

FORCES PART 1

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WHAT IS A FORCE?

- Interaction that changes motion of object
- Can cause object with mass to change velocity >>includes moving from rest
- Push or pull
- Unit of force: N

TYPES OF FORCES:

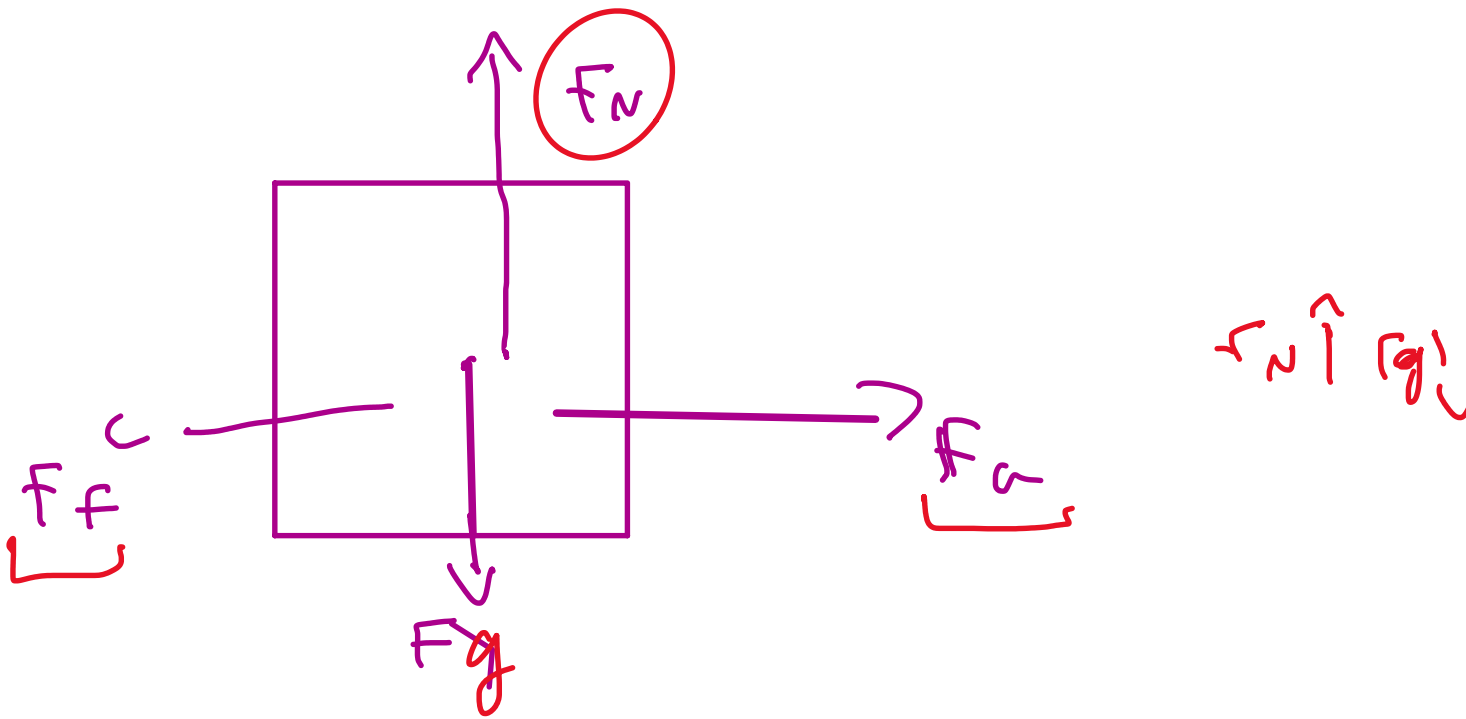
- Gravitational Force: Acts between two masses; always attracts objects; Earth gravity pulling objects towards its centre
- Electromagnetic force: Acts between. Electrically charged particles; Attraction or repulsion; chemical property of atoms
- Strong nuclear force: Strongest of four fundamental forces; between subatomic particles in atomic nucleus; overcomes electromagnetic force that pushes protons apart
- Weak nuclear force: present in radioactive decay or nuclear fusion; weaker than electromagnetic and strong forces; stronger than gravity

NEWTONS LAWS OF MOTION:

1. Law of inertia
 - Object at rest stays at rest
 - Object in motion stays in motion with constant speed and direction unless acted upon by external force
2. Law of acceleration
 - Acceleration of object produced by net force is proportional to magnitude of net force; in the same direction as net force; inversely proportional to mass of object
 - $F = ma$
3. Action and Reaction
 - For every action there is an equal and opposite reaction
 - Opposing force in opposite direction

EXAMPLES:

- Friction
- Tension
- Normal force



Examples:

① Newton's Second Law:

Question: A car has mass of 1200kg and accelerates at 2 m/s^2 . Calculate the net force exerted on car.

Solution:

Given/Unknowns:

$$\begin{aligned} m &= 1200\text{ kg} \\ a &= 2\text{ m/s}^2 \\ F_{\text{net}} &= ? \\ F &= ma \\ F &= 1200(2) \\ &= 2400\text{ N} \end{aligned}$$

(Note: The original image includes a handwritten unit conversion: $\text{kg} \cdot \text{m/s}^2$)

② Newton's First Law:

Question: If no external forces are acting on a moving bicycle, what happens to bicycle?

Solution:

Bicycle moves with constant speed in constant direction

③ Newton's Third law:

Question: When you jump off of a small boat into the water, why does the boat move backwards?

Solution:

When you jump forward force is exerted, boat exerts an equal/opposite force on you, which pushes it backward.

④ Friction:

Question: A 5kg block is being pulled across a table with a force of 20N, and it moves with constant velocity. Calculate force of friction acting on block.

Solution:

Given/Unknowns:

$$\begin{aligned} F_{\text{net}} &= 0 \rightarrow \text{Due to constant velocity} \\ F_x &= 20\text{ N} \\ F_f &= ? \end{aligned}$$

Solution:

$$\begin{aligned} F_f &= 20\text{ N} \\ \text{Due to } F_{\text{net}} &= 0 \end{aligned}$$

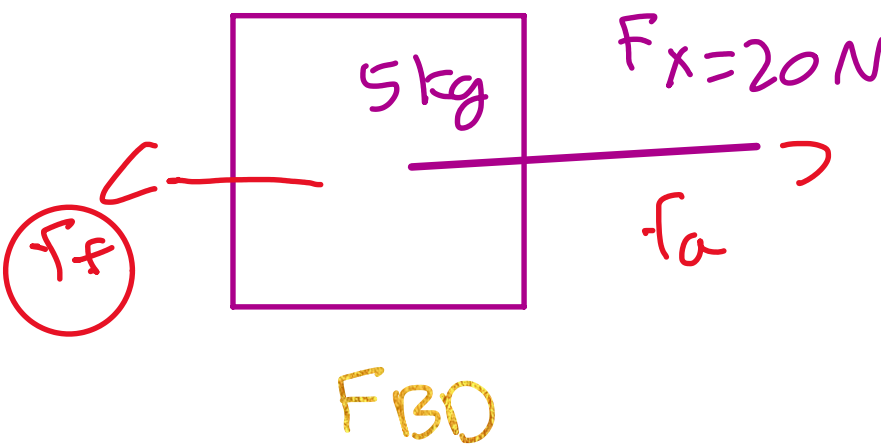
$$F_{\text{net}} = F_x + F_f$$

$$0 = 20 + F_f \rightarrow -20 + 0 = F_f$$

$$F_f = 20$$

$$F_f = -20\text{ N}$$

Direction \rightarrow magnitude



$$F_{\text{net}} = ma$$

$$\begin{aligned} 0 &= 5a \\ a &= 0 \end{aligned}$$

PART 2:

- Normal force
- Static and kinetic force
- Incline planes

PART 3:

- Gravitational force
- Centripetal force