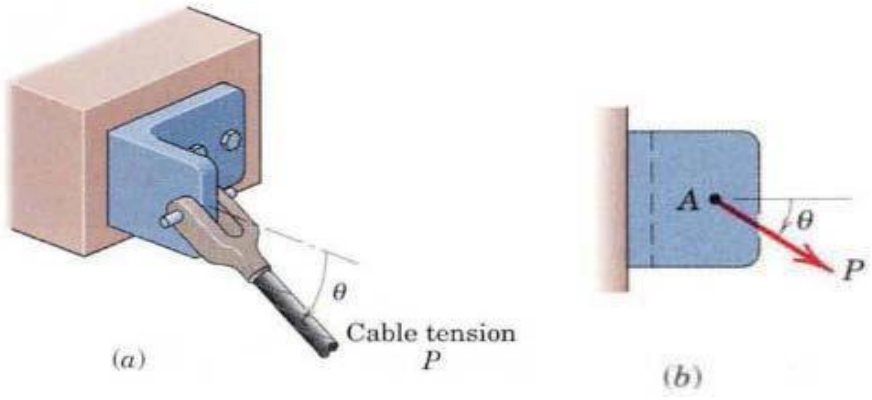
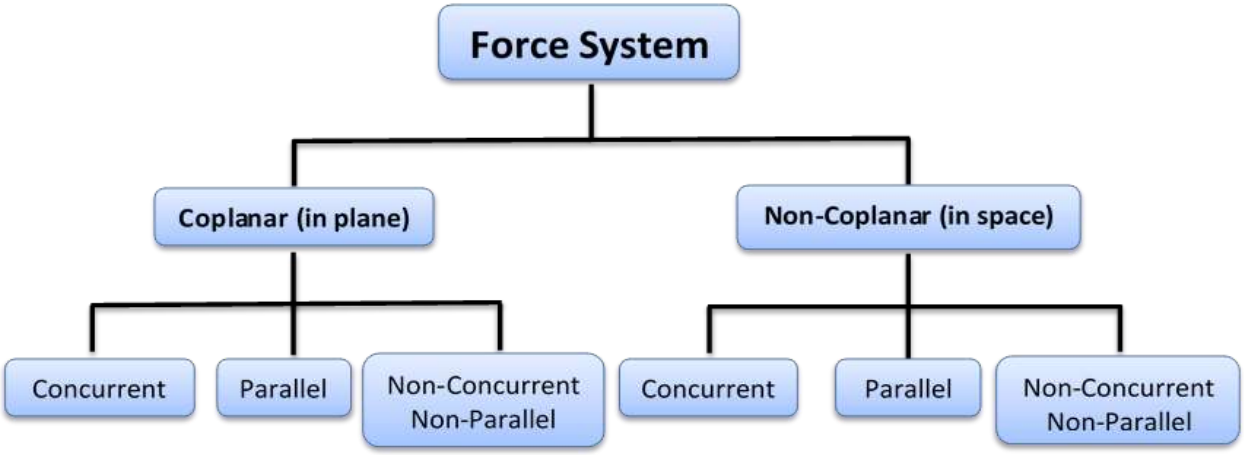
Al-Mustaqbal University / College of Engineering & Technology
Electrical Techniques Engineering Department Class (1st)
Subject (Engineering Mechanics) / Code (UOMU025021)
Lecturer (Msc Hiba Mohsin AL-Bawi)
1stterm – Lecture No.2

Force Systems

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





E-mail: hiba.mohsin.abd@uomus.edu.iq

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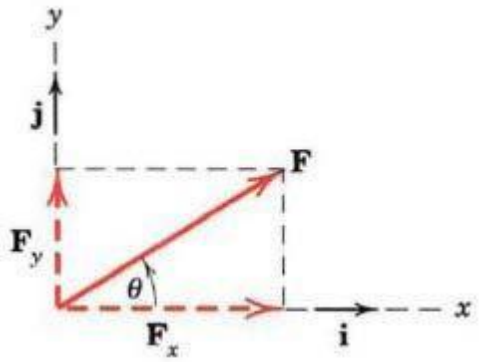
TWO-DIMENSIONAL FORCE SYSTEMS

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

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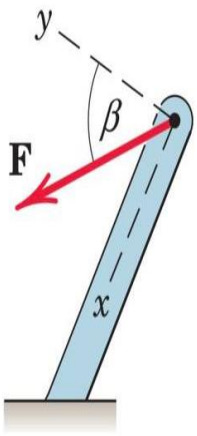
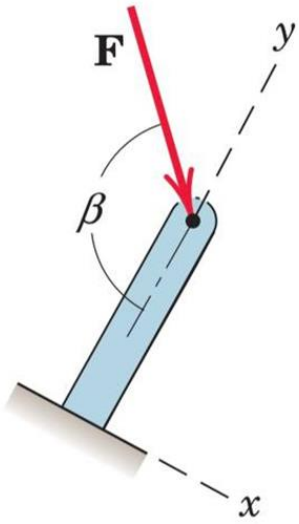
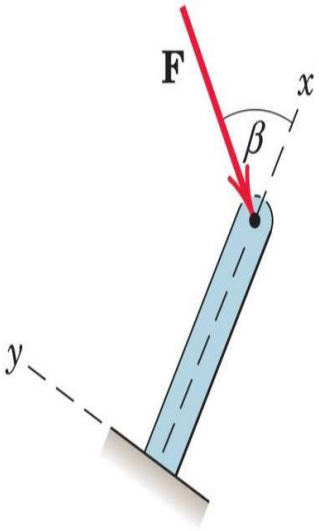


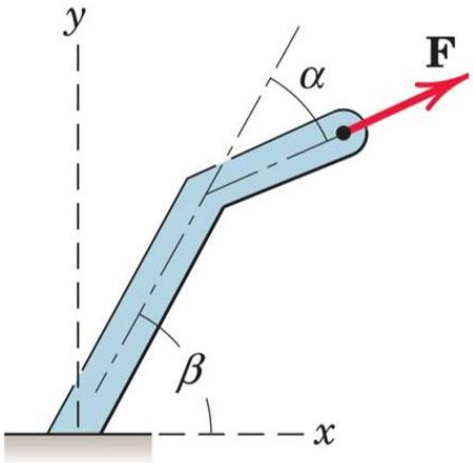
$$F_x = F \sin \beta$$
$$F_y = F \cos \beta$$



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



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



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

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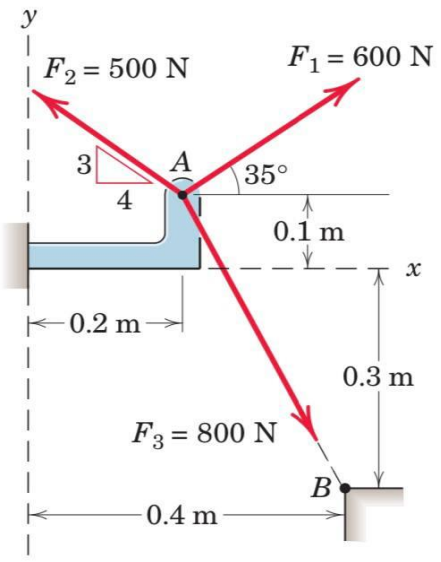
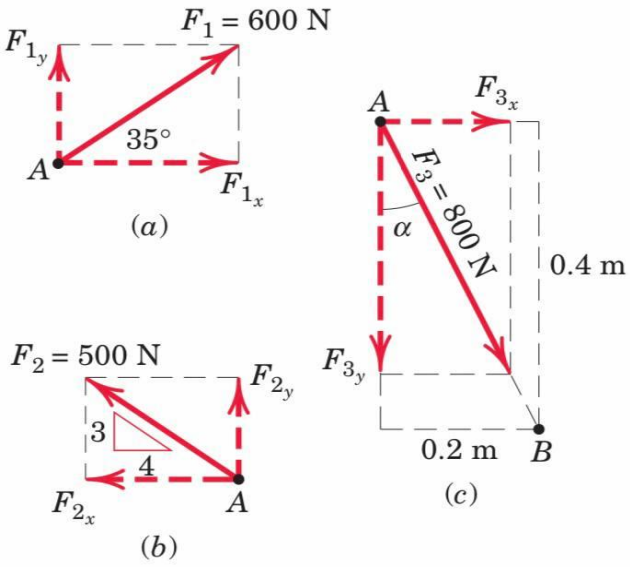
Problem 1

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.





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Solution:

The scalar components of F 1 ' 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

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

$F_{2y} = 500(3/5) = 300\ N$

$\alpha = \tan^{-1} [0.2/0.4]$

$= 26.6°$

Then

$F_{3x} = F_3 \sin\alpha = 800 \sin 26.6° = 358\ N$

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

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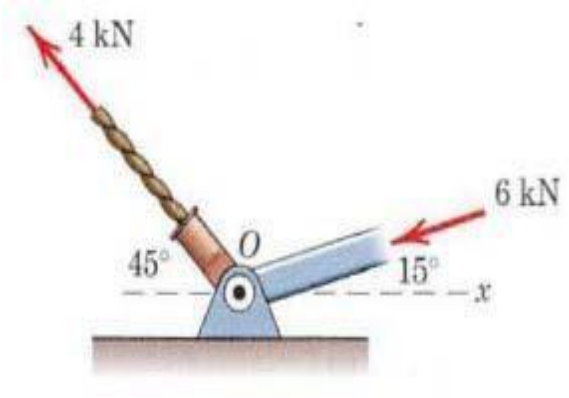
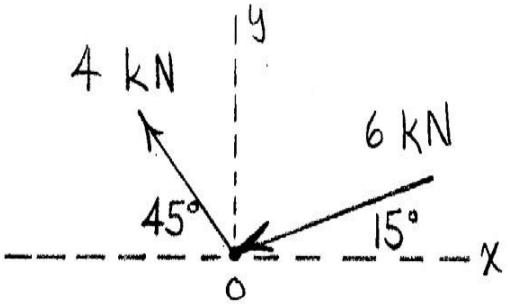
Problem 2

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.





Solution:

$R_x=F_x = -4 \cos 45° - 6 \cos 15° = -8.62\ N$

$R_y=F_y = 4 \sin 45° - 6 \sin 15° = 1.276\ N$

$R=\sqrt{R_x^2+R_y^2}$

$=8.72KN$

$\alpha = \tan^{-1}[R_x/R_y]$

$=171.6°$

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