Unit 2: Forces

FORCES AND FBDs

Forces

- MECHANICS
  - Kinetics – motion only
  - Dynamics – causes of motion ⟸ why it's moving
- Galileo → Leaning Tower of Pisa
- Newton → 3 Laws

- Force – any push or pull on an object
  - can be contact or long range

Types of Forces

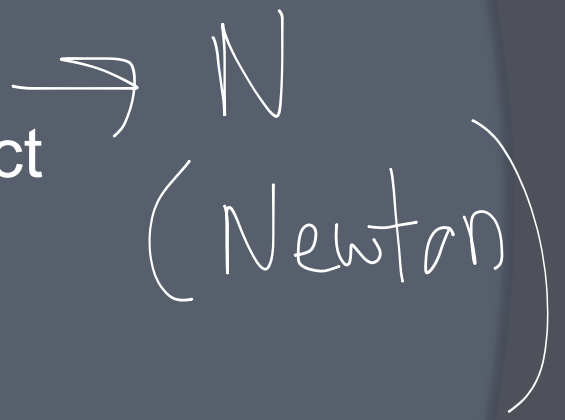
- **Normal** – contact force exerted by a surface on an object
  - direction is perpendicular to and away from the surface
- **Friction** – contact force that acts to oppose sliding motion between surfaces
  - direction is parallel to the surface and opposite the direction of sliding
- **Weight** – long range force due to gravitational attraction between two objects
  - “force of gravity”
  - direction is straight down toward the centre of the earth

Types of Forces

- **Tension** – the pull exerted by a string, rope, or cable when attached to an object and pulled taut
- **Applied** – a push or pull caused by an outside agent
- **Drag** – solid interacts with fluid so as to oppose the motion of the solid through the fluid

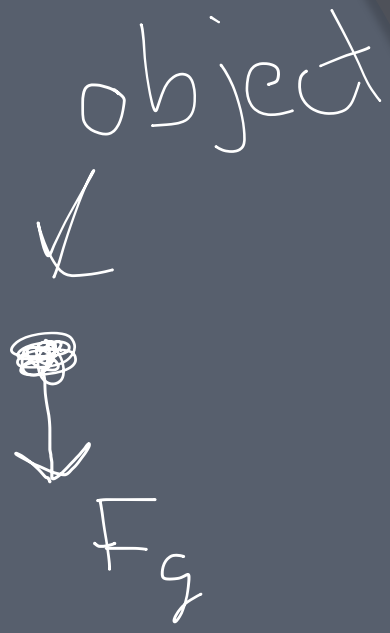
Mass vs. Weight

- mass (kg)
  - amount of matter in an object
- weight (N)
  - force of gravity acting on an object



- on earth, $g=9.8\ m/s^2$ [down]
  - $1N = 1\ kg \cdot m/s^2$

Free Body Diagrams



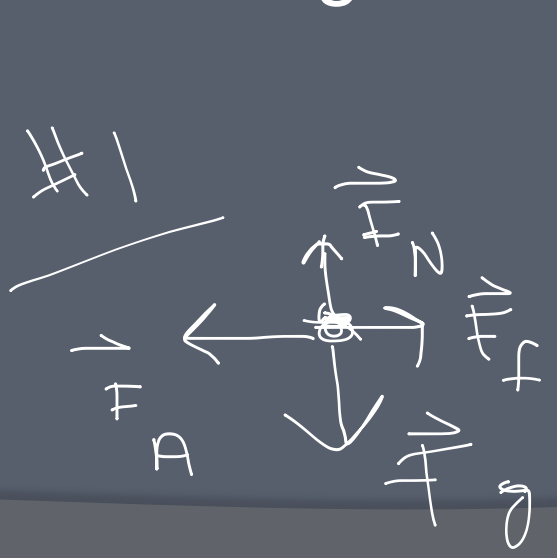
- Use to analyze forces

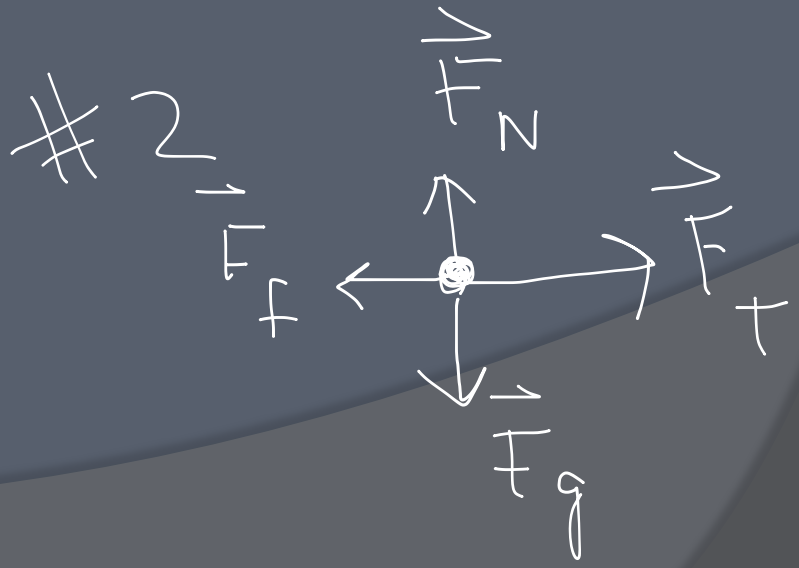
- 5 questions:
  1. Is there gravity? (F_g)
  2. Is it sitting on a surface? (F_N)
  3. Is something pushing or pulling on it? (F_A, F_T)
  4. Is there friction? (F_f)
  5. Is it accelerating?

Free Body Diagrams

Example #1: A box is pushed to the left across a rough, horizontal surface. Draw the FBD.

Example #2: The same box is now pulled to the right with a rope. Draw the FBD.





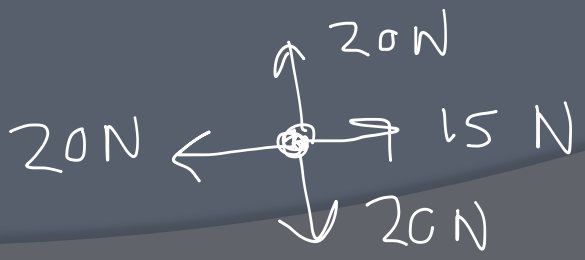
Net Force ($\vec{F}_{Net}$)

- sum of all forces acting on an object
- = 0 for a stationary object
  = 0 for an object in uniform motion (constant velocity)

<u>Example</u>

Calculate the net force when the following forces act on an object:

- 20N [N], 20N [S], 15N [E], 20N [W]



$\therefore \vec{F}_{Net} = 5N[W]$

Four Fundamental Forces

- Gravity
  - weakest
  - attracts only
- Electromagnetic
  - holds atoms and molecules together
  - attracts and repels
- Strong Nuclear
  - holds the nucleus of an atom together
- Weak Nuclear
  - responsible for radiation

Homework

- Read 3.1 (p.114-121) ✓
- answer
  - p.119 #1,2 (Practice questions near top of the page)
  - ~~p.120 #1,3~~
  - ~~p.122 #1,2,7,16ab~~

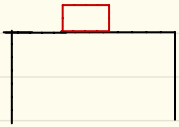
Pg. 122 #1, 2, # 5

↑

F B D only.

Pg 119

#1 a) System Diagram



FBD

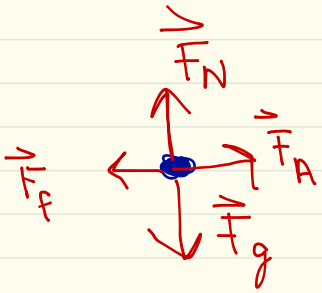
b) System Diagram FBD

W ⟷ E

Pg 119 1c)

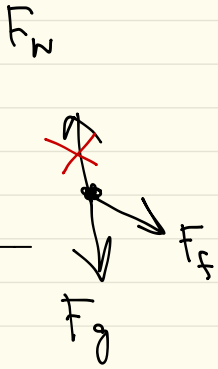
System Diagram

FBD

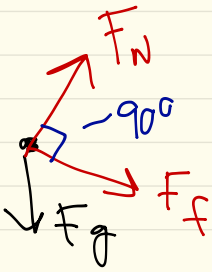


Pg 119 # 2

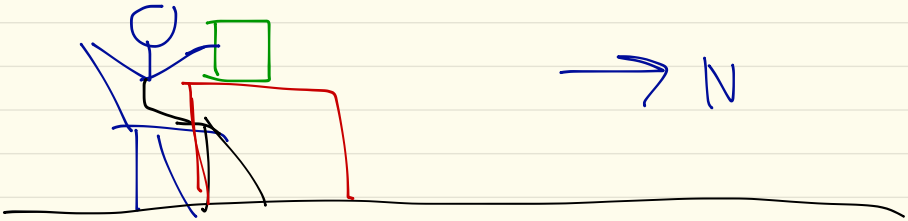
System



* $\vec{F}_N$ is always * perpendicular to surface 90°



Pg 122 #1.



a) $\vec{F_A}$ ∴ North

b) F_A ∴ South

#2 a) gravity

b) Applied Force.
gravity
Normal Force.

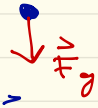
c) Friction
gravity
Applied
Normal Force

Pg 122 #5

a)

b)

c)



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