Unit 2: Dynamics

Study of the causes of motion

Forces → "a push or a pull"

→ a quantity that can cause a change in motion

Types of Forces

- gravitational * 4)
- normal
- electric * } electromagnetic * 2)
- magnetic * }
- strong nuclear * 1)
- weak " * 3)
- friction
- applied
- tension
- elastic/spring

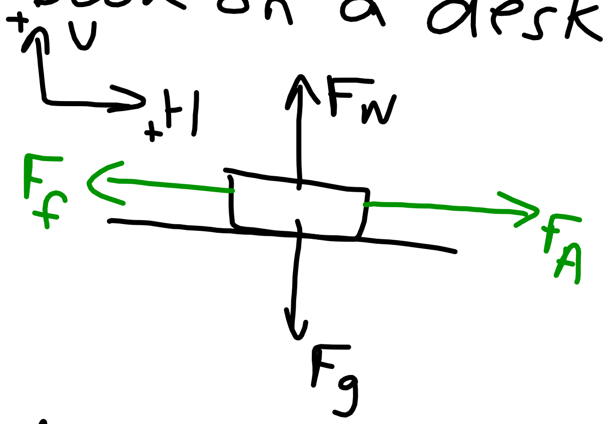
* Fundamental forces

Free-Body Diagrams (FBDs)

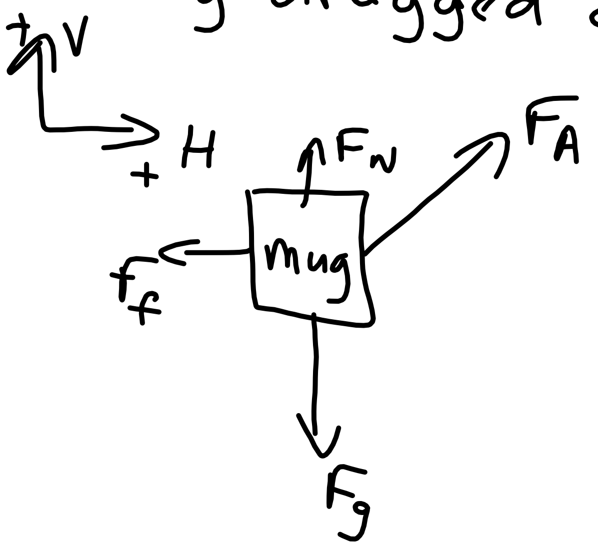
↳ representation of the forces on an object

Ex.

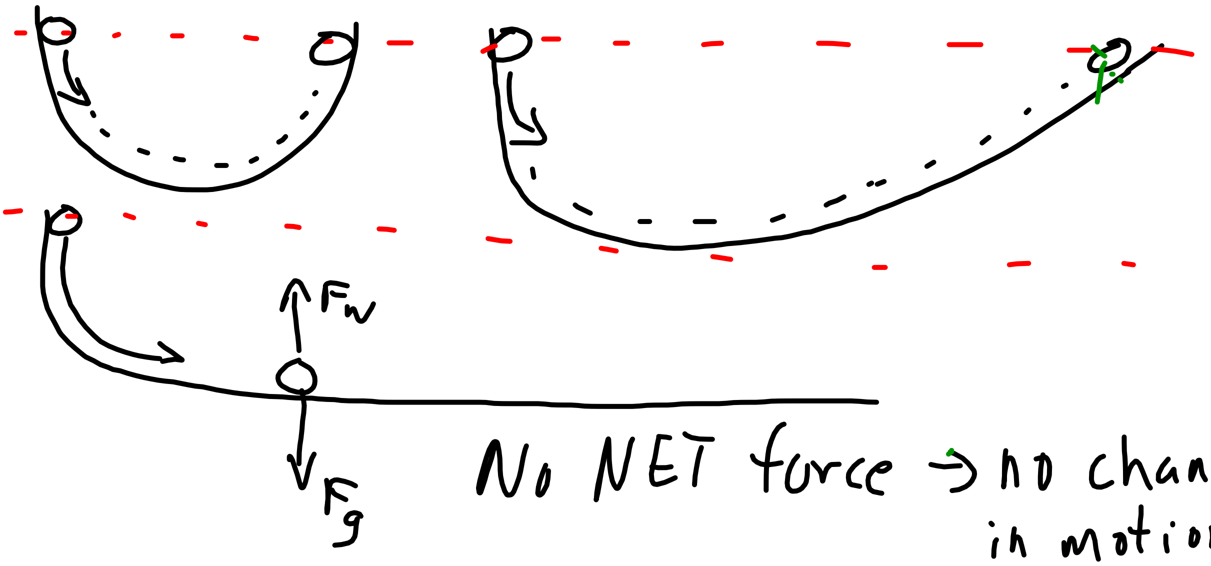
Book on a desk ... pushed



A mug dragged at an angle to the surface



Newton's Laws of Motion



No NET force → no change in motion

Newton's 1st Law (N1L)

An object maintains its velocity unless acted upon by an external, unbalanced force.

N2L

When a force is applied to an object it will accelerate in the direction of the net force. The acceleration is proportional to the force, and inversely prop. to the mass.

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

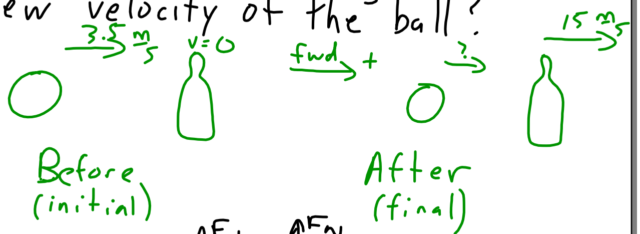
$$1\,N = (1\,kg)\left(1\,\frac{m}{s^2}\right)$$

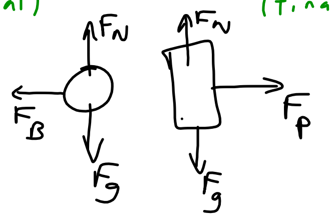
$$= 1\,\frac{kg\,m}{s^2}$$

N3L:

If object 'A' applies a force on object 'B', the 'B' applies a force on 'A' that is equal in magnitude and opposite in direction.

Example: A bowling ball ($m = 6$ kg) is moving forward at 3.5 $\frac{m}{s}$ when it strikes a stationary pin ($m = 1.6$ kg).
After the collision, the pin moves fwd at 15 $\frac{m}{s}$. What is the new velocity of the ball?





Ball

$d = D$

$V_i = 3.5 \frac{m}{s}$

$V_f = V$

$a = ?$

$t = T$

$m = 6$ kg

$F = -F_B$

$\therefore F_B = -\frac{24}{T}$

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

$= \frac{-\frac{24}{T}}{6}$

$= -\frac{4}{T}$

$a = \frac{v_f - v_i}{t}$

$V_f = V_i + at$

$= 3.5 + \left(-\frac{4}{T}\right)(T)$

$= 3.5 - 4$

$V_f = -0.5$ m…

$\therefore$ the ball bounces back @ 0.5 $\frac{m}{s}$

Pin

$d = D$

✓ $V_i = 0$

✓ $V_f = 15 \frac{m}{s}$

$a = ?$

✓ $t = T$

$m = 1.6$ kg

$F = F_p$

$a = \frac{V_f - V_i}{t}$

$a = \frac{15 - 0}{T}$

$a = \frac{15}{T}$

$F = ma$

$\therefore F_p = (1.6)\left(\frac{15}{T}\right)$

$F_p = \frac{24}{T}$