Why do objects move?

FORCES

↳ push/pull

DYNAMICS

Forces and Newton's Laws of Motion

Goal:

- to become familiar with Newton's Laws of Motion

Newton's 1st Law of Motion (inertia):

Objects at rest want to remain at rest, objects in motion want to maintain their velocity.

If forces cause objects to accelerate, how much acceleration do they cause?

F ↑ a ↑

F ↓ a ↓

directly proportional

$F \propto a$

m ↑ a ↓

m ↓ a ↑

inversely proportional

$a \propto \frac{1}{m}$

$$a \propto \frac{F}{m}$$

Newton's 2nd Law

$$\vec{F}_{net} = m\vec{a}$$

no constant needed because

$1N = 1 kg \cdot m/s^2$

Newton's 2nd Law of Motion:

A horizontal force of 100 N is applied to a 15 kg mass. What is the acceleration of the mass?

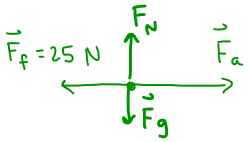
$\vec{F}_{net} = m\vec{a}$

$100\,N = (15\,kg)\vec{a}$

$\frac{100\,N}{15\,kg} = \vec{a} = 6.7\ m/s^2$

If the force of friction is 25 N, what is the acceleration?

Free-body diagram (FBD)



$\vec{F}_{net} = 100\,N + (-25\,N)$

$= 75\ N$

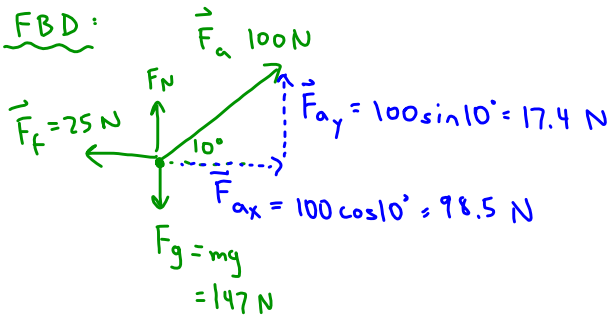
$\vec{F}_{net} = m\vec{a}$

$75\,N = (15\,kg)\vec{a}$

$\vec{a} = 5\ m/s^2$

If the applied force is at an angle of 10^0 from the horizontal what is the accleration?

FBD:



Horizontal:

$\vec{F}_{net} = 98.5\,N + (-25\,N) = 73.5\ N$

Vertical:

$\vec{F}_{net} = \vec{F}_g + \vec{F}_N + \vec{F}_{ay} = 0$

$\vec{F}_{net} = m\vec{a}$

$73.5\,N = (15\,kg)\vec{a}$

$\vec{a} = 4.9\ m/s^2$

$\vec{F}_{net}$ and $\vec{a}$ are always in same direction

Newton's 3rd Law of Motion:

For every action there is an equal and opposite reaction

If Newton's 3rd Law did not apply motion would be impossible.