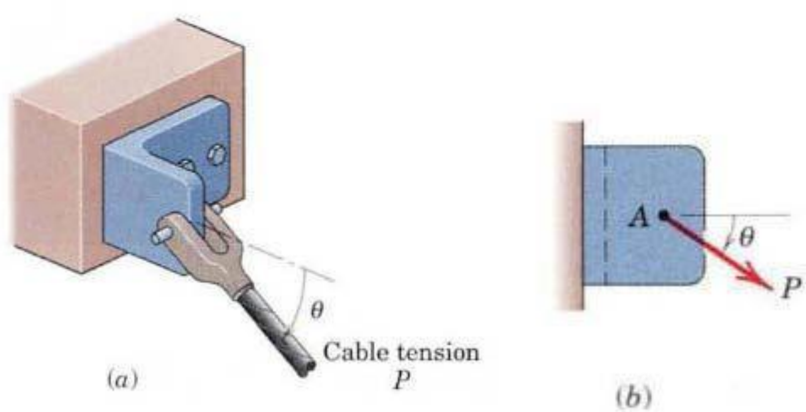
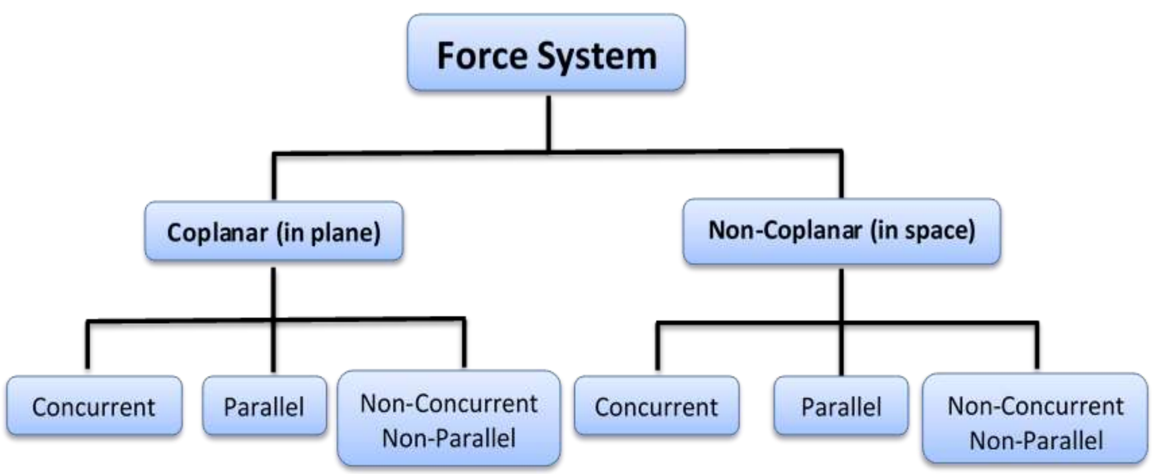
ASST .LEC. Teeb Basim Abbas

Force System

Before dealing with a group or *system* of forces, it is necessary to examine the properties of a single force in some detail. The action of the cable tension on the bracket in Fig. *1a* is represented in the side view, Fig. *1b,* by the force vector P of magnitude **P**. The effect of this action on the bracket depends on *P*, the angle *θ,* and the location of the point of application A





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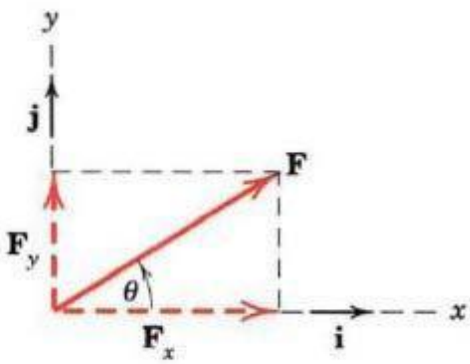
TWO-DIMENSIONAL FORCE SYSTEMS

RECTANGULAR COMPONENTS

The most common two-dimensional resolution of a force vector is into rectangular components. It follows from the parallelogram rule that the vector F of Fig. may be written as

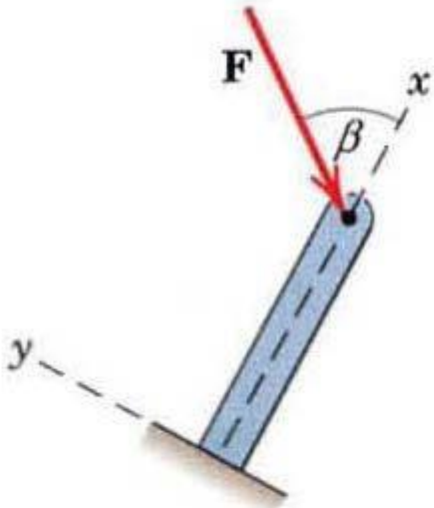


The scalar components can be positive or negative, depending on the quadrant into which F points.

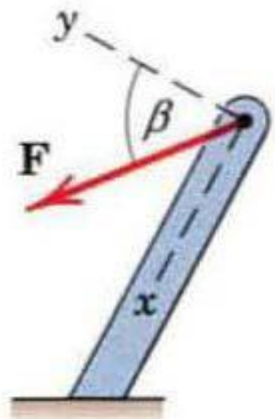
$$F_x = F\cos\theta \qquad F = \sqrt{F_x^2 + F_y^2}$$

$$F_y = F\sin\theta \qquad \theta = \tan^{-1}\frac{F_y}{F_x}$$

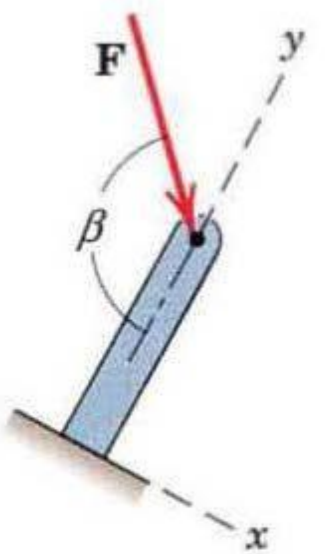
Determining the Components of a Force Dimensions are not always given in horizontal and vertical directions, angles need not be measured counterclockwise from the x-axis, and the origin of coordinates need not be on the line of action of a force



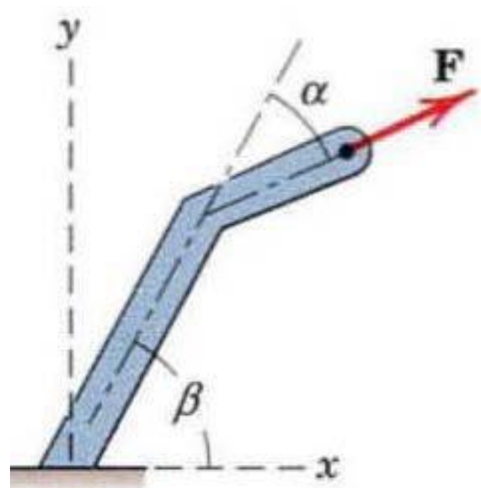
$$F_x = -F\cos\beta$$
$$F_y = -F\sin\beta$$



$$F_x = F\sin\beta$$
$$F_y = F\cos\beta$$



$$F_x = F\sin(\pi-\beta)$$
$$F_y = -F\cos(\pi-\beta)$$



$$F_x = F\cos(\beta-\alpha)$$
$$F_y = F\sin(\beta-\alpha)$$

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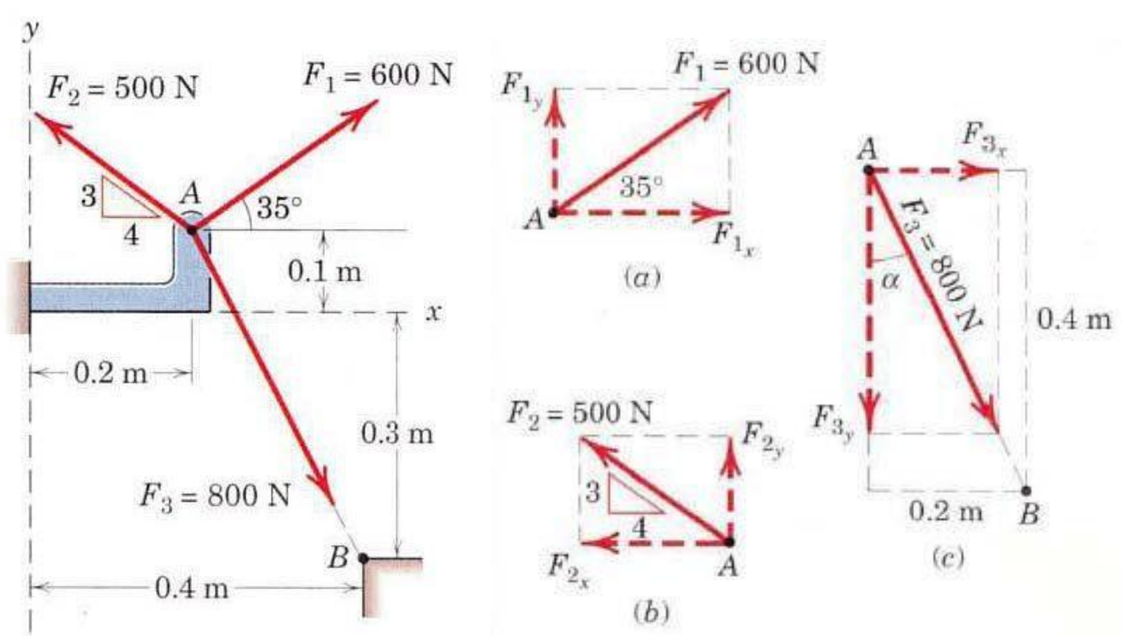
Problem 1

The forces F1, F2, and F3' all of which act on point *A* of the bracket , are specified in three different ways. Determine the *x* and *y* scalar components of each of the three forces.



Solution : The scalar components of F l ' from Fig. a, are

$F_{1x} = 600 \cos 35° = 491$ N

$F_{1y} = 600 \sin 35° = 344$ N

The scalar components of F2 from Fig. *b*, are

$F_{2x} = -500(4/5) = -400$ N

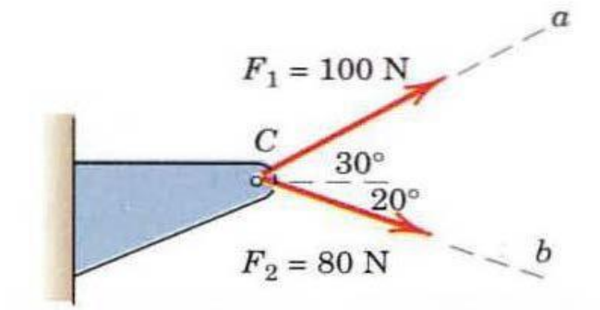
$F_{2y} = 500(3/5) = 300$ N α

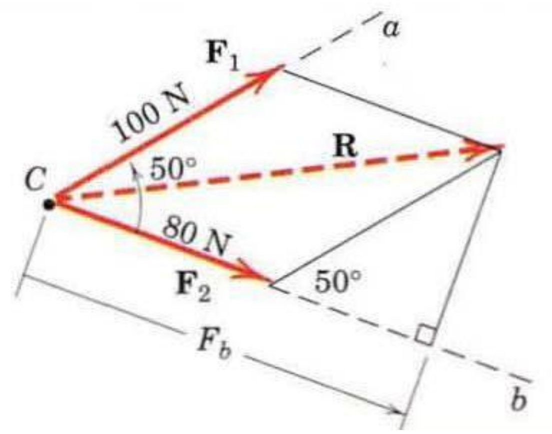
$= \tan^{-1} [0.2/0.4] = 26.6°$

Then $F_{3x} = F_3 \sin\alpha = 800 \sin 26.6° = 358$ N
$F_{3y} = - F_3 \cos\alpha = - 800 \cos 26.6° = - 716$ N

Problem 2

Forces F_1 and F_2 act on the bracket as shown Determine the project ion Fb of their resultant R onto the b-axis.





Solution. The parallelogram addition of F1 and F2 is shown in the figure. Using the law of cosines gives us *R*2 = (80)2 + (100)2 - 2(80)(100) cos 130

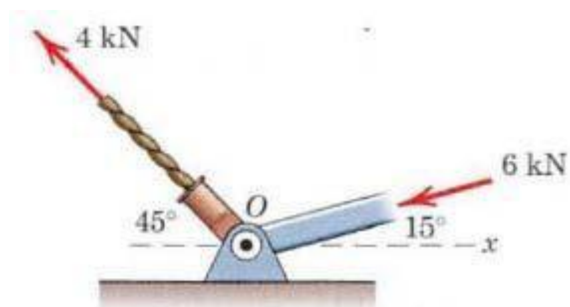
R = 163.4 N

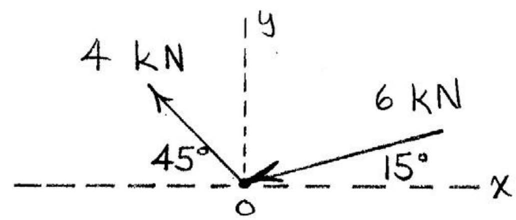
The figure also shows the orthogonal projection Fb of R onto the b-axis. Its length is

*F*b = 80 + 100 cos 50 = 144.3 N

Problem 3

The two structural members, one of which is in tension and the other in compression, exert the indicated forces on joint O. Determine the magnitude of the resultant R of the two forces and the angle θ which R makes with the positive .xaxis.





$$R_x = \Sigma F_x = -4\cos 45° - 6\cos 15° = -8.62 \text{ kN}$$

$$R_y = \Sigma F_y = 4\sin 45° - 6\sin 15° = 1.276 \text{ kN}$$

$$R = \sqrt{R_x^2 + R_y^2} = \underline{8.72 \text{ kN}}$$

$$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right) = \tan^{-1}\left(\frac{1.276}{-8.62}\right) = \underline{171.6°}$$

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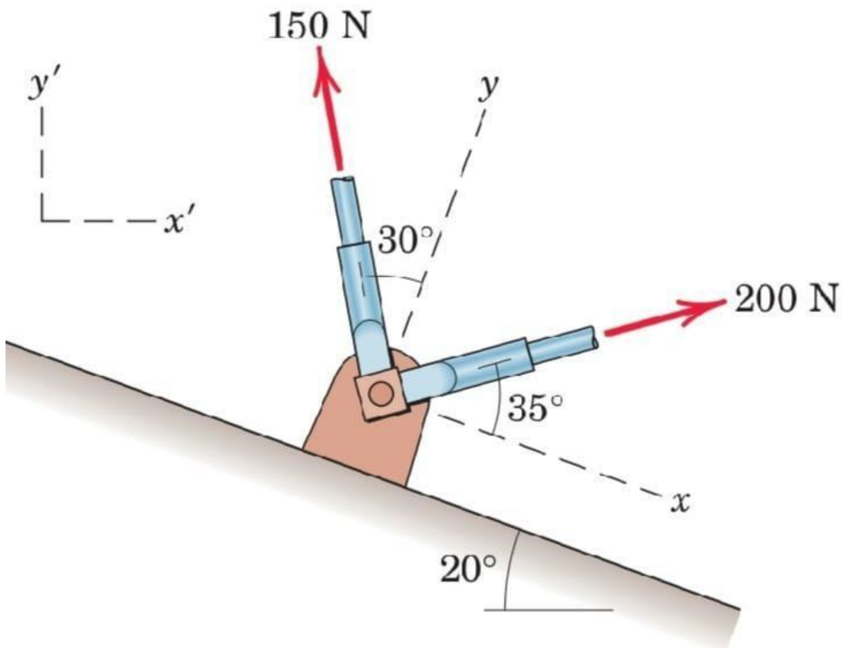
Determine the resultant R of the two forces applied to the bracket



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