

Module I: FORCES AND MOMENT

Session 6

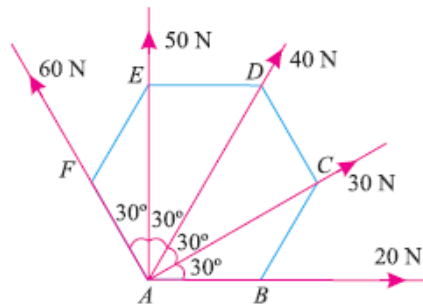
Numerical problems:

Resultant of two forces:

- Two forces act at an angle of 120° . The bigger force is of 40 N and the resultant is perpendicular to the smaller one. Find the smaller force. [Ans. 20 N]
- Find the magnitude of the two forces, such that if they act at right angles, their resultant is $\sqrt{10}$ N. But if they act at 60° , their resultant is $\sqrt{13}$ N. [Ans. 3 N, 1 N]
- Find the resultant of two forces 130 N and 110 N respectively, acting at an angle whose tangent is $12/5$. [Ans. 185.7 N, 30.5°]
- A push of 180 N and pull of 350 N acts simultaneously at a point. Find the resultant of the forces, if the angle between them be 135° . [Ans. 494 N, 30°]
- Find the angle between two equal forces P, when their resultant is equal to (i) P and (ii) $P/2$. [Ans. 120° , 151°]
- The resultant of two forces P and Q is R. If Q is doubled, the new resultant is perpendicular to P. Prove that $Q = R$.
- A boat is rowed at a velocity of 20 km/hour across a river. The velocity of stream is 8 km/hour. Determine the resultant velocity of the boat. [Ans. 21.54 km/hr, 68.20°]
- A block weighing $W = 10$ kN is resting on an inclined plane 20° to the horizontal. Determine its components normal and parallel to the inclined plane. [Ans. 9.4 kN, 3.42 kN]
- The resultant of two forces, one of which is double the other is 260 N. If the direction of the larger force is reversed and the other remains unaltered, the magnitude of the resultant reduces to 180 N. Determine the magnitude of the forces and the angle between the forces. [Ans. 100 N, 200 N, 63.9°]
- Two forces F_1 and F_2 are acting at a point. The angle between the two forces is 50° . It is found that the resultant R is 500 N and makes angles 20° with the force F_1 . Determine the forces F_1 and F_2 . [Ans. 326.35 N, 223.24 N]
- The resultant of two forces $F_1 = 400$ N and $F_2 = 260$ N acting at point A is 520 N. Determine the angle between the two forces and the angle between the resultant and force F_1 . [Ans. 78.13° , 29.29°]
- The resultant of two forces one of which is 3 times the other is 300 N. When the direction of smaller force is reversed, the resultant is 200 N. Determine the two forces and the angle between them. [Ans. 80.6 N, 241.8 N, 50.13°]
- The resultant of two forces is 200 N and the two forces are inclined at 20° and 40° with the resultant, one on either side. Calculate the magnitude of these two forces.

Resultant of several forces:

14. The forces 20 N, 30 N, 40 N, 50 N and 60 N are acting at one of the angular points of a regular hexagon, towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force. [Ans. 155.8 N, 76.6°]

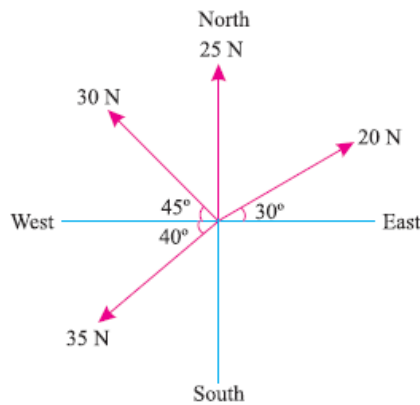


15. The following forces act at a point:

- (i) 20 N inclined at 30° towards North of East, (ii) 25 N towards North,
 (iii) 30 N towards North West, and (iv) 35 N inclined at 40° towards South of West.

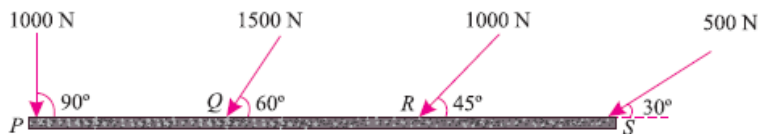
Find the magnitude and direction of the resultant force.

[Ans. 45.6 N, 47.7°]



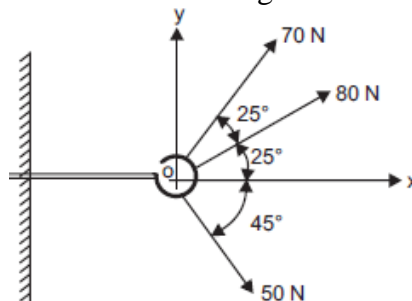
16. Find the magnitude and direction of the resultant force.

[Ans. 3765 N, 59.8°]

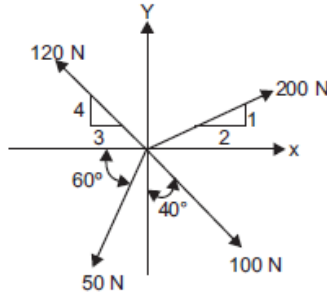


17. Determine the resultant of the three forces acting on a hook.

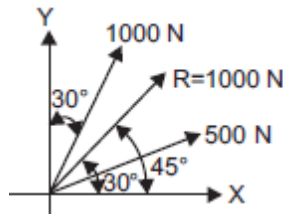
[Ans. 161.48 N, 18.81°]



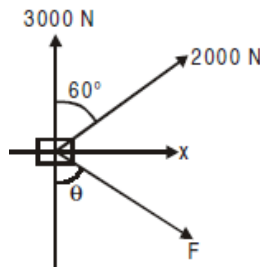
18. Determine the resultant of a system of four forces acting on a body. [Ans. 160.2 N, 24.15°]



19. Two forces acting on a body are 500 N and 1000 N. Determine the third force F such that the resultant of all the three forces is 1000 N directed at 45° to x axis. [Ans. 467.2 N, 61.1°]



20. A body is subjected to the three forces. If possible determine the direction of the force F so that the resultant is in x -direction, when (a) $F = 5000$ N, (b) $F = 3000$ N. [Ans. 36.87° , Not possible]



21. Find the magnitude and direction of the resultant of the concurrent forces of 8 N, 12 N, 15 N and 20 N making angles of 30° , 70° , 120° and 155° respectively with a fixed line. [Ans. 39.5 N, 111.7°]
22. Find magnitude of the resultant force, if 30, 40, 50 and 60 N forces are acting along the lines joining the centre of a square to its vertices. [Ans. 28.3 N]
23. A particle is acted upon by three forces equal to 50 N, 100 N and 130 N, along the three sides of an equilateral triangle, taken in order. Find the magnitude and direction of the resultant force. [Ans. 200 N, 200°]
24. A triangle ABC has its side AB = 40 mm along positive x -axis and side BC = 30 mm along positive y -axis. Three forces of 40 N, 50 N and 30 N act along the sides AB, BC and CA respectively. Determine magnitude of the resultant of such a system of forces. [Ans. 35.8 N]
25. Forces 2, $\sqrt{3}$, 5, $\sqrt{3}$ and 2 kN respectively act at one of the angular points of a regular hexagon towards five other angular points. Determine the magnitude and direction of the resultant force. [Ans. 10 kN, 60°]