

**Course Code: ESC106A**

**Course Title: Construction Materials and Engineering Mechanics**

**Lecture No. 7:**

**Resolution of Forces**

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# Lecture Intended Learning Outcomes

**At the end of this lecture, student will be able to:**

- Explain the concept of resolution of forces
- Solve problems on resolution of forces to find the components of a force



# Contents

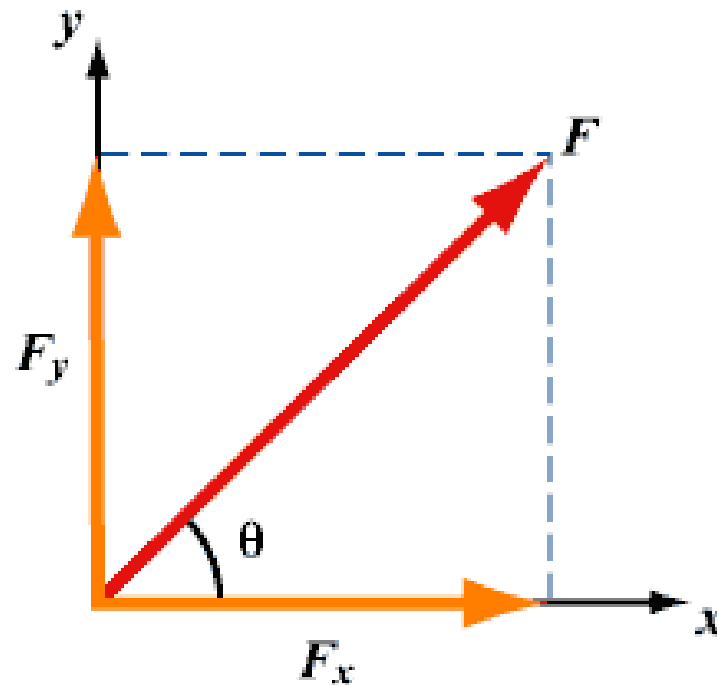
- **Engineering Mechanics**

Resolution of forces; Numerical problems



# Resolution of a force

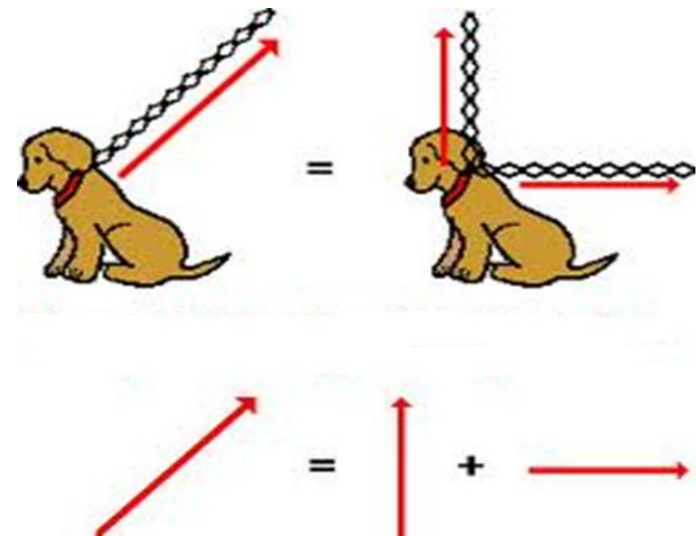
- The technique of finding the components of a force along any direction is called resolution of force



# Resolution of a force

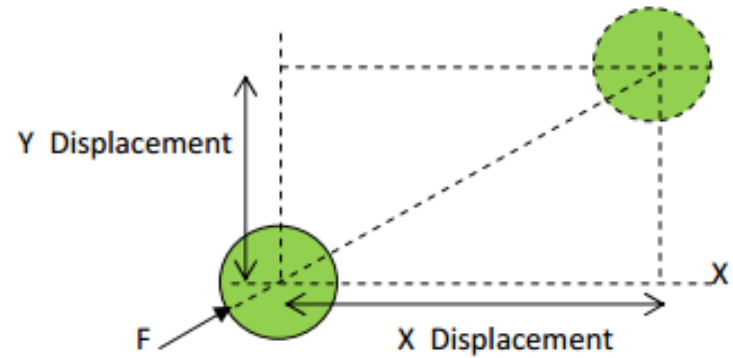
- The technique of finding the components of a force along any direction is called resolution of force

Eg: The upward and rightward force of the chain is equivalent to an upward force and a rightward force by two chains.



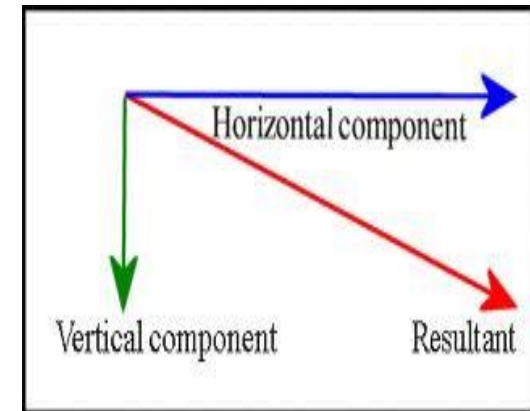
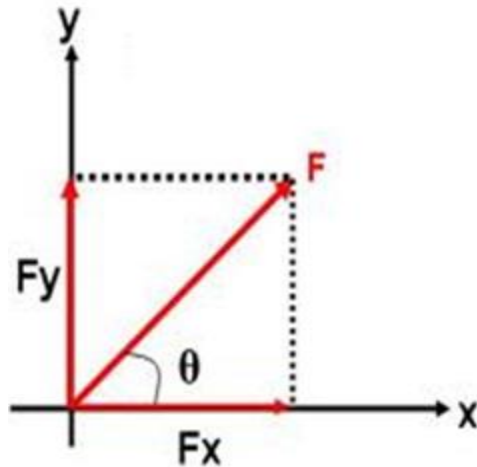
# Resolution of a force

- The force  $F$  is producing, simultaneous  $x$  displacement and  $y$ -displacement
- The part of the force  $F$  which is producing  $x$  displacement is called  $x$  component or horizontal component of the force  $F$  ( $F_x$ )
- The part of the force  $F$  which produces  $y$  – displacement is called  $y$  component of the force or vertical component of force  $F$  ( $F_y$ )



# Components of a Force

- The effect of a force along any specified direction is called Component of a force



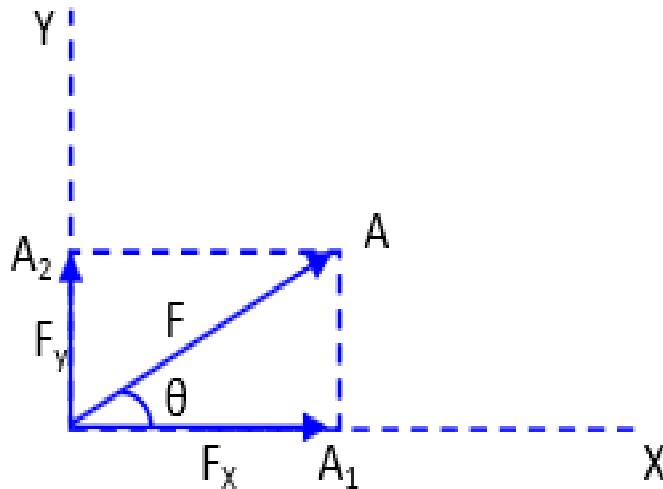
## Note:

$F_x$  is the horizontal component of force  $F$

$F_y$  is the vertical component of force  $F$

# To resolve a force along any direction

- OA represents the force F both in magnitude and direction 'θ' is the acute angle made by the force w.r.t. x direction.



$$\cos \theta = \frac{OA_1}{OA}$$

$$\cos \theta = \frac{F_x}{F}$$

$$F_x = F \cos \theta$$



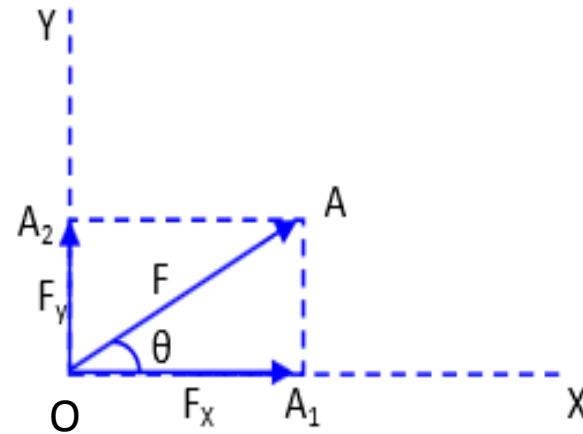
# To resolve a force along any direction

$$\sin \theta = \frac{AA_1}{OA}$$

$$\sin \theta = \frac{OA_2}{OA}$$

$$\sin \theta = \frac{F_y}{F}$$

$$F_y = F \sin \theta$$



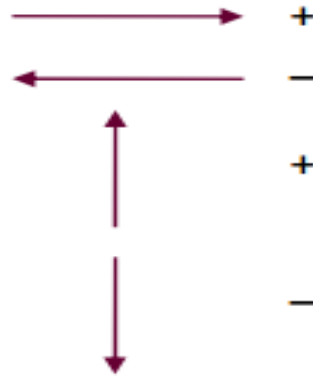
# To resolve a force along any direction

- X component of a force is given by the product of magnitude of the force and cosine of acute angle made by the force w.r.t. x-direction
- Y component of a force is given by the product of magnitude of the force and sine of acute angle made by the force w.r.t. x-direction



## Note:

- Sign convention for the direction of components.



- The horizontal component or 'X' component of a force acting along x direction is the force itself. Whereas, its vertical component or y component is zero.

$$\theta = 0$$

$$F_x = F \cos 0$$

$$= F$$

$$F_y = F \sin 0$$

$$= 0$$



## Note:

$$F_x = F \cos 90$$

$$= 0$$

$$F_y = F \sin 90$$

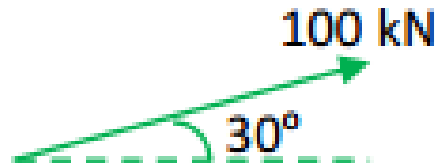
$$= F$$

- 'x' component of a force acting along Y direction is zero. Whereas, its 'y' component is equal to itself.
- If a force is inclined at  $45^\circ$  w.r.t. x axis or y axis then its x component will be equal to y component ( $F_x = F_y$ )



# Problems on Resolution

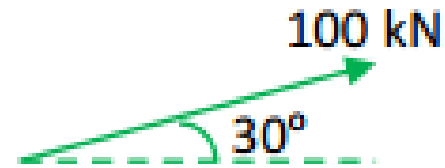
1. Find X and Y components of forces in the following figure.



# Problems on Resolution

## Solution

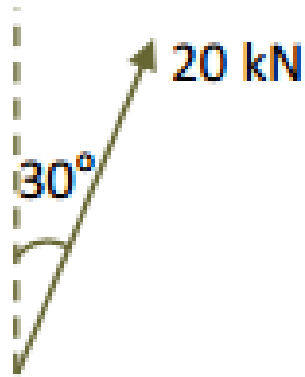
$$\begin{aligned}F_x &= + 100 \cos 30 \\&= + 86.60 \text{ kN} \\&= 86.60 \text{ kN } (\rightarrow)\end{aligned}$$



$$\begin{aligned}F_y &= + 100 \sin 30 \\&= + 50.00 \text{ kN} \\&= 50.00 \text{ kN } (\uparrow)\end{aligned}$$

# Problems on Resolution

2. Find X and Y components of forces in the following figure.



# Problems on Resolution

## Solution

$$F_x = F \cos \theta$$

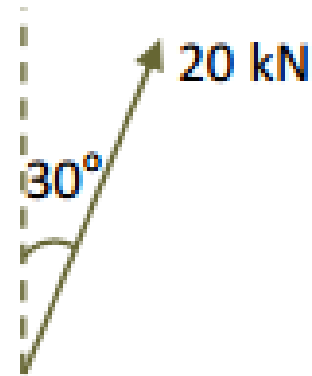
$$= 20 \cos 60$$

$$= 10 \text{ kN}$$

$$F_y = F \sin \theta$$

$$= 20 \sin 60$$

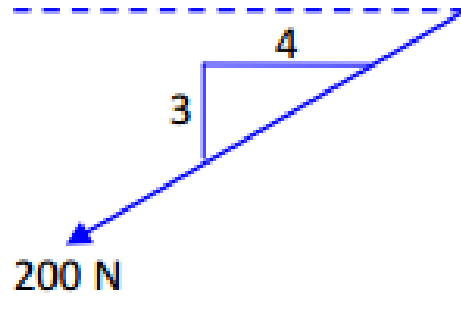
$$= 17.32 \text{ kN}$$





# Problems on Resolution

3. Find X and Y components of forces in the following figure.



# Problems on Resolution

## Solution

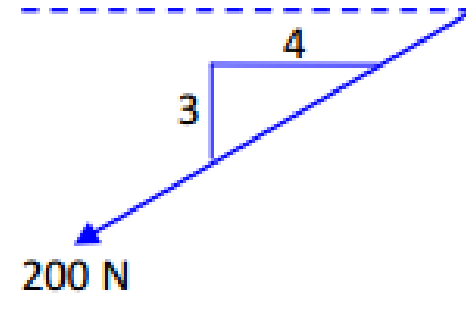
Method-I

$$\tan \theta = \frac{3}{4}$$

$$\theta = 36.87^\circ$$

$$\begin{aligned} F_x &= -200 \cos 36.87^\circ \\ &= -160 \text{ N} \\ &= 160 \text{ N} \quad (\leftarrow) \end{aligned}$$

$$\begin{aligned} F_y &= F \sin \theta \\ &= -200 \sin 36.87^\circ \\ &= -120 \text{ N} \end{aligned}$$



# Problems on Resolution

## Solution

Method-II

$$\cos \theta = \frac{4}{5} = 0.8$$

$$\sin \theta = \frac{3}{5} = 0.6$$

$$F_x = -200 \cos \theta$$

$$= -200 \times 0.8$$

$$= -160 \text{ N}$$

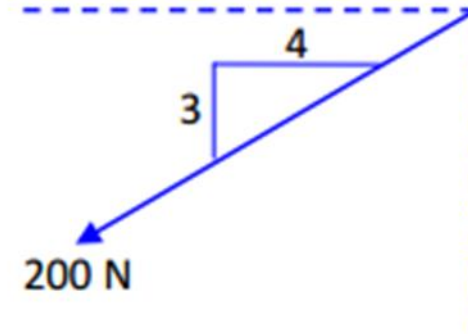
$$= 160 \text{ N} \quad (\leftarrow)$$

$$F_y = -200 \sin \theta$$

$$= -200 \times 0.6$$

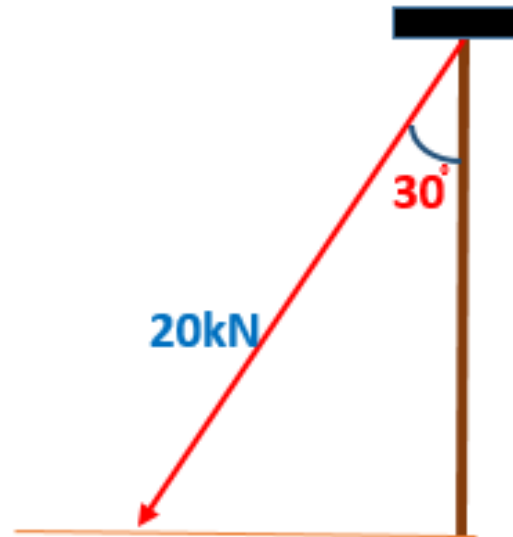
$$= -120 \text{ N}$$

$$= 120 \text{ N} \quad (\downarrow)$$



# Problems on Resolution

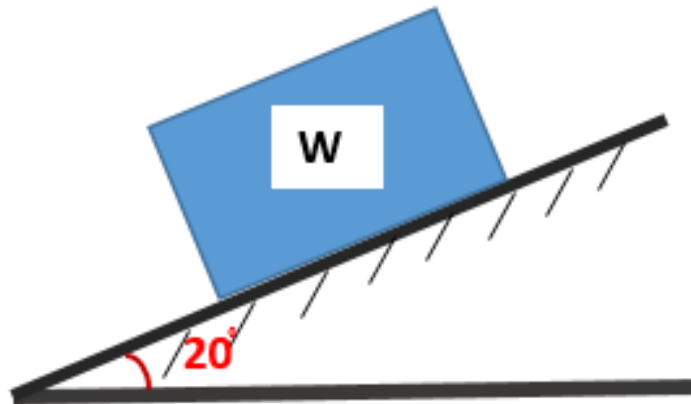
- 4) The guy wire of an electric pole shown in figure makes  $30^\circ$  to the pole and is subjected to 20kN force. Find the vertical and horizontal components of the force



$$F_x = -10\text{kN}$$
$$F_y = -17.321\text{kN}$$

# Problems on Resolution

- 5) A block weighing  $W=10$  kN is resting on an inclined plane as shown in the figure. Determine its components normal to and parallel to the plane.



$$F_x = -3.42 \text{ kN}$$

$$F_y = -9.39 \text{ kN}$$

# Summary

- The technique of finding the components of a force along any direction is called resolution of force
- The effect of a force along any specified direction is called component of a force

