



## Parallel forces in equilibrium

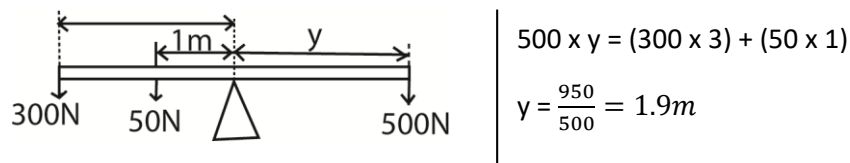
### Conditions for a body to be in equilibrium

When a system of parallel forces act on a body then it will be in equilibrium when;

- (i) the sum of forces acting in one direction are equal to the sum of forces acting in opposite direction.
- (ii) sum of clockwise moments about a point are equal to the sum of anticlockwise moment about the same point

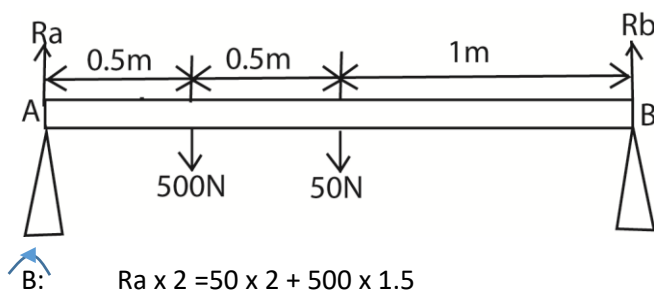
### Example 1

Given the diagram below. Find the value of y



### Example 2

A uniform beam of weight 50N and length 2m rests horizontally on two supports pivoted at each end. A load of weight 500N is placed 0.5m from one end. Find the reaction on each support.



B:

$$R_a \times 2 = 50 \times 2 + 500 \times 1.5$$

$$2R_a = 50 + 750$$

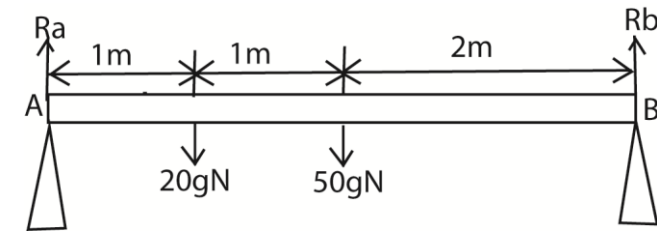
$$R_a = 400N$$

Also  $R_a + R_b = 500N + 50N$

$$R_b = 550N - 400N = 150N$$

### Example 3

A uniform beam of mass 50kg and length 4m rests horizontally on two supports pivoted at each end. A load of 20kg is placed 1m from one end. Find the reaction on each support



B:

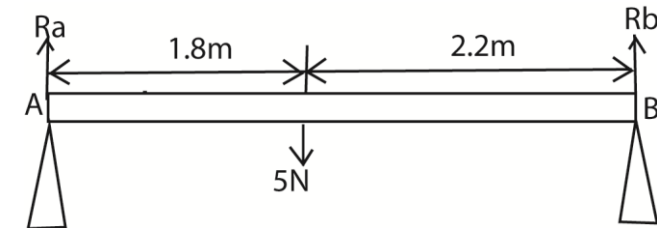
$$R_a \times 4 = 50g \times 2 + 20g \times 3$$
$$4R_a = 100g + 60g = 160 \times 9.8$$
$$R_a = 392\text{N}$$

Also  $R_a + R_b = 500\text{N} + 50\text{N}$

$$R_b = 20g\text{N} + 50g\text{N} - 392\text{N} = 294\text{N}$$

### Example 4

A non-uniform beam AB of length 4m has its weight 5N acting at a point 1.8m from end A. The beam rests horizontally on two supports pivoted at each end. Find the reaction on each support.



B:

$$R_a \times 4 = 5 \times 2.2 = 11$$
$$R_a = 2.75\text{N}$$

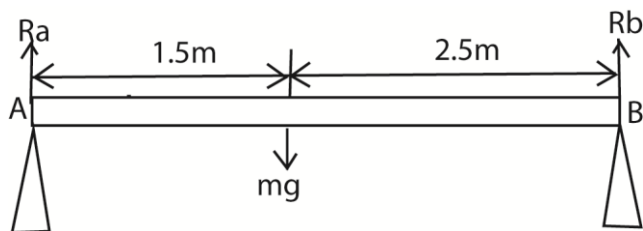
Also  $R_a + R_b = 5\text{N}$

$$R_b = 5\text{N} - 2.75\text{N} = 2.25\text{N}$$

### Example 5

A non-uniform beam AB of length 4m rests in horizontal position on vertical support at A and B. The centre of gravity is at 1.5m from end A. The reaction at B is 37.5N find the

- (a) mass of the beam      (b) reaction at B



$$A: \quad 37.5 \times 4 = mg \times 2.5$$

$$m = 10.2\text{kg}$$

$$\text{Also } R_a + 37.5 = 10.2 \times 9.8$$

$$R_a = 62.5\text{N}$$

### Revision exercise

1. A uniform beam AB of length 10m rests horizontally on two supports A and B. If the beam has a mass of 20g, find the reaction on each support. [98N, 9N]
2. A uniform beam of length 14m and mass 20kg rests horizontally on two supports, one at A and another at C which is 4m from B. find the reactions at each support [58.8N, 137.2N]
3. A uniform beam AB of length 10m and mass 20kg rests horizontally on two supports, one at A and another at C which is 2m from B. If a weight of mass 20kg is attached to the beam at a point 6m from A. Find the reaction on the supports. [392N, 196.2N]
4. A uniform beam AB of length 4m and mass 10kg rests horizontally on two supports at A and the other at C which is 1m from B. Where must a body of mass 50kg stand on the beam so that the reaction on each support is equal? [1.4m]
5. A uniform beam AB of length 12m and mass 12kg rests on two supports A and B. At what distance must a particle of mass 4g be tied so that the reaction of each support is equal. [9m from A]
6. A playground sea saw consists of a uniform beam of length 4m supported at its mid-point. If a girl of mass 25kg sits at one end of the sea saw, find where her brother of mass 40kg must sit if the sea saw is to balance horizontally. [75cm from other end]
7. A broom consists of a uniform broom stick of length 120cm and mass 4kg and a broom head of mass 6kg attached at the other end. Find where a support should be placed so that the broom balances horizontally. [24cm from the head]
8. A non-uniform beam AB of length 4m rests horizontally on two supports, one at A and the other at B. The reaction at the supports are 5gN and 3gN respectively. If instead the rod the rod were to rest horizontally on one support, find how far from A this support would have to be placed. [1.5m from A]
9. A uniform beam AB of mass 80g and of length 100cm is pivoted at 30cm from A, a force of 10N is placed on the beam at the 80cm from end A and a string is tied at the 40cm from end B so that the beam rests horizontally. Find the tension in the string. [17.2N]
10. A uniform beam AB of length 100cm is pivoted at 60cm from end B. The beam rests horizontally when a mass at A is 35g. Calculate the mass 9m) of the beam. [0.14kg]
11. A uniform meter rule pivoted at 10cm mark balances when a mass of 400N is suspended at the 0cm mark. If the system is in equilibrium. Find the mass of the ruler [10kg]
12. Two boys are carrying a uniform ladder of weight 800N, if the boys hold the ladder at 2m and 3m respectively from the centre of gravity, calculate the weight that each boy support. [480N, 320N]

Thank You

Dr. Bbosa Science