Recap

When multiple forces act on an object:

Forces acting in the same direction — we add

Forces acting in opposite directions — "subtract" Add Negative

Forces acting perpendicular — Pythagorean Sum

We use $\sum F$ to denote a net force.

Newton's First Law:

In the absence of a NET force, objects at rest will stay at rest; objects in motion will stay in motion at the same speed and in the same direction.

Draw The Following Situation:

A 30 N force is applied on a box to the right, a 15 N force is applied to the left, a 150 N force is applied downwards, and a 150 N force is applied upwards.

Free body diagram (FBD)

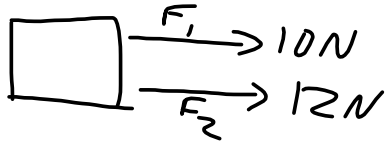
Draw the object we are interested in that forces are acting on.

Draw and label each force vector and indicate the direction force is directed in

Examples

Determine the net force when:

- a 10 N and 12 N force both pull a box to the right.

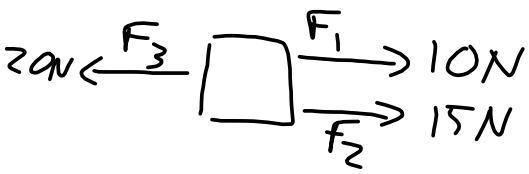


$$\Sigma F = F_1 + F_2$$
$$= 10N + 12N$$
$$= 22N\ [Right]$$

- a 10 N force pulls a box to the left and a 12 N force pulls to the right.

$$\Sigma F = 12N + (-10N)$$
$$= 2N\ [Right]$$

- a 10 N and 15 N force push a box to the right and a 20 N force pushes to the left.



$$\Sigma F = F_1 + F_2 - F_3$$
$$= 10N + 15N - 20N$$
$$= 5N\ [R]$$

Forces in equilibrium occur when all the forces acting on the object create a net force of 0. ($\sum F = 0$)

At times you may need to find what one force needs to be to keep the system in equilibrium.

You can determine the magnitude of this force in 2 ways:

1. Add up all the other forces and determine the magnitude of the net force from all other forces. The last force must be equal in magnitude and opposite in direction to the net force you just found from the other forces.

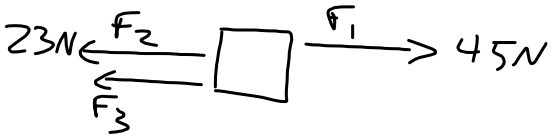
2. Creating an equation where you sum the forces and the sum equals 0. Then rearrange to find the unknown force.

Example

Two Forces act on an object. One force acts to the right with a magnitude of 23 N. What must the other force be to keep the system in equilibrium?

$F_2 = 23N\{L\}$

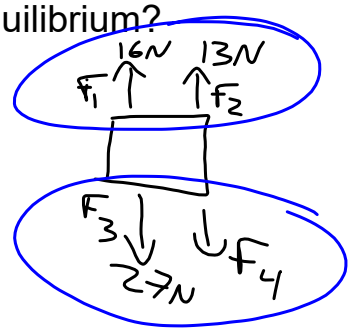
Three Forces act on an object. One force is 45 N acting east, the second force is 23 N west. What must the last force be to keep the system in equilibrium?



$F_1 - F_2 =$
$45N - 23N = 22N$
$F_3 = 22N\{W\}$

$F_1 - F_2 - F_3 = 0$
$F_3 = F_1 - F_2$
$= 45N - 23N = 22N$
$F_3 = 22N\{W\}$

Four forces act on an object. One force is 16 N acting up, the second force is 27 N down, the third force is 13 N up. What must the last force be to keep the system in equilibrium?



$\Sigma F = 0$
$F_1 + F_2 - F_3 - F_4 = 0$
$16N + 13N - 27N = F_4$
$2N = F_4$
down

$F_1 + F_2 = F_3 + F_4$
$16N + 13N = 27N + F_4$
$29N - 27N = F_4$
$2N = F_4$