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Let a weight of 100gf produce a clockwise moment about the middle point. Let its distance from the middle be  $d$  cm. Then, according to principle of moments, Anticlockwise moment = Clockwise moment  
 $50gf \times 50 \text{ cm} = 100gf \times d$   
 So,  $d = \frac{50 \times 50}{100} = 25 \text{ cm}$  from the other end

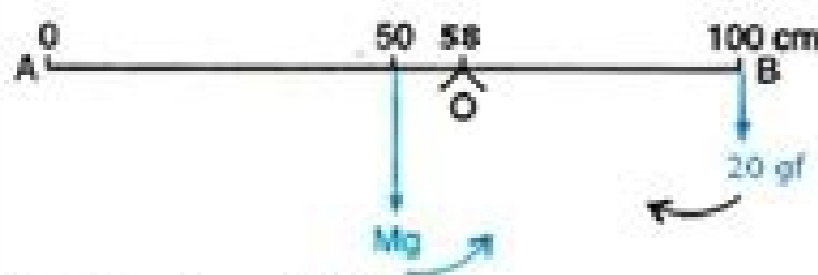
**Question 9:**

A uniform metre rule balance horizontally on a knife edge placed at the 58 cm mark when a weight of 20 gf is suspended from one end.

- (i) Draw a diagram of the arrangement
- (ii) What is the weight of the rule?

**Solution 9:**

(i) Weight  $mg$  ( $W$ ) of rule produces an anti-clockwise moment about the knife edge  $O$ . In order to balance it, 20gf must be suspended at the end  $B$  to produce clockwise moment about the knife edge  $O$ .



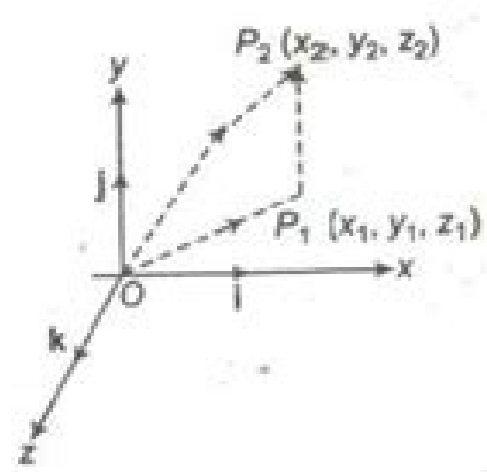
(ii) From the principle of moments, Anticlockwise moment = Clockwise moment  
 $W \times (58-50) = 20gf \times (100 - 58)$   
 $W \times 8 = 20gf \times 42$   
 $W = \frac{20gf \times 42}{8} = 105 \text{ gf}$

**Question 10:**

The diagram below (Fig 1.36) Shows a uniform bar supported at the middle point  $O$ . A weight of 40 gf is placed at a distance 40 cm to the left of the point  $O$ . How can you balance the bar with a weight of 80 gf?



Let  $P_1(x_1, y_1, z_1)$  and  $P_2(x_2, y_2, z_2)$  are any two points, then the vector joining  $P_1$  and  $P_2$  is the vector  $P_1 P_2$ .



The component vectors of  $P$  and  $Q$  are

$OP = x_1i + y_1j + z_1k$

and  $OQ = x_2i + y_2j + z_2k$

i.e.,  $P_1 P_2 = (x_2i + y_2j + z_2k) - (x_1i + y_1j + z_1k)$   
 $= (x_2 - x_1) i + (y_2 - y_1) j + (z_2 - z_1) k$

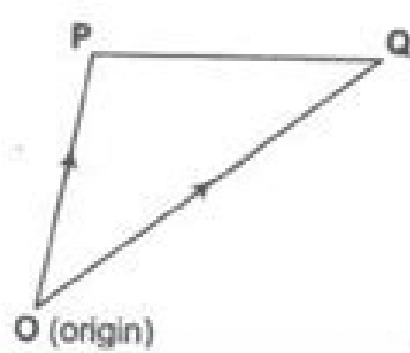
Its magnitude is

$P_1 P_2 = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

**Position Vector of a Point**

The position vector of a point  $P$  with respect to a fixed point, say  $O$ , is the vector  $OP$ . The fixed point is called the origin.

Let  $PQ$  be any vector. We have  $PQ = PO + OQ = -OP + OQ = OQ - OP =$  Position vector of  $Q$  — Position vector of  $P$ .



**Solution 6:**  
 (i) Perpendicular distance of point A from the force  $F = 10 \text{ N}$  at B is 0.5m, while it is zero from the force  $F = 10 \text{ N}$  at A.  
 Hence, moment of force about A is  
 $= 10 \text{ N} \times 0.5\text{m} = 5 \text{ Nm}$  (clockwise)  
 (ii) Perpendicular distance of point B from the force  $F = 10 \text{ N}$  at A is 0.5m, while it is zero from the force  $F = 10 \text{ N}$  at B.  
 Hence, moment of force about B is  
 $= 10 \text{ N} \times 0.5\text{m} = 5 \text{ Nm}$  (clockwise)  
 (iii) Perpendicular distance of point O from either of the forces  $F = 10 \text{ N}$  is 0.25 m.  
 Moment of force  $F (=10 \text{ N})$  at A about O =  $10 \text{ N} \times 0.25\text{m}$   
 $= 2.5 \text{ Nm}$  (clockwise)  
 And moment of force  $F (=10 \text{ N})$  at B about O  
 $= 10 \text{ N} \times 0.25\text{m} (=2.5 \text{ Nm})$  (anticlockwise)  
 Hence, total moment of the two forces about O  
 $= 2.5 - 2.5 = 0 \text{ Nm}$  (clockwise)

**Question 7:**  
 A steering wheel of diameter 0.5 m is rotated anticlockwise by applying two forces each of magnitude 5 N. Draw a diagram to show the application of forces and calculate the moment of couple applied.



Moment of couple = either force  $\times$  couple arm  
 $= 5 \text{ N} \times 0.5 \text{ m}$   
 $= 2.5 \text{ Nm}$

**Question 8:**  
 A uniform metre rule is pivoted at its mid point. A weight of 50 gf is suspended at one end of it. Where should a weight of 100 gf be suspended to keep the rule horizontal?  
**Solution 8:**  
 Let the 100 gf weight produce anticlockwise moment about the middle point of metre rule, i.e., at 50cm.



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