Recap

$\vec{F}_1 + (-\vec{F}_2)$

Adding Forces:

Parallel Forces → Add

Ant: parallel Forces → Subtract

Perpendicular Forces → Pythagorean Theorem

Free Body Diagrams:

→ Object

→ Forces acting on object
(use arrows to rep. the Forces)

→ Velocity (If known)

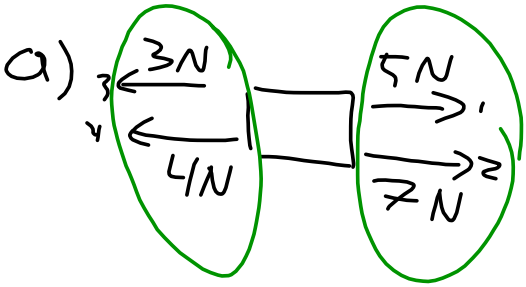
→ acceleration

Equilibrium Forces:

$\Sigma F = 0$

Example:

A 3 N force and 4 N force are acting to the left on an object; a 5 N force and a 7 N force are acting to the right. What is the net force, the object experiences? What force is required to keep the object in equilibrium?

a) 

3N+4N = 7N

5N+7N = 12N

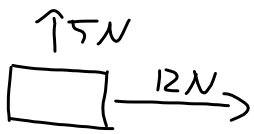
ΣF = "winners" − "losers"
= 12 N − 7 N
= 5 N [Right]

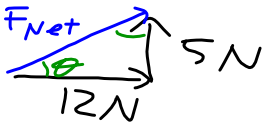
b) 5 N [Left]

Adding Forces Perpendicular

Find a Magnitude and an Angle

Ex. A 12 N force is applied to the right and a 5 N force is applied upwards. What is the net force on the box? (Magnitude and angle)





$\tan\theta = \frac{5N}{12N}$

$\theta = \tan^{-1}\left(\frac{5}{12}\right)$

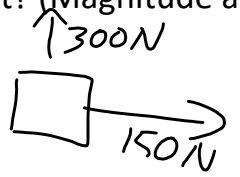
$= 23°$

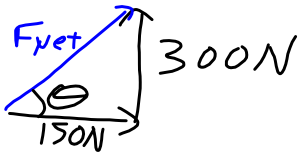
$F_{Net}^2 = (5N)^2 + (12N)^2$

$F_{Net} = 13N$

$F_{Net} = 13N$ 23° above right

Ex. A 150 N force pushes an object to the East while a 300 N force pulls an object North. What is the total force acting on the object? (Magnitude and angle)





$\theta = \tan^{-1}\left(\frac{300N}{150N}\right)$

$= 63.4°$

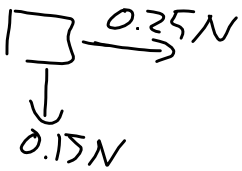
$F_{Net}^2 = (150N^2) + (300N)^2$

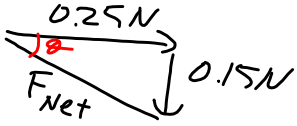
$F_{Net}^2 = 112500N^2$

$F_{Net} = 335.4N$

$F_{Net} = 335.4N\ [E\ 63.4°N]$

Ex. A 0.25 N force acts to the right while a 0.15 N force acts downwards. What is the resultant force on the object? (Magnitude and angle)





$\theta = \tan^{-1}\left(\frac{0.15N}{0.25N}\right)$

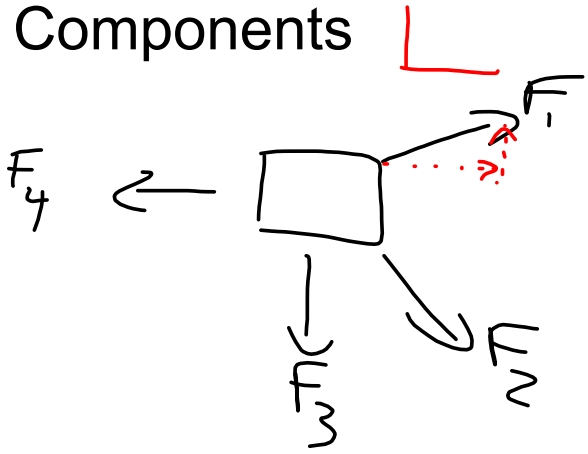
$= 30.9°$

$F_{Net}^2 = (0.15N)^2 + (0.25N)^2$

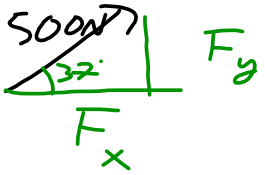
$= 0.29N$

$F_{NET} = 0.29N\ [\text{left } 30.9° \text{ Down}]$

Decomposing Vectors (Forces) into Components



Ex. A 500 N force is applied 36.87° to the horizontal. What are the horizontal and vertical components?



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

$F_x = F\cos\theta$

$= (500N)\cos 36.87°$

$= 400N$

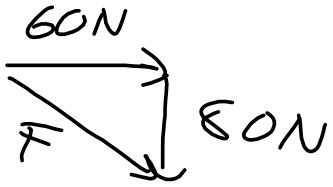
F_y: $\sin\theta = \frac{F_y}{F}$

$F_y = F\sin\theta$

$= (500N)\sin 36.87°$

$= 300N$

Ex. A force has a component of 60 N to the right and a component of 80 N downwards. What is the Resultant force and angle?



$F^2 = (60N)^2 + (80N)^2$

$= 10000N^2$

$F = 100N$

$\theta = \tan^{-1}\left(\frac{80N}{60N}\right)$

$= 53.13°$

$F = 100N$ (Right 53.13° Down)

Homework:

Perpendicular Forces and Decomposing Vectors Practice Sheet