1. A rod of 2m length pivoted at 0.5m is balanced when a weight of 200gf is placed at one of its ends. Calculate the weight of the rod.

   Ans

   At equilibrium, Principle

   Total Anticlockwise moment = Total Clockwise moment

   200 x 0.5 = w x 0.5 ⇒ w = 200gf

2. Calculate the position of the fulcrum at which a meter rule of mass 20gf can be balanced when three weights 50gf, 10gf & 200gf are applied at 20cm, 40cm & 90cm marks respectively.

   Ans

   At equilibrium, Principle by of moments

   Total Anticlockwise moment = Total Clockwise moment

   $50(x-20)+10(x-40)+20(x-50)=200(90-x)$

   $5(x-20)+(x-40)+2(x-50)=20(90-x) \Rightarrow 28x=2040 \Rightarrow x=72.85\text{cm}$

3. Calculate the i) clockwise moment ii) anticlockwise moments & iii) net moment on a rod of length 5m & mass 3000g pivoted at 3m from an end, if 2 weights of 500gf & 800gf are placed at 2m & 4.5m from the same end.

   Ans

   Clockwise Moment = 800 x 1.5 = 1200gf cm

   Anticlockwise moment = 500 x 1+3000 x 0.5 = 500+1500 =2000 gf cm

   Resultant or Net moment = ACM – CM = 800 gf cm (Anticlockwise)

4. The force required to open a nut using a spanner of length 90cm is 50N. Calculate the force required if the spanner is 50cm long.

   Ans

   Moment required to open a given nut is always the same

   $\therefore\ F_1d_1 = F_2d_2 \Rightarrow 50 \times 90 = F_2 \times 50 \Rightarrow F_2 = 90\text{cm}$

5. A meter rule can be balanced about 60 cm mark by placing a block of weight ‘m’ at 90cm mark. State whether the ruler is lighter than or heavier than the block of weight ‘m’? If the mass of the

ruler is 80g & another block of weight 'm' is placed at 100cm mark, then calculate the weight that should be placed at 40cm position to balance the ruler.

Ans

At equilibrium by of moments

Anticlockwise moment = Clockwise moment

$W \times 10 = m \times 30 \Rightarrow W = 3m$

$\therefore m = \frac{W}{3} \Rightarrow m < W$ [W = wt of rules]

As $W = 80gf$, $m = \frac{W}{3} = \frac{80}{3} gf$

At equilibrium by principle of moments

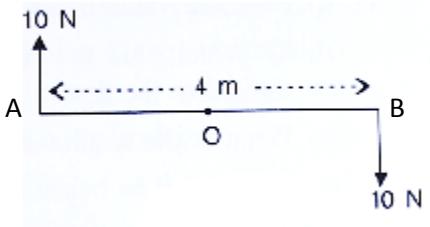
Total Anticlockwise moment = Total Clockwise moment

$80 \times 10 + x \times 20 = \left(\frac{80}{3}\right) \times 30 + \left(\frac{80}{3}\right) \times 40$

$\Rightarrow x = 53.33gf$

6. Two forces each of magnitude 10 N act vertically upwards and downwards respectively at the two ends A and B of a uniform road of length 4 m which is pivoted at its mid point O as shown in fig. Determine the magnitude of resultant moment of forces about the pivot O.

Ans



Given, AB =4m hence, OA=2m and OB =2m

Moment of force F(=10N) at A about the point O

= F x OA= 10 x 2= 20Nm (clockwise)

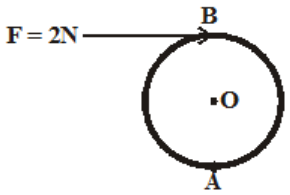
Moment of force F (=10N) at point B about the point O

= F x OB= 10 x 2 =20Nm (clockwise)

Total moment of forces about the mid-point O=

=20 +20= 40Nm(clockwise)

7. A wheel of diameter 2 m is shown in the figure. A force F = 2 N is applied at B in the direction shown in figure. Calculate the moment of force about



(i) centre O, and

(ii) point A.

Ans

Given , F= 2N

Diameter=2m

Perpendicular distance between B and O =1m

(i) Moment of force at point O

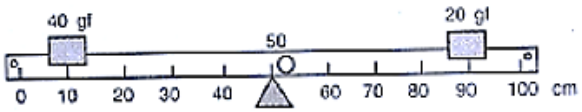
= F x r

= 2 x 1=2Nm (clockwise)

(ii) Moment of force at point A= F x r

= 2 x 2=4Nm (clockwise)

8. Fig shows a uniform metre rule placed on a fulcrum at its mid-point O and having a weight 40 gf at the 10 cm mark and a weight of 20 gf at the 90 cm mark.



(i) Is the metre rule in equilibrium? If not, how will the rule turn?

(ii) How can the rule be brought in equilibrium by using an additional weight of 40 gf?

Ans

(i) Anticlockwise moment $= 40\ \text{gf} \times (50 - 10)\ \text{cm} = 40\text{gf} \times 40\text{cm} = 1600\ \text{gf} \times \text{cm}$

Clockwise moment = $20\text{gf} \times (90 - 50) = 20\ \text{gf} \times 40\text{cm} = 800\ \text{gf} \times \text{cm}$

Anticlockwise moment is not equal to clockwise moment.

Hence the metre rule is not in equilibrium and it will turn anticlockwise.

(ii) To balance it, 40gf weight should be kept on right hand side so as to produce a clockwise moment about the middle point.

Let its distance from the middle be d cm.

Then, clockwise moment = $20\ \text{gf} \times 40\text{cm} + 40\text{gf} \times \text{d cm}$

From the principle of moments,

Anticlockwise moment= Clockwise moment

$40\ \text{gf} \times 40\ \text{cm} = 20\text{gf} \times 40 + 40 \times \text{d cm}$

$1600 - 800 = 40\text{gf} \times \text{dcm}$

So, $\text{d} = \frac{800\text{gf cm}}{40\text{gf}} = 20$ (on the other side)

Hence, by placing the additional weight of 40 gf at the 70 cm mark the rule can be brought in equilibrium.

9. State the condition when a body is in
   (i) Static
   (ii) Dynamic equilibrium
   Give one example of static and dynamic equilibrium.
   Ans
   (i) When a body remains in the state of rest under the influence of the applied forces, the body is in static equilibrium. For example a book lying on a table is in static equilibrium.
   (ii) When a body remains in the same state of motion (translational or rotational), under the influence of the applied forces, the body is said to be in dynamic equilibrium. For example, a rain drop reaches the earth with a constant velocity is in dynamic equilibrium.

10. Name the force which is a must for sustaining circular motion.
    Ans
    Centripetal Force

11. What is the basic difference between uniform linear motion & uniform circular motion?
    Ans
    Uniform Linear Motion: Velocity is constant & thus it is a uniform motion. Acceleration is zero.
    Uniform Circular Motion: Velocity is not constant due to continuous change in Direction & thus it is not a uniform motion. Acceleration is called Centripetal acceleration.

12. What will happen to a car moving on a circular path if the friction between the car and the road suddenly disappears?
    Ans
    If friction disappears there is no Centripetal force available to sustain circular motion and hence the car will skid along the tangent at the point of the path when friction disappears.

13. Explain the motion of a planet around the sun in a circular path.
    Ans
    A planet moves around the sun in a nearly circular path for which the gravitational force of attraction on the planet by the sun provides the necessary centripetal force required for circular motion.

14. Where is the C.G. of a

(i) Ring

(ii) Rhombus

(iii) Scalene Triangle

(iv) Cylinder

Ans

(i) Ring: Centre of the ring.

(ii) Rhombus: At the point of intersection of the diagonals.

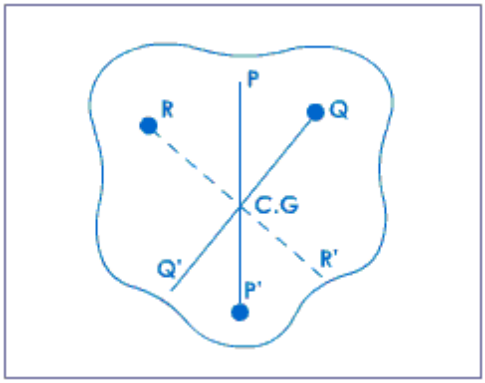
(iii) Scalene triangle: At the point of intersections of medians.

(iv) Cylinder: Midpoint of the axis of the cylinder.

15. How do you determine C.G. of an irregular object?

Ans

Centre of gravity of an irregularly shaped lamina can be determined using a plumb line as follows: Make three holes near the edge of the lamina so that the lamina swings freely when pivoted from each hole. Hang the lamina about one of its holes (point P as shown in the diagram below) on a pin clamped on a retort stand.



Suspend a plumb line from P and mark the position PP' on the lamina.

Repeat the experiment by suspending the lamina from Q and R and similarly mark the plumb line positions QQ' and RR'. You will observe that all the three lines, PP', QQ' and RR' intersect at one point. This point of intersection of these lines is the centre of gravity of the lamina.