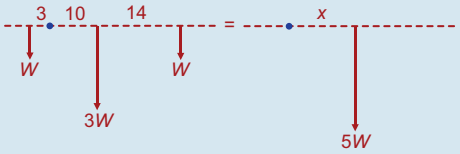
Here, then, is the diagram of the forces. The total weight of the compound body is $5W$ which acts through a point which is x cm from O.



By the Principle of Moments:

$W(-3) + 3W(10) + W(24) = 5W(x)$

… divide by W

$\Rightarrow 5x = 51$

$\Rightarrow x = 10.2$ cm

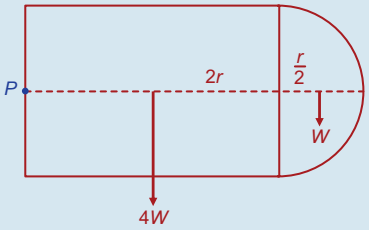
Q. 14. (i) $CSA_{\text{cylinder}} = 2\pi rh = 2\pi(r)(4r) = 8\pi r^2$

$CSA_{\text{hemisphere}} = 2\pi r^2$

$\Rightarrow CSA_{\text{cylinder}} = 4(CSA_{\text{hemisphere}})$

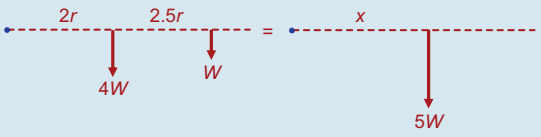
$\Rightarrow W_{\text{cylinder}} = 4(W_{\text{hemisphere}})$

(ii)



Let W be the weight of the hemisphere. Therefore $4W$ is the weight of the cylinder. W acts through a point $\frac{r}{2}$ from the top of the cylinder. $4W$ acts through a point $\frac{1}{2}h = \frac{1}{2}(4r) = 2r$ from the base of the hemisphere.

Here, then, is the diagram of the forces. The total weight of the compound body is $5W$ which acts through a point which is a distance of x from P.



By the Principle of Moments:

$4W(2r) + W(4.5r) = 5W(x)$

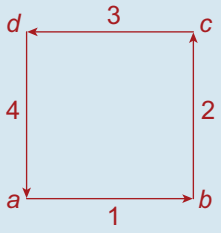
… divide by W

$\Rightarrow 5x = 12.5r$

$\Rightarrow x = 2.5r$.

Exercise 8E

Q. 1.



$\vec{R} = \vec{i} + 2\vec{j} - 3\vec{i} - 4\vec{j}$

$= -2\vec{i} - 2\vec{j}$

$|\vec{R}| = \sqrt{(-2)^2 + (-2)^2}$

$= \sqrt{8}$ N

$\overrightarrow{db} = 3\sqrt{2}\left(\frac{1}{\sqrt{2}}\vec{i}\right) - 3\sqrt{2}\left(\frac{1}{\sqrt{2}}\right)\vec{j}$

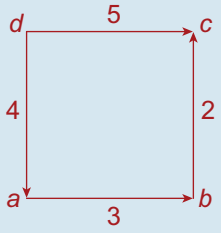
$= 3\vec{i} - 3\vec{j}$

The new resultant $= (-2\vec{i} - 2\vec{j}) + (3\vec{i} - 3\vec{j})$

$= \vec{i} - 5\vec{j}$

$\therefore |\vec{R}| = \sqrt{1^2 + (-5)^2} = \sqrt{26}$ N

Q. 2.



$\vec{R} = 3\vec{i} - 2\vec{i} + 5\vec{i} - 4\vec{j}$

$= 8\vec{i} - 6\vec{j}$

$|\vec{R}| = \sqrt{8^2 + (-6)^2}$

$= \sqrt{100}$

$= 10$ N

Let x = the distance of its line of action from a.

The moment of the sum = the sum of the moments. (Taking moments about a)

$-10(x) = 3(0) - 2(1) - 5(1) + 4(0)$

$\Rightarrow x = \frac{7}{10}$ m

$= 70$ cm

Let it intersect at a distance k from a, therefore a distance $(1 - k)$ from b.