<table>
<tr><td>Question Number</td><td>Scheme</td><td>Marks</td></tr>
<tr><td>5(a)</td><td>$\bar{x} = \dfrac{\pi\int_0^{4r} x\left(\frac{1}{4}x\right)^2 \mathrm{d}x}{\frac{4\pi r^3}{3}}$ or $\bar{x} = \dfrac{\pi\int_0^{4r} x\left(r-\frac{1}{4}x\right)^2 \mathrm{d}x}{\frac{4\pi r^3}{3}}$</td><td>M1A1</td></tr>
<tr><td></td><td>$= \dfrac{3}{256r^3}\left[x^4\right]_0^{4r}$</td><td>A1</td></tr>
<tr><td></td><td>$= 3r$*</td><td>A1*</td></tr>
<tr><td></td><td></td><td>(4)</td></tr>
<tr><td>5(b)</td><td>
<table>
<tr><td></td><td>Cone</td><td>Cylinder</td><td>S</td></tr>
<tr><td>Mass ratio</td><td>$\frac{4\pi r^3}{3}$</td><td>$\pi\left(\frac{1}{2}r\right)^2 \times r$</td><td>$\left(\frac{4\pi r^3}{3} - \pi\left(\frac{1}{2}r\right)^2 \times r\right)$</td></tr>
<tr><td></td><td>$\frac{4}{3}$</td><td>$\frac{1}{4}$</td><td>$\frac{13}{12}$</td></tr>
<tr><td>Distance from vertex</td><td>$3r$</td><td>$\left(4r - \frac{1}{2}r\right)$</td><td>$\bar{y}$</td></tr>
<tr><td>Distance from plane face</td><td>r</td><td>$\frac{1}{2}r$</td><td>$\bar{y}$</td></tr>
</table>
</td><td>B1

B1</td></tr>
<tr><td></td><td>$\left(\frac{4\pi r^3}{3} \times 3r\right) - \left(\pi\left(\frac{1}{2}r\right)^2 \times r\right)\left(4r - \frac{1}{2}r\right) = \left(\frac{4\pi r^3}{3} - \pi\left(\frac{1}{2}r\right)^2 \times r\right)\bar{y}$</td><td>M1A1</td></tr>
<tr><td></td><td>$\bar{y} = \frac{75}{26}r$ *</td><td>A1*</td></tr>
<tr><td></td><td></td><td>(5)</td></tr>
<tr><td>5(c)</td><td>$\tan\alpha = \dfrac{r}{4r - \frac{75}{26}r}$</td><td>M1A1</td></tr>
<tr><td></td><td>$\tan\alpha = \dfrac{26}{29}$</td><td>A1</td></tr>
<tr><td></td><td></td><td>(3)</td></tr>
<tr><td></td><td></td><td>(12)</td></tr>
<tr><td></td><td>Notes for question 5</td><td></td></tr>
<tr><td>5(a)</td><td></td><td></td></tr>
<tr><td>M1</td><td>Correct method to find the distance of the centre of mass from vertex or plane face, using $\bar{x} = \dfrac{\pi\int_0^{4r} xy^2 \mathrm{d}x}{\frac{4\pi r^3}{3}}$. The formula must be correct but allow a constant multiple if it appears in both numerator and denominator or cancelled π. The y</td><td></td></tr>
</table>

Question Number	Scheme	Marks
	must be replaced with $y = \frac{1}{4}x$ or $y = r - \frac{1}{4}x$. Condone a gradient of $\pm\frac{r}{h}$ if h is later replaced with $4r$. There must be an attempt to integrate the numerator i.e. the power of x must increase by 1. The denominator of $\frac{4\pi r^3}{3}$ is given in the question. Condone sight of vol = $\pi\int_0^{4r}\left(\frac{1}{4}x\right)^2 \mathrm{d}x$ as denominator. Ignore limits for the method mark.	
A1	Correct equation for the distance of the centre of mass from vertex or plane face. $\bar{x} = \frac{\pi\int_0^{4r} x\left(\frac{1}{4}x\right)^2 \mathrm{d}x}{\frac{4\pi r^3}{3}}$ or $\bar{x} = \frac{\pi\int_0^{4r} x\left(r-\frac{1}{4}x\right)^2 \mathrm{d}x}{\frac{4\pi r^3}{3}}$ Ignore limits.	
A1	A correct expression for the distance of the centre of mass from vertex or plane face following integration and division by $\frac{4\pi r^3}{3}$. Limits must be correct at this point. $\frac{3}{256r^3}\left[x^4\right]_0^{4r}$ or $\frac{3}{4r^3}\left[\frac{r^2x^2}{2} - \frac{rx^3}{6} + \frac{x^4}{64}\right]_0^{4r}$	
A1*	Given answer obtained from complete and correct working. If distance is found from plane face this must be subtracted to find required distance.	
5(b)		
B1	Correct mass ratios	
B1	Correct distances (for their parallel axis) Ignore signs.	
M1	Form a moments equation with correct number of terms (allow about a parallel axis). Equation must be dimensionally correct (mass ratio × distance).	
A1	Correct unsimplified equation	
A1*	Given answer obtained from complete and correct working. Working should include a line of simplification. The simplification could occur between the moments equation and the given answer or in the initial stage eg in a table.	
5(c)		
M1	Use of tan to obtain an equation for a relevant angle, allow reciprocal $\frac{r}{4r - \frac{75}{26}r}$	
A1	For a correct equation, condone reciprocal.	
A1	Correct answer, $\tan\alpha = \frac{26}{29}$ o.e. Must be an exact value for $\tan\alpha$. A0 if they got straight to α.	