

Question	Scheme	Marks	AOs
6	Integrate \mathbf{a} w.r.t. time	M1	1.1a
	$\mathbf{v} = \frac{5t^2}{2}\mathbf{i} - 10t^{\frac{3}{2}}\mathbf{j} + \mathbf{C}$ (allow omission of \mathbf{C})	A1	1.1b
	$\mathbf{v} = \frac{5t^2}{2}\mathbf{i} - 10t^{\frac{3}{2}}\mathbf{j} + 20\mathbf{i}$	A1	1.1b
	When $t = 4$, $\mathbf{v} = 60\mathbf{i} - 80\mathbf{j}$	M1	1.1b
	Attempt to find magnitude: $\sqrt{(60^2 + 80^2)}$	M1	3.1a
	Speed = 100 m s^{-1}	A1ft	1.1b
			(6 marks)
Notes:			
<p>1st M1: for integrating \mathbf{a} w.r.t. time (powers of t increasing by 1)</p> <p>1st A1: for a correct \mathbf{v} expression without \mathbf{C}</p> <p>2nd A1: for a correct \mathbf{v} expression including \mathbf{C}</p> <p>2nd M1: for putting $t = 4$ into their \mathbf{v} expression</p> <p>3rd M1: for finding magnitude of their \mathbf{v}</p> <p>3rd A1: ft for 100 m s^{-1}, follow through on an incorrect \mathbf{v}</p>			

Question	Scheme	Marks	AOs
7(a)	$R = mg\cos\alpha$	B1	3.1b
	Resolve parallel to the plane	M1	3.1b
	$-F - mg\sin\alpha = -0.8mg$	A1	1.1b
	$F = \mu R$	M1	1.2
	Produce an equation in μ only and solve for μ	M1	2.2a
	$\mu = \frac{1}{4}$	A1	1.1b
		(6)	
(b)	Compare $\mu mg\cos\alpha$ with $mg\sin\alpha$	M1	3.1b
	Deduce an appropriate conclusion	A1 ft	2.2a
		(2)	
			(8 marks)
Notes:			
<p>(a) B1: for $R = mg\cos\alpha$ 1st M1: for resolving parallel to the plane 1st A1: for a correct equation 2nd M1: for use of $F = \mu R$ 3rd M1: for eliminating F and R to give a value for μ 2nd A1: for $\mu = \frac{1}{4}$</p>			
<p>(b) M1: comparing size of limiting friction with weight component down the plane A1ft: for an appropriate conclusion from their values</p>			

Question	Scheme	Marks	AOs
8(a)	Use of $\mathbf{v} = \mathbf{u} + \mathbf{at}$: $(10.5\mathbf{i} - 0.9\mathbf{j}) = 0.6\mathbf{j} + 15\mathbf{a}$	M1	3.1b
	$\mathbf{a} = (0.7\mathbf{i} - 0.1\mathbf{j}) \text{ m s}^{-2}$ Given answer	A1	1.1b
		(2)	
(b)	Use of $\mathbf{r} = \mathbf{ut} + \frac{1}{2} \mathbf{at}^2$	M1	3.1b
	$\mathbf{r} = 0.6\mathbf{j} t + \frac{1}{2}(0.7\mathbf{i} - 0.1\mathbf{j}) t^2$	A1	1.1b
		(2)	
(c)	Equating the i and j components of r	M1	3.1b
	$\frac{1}{2} \leftarrow 0.7 t^2 = 0.6 t - \frac{1}{2} \leftarrow 0.1 t^2$	A1ft	1.1b
	$t = 1.5$	A1	1.1b
		(3)	
(d)	Use of $\mathbf{v} = \mathbf{u} + \mathbf{at}$: $\mathbf{v} = 0.6\mathbf{j} + (0.7\mathbf{i} - 0.1\mathbf{j}) t$	M1	3.1b
	Equating the i and j components of v	M1	3.1b
	$t = 0.75$	A1 ft	1.1b
		(3)	
			(10 marks)
Notes:			
(a)			
M1: for use of $\mathbf{v} = \mathbf{u} + \mathbf{at}$			
A1: for given answer correctly obtained			
(b)			
M1: for use of $\mathbf{r} = \mathbf{ut} + \frac{1}{2} \mathbf{at}^2$			
A1: for a correct expression for r in terms of t			
(c)			
M1: for equating the i and j components of their r			
A1ft: for a correct equation following their r			
A1: for $t = 1.5$			
(d)			
M1: for use of $\mathbf{v} = \mathbf{u} + \mathbf{at}$ for a general t			
M1: for equating the i and j components of their v			
A1ft: for $t = 0.75$, or a correct follow through answer from an incorrect equation			

Question	Scheme	Marks	AOs
9(a)	Take moments about A (or any other complete method to produce an equation in S , W and α only)	M1	3.3
	$W \cos \alpha + 7W \cos \alpha = S \sin \alpha$	A1 A1	1.1b 1.1b
	Use of $\tan \alpha = \frac{5}{2}$ to obtain S	M1	2.1
	$S = 3W$ *	A1*	2.2a
		(5)	
(b)	$R = 8W$	B1	3.4
	$F = \frac{1}{4} R (= 2W)$	M1	3.4
	$P_{\text{MAX}} = 3W + F$ or $P_{\text{MIN}} = 3W - F$	M1	3.4
	$P_{\text{MAX}} = 5W$ or $P_{\text{MIN}} = W$	A1	1.1b
	$W \leq P \leq 5W$	A1	2.5
		(5)	
(c)	M(A) shows that the reaction on the ladder at B is unchanged	M1	2.4
	also R increases (resolving vertically)	M1	2.4
	which increases max F available	M1	2.4
		(3)	
			(13 marks)

Question 9 continued**Notes:****(a)****1st M1:** for producing an equation in S , W and α only**1st A1:** for an equation that is correct, or which has one error or omission**2nd A1:** for a fully correct equation**2nd M1:** for use of $\tan \alpha = \frac{5}{2}$ to obtain S in terms of W only**3rd A1*:** for given answer $S = 3W$ correctly obtained**(b)****B1:** for $R = 8W$ **1st M1:** for use of $F = \frac{1}{4} R$ **2nd M1:** for either $P = (3W + \text{their } F)$ or $P = (3W - \text{their } F)$ **1st A1:** for a correct max or min value for a correct range for P **2nd A1:** for a correct range for P **(c)****1st M1:** for showing, by taking moments about A , that the reaction at B is unchanged by the builder's assistant standing on the bottom of the ladder**2nd M1:** for showing, by resolving vertically, that R increases as a result of the builder's assistant standing on the bottom of the ladder**3rd M1:** for concluding that this increases the limiting friction at A

Question	Scheme	Marks	AOs
10(a)	Using the model and horizontal motion: $s = ut$	M1	3.4
	$36 = U t \cos \alpha$	A1	1.1b
	Using the model and vertical motion: $s = ut + \frac{1}{2}at^2$	M1	3.4
	$-18 = U t \sin \alpha - \frac{1}{2}gt^2$	A1	1.1b
	Correct strategy for solving the problem by setting up two equations in t and U and solving for U	M1	3.1b
	$U = 15$	A1	1.1b
		(6)	
(b)	Using the model and horizontal motion: $U \cos \alpha$ (12)	B1	3.4
	Using the model and vertical motion: $v^2 = (U \sin \alpha)^2 + 2(-10)(-7.2)$	M1	3.4
	$v = 15$	A1	1.1b
	Correct strategy for solving the problem by finding the horizontal and vertical components of velocity and combining using Pythagoras: Speed = $\sqrt{(12^2 + 15^2)}$	M1	3.1b
	$\sqrt{369} = 19 \text{ m s}^{-1}$ (2sf)	A1 ft	1.1b
		(5)	
(c)	Possible improvement (see below in notes)	B1	3.5c
	Possible improvement (see below in notes)	B1	3.5c
		(2)	
			(13 marks)

Question 10 continued**Notes:****(a)****1st M1:** for use of $s = ut$ horizontally**1st A1:** for a correct equation**2nd M1:** for use of $s = ut + \frac{1}{2}at^2$ vertically**2nd A1:** for a correct equation**3rd M1:** for correct strategy (need both equations)**2nd A1:** for $U = 15$ **(b)****B1:** for $U\cos\alpha$ used as horizontal velocity component**1st M1:** for attempt to find vertical component**1st A1:** for 15**2nd M1:** for correct strategy (need both components)**2nd A1ft:** for 19 m s^{-1} (2sf) following through on incorrect component(s)**(c)****B1, B1:** for any two of

e.g. Include air resistance in the model of the motion

e.g. Use a more accurate value for g in the model of the motion

e.g. Include wind effects in the model of the motion

e.g. Include the dimensions of the stone in the model of the motion