2	$\uparrow N_1 \cos\theta_1 = mg$ $\rightarrow N_1 \sin\theta_1 = m\left(r\sin\theta_1\right)\omega_1^2$
	$\uparrow N_2 \cos\theta_2 = mg$ $\rightarrow N_2 \sin\theta_2 = m\left(r\sin\theta_2\right)\omega_2^2$
	$\dfrac{\frac{5}{4}g}{\frac{5}{3}g} = \dfrac{r\omega_1^2}{r\omega_2^2}$
	$\dfrac{\omega_1}{\omega_2} = \frac{1}{2}\sqrt{3}$

6(a)	Let v be the speed of P before the collision. Energy conservation before the collision: $\frac{1}{2}m(17ag)+\frac{3}{2}mag=\frac{1}{2}mv^2$
	$v=\sqrt{20ag}$
6(b)	Let w_P be speed of P after the collision and V be its speed at the top. N2L: $\frac{mV^2}{a}=(T)+mg\ \left[V=\sqrt{ag}\right]$
	Energy equation: $\frac{1}{2}mw_P^2=\frac{1}{2}mV^2+2mga$
	$w_P=\sqrt{5ag}$
6(c)	Let w_Q the speed of Q after the collision. $mv=kmw_Q-mw_P$
	$w_P+w_Q=ev\ [=v]$ OR $\frac{1}{2}mv^2=\frac{1}{2}mw_P^2+\frac{1}{2}kmw_Q^2$
	$k=3$

1	$T_A \cos 45° + T_B \sin 45° = m\omega^2 l \sin 45°$
	$T_A \sin 45° - T_B \cos 45° = mg$
	$2T_A = m\omega^2 l + \sqrt{2}\, mg$
	$T_A = \frac{1}{2} m\left(\omega^2 l + \sqrt{2}\, g\right)$

6	A to ground: $\frac{1}{2}mu^2 + 2mga = \frac{1}{2}m(3u)^2$ $\left[u^2 = \frac{1}{2}ga\right]$ A to B: $\frac{1}{2}mv^2 + mga\cos\theta = \frac{1}{2}mu^2 + mga$ $\left[v^2 = u^2 + 2ag(1-\cos\theta)\right]$ B to ground: $\frac{1}{2}mv^2 + mga\cos\theta = \frac{1}{2}m(3u)^2 - mga$ $\left[v^2 = 9u^2 - 2ag(1+\cos\theta)\right]$
	$mg\cos\theta = \dfrac{mv^2}{a}$ $\left[v^2 = ag\cos\theta\right]$
	$ga\cos\theta = \frac{1}{2}ga + 2ag(1-\cos\theta)$
	$\cos\theta = \frac{5}{6}$
	Horizontally at ground: $v\cos\theta = 3u\cos\beta$. $\cos\beta = \dfrac{\sqrt{\frac{5}{6}ga}\left(\frac{5}{6}\right)}{3\sqrt{\frac{1}{2}ga}} = \left(\frac{5}{54}\sqrt{15}\right)$ OR $v_x = v\cos\theta = \sqrt{\frac{5}{6}ga}\left(\frac{5}{6}\right)$, $v_y^2 = (v\sin\theta)^2 + 2ga(1+\cos\theta) = \frac{847}{216}ga$ $\tan\beta = \dfrac{\sqrt{\frac{847}{216}ga}}{\sqrt{\frac{5}{6}ga}\left(\frac{5}{6}\right)}$
	$\beta = 69.0°$

1	For A: $T = mg$ For B vertically: $T\cos\theta = 0.5mg$
	$\theta = 60°$
	For B horizontally: $T\sin\theta = 0.5m\left(BR\sin\theta\right)\omega^2$
	$BR\cos\theta = AR \quad \left[BR = 8a\right]$
	$\omega = \frac{1}{2}\sqrt{\frac{g}{a}}$

4(a)	At top $R \geqslant 0$, so $\frac{mw^2}{a} \geqslant mg$.
	$\frac{1}{2}mv^2 - \frac{1}{2}mw^2 \geqslant mga\left(1-\cos\theta\right)$
	$\frac{1}{2}mv^2 \geqslant \frac{13}{9}mga$
	$v \geqslant \frac{1}{3}\sqrt{26ag}$
4(b)	Maximum reaction is at bottom: $\frac{1}{2}mv^2 + mga\left(1+\cos\theta\right) = \frac{1}{2}mV^2 \quad \left[V^2 = 5ag\right]$
	$R_{\max} - mg = \frac{mV^2}{a}$
	$R_{\max} = 6mg$

3(a)	$8 = \dfrac{32x}{2}$ leading to $x = 0.5$.
	Hence, $\lvert PA \rvert = 2.5$ and $\sin\alpha = \frac{1.5}{2.5} = 0.6$.
3(b)	$(\uparrow)\ R = 1.6g - 8\cos\alpha$ $(\leftarrow)\ mr\omega^2 = 8\sin\alpha + \mu R$
	$8\left(\frac{3}{5}\right) + 0.5\left(1.6g - 8\left(\frac{4}{5}\right)\right) = 1.6 \times 1.5\omega^2$
	$\omega^2 = 4$ leading to $\omega = 2$
	Number of revolutions per minute = $\dfrac{60}{\pi} = 19.1$.

7(a)	$R_A = \dfrac{mu^2}{a}$ $R_B = \dfrac{mv^2}{a} - mg\cos\theta$
	$\dfrac{mu^2}{2a} = \dfrac{mv^2}{a} - mg\cos\theta$ leading to $v^2 = \frac{1}{2}u^2 + agk$.
	$\frac{1}{2}mu^2 = \frac{1}{2}mv^2 + magk$ leading to $v^2 = u^2 - 2agk$.
	$\frac{6}{5}ag - 2agk = \frac{3}{5}ag + agk$
	$k = \frac{1}{5}$
7(b)	$\left[R_B = 0 \text{ leading to } u^2 = \frac{3}{5}ag\right]$ $u = \sqrt{\frac{3}{5}ag}$

7(c)	Vertically B to C: $t = \dfrac{2v\sin\theta}{g}$ Horizontally B to C: $2a\sin\theta = v\cos\theta \times t = v\cos\theta \times \dfrac{2v\sin\theta}{g}$
	$v^2 = \dfrac{ag}{\cos\theta}$
	$u^2 = \dfrac{ag}{\cos\theta} + 2agk$
	$u^2 = \frac{27}{5}ag, \quad u = \sqrt{\frac{27}{5}ag}$
	Alternative method for question 7(c)
	Equation of trajectory: $0 = 2a\sin\theta(\tan\theta) - \dfrac{g(2a\sin\theta)^2}{2(v\cos\theta)^2} \quad \left[0 = \frac{4}{5}\sqrt{6}a\left(2\sqrt{6}\right) - \dfrac{g\left(\frac{4}{5}\sqrt{6}\right)^2}{\frac{2}{25}v^2}\right]$
	$v^2 = \dfrac{ag}{\cos\theta}$
	$u^2 = \dfrac{ag}{\cos\theta} + 2agk$
	$u^2 = \frac{27}{5}ag, \quad u = \sqrt{\frac{27}{5}ag}$

7(c)	**Alternative method for question 7(c)**
	$y = x\tan\theta - \dfrac{gx^2}{2v^2\cos^2\theta}$ leading to $\dfrac{dy}{dx} = \tan\theta - \dfrac{gx}{v^2\cos^2\theta}$ Reaches maximum when $x = a\sin\theta$: $0 = \tan\theta - \dfrac{ga\sin\theta}{v^2\cos^2\theta}$
	$v^2 = \dfrac{ag}{\cos\theta}$
	$u^2 = \dfrac{ag}{\cos\theta} + 2agk$
	$u^2 = \frac{27}{5}ag$, $u = \sqrt{\frac{27}{5}ag}$

1	$T\cos\theta = mg$ $T\sin\theta = m\omega^2 r$
	'$\frac{5}{3}mg$' $\sin\theta = m\omega^2 a\sin\theta$
	$\omega = \sqrt{\dfrac{5g}{3a}}$

5(a)	$\frac{1}{2}mv^2 + mgr\cos\alpha = \frac{1}{2}m\left(\frac{3}{2}gr\right) \quad \left[v^2 = \frac{3}{2}gr - 2gr\cos\alpha\right]$
	$mg\cos\alpha = \dfrac{mv^2}{r}$
	$mg\cos\alpha = m\left(\frac{3}{2}g - 2g\cos\alpha\right)$
	$\cos\alpha = \frac{1}{2}, \quad \alpha = 60°$
5(b)	$v^2 = \frac{1}{2}gr$
	$0 = \left(\sin'60°'\sqrt{'v^2'}\right)^2 - 2gh$
	$h = \frac{3}{16}r$
	Total height = $\frac{3}{16}r + r\cos 60 = \frac{11}{16}r$