Question Number	Scheme	Marks
4(a)	$M\bar{y} = (\rho)\pi\int_0^a y\left(a^2 - y^2\right)\mathrm{d}y$	M1 A1
	$M\bar{y} = (\rho)\pi\left[\frac{a^2y^2}{2} - \frac{y^4}{4}\right]_0^a$	A1
	$\left(M\bar{y} = (\rho)\pi\frac{a^4}{4}\right)$	
	$\bar{y} = \frac{(\pi\rho)\frac{a^4}{4}}{(\pi\rho)\frac{2a^3}{3}} = \frac{3a}{8}$ *	M1A1 *
	S.C. Clear use of r = 1, with a substituted at end can score max M1A0A0 M1A0	(5)
(b)	$(k+1)m\bar{x} = kma\left(\Rightarrow \bar{x} = \frac{ka}{k+1}\right)$	M1A1
	$(k+1)m\bar{y} = m\times\frac{3}{8}a\left(\Rightarrow \bar{y} = \frac{3a}{8(k+1)}\right)$	A1
	$\tan\alpha = \frac{\bar{x}}{\bar{y}}$	M1
	$k = \frac{3\sqrt{3}}{8}$	A1
		(5)
		[10]
Alt b	Moments about O $m\times\frac{3a}{8}\sin\alpha = kma\times\cos\alpha$	M1A2
	$k = \frac{3\sqrt{3}}{8}$	M1A1

(a)

M1 Using $(\pi)\int_0^r x^2 y\,\mathrm{d}y$ with or without π. Must be dimensionally correct with integrand of the form $y\left(a^2-y^2\right)$. Limits not needed.

A1 $\int_0^a y\left(a^2-y^2\right)\mathrm{d}x$ Correct integral. Limits not needed.

A1 Correct integration. Limits not needed.

M1 Using $\bar{y}=\dfrac{\int_0^a \pi x^2 y\,\mathrm{d}y}{\frac{2}{3}\pi a^3}$. π in numerator and denominator or in neither.

A1 Correct **given** result with no errors seen. **Cso**

S.C. If they clearly find CoM of a hemisphere with a radius other than *a*, they can gain the M marks for a correct method for their hemisphere. If they work with an algebraic radius, they can gain the first 2 A marks and if they replace their radius with *a* at the end, they can gain the final mark.

(b) First 3 marks can be awarded for equations only seen as part of a vector equation.

M1 Dimensionally correct moments equation for $\bar{x}$ or $\bar{y}$

A1 Correct equation in $\bar{x}$ or $\bar{y}$ (Give BOD on use of *x* and/or *y*).

A1 Correct equations for $\bar{x}$ and $\bar{y}$

M1 Dividing to form equation in $\tan\alpha$ and solve for *k*. Trig must be right

A1 $k=\dfrac{3\sqrt{3}}{8}$ any correct exact form.

ALT b) - Taking moments about *O*.

M1 Dimensionally correct moments equation about *O*.

A1 Moments equation with at most one error.

A1 Fully correct equation.

M1 Solve for *k*.

A1 c.a.o.