Question Number	Scheme	Marks
6(a)	Resolve Vertically $R\cos\theta = mg$	B1
	Resolve Horizontally	M1
	$R\sin\theta = \frac{mv^2}{r}$	A1ft
	$\tan\theta = \frac{3}{4} = \frac{v^2}{50g} \quad \Rightarrow v = ...$	DM1
	$v = 19$ (m s^{-1})	A1
		(5)
(b)	Resolve Vertically	M1
	$R\cos\theta - F\sin\theta = mg$	A1
	Resolve Horizontally	M1
	$R\sin\theta + F\cos\theta = \frac{mv^2}{r}$	A1 A1
	$F = \frac{1}{4}R$	B1
	Solve for v	DM1
	$v = 25$ (m s^{-1})	A1
		(8)
		(13 marks)

Notes	
(a) B1	Resolve vertically; correct equation only.
M1	Equation of motion horizontally: allow any form for acceleration and condone sin/cos confusion. Award if their "R" is $mg\cos\theta$ but M0 for "R" = mg
A1ft	Correct equation. Ft their "R". N.B. The first three marks can be awarded for the equation $mg\tan\theta = \frac{mv^2}{r}$
DM1	Substitute for trig ratios and reach v^2 = … or v = … Dependent on previous M mark.
A1	19 or 19.2 only
(b) M1	Resolve vertically. Must have all terms but condone sign errors and sin/cos confusion. M0 for use of their R from part (a)
A1	Correct unsimplified equation
M1	Resolve horizontally. Must have all terms but condone sign errors and sin/cos confusion. M0 for use of their R from part (a)
A1	Unsimplified equation with at most one error. Acceleration must be in correct form.
A1	Correct unsimplified equation
B1	Use of $F = \frac{1}{4}R$ where R is the normal reaction in part (b) (E.g. not their R from (a), not mg, not $mg\cos\theta$) Must be substituted into an equation.
DM1	Eliminate R and F to form equation in v. Dependent on both previous M marks.
A1	25 or 24.6 only

Alt (a)	For first three marks: resolve parallel to track $mg\sin\theta = \frac{mv^2}{r}\cos\theta$ M1 for both terms (condone sin/cos confusion); B1 one term correct, A1 both correct.
Alt (b)	For first 5 marks, resolve parallel and perpendicular to track: $F + mg\sin\theta = m\left(\frac{v^2}{r}\right)\cos\theta$ $R - mg\cos\theta = m\left(\frac{v^2}{r}\right)\sin\theta$ Score "best" equation seen as M1A1A1 and second equation as M1A1

7.

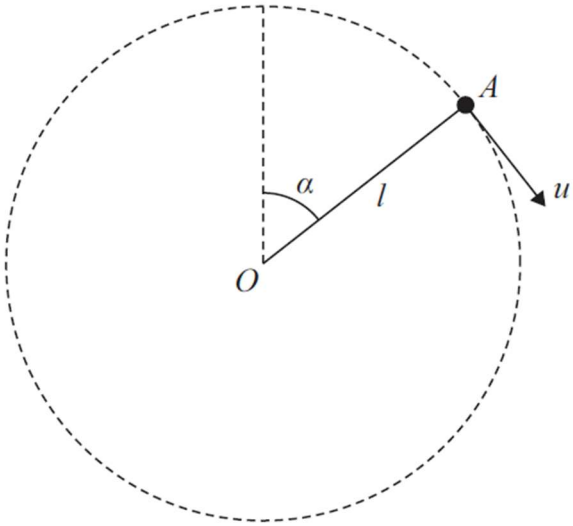


Figure 2

A particle of mass m is attached to one end of a light rod of length l. The other end of the rod is attached to a fixed point O. The rod can turn freely in a vertical plane about a horizontal axis through O.

The particle is projected with speed u from a point A, where OA makes an angle α with the upward vertical through O, as shown in Figure 2.

The particle moves in complete vertical circles.

Given that $\cos\alpha = \frac{4}{5}$

(a) show that $u > \sqrt{\frac{2gl}{5}}$

(4)

As the rod rotates, the least tension in the rod is T and the greatest tension is $4T$.

(b) Show that $u = \sqrt{\frac{17}{5}gl}$

(11)

(Total for Question 7 is 15 marks)