# BSP1153
# Mechanics & Thermodynamics
# Newton's Law

**by**
**Dr. Farah Hanani bt Zulkifli**

**Faculty of Industrial Sciences & Technology**
**farahhanani@ump.edu.my**

# Chapter Description

- Expected Outcomes
  - To solve physics's problems by apply the Newton's Law in the horizontal, vertical and along a slope motion.

- References
  - Young, H.D. & Freeman, R.A. University Physics with Modern Physics (14th Ed.) Pearson, 2015
  - University physics with modern physics / Wolfgang Bauer, Gary D. Westfall, Mc Graw Hill, 2014
  - Paul E. Tippens, Physics 7th Edition. Mc Graw Hill, 2013
  - Physics for scientists and engineers : a strategic approach / Randall D. Knight, Boston, MA : Pearson, 2013
  - Giancoli, D.C. Physics for Scientists and Engineers: with Modern Physics (4th Edition). Pearson Prentice Hall, 2013
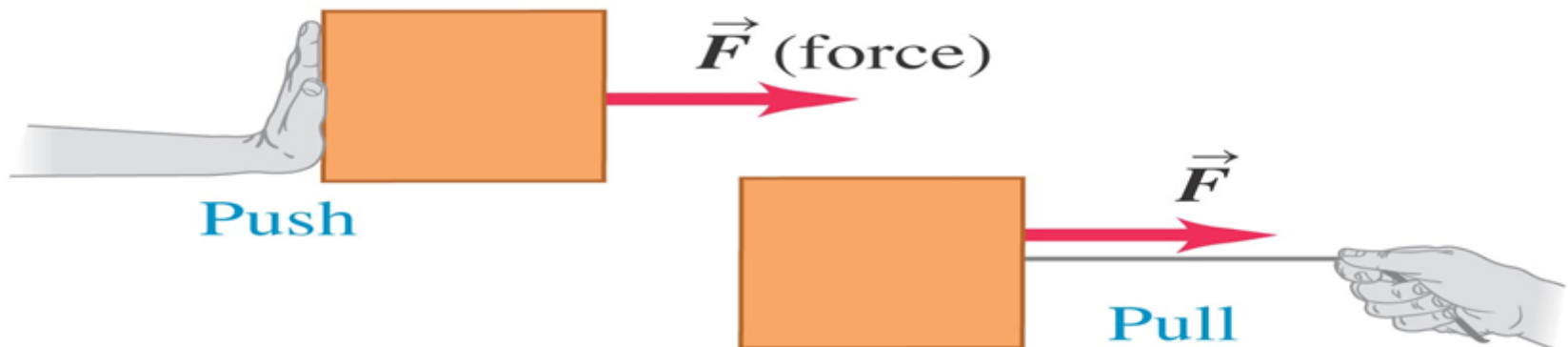
# **Force**

- Force, *F* ("push" or "pull") : interaction between object-object or object-environment.

- It is a vector quantity. (involving **magnitude & direction**)

- Unit of *F* is Newton (N) or kgms$^{-2}$



$\vec{F}$ (force)

Push

$\vec{F}$

Pull

# Types of forces

1. Normal force —An object in rests on the surface always have a force push back. (directed perpendicular)

2. Frictional forces — motion along the surface can be resist the frictional forces. (directed parallel)

(a) **Normal force $\vec{n}$:** When an object rests or pushes on a surface, the surface exerts a push on it that is directed perpendicular to the surface.

$\vec{n}$

$\vec{n}$
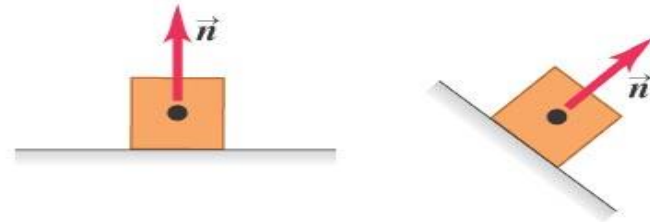
(b) **Friction force $\vec{f}$:** In addition to the normal force, a surface may exert a frictional force on an object, directed parallel to the surface.
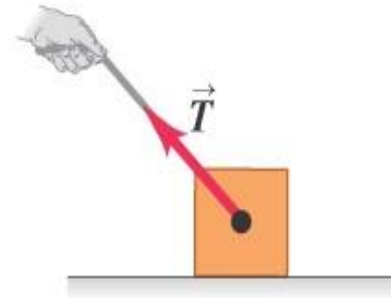
$\vec{n}$

$\vec{f}$
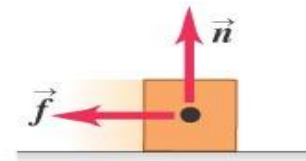
3. Tension forces — Force exerted on an object through cable or cord is called tension.

(c) **Tension force $\vec{T}$:** A pulling force exerted on an object by a rope, cord, etc.



4. Weight — The pull of gravity on an object.

(d) **Weight $\vec{w}$:** The pull of gravity on an object is a long-range force (a force that acts over a distance).
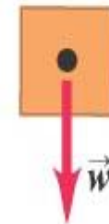
# Newton's 1st Law

- An object at rest remains at rest while an object in motion remains in constant motion in a straight line unless there is a force acted on the object (no resultant force).

- Also known as Inertia.

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# Newton's 2$^{nd}$ Law

- If there is a resultant force acts on an object, the object will move or experience acceleration (if the object in motion).

- The direction of $a$ is always in the direction of F$_{resultant}$.

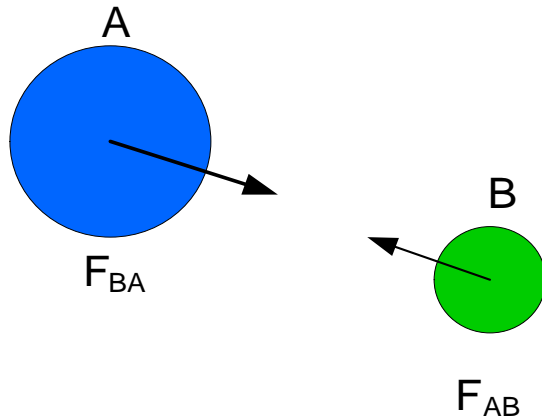- Knowing that, $a$ α $F/m$

- So , F = ma

# Newton's 3rd Law

- **Each action force have an equal <u>and</u> opposite reaction force.**

- **Known as action-reaction pair.**

$$F_{BA} = - F_{AB}$$

A

B

$F_{BA}$

$F_{AB}$

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# **Free Body Diagram**

- Simplified sketch of a system.

- Method:

  1. Draw a simple sketch of the body/object.

  2. Draw all the possible forces acting on the object.

  3. Label each force by considered its magnitude and direction.

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# Remember!

For case involving **TENSION** (in rope/cable/cord) and **SPRING** force:

- In free-body diagram, the direction of tension force must be **AWAY** from the subject focus.
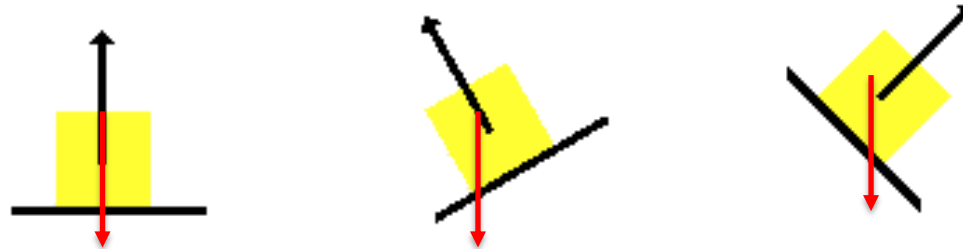
# Inclined plane



Normal forces are always directed perpendicular to the surface.

- There are two forces (gravitational and normal) that acted on the object that is positioned on an inclined plane.

- Gravitational force: downward direction, $F_{II}$ = mg sin θ, $F_{\perp}$ = mg cos θ

- Normal force: upward direction

- Frictional force will acted in the opposite direction of motion.

# Forces of friction

- Force that resist the motion of material in contact with surface.

- Frictional force, $F_{fr} = \mu F_N$

  Where,

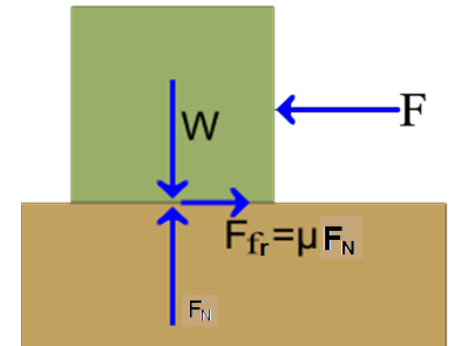        $F$ = Pull of push force that cause the motion on the object

        $F_N$ = normal force

        $W$ = Weight of the object

        $\mu$ = Friction's coefficient

# See you in Chapter 5!!

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