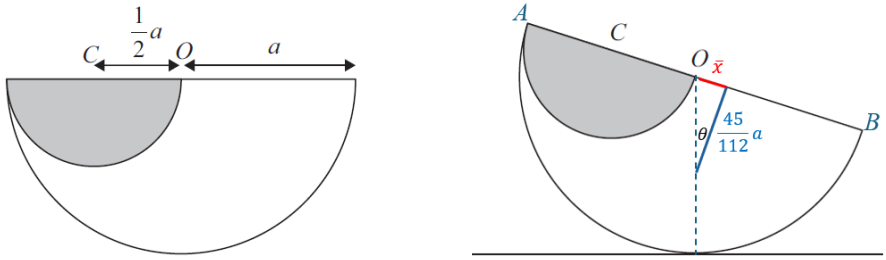
Question Number	Scheme	Marks
		
6(a)	Use of $\int xy^2\mathrm{d}x$ with circle equation	M1
	$\int_0^a x(a^2-x^2)\mathrm{d}x$	A1
	$\left[\frac{a^2x^2}{2}-\frac{x^4}{4}\right]_0^a=\frac{a^4}{4}$	A1
	Use of $\bar{x}=\frac{\pi\int_0^a x(a^2-x^2)\mathrm{d}x}{\frac{2}{3}\pi a^3}$	dM1
	$\left\{\frac{\pi\frac{a^4}{4}}{\frac{2}{3}\pi a^3}\Rightarrow\right\}=\frac{3}{8}a$ *	A1*
		(5)
6(b)	Mass ratios: 8 1 7	B1
	Distances: $\frac{3}{8}a$ $\frac{3}{16}a$ $\bar{y}$	B1
	$8\times\frac{3a}{8}-1\times\frac{3}{16}a=7\bar{y}$	M1
	$\left(\bar{y}=\right)\frac{45}{112}a$ *	A1*
		(4)
6(c)	Form a moments equation about an axis perpendicular to *OC* • Axis through *O*: $\left(8\times0+\right)\ 1\times\frac{a}{2}=7\bar{x}$ • Axis through *A*: $8\times a-1\times\frac{a}{2}=7\bar{x}$ • Axis through *B*: $8\times a-1\times\frac{3a}{2}=7\bar{x}$ If equation is seen in earlier working, it must be used in (c) to earn the marks in (c)	M1
	Correct $\bar{x}$ for their axis through *O*: $\left(\bar{x}=\right)\frac{a}{14}$ *A*: $\left(\bar{x}=\right)\frac{15a}{14}$ *B*: $\left(\bar{x}=\right)\frac{13a}{14}$	A1

	Method to find an expression for tan of a relevant angle	dM1
	$\tan\theta = \dfrac{\bar{x}}{\frac{45}{112}a}$	A1ft
	$\tan\theta = \dfrac{8}{45}$	A1
		(5)
		(14)

Notes for question 6		
(a)	N.B. M0 for a lamina	
M1	Use of $\int xy^2\mathrm{d}x$ with their attempt at a circle equation. The equation for y must be substituted into the formula in terms of x. Allow use of alternative forms if their circle equation is substituted in correctly to give an equation with one variable (including the 'dx') For example use of $\int yx^2\mathrm{d}y$ would need the circle equation substituted in for x^2 to give an integral in terms of y. Condone consistent use of r instead of a.	
A1	Correct expression with correct limits seen at some stage $\int_0^a x(a^2-x^2)\mathrm{d}x$	
A1	Correct expression $\frac{a^4}{4}$. If $\frac{a^4}{4}$ is not explicitly stated, accept correct integrated expression with correct limits.	
dM1	Dependent on previous M mark. A complete method to find the required distance using the equation of a circle. They may use $\frac{2}{3}\pi a^3$ or integrate correctly to find the volume. $\bar{x} = \dfrac{\pi\int_0^a xy^2\mathrm{d}x}{\frac{2}{3}\pi a^3}$ or $\bar{x} = \dfrac{\pi\int_0^a xy^2\mathrm{d}x}{\pi\int_0^a y^2\mathrm{d}x}$ If seen, ρ and/or π must be present in both numerator and denominator.	
A1*	Given answer obtained from complete and correct working. Must be positive and in terms of a. Condone r replaced with a at the final stage.	
(b)	N.B. For a lamina, max score 0100	
B1	Correct mass ratios seen or implied.	
B1	Correct distances, allow if measured from a parallel axis. Ignore signs.	
M1	Method to form a dimensionally correct moments equation (the small hemisphere must be subtracted from the large hemisphere). All required terms present.	
A1*	Given answer obtained from a fully correct moments equation.	
(c)	N.B. M0 for a lamina	
M1	Method to form a dimensionally correct moments equation about an axis perpendicular to OC (the small hemisphere must be subtracted from the	

	large hemisphere). All required terms present. Use of correct mass ratios. Both distances must be measured from the same axis.	
A1	Correct distance for their axis, accept ±	
dM1	Dependent on previous M. Find an expression for tan of a relevant angle $\left(\theta \text{ or} \left(90° - \theta\right)\right)$. Must be dimensionally correct.Must use the given answer from (b) and $\bar{x}$ as the distance to the axis through *O*. The correct addition or subtraction is required if an alternative axis is used. Condone if expressed immediately as $\theta = \tan^{-1}\left(\dfrac{\bar{x}}{\frac{45}{112}a}\right)$ and condone the reciprocal.	
A1ft	Correct equation. Follow through their calculated $\left\|\bar{x}\right\|$ Do not condone the reciprocal. Must be $\tan\theta =$ …	
A1	Correct exact answer. Must be $\tan\theta =$ … ISW Accept recurring decimal with correct notation. $0.1\dot{7}$	