5.4.2 Principle of moments

We have seen (in section 5.4.1) that when more than one moment acts on an object, we can sum together the individual moments. (In 2 dimensions, we take clockwise moments to be positive and anticlockwise moments to be negative.)

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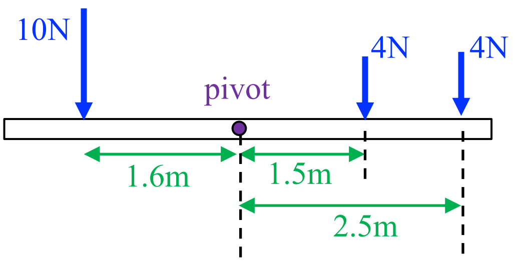
The principle of moments deals with the situation in which forces acting on a body produce no turning affect. In this case:

$$\textit{the sum of clockwise moments} = \textit{the sum of anticlockwise moments}$$

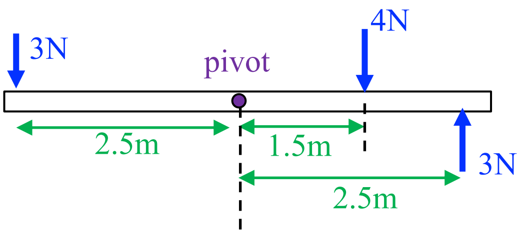
The body is said to be in <u>equilibrium</u>.

(1)✎Which of the following is in equilibrium? (Hint: find whether the sum of clockwise moments = sum of anticlockwise moments.)

(i)



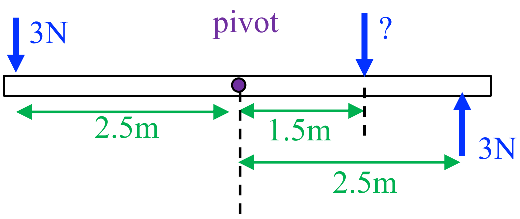
(ii)



We can use the principle of moments, in situations where there is equilibrium, to find missing values.

Worked example:

The following beam is in equilibrium. Find the missing force.

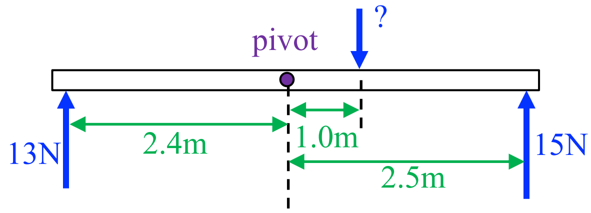


In this situation, the two 3N forces are producing anticlockwise moments. The missing force should produce a clockwise moment to balance these.

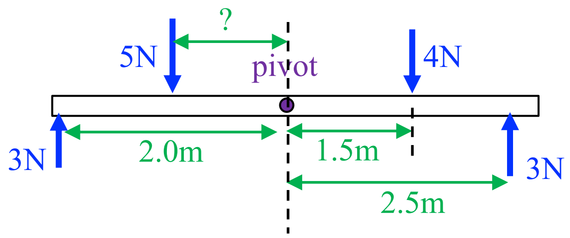
$$\text{the sum of clockwise moments} = \text{the sum of anticlockwise moments}$$
$$? \times 1.5 = (3 \times 2.5) + (3 \times 2.5)$$
$$? = \frac{(3 \times 2.5) + (3 \times 2.5)}{1.5}$$
$$? = 10N$$

(2)✐Use the principle of moments to find the missing values in the following:

(i)



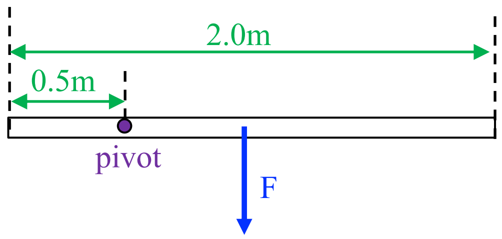
(ii)



Moment due to weight

Sometimes the weight of an object can produce a moment.

Consider the following:



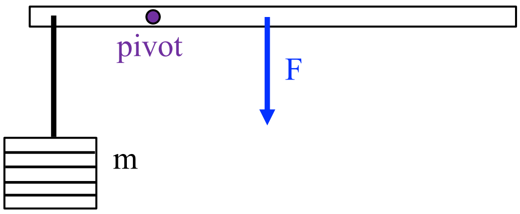
A beam with a mass of 0.2kg is suspended from a <u>non-central</u> pivot point.

(3)✐What do you think the force F represents?

(4)✐What is the size of force F?

(5)✐What is the resultant moment on the beam?

With the addition of a known mass (m), we can use this technique to work out the mass of a beam of unknown mass. The equipment used is shown below:



(6)✐Using the principle of moments, explain how you would obtain the mass of the beam.