Question Number		Mark	Note
4a	<table><tr><td></td><td>*ABDE*</td><td>*BCD*</td><td>*PQR*</td><td>template</td></tr><tr><td>Mass</td><td>16</td><td>8π</td><td>2π</td><td>$6\pi+16$</td></tr><tr><td>From *BD*</td><td>$-a$</td><td>$\frac{16a}{3\pi}$</td><td>$\frac{8a}{3\pi}$</td><td>(*d*)</td></tr></table>	B1 B1	Correct mass ratios Correct distances from *BD* or from a parallel axis (Condone sign error)
	Moments about *BD*, using their table **N.B**. c of m of 'RH part' = $\frac{112a}{18\pi}$ then $\left(\frac{112a}{18\pi}\times 6\pi\right)-16a=(6\pi+16)d$	M1	Allow use of a parallel axis. Dimensionally consistent terms. All terms required. Correct pairings Condone sign error(s)
	$-16a+8\pi\times\frac{16a}{3\pi}-2\pi\times\frac{8a}{3\pi}=(6\pi+16)d$	A1	Correct unsimplified equation for their parallel axis.
	$d=\frac{64a}{3(16+6\pi)}=\frac{32a}{3(8+3\pi)}$ *	A1*	Obtain **given answer** from full and correct working. Need *d* = not $\bar{x}$
		[5]	
4b	Vertical distance of c of m from *B* = 4*a*	B1	Seen or implied
	Use of trigonometry to obtain a relevant angle $\tan\phi=\frac{32a}{3(8+3\pi)\times 4a}$ e.g. $\left(=\frac{8}{3(8+3\pi)}\right)\ (=0.153....)$	M1	M0 if they don't use 4*a*
	$\phi=8.7$	A1	8.7 or better (8.700966…)
		[3]	
4c	Moments about *B* or any other complete method to obtain in equation in *k*, *W* and *a* only. e.g. resolve horizontally (*X* = *W*) and	M1	All terms required. Terms dimensionally consistent. Condone sign

	vertically ($Y = (15 + k)\,W$) and Moments about another point.		errors.
	$\frac{32}{3(8+3\pi)} a \times 15W - 2akW = 8a \times W$	A1 A1	Unsimplified equation with at most one error Correct unsimplified equation
	$(k) = \frac{48-12\pi}{8+3\pi}$ or equivalent single fraction	A1	0.59 or better (0.59116…..)
		[4]	
		(12)	