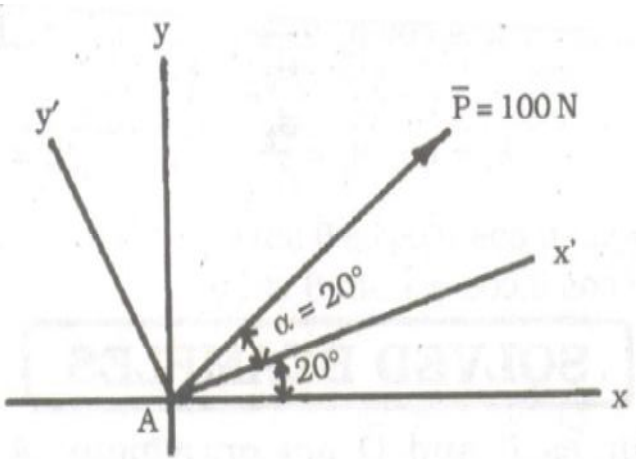
Applied Mechanics Department
S. V. National Institute of Technology, Surat

Engineering Mechanics Tutorial: Force

Q.	Problem	Figure

01 If the force exerted on point A is 100N in the direction shown in fig. Determine the force component acting along

(a) The x and y axes,
(b) The x' and y' axes,
(c) The x and y' axes and
(d) Determine the angle α, knowing that the component of forces along the x axes is to be 80 N while resolving along the x and y' axes

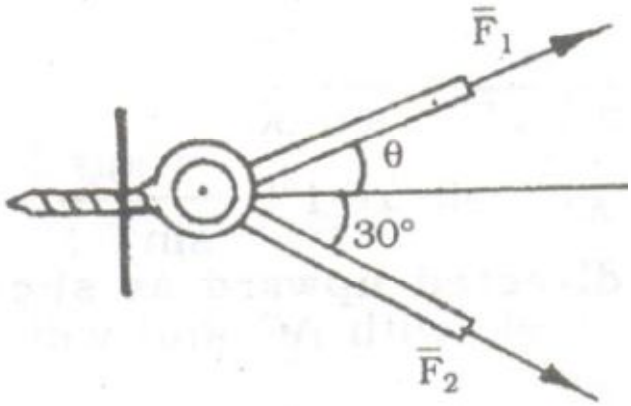


Ans.

(a) P_x=76.60 N, P_y= 64.28 N
(b) $P_{x'}$ =93.97 N, $P_{y'}$ = 34.20 N
(c) P_x=100 N, $P_{y'}$ = 68.40 N
(d) α =41.26^0

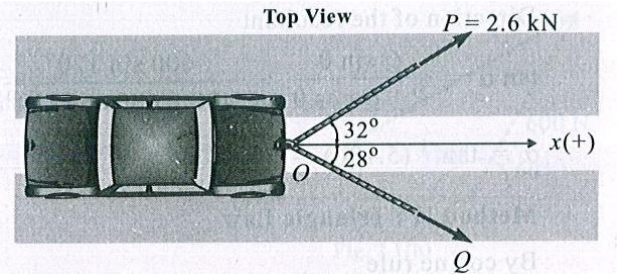
02 The hook shown is subjected to two forces, F_1 and F_2. If it is required that the resultant force have a magnitude of 250 N and be directed horizontal towards right, determine

(a) The magnitude of F_1 and F_2 provide θ = 50^0
(b) The magnitude of F_1 and F_2 if F_1 is to be minimum.



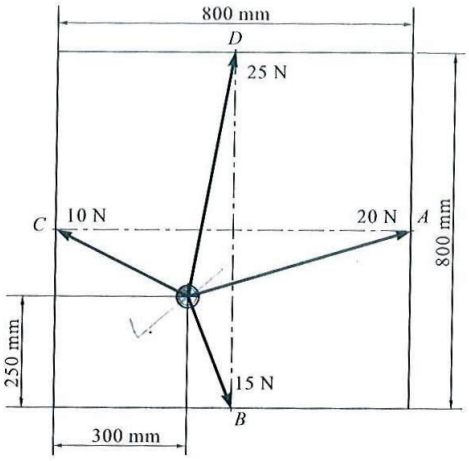
Ans. (a) F_1 =79.81N, F_2 = 102.61 N
(b) F_1=75 N, F_2 =129.90N

03 A car is pulled by means of two ropes as shown in figure. The tension in one rope is P=2.6KN. If the resultant of two forces applied at O is directed along the x- axis of the car. Find the tension in the other rope and magnitude of the resultant.



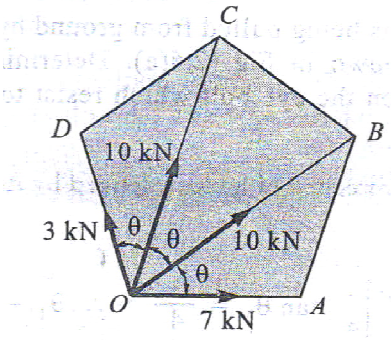
Ans. Q= 2.934kN
R= 4.8kN(→)

04 The striker of carom board laying on the board is being pulled by four players as shown in figure. The players are sitting exactly at the centre of the four sides. Determine the resultant of forces in magnitude and direction.



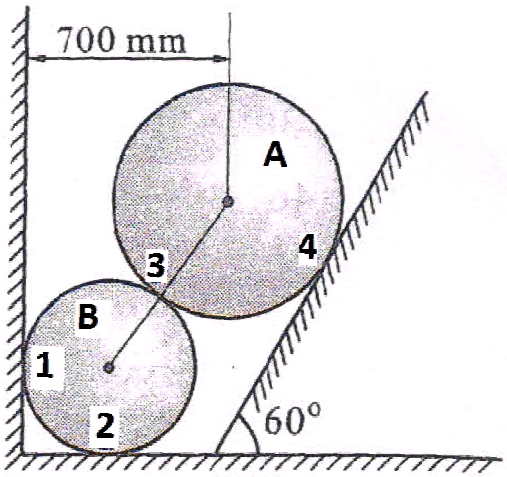
Ans. Θ= 45.89°
R=29.09N

05 Forces 7 kN, 10 kN, 10 kN and 3 kN respectively act at one of the angular point of a regular pentagon towards the other four point taken in order. Find their resultants completely.



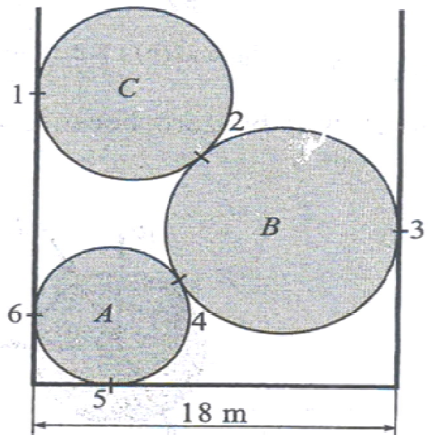
Ans.
R = 25.10 kN
θ = 46.59^0

06 Two spheres A and B of weight 1000N and 750 N, respectively are kept as shown in the Figure. Determine the reactions at all contact points 1, 2, 3 and 4. Radius of A = 400 mm and Radius of B = 300 mm.



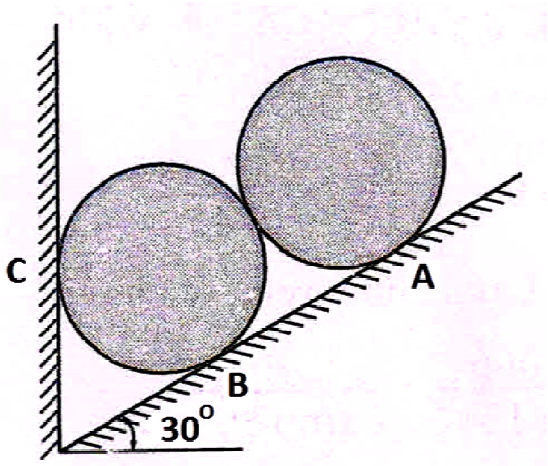
Ans.
R_1 = 496.65 N
R_2 = 1463.26 N
R_3 = 869.14 N
R_4 = 573.48 N

07 Three cylinders are piled up in a rectangular channel as shown in Fig. Determine the reactions at point 5 & 6.
(Cylinder A : radius = 4 cm, m = 15 kg, Cylinder B : radius = 6 cm, m = 40 kg,
Cylinder C : radius = 5 cm, m = 20 kg).



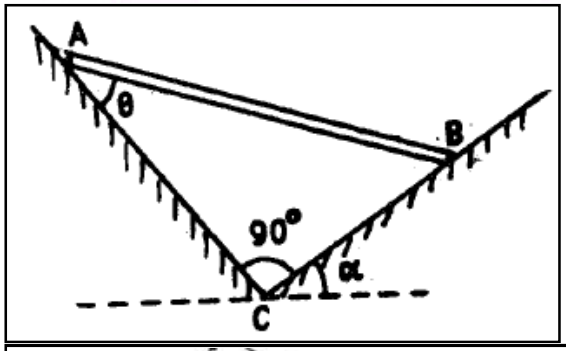
R_5 = 735.75 N
R_6 = 784.80 N

08 Two identical rollers each of mass 50 kg are supported by an inclined plane and a vertical wall as shown in Figure-2. Assuming smooth surfaces, find the reactions induced at the point of contacts at A, B and C.



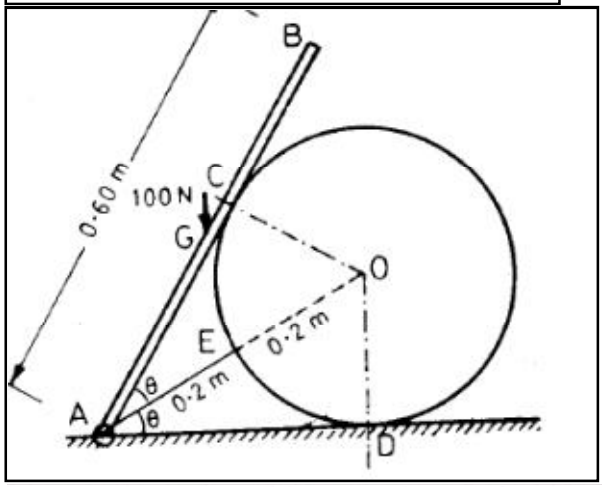
Ans.
R_A =424.79 N
R_B =707.97 N
R_C = 566.38 N

09 A uniform rod AB remains in equilibrium in a vertical plane, resting on smooth inclined planes AC and BC, which are at right angles. If the plane BC is at angle α with the horizontal, find the inclination θ of the rod with the plane AC.



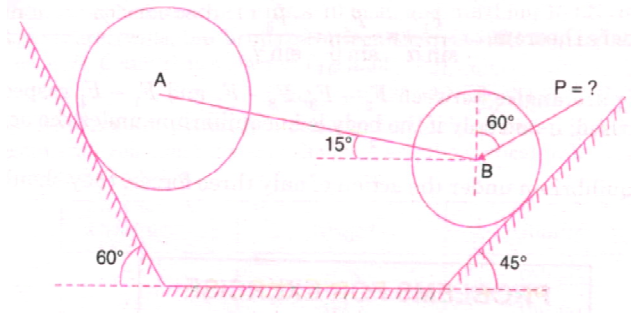
Ans. θ = α

10 The figure below shows a smooth cylinder of radius 0.2m supporting a rod AB 0.6m long weighing 100 N. The end of rod A is hinged to a horizontal surface AD. The cylinder is also attached to the hinge by string of length 0.2m. Find the tension in the string.



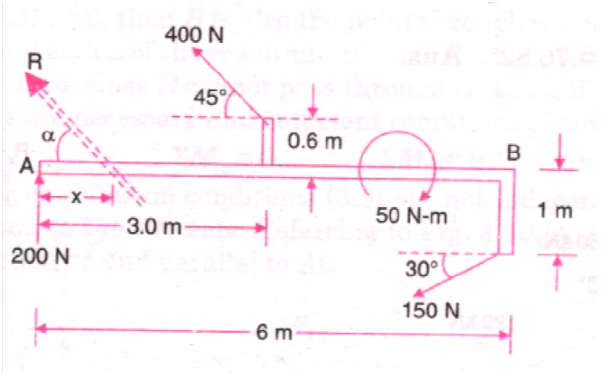
Ans.
T =43.30 N

11 Cylinder A weighing 4000 N and cylinder B weighing 2000 N, rest on smooth inclines as shown in figure . They are connected by a bar of negligible weight hinged to geometric centres of the cylinders by smooth pins. Find the force P to be applied as shown in figure such that it will hold the system in given position.



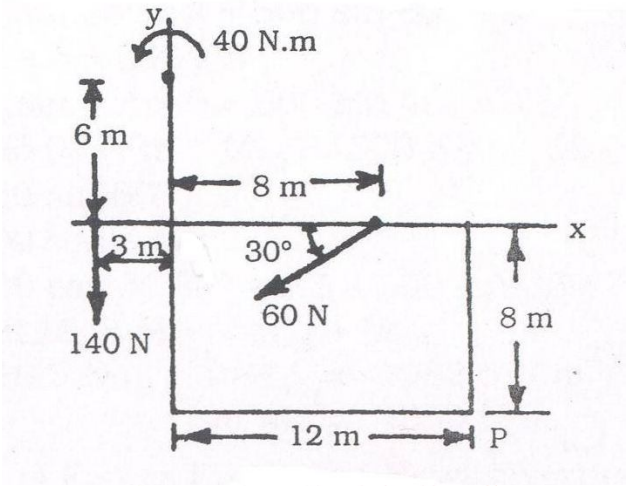
Ans. P= 1071.81 N

12 A bracket is subjected to three forces and a couple as shown in figure. Determine the magnitude, direction and the line of action of resultant.



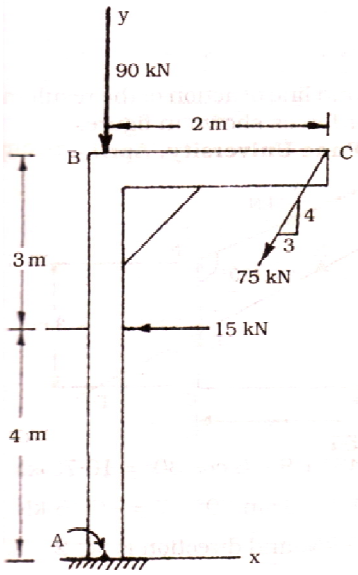
Ans.
R = 580.2 N
α = 44.76^0
x = 0.952

13 Replace the force and couple moment system by an equivalent force and couple moment acting at Point P.



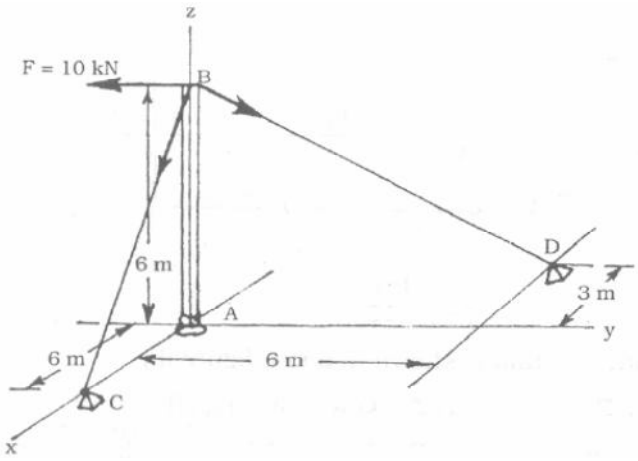
Ans.
R = -51.96 i -170 j
M = 2675.7 N.m

14 The frame shown in Figure is subjected to three coplanar forces. Replace this loading by an equivalent single resultant force and specify where the line of action of the resultant intersects members AB and BC



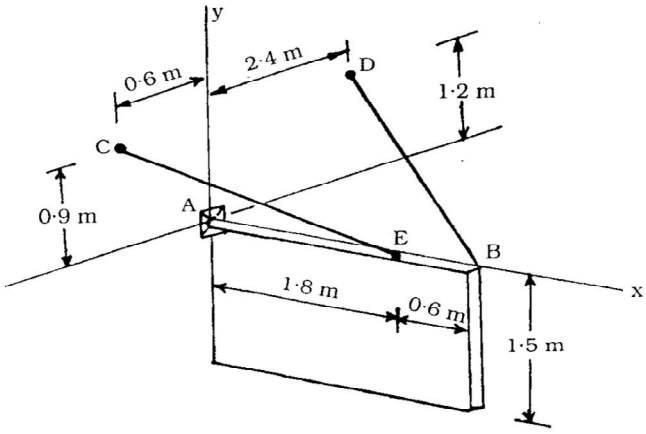
Ans.
Rx = 60 kN (←)
Ry = 150 kN (↓)
R = 161.6 kN
θ = 248.2^0 / 68.2^0
Member AB = 4.25 m from A
Member BC = 1.10 m from B

15 Determine the tension in cables BC and BD and the reactions at the ball-and-socket joint A for the mast shown in figure. Force acting at B is F = -10 j kN.



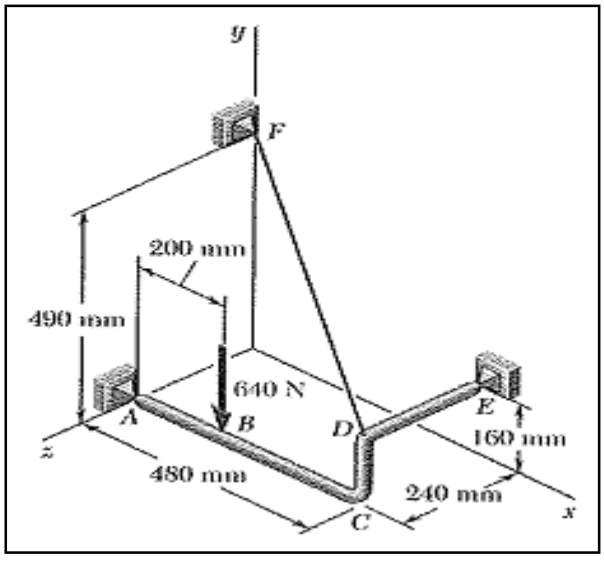
Ans
T_{BD} =15 kN
T_{BC} =7.1 kN
A_X = 0, A_Y =0, A_Z = 15 kN

16 A 120 kg sign board of uniform density measures 1.5 x 2.4 m and is supported by a ball and socket at A and by two cables as shown in fig. Determine the tension in each cable and the reaction at A.



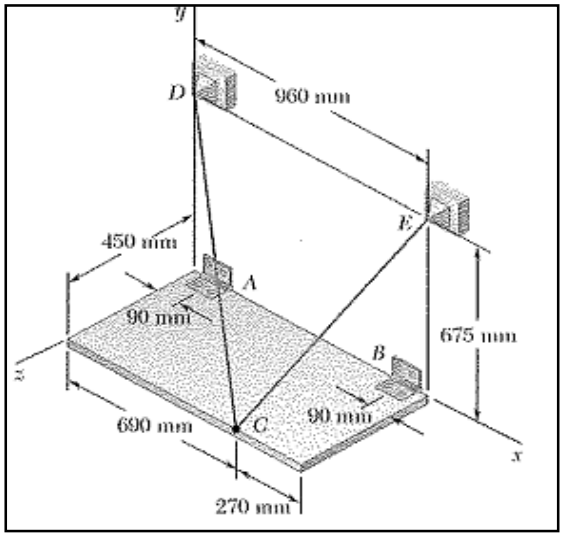
Ans.
T_{EC} =1375.5 N
T_{BD} =440.15 N
A_x = 1478 N, A_y = 440.5 N,
A_z = -104 N

17 The pipe ACDE is supported by ball and socket joint at A and E by wire DF. Determine the tension in wire when a 640N of load is applied at B as shown.



Ans. T = 343 N

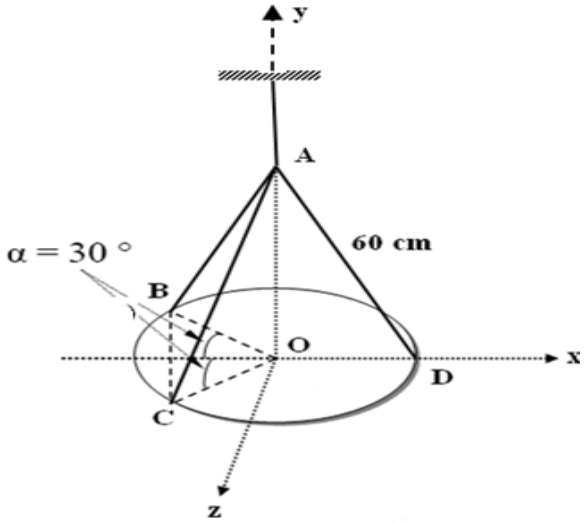
18 A 100kg uniform rectangular plate is supported in position shown by hinges A and B and by cable DCE that passes over a frictionless hook at C. Assuming that tension is the same in both parts of cable determine, (a) tension in cable, (b) reactions at A and B. Assuming that hinge at B does not exceed any axial thrust.



Ans.

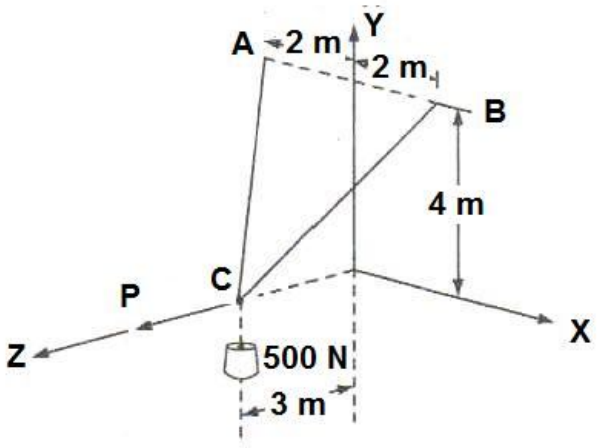
$T = 345$ N, $B_y = 113.2$ N
$B_z = 185.49$ N, $A_x = 114.4$ N
$A_y = 377$ N, $A_z = 141.5$ N

19 A 50 N circular plate of 18 cm radius is supported (as shown in Figure) by three wires, each of 60 cm length. Determine the tension in each wire knowing that $\alpha = 30°$.



$T_{AB} = 14.04$ N
$T_{AC} = 14.04$ N
$T_{AD} = 24.00$ N

20 A Load of 500 N is to be held in equilibrium by means of two strings CA and CB and by a force P (along Z axis) as shown in Figure. Determine tensions in strings and magnitude of P. (Point A & B lie in X-Y plane)



$T_{CA} = T_{CB} = 336.57$ N, $P = 375$ N