Question Number	Scheme	Marks
5.	$PM = 3.5 - 2\tan 45^o = 1.5$ OR $PB = \sqrt{3.5^2 + (\frac{2}{\sin 45})^2 - 2\times 3.5\times(\frac{2}{\sin 45})\cos 45^o} = 2.5$	M1
	$\tan\alpha = \frac{1.5}{2}; \cos\alpha = \frac{4}{5}; \sin\alpha = \frac{3}{5}$	
	OR $\alpha = 37^o$ *or* $(90^o - \alpha) = 53^o$ (at least 2SF)	A1
	$T_P\cos\alpha + T_Q\cos 45^o = 6g$	M1 A2 -1 ee
	$T_P\sin\alpha = T_Q\cos 45^o$	M1 A1
	$T_P = \frac{30g}{7} = 42$ N; $T_Q = 36$ or 35.6 N	**DM1** A1; A1
		10
	Notes	
	First M1 for finding the length of *PM* or *PB*	
	First A1 for a correct trig ratio for α or $(90^o - \alpha)$ or a correct value for α or $(90^o - \alpha)$ Do not penalise accuracy here if their final answers for the tensions are correct.	
	N.B. If they assume the tensions are the same , no further marks available If they think α = 30 or 60 or....., they could get all 5 resolving marks as a value of α is not required **but if α = 45, only M marks available.** However, if α and 45 are interchanged in the resolving equations - no marks available for resolving	
	Second M1 for resolving vertically with usual rules	
	Second/Third A1's for a correct equation, (α does not need to be substituted) -1 each error	
	Third M1 for resolving horizontally with usual rules	
	Fourth A1 for a correct equation (α does not need to be substituted but if it is , follow through on their value)	
	Fourth DM1, dependent on all **THREE** previous M marks, for solving for either tension	
	Fifth A1 for T_P Allow 42.0 Units not needed	
	Sixth A1 for T_Q Units not needed	
	Alternative, using Triangle of Forces/Lami's Theorem, for middle 5 marks.	
	$\frac{T_P}{\sin 45^o} = \frac{6g}{\sin(45^o + \alpha)}$ OR $\frac{T_Q}{\sin(180^o - \alpha)} = \frac{6g}{\sin(45^o + \alpha)}$	M1 A2 -1 ee
	$\frac{T_Q}{\sin(180^o - \alpha)} = \frac{6g}{\sin(45^o + \alpha)}$ OR $\frac{T_P}{\sin 45^o} = \frac{6g}{\sin(45^o + \alpha)}$ OR $\frac{T_P}{\sin 45^o} = \frac{T_Q}{\sin(180^o - \alpha)}$	M1 A1
	N.B. Treat omission of g as one error	

A1	**N.B.** They may find q (M1A1) and subtract from $5m$	
Question Number	**Scheme**	**Marks**
8(a)	Perpendicular to the plane: $R + 18\sin 40° = 2g\cos 30°$	M1 A1
	Equation of motion parallel to the plane: $18\cos 40° - F - 2g\sin 30° = 2a$ (or -2a)	M1 A1 A1
	$F = 0.3R$	B1
	$18\cos 40° - 0.3\left(2g\cos 30° - 18\sin 40°\right) - 2g\sin 30° = 2a$	dM1
	$a = 1.18$ or 1.2 $\left(\text{m s}^{-2}\right)$	A1 cao
		(8)
8(b)	$v^2 = 2^2 + 2('1.18')5$	M1 A1**ft**
	$v = 3.98$ or 4.0 or 4 (m s^{-1})	A1 cao
	N.B. For (a) and (b), penalise over accurate answers ONCE only.	(3)
8(c)	$R = 2g\cos 30°\left(= g\sqrt{3}\right)$	B1
	Friction = $0.3\times 2g\cos 30°$ OR $0.3\times 2g\sin 30°$	M1
	Compares Friction with weight component parallel to plane Eg Consider: $2g\sin 30° - 0.3\left(2g\cos 30°\right)$ $(= 2a)$ **OR** $0.3\left(2g\cos 30°\right) - 2g\sin 30°$ $(= 2a)$	dM1
	$(a) > 0$ **OR** $(a) < 0$ Concludes that P will not remain at rest oe	A1
		(4)
(15)		
NOTES		
(a)		
M1	Correct number of terms, forces resolved *perp to the plane* where appropriate, condone sign errors and sin/cos confusion, forces and angles paired up correctly	
A1	Correct unsimplified equation.	
M1	Equation of motion parallel to the slope. Correct number of terms, forces resolved where appropriate, condone sign errors and sin/cos confusion, forces and angles paired up correctly	
A1	Correct unsimplified equation with at most one error	
A1	Fully correct unsimplified equation	
B1	Use of $F = 0.3R$	
dM1	Eliminate F and R to form an equation in a, dependent on two M's	
A1	Correct value for a. Must be 2 or 3sf	

(b)		
M1	Complete method to form an equation in v or v^2	
A1ft	Correct unsimplified equation. Follow through on their value for a.	
A1	Cao. Must be positive. Note that $a = 1.2$ leads to $v = 4$.	
(c)		
B1	Correct expression or value for **new** R	
M1	Find the max friction. M0 if the previous R is used.	
dM1	Correct comparison between max friction value and weight component (force parallel to slope), dependent on previous M	
A1	Correct statement from fully correct working. Concludes that P will not remain at rest.	

3(a)	$5.5 = \frac{1}{2}a.2^2$	M1	Complete method using *suvat* equations to form an equation in a only
	$\Rightarrow a = 2.75$	A1	
		(2)	
(b)	$R = 30\sin\alpha + 2g\cos\alpha$	M1	Resolve perpendicular to the plane to find an expression for R. Must have all terms. Condone sign errors and sin/cos confusion.
		A2	-1 each error. All correct A1A1, one error A1A0, two or more errors A0A0 ($R = 33.68$)
	$-F + 30\cos\alpha - 2g\sin\alpha = 2a$	M1	Equation of motion parallel to the plane with a or their a. Must have all terms. Condone sign errors and sin/cos confusion.
		A2	-1 each error ($F = 6.74$)
	$\mu = \dfrac{30\cos\alpha - 2g\sin\alpha - 5.5}{30\sin\alpha + 2g\cos\alpha}$	DM1	Use $F = \mu R$ Dependent on the 2 previous M marks
	$= 0.200$ or 0.20	A1	Do not accept 0.2
		(8)	
		10	
4.		M1	Use $s = ut + \frac{1}{2}at^2$ or a complete *suvat* route to find h in terms of t
	$h = \frac{1}{2}gt^2$	A1	Or $h = \frac{1}{2}g(t+1)^2$. The expression for time used in the first equation defines the expression expected in the second equation.
	$h = 19.6(t-1) + \frac{1}{2}g(t-1)^2$	A1	Or $h = 19.6(t) + \frac{1}{2}g(t)^2$ or $h = 4.9 + \left(9.8t + \frac{1}{2}gt^2\right)$
	$\frac{1}{2}gt^2 = 19.6(t-1) + \frac{1}{2}g(t-1)^2$	M1	Equate the two expressions for h.
		DM1	Solve for t. Dependent on the previous M1.
	$t = 1.5$	A1	Using the "Or" approach gives $t = 0.5$
	$h = 11$ m or 11.0 m	A1	Accept 2 or 3 s.f. only
		7	