Chapter 2 :- Force and Newton's laws of motion

↳ anything that is measurable and cause change in motion of an object.

→ Newton's first law:

↳ any object continues at rest, or at constant velocity unless an external force acts on it.

→ Newton's second law:

↳ an external force gives an object an acceleration

$$F = ma$$

if $F = 2F$

$\therefore a = 2a$

if $m = 2m$ $\quad \therefore a = \frac{a}{2}$

Weight and mass

↳ force due to the gravity = W (vector) N

↳ scaler (Kg)

$$F = ma \quad \text{when } a = g$$

$$F = \boxed{mg = W} \quad \text{downward}$$

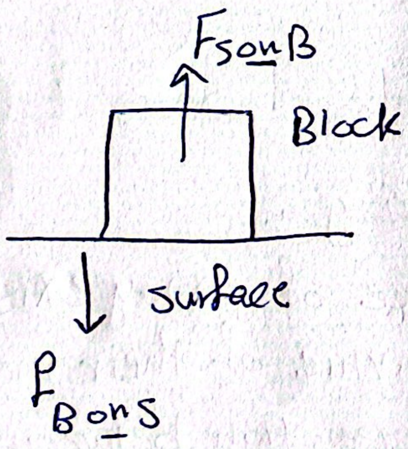
* Force must have magnitude and direction.

Newton's Third law:

for every action there is an equal and opposite reaction

(force comes in pairs) (action-reaction pairs)

→ suppose that the "action" is the force exerted by object 1 on object 2 ∴ then object 2 will exert a force of equal size, but in the opposite direction.



see example 2.1

HW: figure 2.6 (flowerpot sits on a table) page 19 analyze the force in details.

*Kinds of force :-

1. electromagnatic force EM (force holds atoms and together) charged particles
2. The gravitational force
3. Strong force → these forces maintain the structure of the atomic nucleus
4. weak neucler force → However the importance of these forces in biological systems is not obvious
5. Drag forces
6. Tension force
7. Normal and friction force

→ Newton's theory of gravity :-

based on that the force of gravity exists between 2 bodies by virtue of their mass and decreases with the seperation between these bodies.

$$F = G \frac{m_1 m_2}{r^2}$$

→ object near to the Earth will experience an attractive gravitational force exerted by the earth

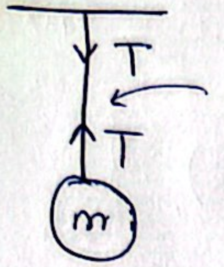
$$F = G \frac{M_E m}{r^2} = ma$$

let $R = r^2 = 6.37 \times 10^6 m$ radius of earth

$$a = g = \frac{G M_E}{R^2}$$

$$\boxed{g = 9.81 \, m/s^2}$$

nsion :-



This force which exist in the body of a flexible cable or line

→ Tension exists at each point in the cable when forces are applied in opposite direction at each end of the cable., These forces are the sum of the microscopic forces acting between the component molecules of the cable.

Drag Force:

This force existed when an object moving through gases and liquids

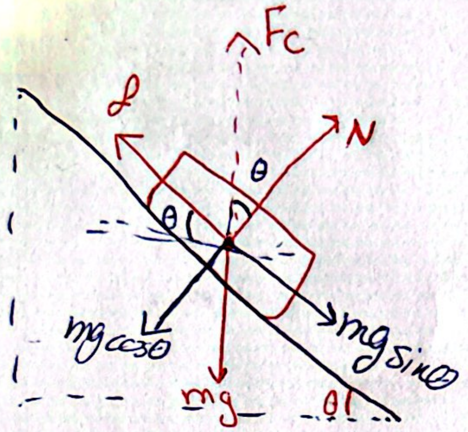
→ when the object gets in the fluid, ~~a fluid~~ must move the fluid out of the way this will be easier or harder depend on the viscosity of the fluid

if this fluid is air → this force known as ~~the Drag force~~ air resistance

$$f = K V^2$$

↳ is determined by the shape of the object.

normal force and friction:-



$\sum F_y = 0$

No motion on the y-axis

N: normal force, which is the reaction force due to the action force of W

$$\therefore \boxed{N = mg\cos\theta} \quad \text{--- (1)}$$

- $\sum F_x = ma_x$ if the particle is moving

$\sum F_x = 0$ if the particle is stationary.

$$\boxed{f = mg\sin\theta} \quad (2)$$

$$f = N\tan\theta$$

→ if θ increased, the block will start to slide, θ: called the critical angle θ_c

$$f_{max} = \mu_{max} N$$

$$\therefore \mu_{max} = \tan\theta_c$$

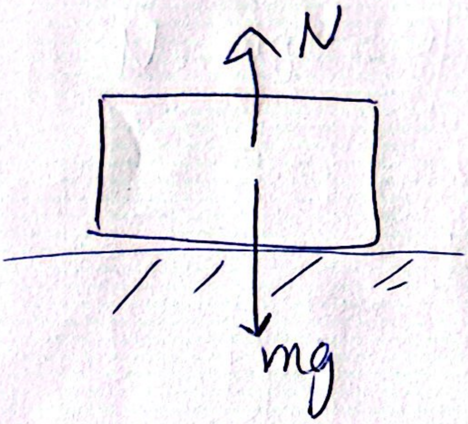
$f = \mu N$

Static cofficients

Kinetic cofficients

→ as θ decreased to zero $\therefore$ the surface is horizontal since $\sin\theta = 0$

$\therefore$ $\underline{N = mg}$



Discussion problems: 1, 2, 8, 9, 10