Q	Scheme	Marks	Notes
3(a)	<table><tr><td>Large disc</td><td>Small disc</td><td>Template</td></tr><tr><td>πR^2</td><td>πr^2</td><td>$\pi R^2 - \pi r^2$</td></tr><tr><td>0</td><td>$R-r$</td><td>$\pm kr$</td></tr></table>	B1	correct area ratios and distances seen or implied Allow + *kr* or -*kr*
	Moments about axis through *X*	M1	Or moments about a parallel axis. Need all terms but condone sign errors Do not need to see the zero term Dimensionally consistent Could be part of a vector equation
	$(0\times\pi R^2)-\pi r^2\times(R-r)=\left(\pi R^2-\pi r^2\right)\times(-kr)$ Moments about the left-hand end of the diameter through *X* and *Y* gives: $\pi R^2.R-\pi r^2\left(2R-r\right)=\pi\left(R^2-r^2\right)\left(R-kr\right)$	A1	Correct unsimplified equation Do not need to see the zero term Must be using – *kr* (unless they have changed the sign on the left-hand side)
	$r=\dfrac{k}{1-k}R$ *	A1*	Obtain **given answer** from correct working e.g. via $\dfrac{r}{R+r}=k$
			If they use $\bar{x}$ in place of $\pm kr$ and never substitute $\pm kr$ they can score B0M1A0A0
		(4)	
3(b)	$0<\dfrac{k}{1-k}R<R$	M1	use of correct inequality
	$(0<)k<(1-k)\Rightarrow(0<)k<\dfrac{1}{2}$	A1	Correct only Only need the right-hand value. A0 with an incorrect left hand value
		(2)	
3(c)	$k=\dfrac{4}{9}\Rightarrow r=\dfrac{4}{5}R$	B1	Seen or implied (this mark could be implied by the correct expression for tanα in terms of *k*)
	$\tan\alpha=\dfrac{R}{kr}\quad\left(=\dfrac{R}{\frac{4}{9}\times\frac{4}{5}R}=\dfrac{45}{16}\right)$ $\left(\tan\alpha=\dfrac{1-k}{k^2}\right)$	M1	Correct use of trig in a correct triangle Available for finding 90 - α
	$\alpha = 70^o$	A1	or better (70.426…) Accept 109.6, 250.4 and 289.6
		(3)	

Q	Scheme	Marks	Notes
3(d)	Moments about an axis through P	M1	dimensionally consistent, condone sign errors and missing g throughout The equation should be of the form $M_1gR = Mg$ x a distance(in r or R) Moments about any other axis requires use of the forces acting at P
	M(P), $M_1gR = Mg \times \frac{4}{9}r$ Or $M_1gR = Mg \times \frac{16}{45}R$	A1	correct unsimplified equation in r and / or R
	$M_1 = \frac{16}{45}M$	A1	Accept 0.36 M or better
		(3)	
		(12)	