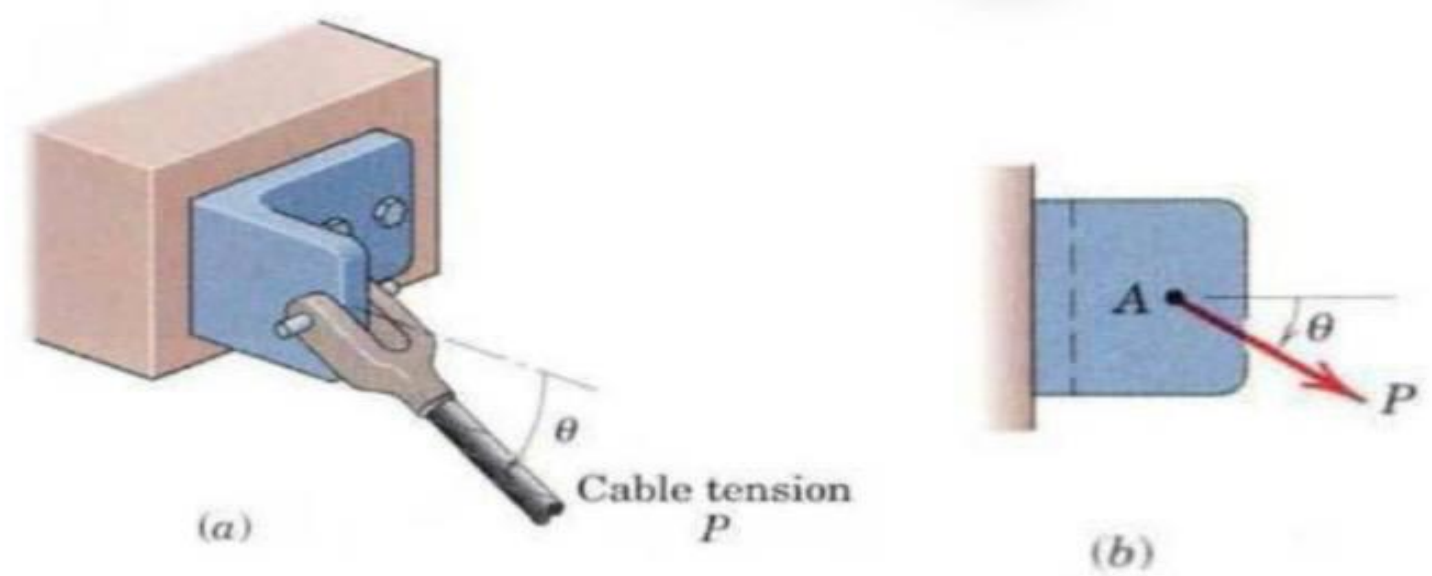
Al-Mustaqbal University
Department of Power Mechanical Techniques Engineering
(Refrigeration and Air Conditioning)
Class one - first semester

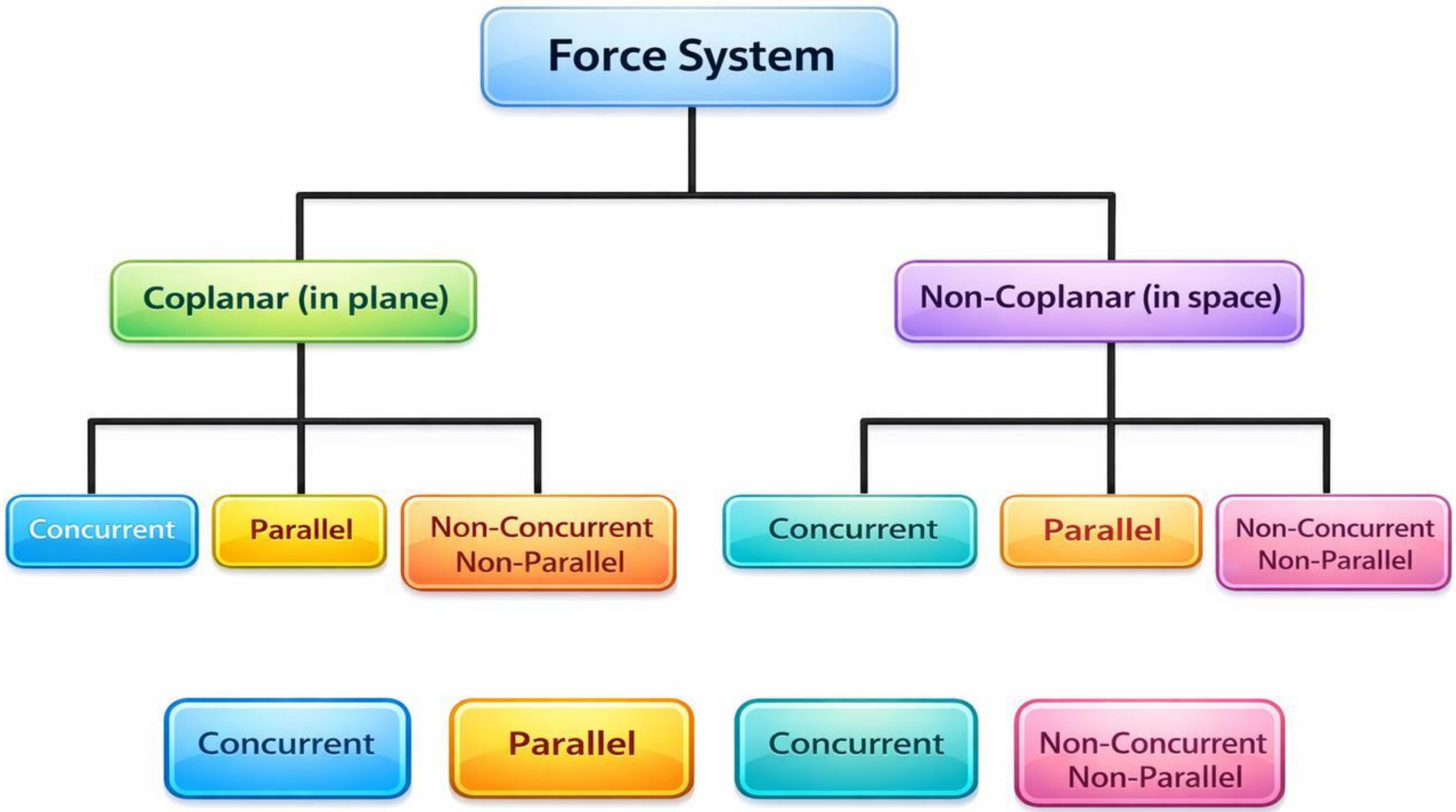
Engineering Mechanical

Lecture3: Force System
ASST.LEC. Zahraa Hussein Jassim

Force System

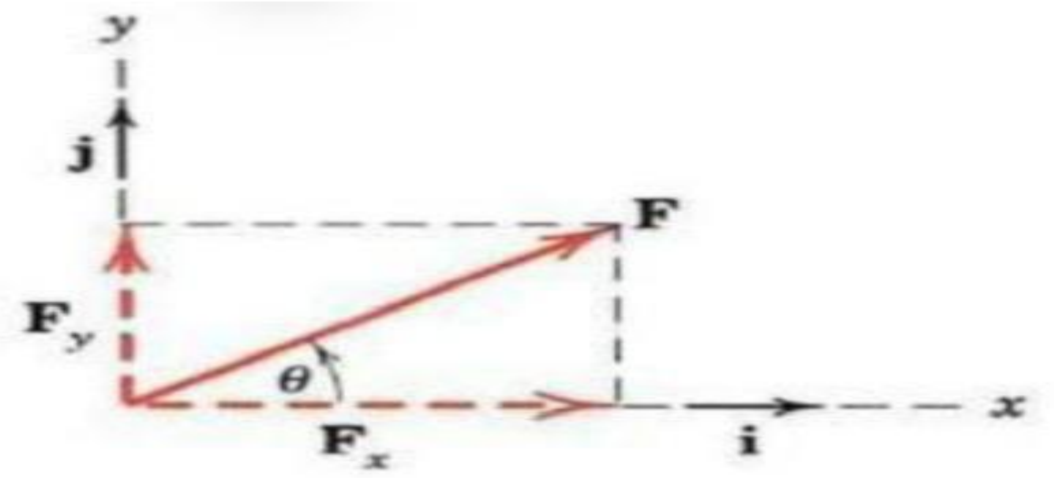
Before dealing with a group or system of forces, it is necessary to examine the properties of a single force in some detail. The action of the cable tension on the bracket in Fig. 1a is represented in the side view, Fig. 1b, by the force vector P of magnitude P. The effect of this action on the bracket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




Force System
Coplanar (in plane)
Non-Coplanar (in space)
Concurrent
Parallel
Non-Concurrent
Non-Parallel
Concurrent
Parallel
Non-Concurrent
Non-Parallel
Concurrent
Parallel
Concurrent
Non-Concurrent
Non-Parallel

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



Force System

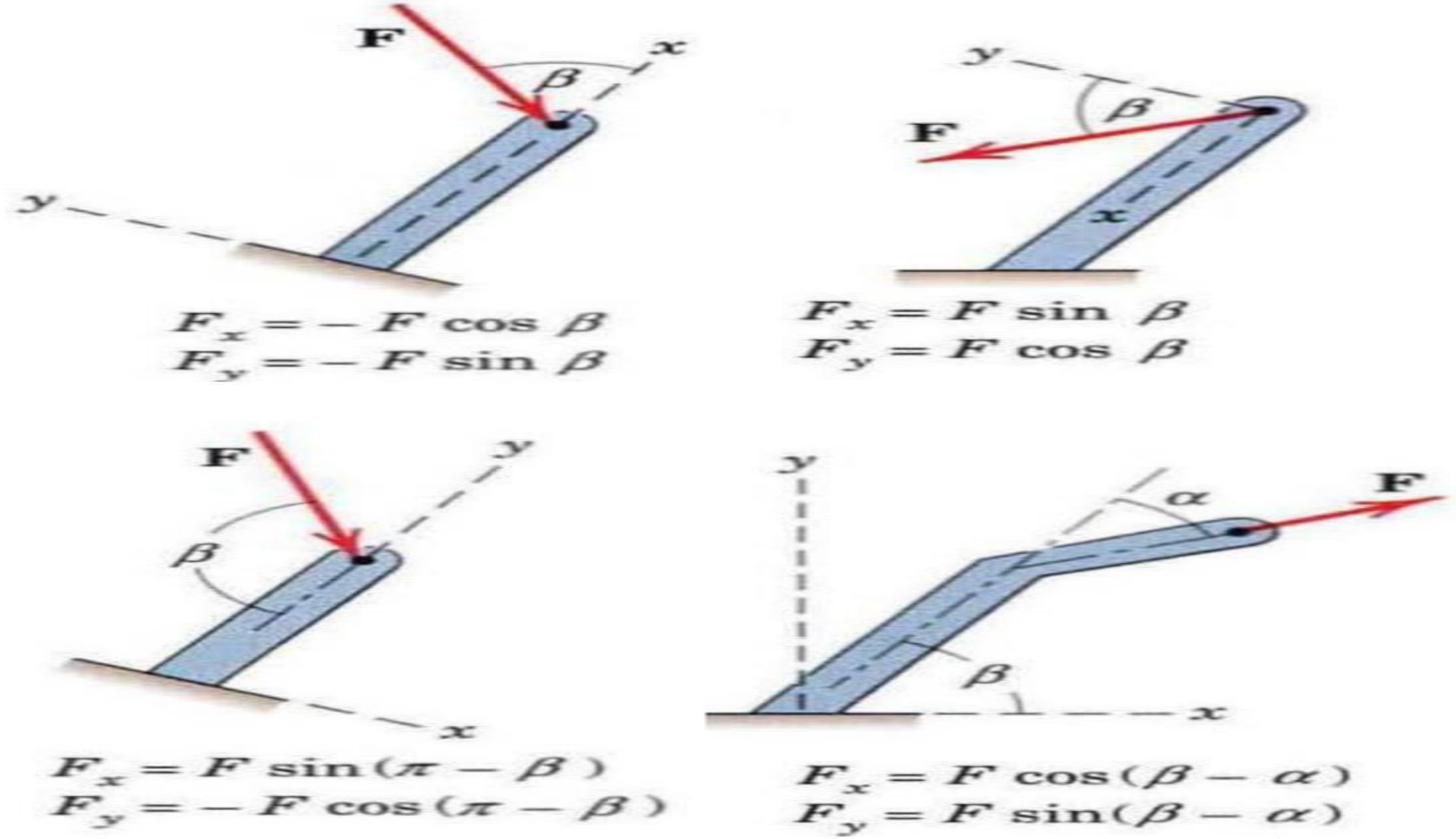
- The scalar components can be positive or negative, depending on the quadrant into which F points.

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

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

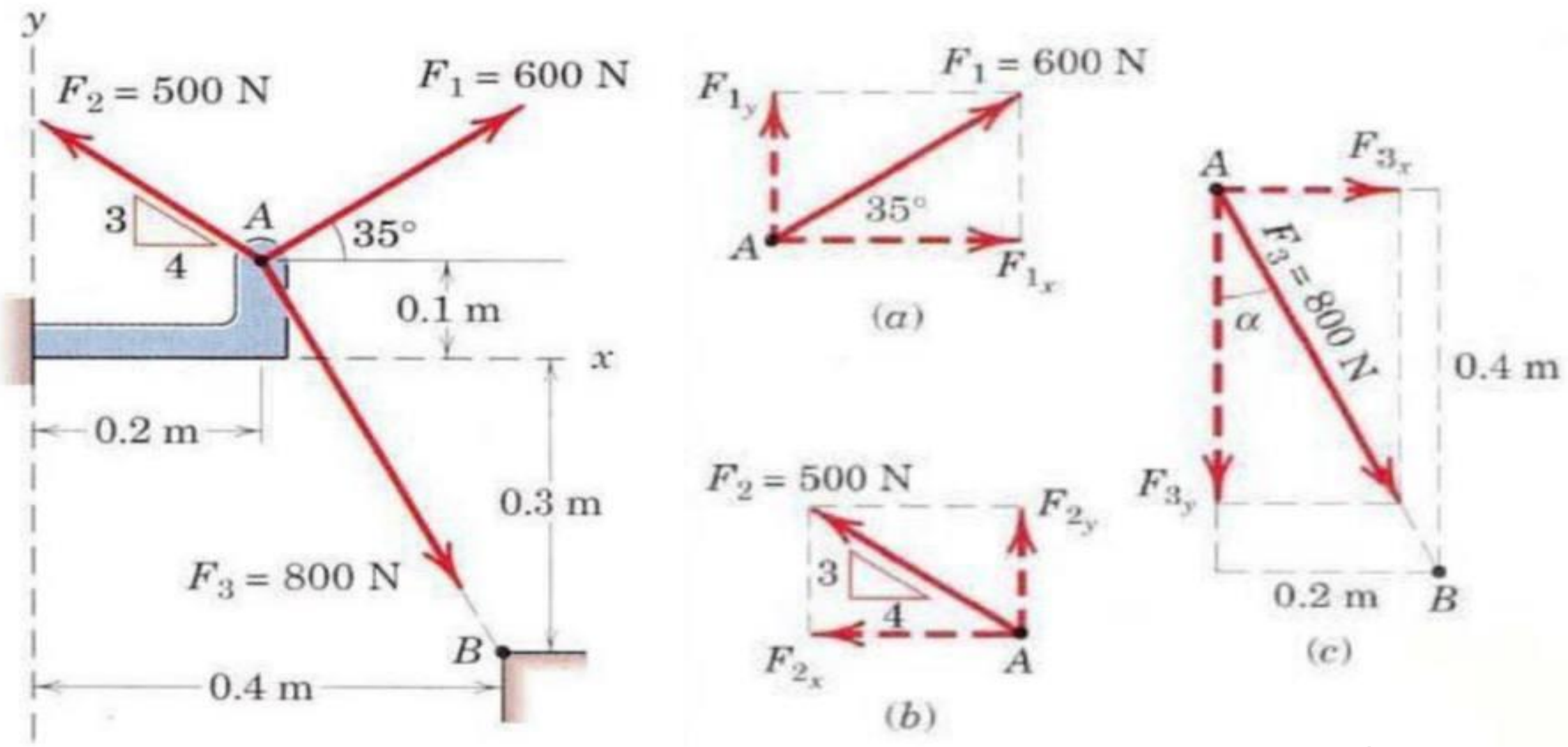
- Determining the Components of a Force Dimensions are not always given in horizontal and vertical directions, angles need not be measured counterclockwise from the x-axis, and the origin of coordinates need not be on the line of action of a force

Force System



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.

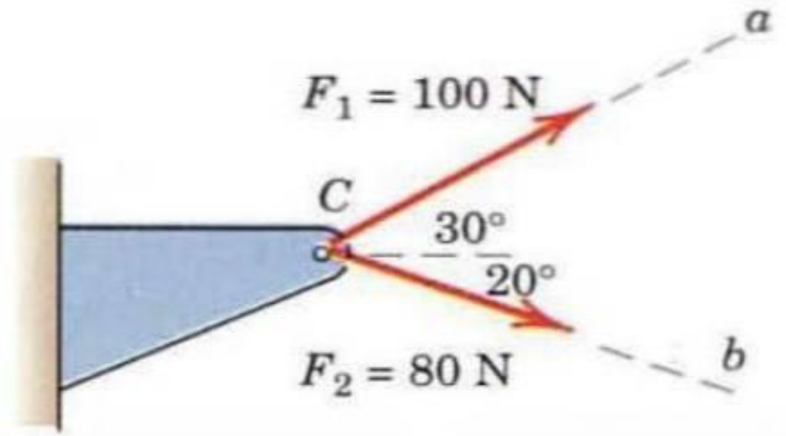


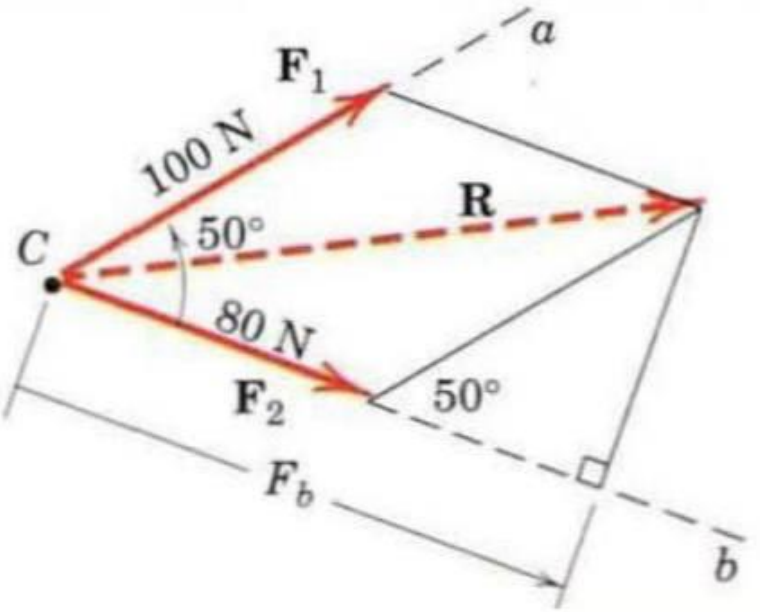
Solution

- Solution: The scalar components of F l ' from Fig. a, are F1x = 600 cos 35° = 491 N
- F ly = 600 sin 35° = 344 N
- The scalar components of F2 from Fig. b, are
- F2x= -500(4/5) = -400 N
- F2y= 500(3/5) = 300 N a
- = tan-1 [0.2/0.4] = 26.6°
- Then F3x = F3 sina = 800 sin 26.6° = 358 N F3y = - F; cosa = - 800 cos 26.6° = - 716 N

Problem 2

- Forces F1 and F2 act on the bracket as shown Determine the project ion Fb
- of their resultant R onto the b-axis.



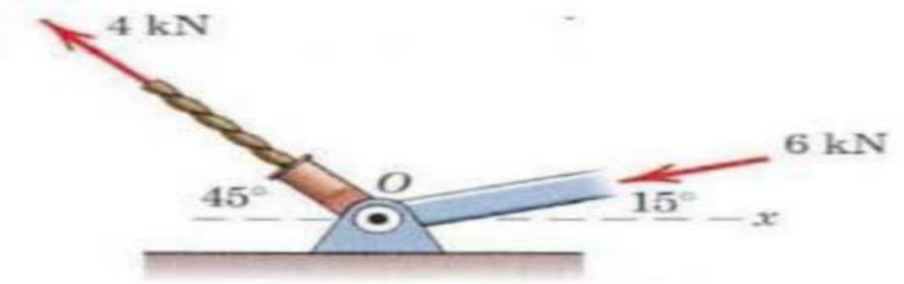


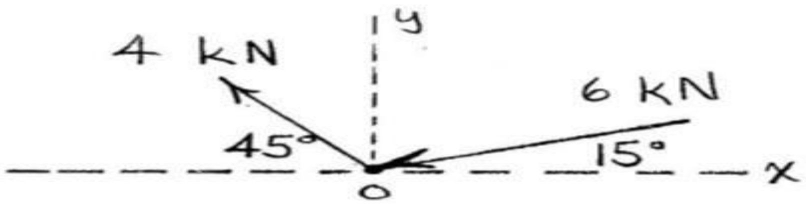
Solution.

- Solution. The parallelogram addition of F1 and F2 is shown in the figure.
- Using the law of cosines gives us R2 = (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
- Fb = 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 0 which R makes with the positive xaxis.





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

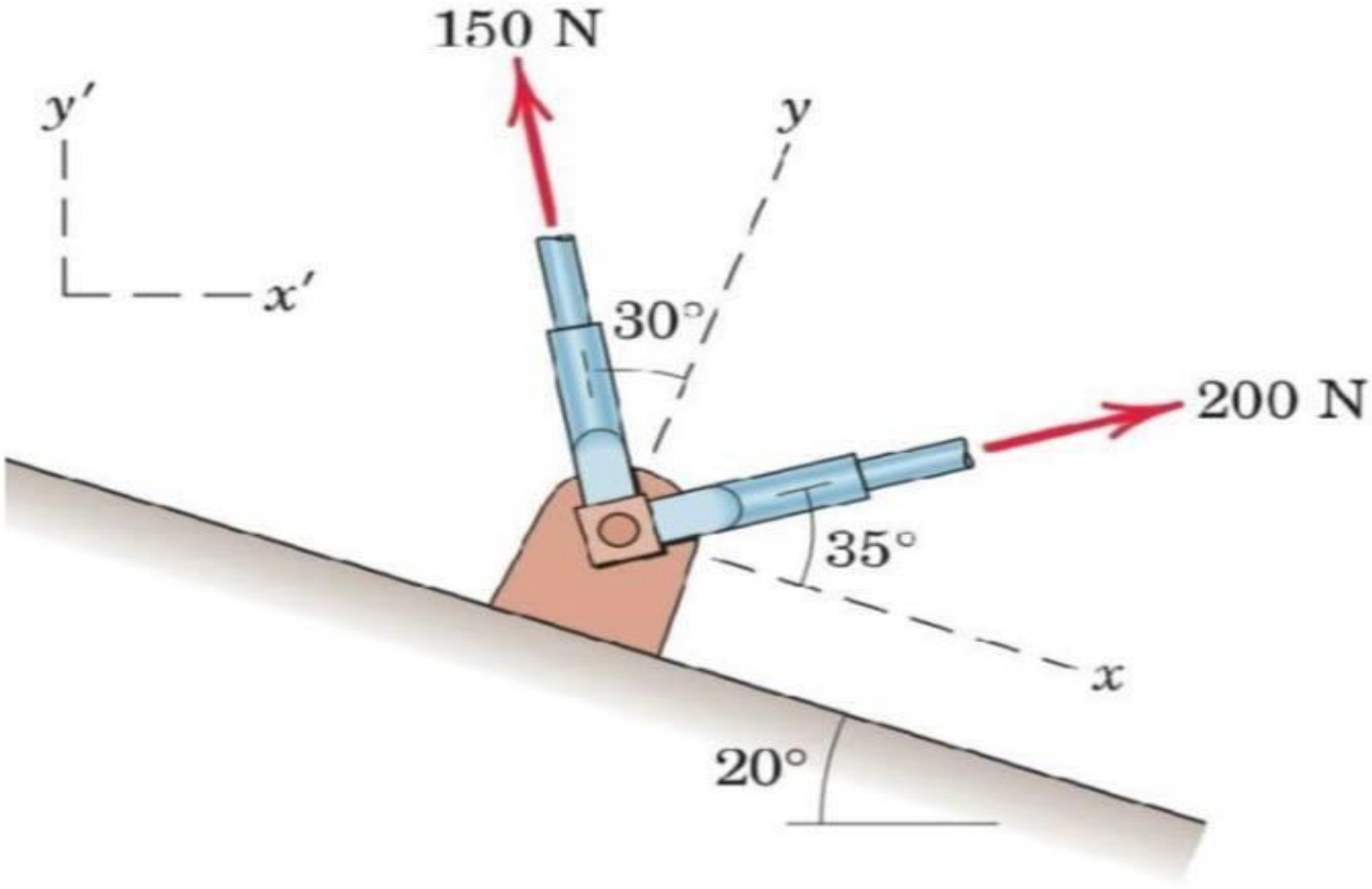
$$R_y = \Sigma F_y = 4\sin 45° - 6\sin 15° = 1.276 \text{ kN}$$

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

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

H.W

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




Thank you
for listening