A, M and B annotations must be used on your standardisation scripts for responses that are not awarded either 0 or full marks. It is vital that you annotate standardisation scripts fully to show how the marks have been awarded.

For subsequent marking you must make it clear how you have arrived at the mark you have awarded.

b An element of professional judgement is required in the marking of any written paper. Remember that the mark scheme is designed to assist in marking incorrect solutions. Correct *solutions* leading to correct answers are awarded full marks but work must not be judged on the answer alone, and answers that are given in the question, especially, must be validly obtained; key steps in the working must always be looked at and anything unfamiliar must be investigated thoroughly.

Correct but unfamiliar or unexpected methods are often signalled by a correct result following an *apparently* incorrect method. Such work must be carefully assessed. When a candidate adopts a method which does not correspond to the mark scheme, award marks according to the spirit of the basic scheme; if you are in any doubt whatsoever (especially if several marks or candidates are involved) you should contact your Team Leader.

c The following types of marks are available.

M
A suitable method has been selected and *applied* in a manner which shows that the method is essentially understood. Method marks are not usually lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, eg by substituting the relevant quantities into the formula. In some cases the nature of the errors allowed for the award of an M mark may be specified.

A
Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated Method mark is earned (or implied). Therefore M0 A1 cannot ever be awarded.

B
Mark for a correct result or statement independent of Method marks.

E
A given result is to be established or a result has to be explained. This usually requires more working or explanation than the establishment of an unknown result.

Unless otherwise indicated, marks once gained cannot subsequently be lost, eg wrong working following a correct form of answer is ignored. Sometimes this is reinforced in the mark scheme by the abbreviation isw. However, this would not apply to a case where a candidate passes through the correct answer as part of a wrong argument.

d When a part of a question has two or more 'method' steps, the M marks are in principle independent unless the scheme specifically says otherwise; and similarly where there are several B marks allocated. (The notation 'dep *' is used to indicate that a particular mark is dependent on an earlier, asterisked, mark in the scheme.) Of course, in practice it may happen that when a candidate has once gone wrong in a part of a question, the work from there on is worthless so that no more marks can sensibly be given. On the other hand, when two or more steps are successfully run together by the candidate, the earlier marks are implied and full credit must be given.

e The abbreviation ft implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A and B marks are given for correct work only — differences in notation are of course permitted. A (accuracy) marks are not given for answers obtained from incorrect working. When A or B marks are awarded for work at an intermediate stage of a solution, there may be various alternatives that are equally acceptable. In such cases, exactly what is acceptable will be detailed in the mark scheme rationale. If this is not the case please consult your Team Leader.

Sometimes the answer to one part of a question is used in a later part of the same question. In this case, A marks will often be 'follow through'. In such cases you must ensure that you refer back to the answer of the previous part question even if this is not shown within the image zone. You may find it easier to mark follow through questions candidate-by-candidate rather than question-by-question.

f Unless units are specifically requested, there is no penalty for wrong or missing units as long as the answer is numerically correct and expressed either in SI or in the units of the question. (e.g. lengths will be assumed to be in metres unless in a particular question all the lengths are in km, when this would be assumed to be the unspecified unit.)

We are usually quite flexible about the accuracy to which the final answer is expressed and we do not penalise over-specification.

When a value is given in the paper
Only accept an answer correct to at least as many significant figures as the given value. This rule should be applied to each case.

When a value is not given in the paper
Accept any answer that agrees with the correct value to 2 s.f.

ft should be used so that only one mark is lost for each distinct error made in the accuracy to which working is done or an answer given. Refer cases to your Team Leader where the same type of error (e.g. errors due to premature approximation leading to error) has been made in different questions or parts of questions.

There are some mistakes that might be repeated throughout a paper. If a candidate makes such a mistake, (eg uses a calculator in wrong angle mode) then you will need to check the candidate's script for repetitions of the mistake and consult your Team Leader about what penalty should be given.

There is no penalty for using a wrong value for *g*. E marks will be lost except when results agree to the accuracy required in the question.

g Rules for replaced work

If a candidate attempts a question more than once, and indicates which attempt he/she wishes to be marked, then examiners should do as the candidate requests.

If there are two or more attempts at a question which have not been crossed out, examiners should mark what appears to be the last (complete) attempt and ignore the others.

NB Follow these maths-specific instructions rather than those in the assessor handbook.

h For a *genuine* misreading (of numbers or symbols) which is such that the object and the difficulty of the question remain unaltered, mark according to the scheme but following through from the candidate's data. A penalty is then applied; 1 mark is generally appropriate, though this may differ for some units. This is achieved by withholding one A mark in the question.

Marks designated as cao may be awarded as long as there are no other errors. E marks are lost unless, by chance, the given results are established by equivalent working.

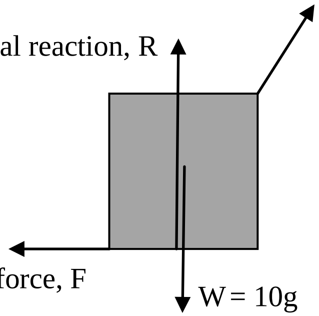
'Fresh starts' will not affect an earlier decision about a misread.

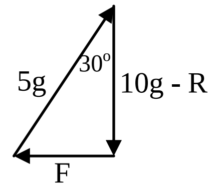
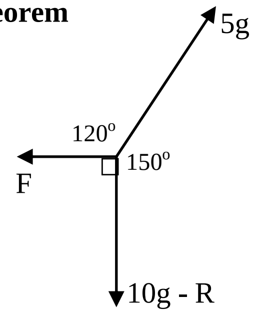
Note that a miscopy of the candidate's own working is not a misread but an accuracy error.

i If a graphical calculator is used, some answers may be obtained with little or no working visible. Allow full marks for correct answers (provided, of course, that there is nothing in the wording of the question specifying that analytical methods are required). Where an answer is wrong but there is some evidence of method, allow appropriate method marks. Wrong answers with no supporting method score zero. If in doubt, consult your Team Leader.

j If in any case the scheme operates with considerable unfairness consult your Team Leader.

SECTION A

Qu	Part	Answer	Mark	Guidance
1	(i)		B1 B1 B1	Four correct forces. If one force is missing, or there is one extra force, the marks for labels and arrows may still be obtained. Labels (any correct descriptions) Arrows The force T may be replaced by vertical and horizontal components. Allow if both the force and components are given, only if the components are presented differently from other forces.
			[3]	
	(ii)	$R + 5g\cos 30° = 10g$ $R = 55.564... = 55.6$ to 3 sf $F = 5g\sin 30° = 24.5$	M1 A1 B1	Attempt at vertical equation; 3 relevant terms must be seen. Allow sin-cos interchange and omission of g for this mark. Allow 2.5 if g is missing throughout this part.
			[3]	
	(iii)	Resultant = $\sqrt{55.564...^2 + 24.5^2}$ = 60.726, so 60.7 to 3 sf	M1 A1	FT from part (ii) but the figures must be consistent with those answers. cao
			[2]	

Qu	Part	Answer	Mark	Guidance
1	(ii)	**Alternative: Using triangle of forces**  $10g - R = 5g\cos 30°$ $R = 55.6$ $F = 5g\sin 30° = 24.5$	 **M1** **A1** **B1**	
			[4]	
1	(ii)	**Alternative: Using Lami's theorem**  $\frac{F}{\sin 150°} = \frac{5g}{(\sin 90°)} = \frac{10g - R}{\sin 120°}$ $R = 55.6$ $F = 5g\sin 30° = 24.5$	 **M1** **A1** **B1**	Allow M1 for $\frac{5g}{(\sin 90°)} = \frac{10g - R}{\sin 120°}$
			[4]	

Qu	Part	Answer	Mark	Guidance
2	(i)	Vertical motion Initial velocity = $28\sin 30^{o} = 14 \text{ m s}^{-1}$	B1	Award for 14 or $28\sin 30^{o}$ seen.
		$v^2 - u^2 = 2as \Rightarrow 0^2 - 14^2 = 2\times(-9.8)\times y$	M1	A valid attempt to find y when the vertical component of velocity is 0
		$y = 10$	A1	
		Maximum height = 10 + 1 = 11 m	B1	This mark should be given retrospectively if y_0 has been introduced earlier. FT from their answer for y for this mark only. Only penalise omission of initial height once in the whole question.
			[4]	
	(ii)	Horizontal motion Initial velocity = $28\cos 30^{o}$ (=24.25) m s^{-1}		
		To reach Q, $28\cos 30°\times t = 70$	M1	A valid attempt to find t when the ball reaches Q
		$\Rightarrow t = \left(\frac{5\sqrt{3}}{3}\right) = 2.886...$	A1	
		Height at Q = $1 + 14\times 2.886... - \frac{1}{2}\times 9.8\times 2.886...^2$	M1	A valid attempt to find the height of the ball at Q Allow their value of t
		Height = 0.58 m so the ball is caught and the batsman is out.	A1	Height and conclusion required. If the initial height has been omitted, give this mark for a height of -0.42 and the batsman scoring 1 run. Allow answer 0.53 following rounding t to 2.89.
			[4]	

Qu	Part	Answer	Mark	Guidance
2	(i)	**Alternative: 2-stage use of suvat equations**		
		Vertical motion Initial velocity = $28\sin 30^{o} = 14\text{ m s}^{-1}$	B1	
		$v=u+at \Rightarrow 0=14-9.8t \Rightarrow t=\frac{14}{9.8}(=1.428...)$		
		$s=ut+\frac{1}{2}at^2 \Rightarrow y=14\times(1.428...)-4.9\times(1.428...)^2$	M1	This mark is for a valid 2 (or more) stage method that should lead to the correct height.
		$y=10$	A1	
		Maximum height = 10 + 1 = 11 m	B1	This mark should be given retrospectively if y_0 has been introduced earlier. FT from their answer for y for this mark only. Only penalise omission of initial height once.
			[4]	
	(ii)	**Special case: Finding where the ball lands**		This is not a complete method and so only 3 marks are available
		Either The ball lands when $1+14t-4.9t^2=0 \Rightarrow t=2.926...$ **Or** The ball lands when $14t-4.9t^2=0 \Rightarrow t=2.857...$	SC M1	A valid attempt to find t when the ball hits the ground,
		Either $t=2.926... \Rightarrow x=70.97$ **Or** $t=2.857... \Rightarrow x=69.28...$	SC A1	A valid attempt to find x when the ball hits the ground.
		Either The ball is above the ground when it passes Q **Or** The ball bounces before Q so the batsman scores 1 run	SC A1	
			[3]	

Qu	Part	Answer	Mark	Guidance
2		**Alternative method: Using the equation of the trajectory**		
	(i)	$y = (y_0) + x\tan\alpha - \dfrac{gx^2}{2u^2\cos^2\alpha}$		
		$y = (1) + \dfrac{x}{\sqrt{3}} - \dfrac{9.8x^2}{2\times\left(\dfrac{\sqrt{3}}{2}\right)^2\times 28^2}$		
		$y = (1) + \dfrac{x}{\sqrt{3}} - 0.008\dot{3}x^2$	**B1**	Or equivalent
		$\dfrac{dy}{dx} = \dfrac{1}{\sqrt{3}} - 0.01\dot{6}x$	**M1**	
		$\dfrac{dy}{dx} = 0 \Rightarrow x = 34.64...$	**A1**	
		$x = 34.64... \Rightarrow y = (1) + \dfrac{34.64...}{\sqrt{3}} - 0.008\dot{3}\times(34.64...)^2 = (1) + 10$		
		Maximum height = 10 + 1 = 11 m	**B1**	This mark should be given retrospectively if y_0 has been introduced earlier. FT from their answer for y for this mark only. Only penalise omission of initial height once.
			[4]	

Qu	Part	Answer	Mark	Guidance
2	(ii)	When x = 70, $y = (1) + \frac{70}{\sqrt{3}} - 0.008\dot{3} \times 70^2$ Height at Q = 0.581... m So the ball is caught and the batsman is out.	M1 A1 M1 A1	For using the equation of the trajectory with x = 70 If the initial height has been omitted, give this mark for a height of -0.42 and the batsman scoring 1 run.
			[4]	

Qu	Part	Answer	Mark	Guidance
3	(i)	For whole system, $F = ma$		Or equivalent
		$D-(300+100)=(1000+600)\times a$	M1	Use of Newton's 2nd Law with correct elements on whole system.
		$D=1200 \Rightarrow a=0.5$; (the acceleration is 0.5 m s^{-2})	A1	
		For trailer, $T-100=600\times 0.5$	M1	Use of Newton's 2nd Law on the trailer
		(The tension is) 400 N	A1	FT from their value for a
		Alternative: Using the car		
		For car 1200 - 300 - T = 1000 × 0.5	M1	Use of Newton's 2nd Law on the car
		(The tension is) 400 N	A1	FT from their value for a
			[4]	
	(ii)	For whole system , → $-400=1600\times a$	M1	Use of Newton's 2nd Law on whole system in the new situation. Give no marks for part (ii) if a new acceleration is not used.
		$\Rightarrow a=-0.25$; (the acceleration is -0.25 m s^{-2})	A1	
		For trailer → $T-100=600\times(-0.25)$	M1	Or equivalently for the car
		$T=-50$		
		There is thrust of 50 N (or the rod is in compression)	A1	FT from their value for a but only if different from that in part (i)
			[4]	

Qu	Part	Answer	Mark	Guidance
3	(i)	**Alternative: Using simultaneous equations**		
		For car, 1200 - 300 - T = 1000a	M1	Use of Newton's 2nd Law on the car
		For trailer $T - 100 = 600a$	M1	Use of Newton's 2nd Law on the trailer
		Solving simultaneously		
		$a = 0.5$; (the acceleration is 0.5 $m\,s^{-2}$)	A1	Dependent on both M marks
		$T = 400$; (the tension is 400 N)	A1	Dependent on both M marks
			[4]	
	(ii)	**Alternative: Using simultaneous equations**		
		For car - 300 - T = 1000a	M1	Use of Newton's 2nd Law on both the car and the trailer in the new situation
		For trailer $T - 100 = 600a$		
		Solving simultaneously	M1	Dependent on previous M mark
		$a = -0.25$; (the acceleration is -2.5 $m\,s^{-2}$)	A1	
		$T = -50$		
		There is thrust of 50 N	A1	
			[4]	

Qu	Part	Answer	Mark	Guidance
4	(i)	$1.25\ \text{m s}^{-2}$, $0\ \text{m s}^{-2}$, $-2.5\ \text{m s}^{-2}$	B1	One correct non-zero value
			B1	All three values correct
			[2]	
	(ii)	$R - mg = m \times 1.25$	M1	FT from part (i) for the positive acceleration. Do not penalise calculations for more than one phase of the motion for this mark.
		The force is 552.5 N	A1	cao with no FT for the acceleration
			[2]	

Qu	Part	Answer	Mark	Guidance
5		Alice's velocity at time t s is given by	M1	Attempt to find the velocity at time t
		$v = \left(\int a\,dt\right) = \int\left(-2-\frac{t}{2}\right)dt = -2t-\frac{t^2}{4}(+c)$	A1	Condone missing constant of integration for this mark
		When t = 0, v = 21 $\Rightarrow c = 21$ and so $v = 21-2t-\frac{t^2}{4}$	A1	For finding $c = 21$
		When v =0, $t^2+8t-84=0$	M1	Attempt to find t when v = 0
		So t = 6 (or -14)	A1	
		Distance travelled	M1	Attempt to find distance travelled when v = 0
		$= \int_0^6\left(21-2t-\frac{t^2}{4}\right)dt = \left[21t-t^2-\frac{t^3}{12}\right]_0^6 = 72$	A1	Cao for 72 m. This answer may be obtained using a constant of integration with value 0; condone this not being seen.
		Since 72 < 75, Alice's car does not hit the tree.	B1	cao
			[8]	

Qu	Part	Answer	Mark	Guidance
		Special case for the last 5 marks		
		Attempt to find distance travelled	**SC M1**	
		$s=\int\left(21-2t-\frac{t^2}{4}\right)dt=21t-t^2-\frac{t^3}{12}(+c)$	**SC A1**	
		The car would hit the tree when $s=75$	**SC M1**	
		$21t-t^2-\frac{t^3}{12}=75 \Rightarrow t^3+12t^2-252+900=0$	**SC A1**	
		This equation has no positive roots so the car does not hit the tree	**SC B1**	
			[8]	

Qu	Part	Answer	Mark	Guidance
5		**Possible limited credit for those using suvat equations** The three M marks are available to those candidates who (incorrectly) use constant acceleration formulae but do address the problem solving aspects of this question. The A marks may not be given nor may the final B mark. So the maximum possible mark for such candidates is 3.		
		Attempt to find the velocity at time t	**M1**	$v = u + at$ is written as $v = 21 + \left(-2 - \frac{1}{2}t\right)t$
		Attempt to find t when $v = 0$	**M1**	$0 = 21 - 2t - \frac{1}{2}t^2 \Rightarrow t^2 + 4t - 42 = 0$ $t = 4.78...\ (\text{or} -8.78...)$
		Attempt to find distance travelled when $v = 0$	**M1**	$s = ut + \frac{1}{2}at^2 \Rightarrow s = 21t + \frac{1}{2}\left(-2 - \frac{1}{2}t\right)t^2$ $t = 4.78... \Rightarrow s = 50.21...$ Notice $-2 + \sqrt{46} = 4.78...$
			[3]	
		Special case Using $s = 75$ to form an equation in t	**SC M1**	$s = ut + \frac{1}{2}at^2 \Rightarrow 75 = 21t + \frac{1}{2}\left(-2 - \frac{1}{2}t\right)t^2$
		Showing this equation has no positive roots	**SC M1**	$t^3 + 4t^2 - 84t + 300 = 0$ is shown to have no positive roots
			[2]	
		Caution No credit should be given for assuming $v = 0$ when $s = 75$		eg $v^2 = u^2 + 2as \Rightarrow 0 = 21^2 - 2\left(2 + \frac{1}{2}t\right) \times 75$ gets 0 marks.

SECTION B

Qu	Part	Answer	Mark	Guidance
6	(i)	Differentiate $\mathbf{r_A}$	M1	Either calculus or constant acceleration formulae may be used. This mark should be awarded automatically if the two answers that follow are correct.
		$\mathbf{v_A} = \begin{pmatrix} 1 \\ 2t \end{pmatrix}$	A1	
		$\mathbf{a_A} = \begin{pmatrix} 0 \\ 2 \end{pmatrix}$	B1	
			[3]	
	(ii)	Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$ or integration of $\mathbf{a_B}$	M1	
		$\mathbf{v_B} = \begin{pmatrix} 1 \\ -4 \end{pmatrix} + \begin{pmatrix} 0 \\ 2 \end{pmatrix}t = \begin{pmatrix} 1 \\ -4+2t \end{pmatrix}$	A1	
		Use of $\mathbf{r} = \mathbf{r_0} + \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$ or integration of $\mathbf{v_B}$	M1	
		$\mathbf{r_B} = \begin{pmatrix} -1 \\ 10 \end{pmatrix} + \begin{pmatrix} 1 \\ -4 \end{pmatrix}t + \frac{1}{2}\begin{pmatrix} 0 \\ 2 \end{pmatrix}t^2 = \begin{pmatrix} -1+t \\ 10-4t+t^2 \end{pmatrix}$	A1	
			[4]	

Qu	Part	Answer	Mark	Guidance
6	(iii)	If they meet $\mathbf{r_A} = \mathbf{r_B}$, so $t^2 - 2 = 10 - 4t + t^2$	M1	Equating the y-components. FT from (ii).
		They meet when $t = 3$	A1	No FT from (ii).
		The x-components are also be equal: $t - 1 = -1 + t$	B1	Only award this mark if the x-components are considered
		Position is (2, 7)	B1	This may be given in vector form. Allow from trial and error.
			[4]	
	(iv)	If their motions are parallel, $\mathbf{v_B} = k\mathbf{v_A}$	M1	For considering the velocities of the two beetles. FT from (i). k may be implied,
		$\begin{pmatrix} 1 \\ -4+2t \end{pmatrix} = k\begin{pmatrix} 1 \\ 2t \end{pmatrix}$		
		x-component $\Rightarrow k = 1$	A1	This may be implied by stating that the x-components are equal.
		y-component $\Rightarrow -4 + 2t = 2t$	A1	
		No solution so their motions are never parallel	A1	Cao and from correct working with no FT.
			[4]	
	(v)	$1^2 + (-4+2t)^2 = 1^2 + (2t)^2$	M1	This mark is for equating speeds. Since the x-components are both equal to 1 it may be given for the squared y-components only.
		$\Rightarrow \quad t = 1 \quad$ (only)	A1	Accept correct argument for only one time (with t =1 not stated)
		At t = 1, $v = \sqrt{5}$, (so speed is 2.236 m s^{-2})	B1	
			[3]	

Qu	Part	Answer	Mark	Guidance
6	(iii)	**Alternative: Using equations of paths**		
		Equation of beetle A: $y=x^2+2x-1$		
		Equation of beetle B: $y=x^2-2x+7$		
		Solving these equations gives their meeting point(s)	**M1**	Complete method must be indicated
		They meet where $x^2+2x-1=x^2-2x+7 \quad (=y)$	**A1**	Correct equations
		Solving gives $x=2$	**A1**	
		They meet at (2, 7)	**B1**	
			[4]	
	(iv)	**Alternative: Comparing gradients**		
		Comparing gradients	**M1**	A valid attempt to use calculus to equate their gradients
		For beetle A, $\frac{dy}{dx}=2x+2$	**A1**	Or $\tan\theta_A = \frac{2t}{1}$
		For beetle B, $\frac{dy}{dx}=2x-2$	**A1**	$\tan\theta_B = \frac{2t-4}{1}$
		There is no value of x for which $2x+2=2x-2$, so their motions are never parallel	**A1**	Cao and from correct working with no FT.
			[4]	

Qu	Part	Answer	Mark	Guidance
7	Much of this question can be answered using energy methods which are beyond the specification for this unit. Full marks should be given for fully correct answers using such methods but no credit should be given for incorrect working.			
	(i)	Component of weight parallel to the slope $= 5g\sin\alpha \ (= 4g\ )$	M1	For a valid method to find the acceleration down the slope, Allow sin-cos interchange for this mark only.
		Newton's 2nd law $\Rightarrow\ a = 0.8g = 7.84$	A1	
				Special case Give **M0 A0 + SC B1** for $a = 0.8g$ without adequate explanation
		$v^2 - u^2 = 2as:\ \ v^2 - 0^2 = 2\times 7.84\times 80$	M1	For an attempt to find the speed at Q Accept $v^2 = 2\times 9.8\times 80\times 0.8$ for this mark only.
		$v = 35.4$	A1	Correct working required for this given answer
		Predicted speed at S is 35.4 $m\,s^{-1}$	B1	cao
		Model A predicts the stone will never stop	B1	Allow any comment that it is still moving, also that no friction is unrealistic
			[6]	

Qu	Part	Answer	Mark	Guidance
	(ii)	The motion is in 2 stages	M1	For considering motion down the slope and horizontally separately
		Motion down the slope $5a = 4g - 19.6 \Rightarrow a = 3.92$		
		At the bottom of the slope $v^2 = 627.2\ (= 64g)$, (v = 25.04)	A1	Accept $v = 25$ here and subsequently.
		Along the horizontal $5a = -19.6 \Rightarrow a = -3.92$	M1	Dependent on the previous M mark. Consideration of the horizontal motion with $u = 25.0...(\text{FT}), v = 0$ and $a = \pm 3.92$
		$v^2 - u^2 = 2as:\ 0^2 - 627.2 = 2\times(-3.92)\times s$		
		$s = 80$ as required	A1	
			[4]	
	(iii)	The answers for the first three B marks may be implied by subsequent correct answers following correct working.		
		Along the horizontal, $5a = -24.5 \Rightarrow a = -4.9$	B1	For the (negative) acceleration during the horizontal motion
		$v^2 - u^2 = 2as:\ 0^2 - u^2 = 2\times(-4.9)\times 80$		
		$u^2 = 784$, (u = 28)	B1	For the initial speed of the horizontal motion.
		Along the slope, $v^2 - u^2 = 2as:\ 784 - 0^2 = 2\times a\times 80$		
		$\Rightarrow a = 4.9$	B1	For the acceleration down the slope
		$5a = 4g - F_1$, $F_1 = 4\times 9.8 - 5\times 4.9$		
		$F_1 = 14.7$	B1	For the value of F_1
			[4]	

Qu	Part	Answer	Mark	Guidance
7	(iv)	Using $v = u + at$		
		Along the slope $\sqrt{784} = 0 + 4.9t \Rightarrow t = 5.714...$	B1	FT for $\sqrt{784}$ from part (iii)
		Along the horizontal $0 = \sqrt{784} - 4.9t \Rightarrow t = 5.714...$	B1	FT for $\sqrt{784}$ from part (iii)
		Total time is 11.4 seconds	B1	cao
			[3]	
	(v)	A stone might bounce and not slide and possibly travel further.	B1	Any plausible comment, eg friction is not constant. Do not allow statements that heavier stones travel faster but do allow statements that heavier stones require greater resistance forces.
			[1]	

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