REVIEW QUESTIONS

1. Define moment and moment of force.
2. List some engineering applications of moment.
3. State the possible displacements of a body subjected to a general force system.
4. State and prove Varignon's theorem.
5. What is a couple? Enumerate its various characteristics.
6. Can a couple be balanced by a single force applied to a body?
7. Is it true that the line of action of the resultant of the parallel forces always passes between the lines of action of these forces?
8. Outline the steps involved in the graphical method for the determination of the resultant of parallel forces.
9. State the equilibrium conditions for bodies acted upon by a system of (*i*) coplanar concurrent forces, (*ii*) coplanar non-concurrent forces.
10. Find the magnitude of the two like parallel forces acting at a distance of 24 cm, whose resultant is 200 N and its line of action is at a distance of 6 cm from one of the forces. **[Ans.** 50 N, 150 N]
11. Three like parallel force 20 N, 40 N and 60 N are acting at points A, B and C respectively on a straight line ABC. The distances are $AB = 3$ m, $BC = 4$ m. Find the resultant and also the distance of the resultant from point A on line ABC. **[Ans.** 120 N, 4.5 m]
12. Four parallel forces of magnitudes 100 N, 200 N, 50 N and 400 N are shown in Fig. 3.110. Determine the magnitude of the resultant and also the distance of the resultant from point A. **[Ans.** $R = 250$ N & 4.3 m]

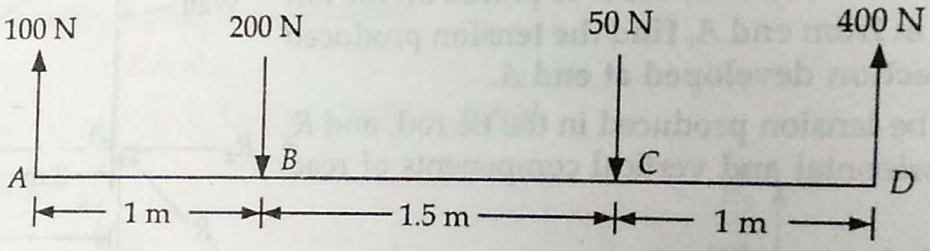

Fig. 3.110

13. Two like parallel forces P and Q act on a rigid body at A and B respectively. If P and Q be inter changed in position, show that the point of application of the resultant will be displaced through a distance d along AB, where

$$d = \frac{P - Q}{P + Q} \times AB$$

14. $ABCD$ is a rectangle in which $AB = CD = 100$ mm and $BC = DA = 80$ mm. Forces of 100 N each act along AB and CD and forces of 50 N each act along BC and DA. Find the resultant moment of two couples. **[Ans.** 13 Nmm]
15. Three forces, acting on a rigid body, are represented in magnitude, direction and line of action by the three sides of a triangle taken in order. Prove that the forces are equivalent to a couple whose moment is equal to twice the area of the triangles.

16. A beam AB of span 8 m is hinged at A and is on rollers at B. It carries a uniformly distributed load, a concentrated load and an externally applied moment as shown in Fig 3.111. Determine the reactions at A and B for the loading shown.

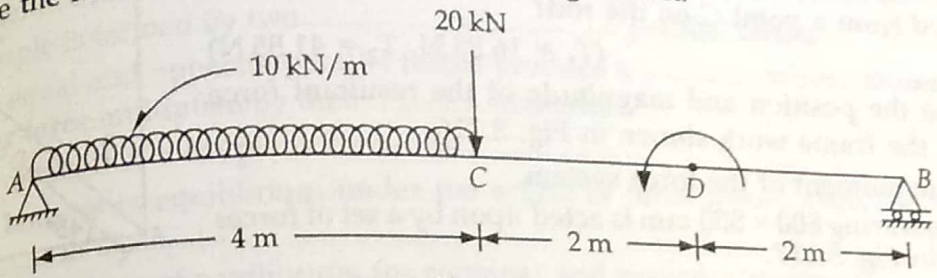

Fig. 3.111

(R_b = 10 kN down and, R_a = 70 kN)

17. For the lever system depicted in Fig. 3.112, determine the force P required to keep it in equilibrium.

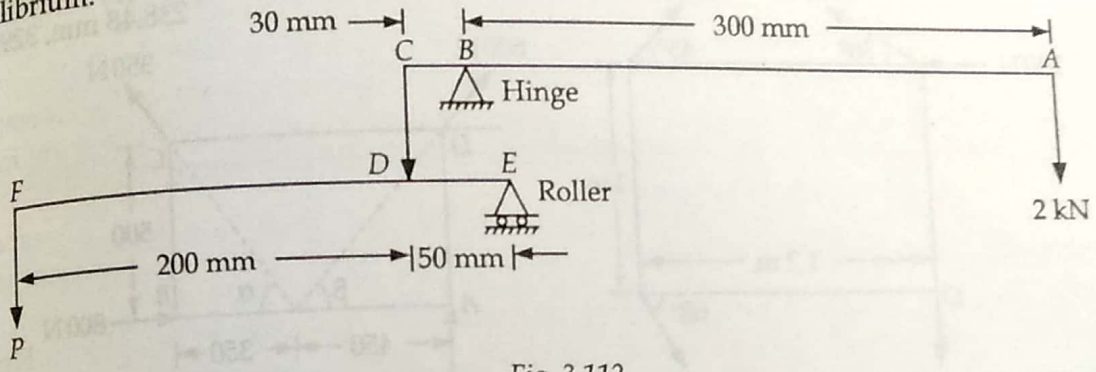

Fig. 3.112

18. Fig. 3.113 shows a horizontal beam AD of a jib-crane supported horizontally at the point A and by a tie rod BC. Calculate the tension in the tie rod when a load of 1 kN is acting at point D on the beam.

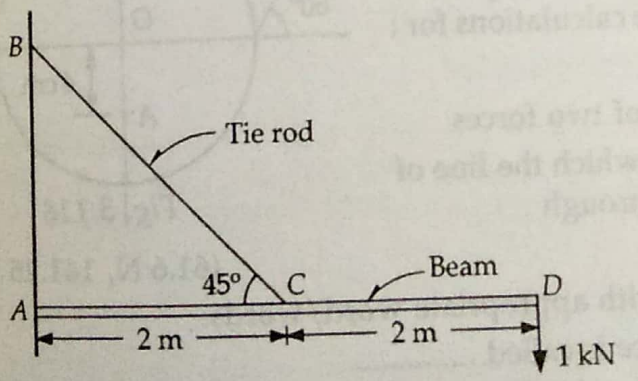

Fig. 3.113

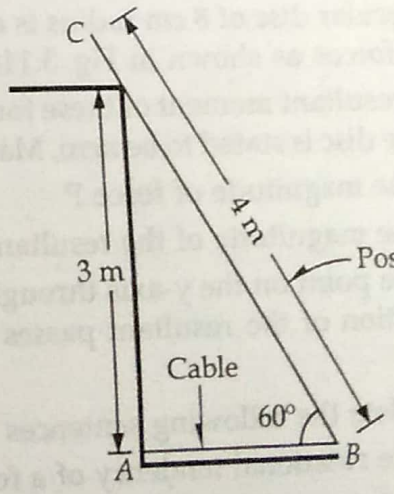

Fig. 3.114

19. A post BC of weight 18 N is prevented from sliding with the help of cable AB as shown in Fig. 3.114. Assuming all surfaces to be smooth, work out the tension developed in the cable.

(5.19 N)

20. A uniford rod AB of 1 m length and 1 kg mass is suspended from its ends as shown in Fig. 3.115. What amount of tensions would be induced in the strings when a mass of 5 kg is suspended from a point C on the rod?

(T_1 = 16.85 N, T_2 = 41.85 N)

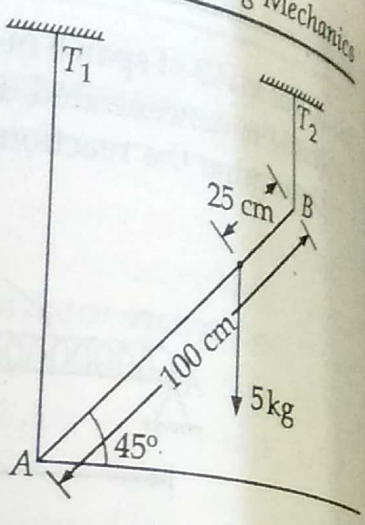

Fig. 3.115

21. Determine the position and magnitude of the resultant force acting on the frame work shown in Fig. 3.116.

What is the moment of the force system.

22. A plate measuring 800 × 500 mm is acted upon by a set of forces as shown in Fig. 3.117.

Determine the resultant of these forces and also locate the points where the line of action of resultant intersets the edges of the plate.

(1706.76 N, 54,1°, 193.19 mm 238.48 mm, 329.48 mm)

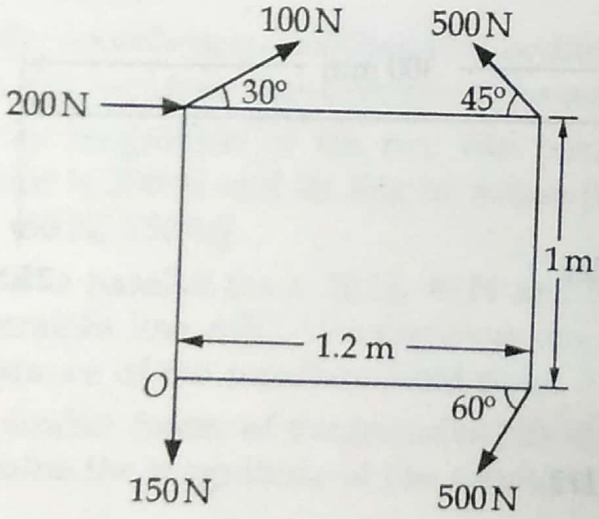

Fig. 3.116

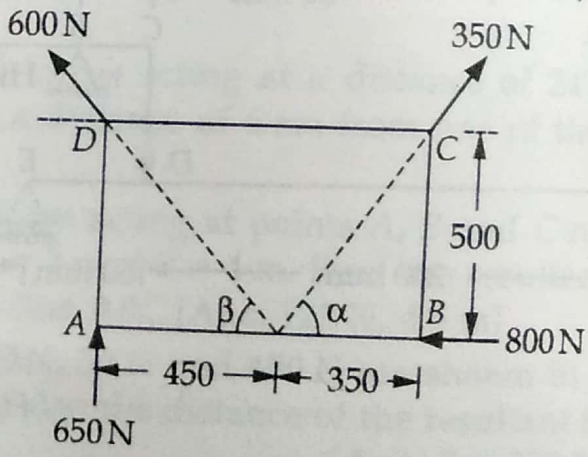

Fig. 3.117

23. A circular disc of 8 cm radius is acted upon by set of two forces as shown in Fig. 3.118.

The resultant moment of these forces about a point A on the disc is stated to be zero. Make calculations for :

(*a*) the magnitude of force P

(*b*) the magnitude of the resultant of two forces

(*c*) the point on the y-axis through which the line of action of the resultant passes through

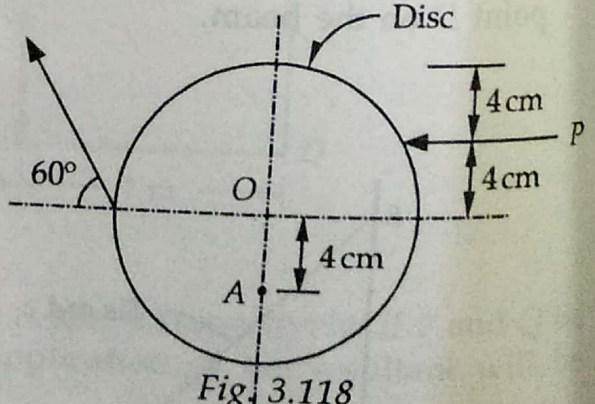

Fig. 3.118

(61.6 N, 141.25 N, 2.20 cm)

4. Complete the following sentences with appropriate word/words:

12. Show that if a body is in equilibrium under the action of three forces (concurrent), those forces will always lie along the sides of a closed triangle.
13. The resultant of two equal forces acting at a point also equals to P. Determine the angle between the two forces.
14. A force of 200 N is resolved into two components. If one of the components is equal to 120 N and makes an angle of 30° with the 200 N force, find the other component and the angle between the components.
15. Refer Fig. 2.87 for a system of concurrent coplanar forces. If the resultant is zero, find the magnitude and direction of force P.

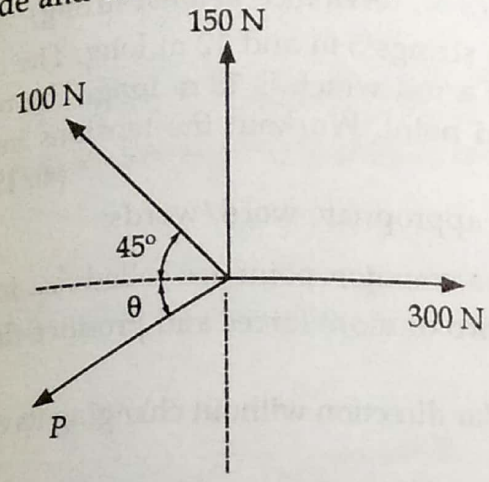

Fig. 2.87

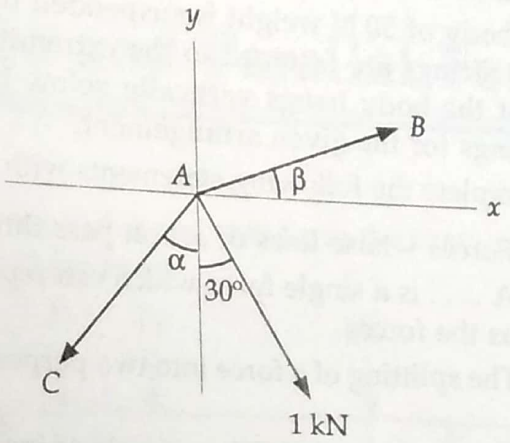

Fig. 2.88

16. A 1 kN force has been resolved into components along AB and AC directions in the x-y plane specified by the angles α and β as shown in Fig. 2.88. If the component along AC is 2 kN and the component along AB is 1.6 N, determine the angles α and β.
17. Two ropes are tied together at C. If the maximum permissible tension in each rope is 4 kN, make calculations for the maximum force P that can be applied and in which direction.

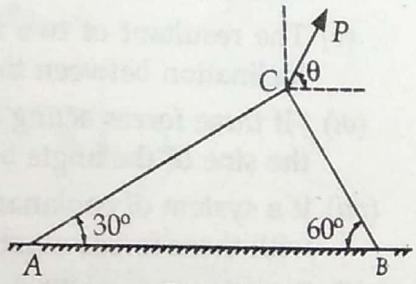

Fig. 2.89

18. A body is free to slide on a smooth vertical circular wire and is connected by a string, equal in length to the radius of the circle, to the highest point of the circle. Find the tension developed in the string, and the reaction of the circle.

(Each is equal to weight of the body)

19. A particle is acted upon by the force system shown in Fig. 2.90. Determine the magnitude and direction of the resultant.
20. Three forces $2P$, $3P$ and $4P$ act along three sides of an equilateral triangle taken in order. Find the magnitude and line of action of the resultant force (1.732 P, 210°).

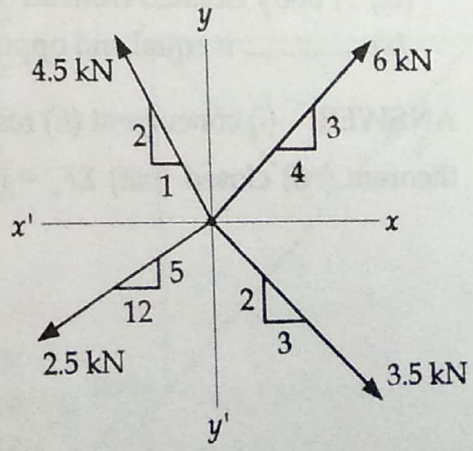

Fig. 2.90

21. A small block of weight 100 N is placed on an inclined plane which makes an angle θ = 30° with the horizontal. What is the component of this weight (*i*) parallel to the inclined plane and (*ii*) perpendicular to the inclined plane. (8.66 N, 50 N)

22. A lamp weighing 5 N is suspended from the ceiling by a chain. It is pulled aside by a horizontal chord until the chain makes an angle of 60° with the ceiling. Determine the tensions in the chain and the chord. (5.77 N, 2.89 N)

23. A weight W is supported by the two strings at right angles to one another and attached to two points in the same horizontal line. Prove that the tensions induced in the strings are inversely proportional to their lengths.

24. The top of an electric pole is connected with a stay wire which makes an angle of 60° with the horizontal. If a horizontal force of 100 N is essential for keeping the pole vertical, determine tension induced in the stay wire. Also workout vertical component of this tension and state the purpose served by it.(200 N, 173 N, resistance against lifting)

25. A body of 50 N weight is suspended by two strings 5 m and 12 m long. The other ends of the strings are fastened to the extremities of a rod which is 13 m long. The rod is so held that the body hangs vertically below its mid point. Workout the tensions induced in the strings for the given arrangement. (46.15 N, 19.23 N)

26. Complete the following statements with most appropriate word/words:

(*i*) Forces whose lines of action pass through