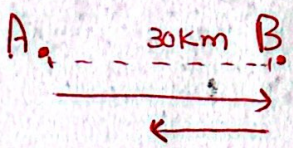
Chapter 1 : Kinematics

1.2 : Distance and displacement

Distance : the length of the path that the object took in travelling from one place to another (scaler quantity)

Displacement: the distance travelled, but with a direction associated (vector quantity)
→ or the distance from the starting point to the end point.

example



Distance : 30 + 15 = 45 km
Displacement : 30 - 15 = 15 km

1.3 : speed and Velocity

scaler

vector

Velocity: the change in position, divided by the time it took for this change to occur (magnitude and direction)

speed : is the magnitude of the velocity, without a direction

$$\vec{v} = \frac{\Delta x}{\Delta t} \qquad \Delta x : \text{the displacement}$$

$$\Delta x = x_f - x_i$$

1.4 : acceleration

the rate of change of velocity (vector)

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$$

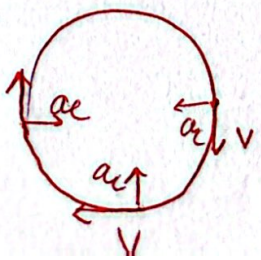
$$\Delta v = v_f - v_i$$

→ The acceleration vector may point in the opposite direction, when ?!

when the object slowing down

→ the object will have [redacted] $\underline{a}$ even if its speed does's change at all ? the acceleration vector point in a direction $\perp$ to the velocity vector

like the circular motion



→ $\vec{a}$ could be constant if the velocity changes by the same amount every Δt

↳ * then we can calculate v at any time, since we know how much the velocity increases every second

$$v = at$$

t : elapsed time

* if the object had not been at rest initially

$$\Delta v = at$$

↳ The change of velocity after acceleration begins

$$v_f - v_i = at \Rightarrow \boxed{v_f = v_i + at}$$

→ This velocity called instantaneous

1.5 : Average Velocity or speed

$$V_{av} = \frac{\text{total displacement}}{\text{total time}}$$

→ this value don't require any knowledge of details of your trip

$$d = V_{av}\, t = \frac{1}{2}(V_f + V_i)\, t$$

$$\boxed{d = V_i t + \frac{1}{2} a t^2}$$

If $V_i = 0$

$$\boxed{d = \frac{1}{2} a t^2}$$

see example 1.1

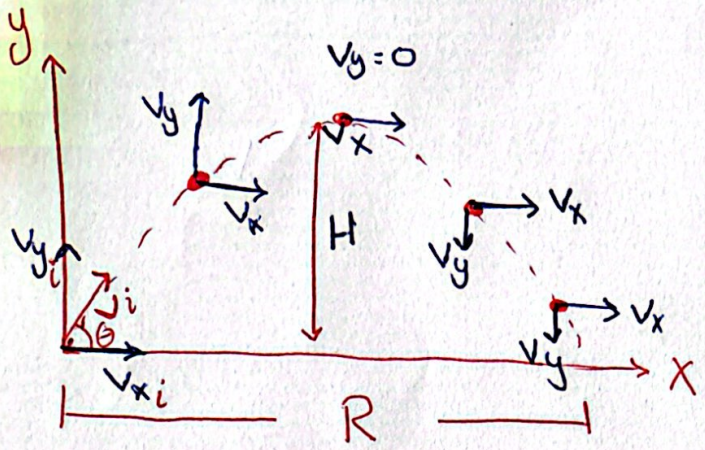
1.6 : The acceleration Due to Gravity

$$g = 9.81\ m/s^2$$

$$V = gt$$

see example 1.2 , 1.3 , 1.4 , 1.5

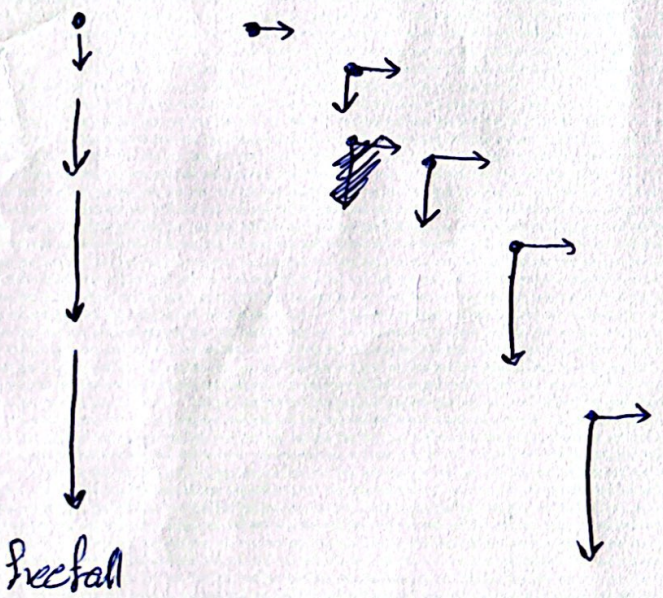
1.7: Independene of motion in 2D



V_x constant (don't change with time) (no acceleration)

V_y changes due to the deacceleration of gravity

→ So the vertical and the horizontal component of velocity are independent.



→ 4 important quantity

1. max height H
2. R (trip distance)
3. t_1 (time at the max height) زمن الوصول لأقصى ارتفاع
4. t (the whole time) زمن التحليق

Equations:-

$V_{x_i} = V_i \cos\theta$

$V_{y_i} = V_i \sin\theta$

* at max height

$V_y = V_{y_i} - g t_1$

$V_{y_i} = g t_1$

(1) $\boxed{t_1 = \frac{V_{y_i}}{g} = \frac{V_i \sin\theta}{g}}$ زمن الوصول لأقصى ارتفاع

زمن التحليق

$t = 2t_1$

② $\boxed{t = \frac{2V_i \sin\theta}{g}}$

Discussion problems
1, 2, 3, 4, 8

* He max heights H

$V_y^2 = V_{yi}^2 - 2gH$

$0 = V_{yi}^2 - 2gH$

$H = \frac{V_{yi}^2}{2g}$

③ $\boxed{H = \frac{(V_i \sin\theta)^2}{2g}}$

* R trip distance

$R = V_{xi} * t$

④ $\boxed{R = V_i \cos\theta * t}$

$= V_i \cos\theta * \frac{2V_i \sin\theta}{g}$

④ $\boxed{R = \frac{V_i^2 \sin(2\theta)}{g}}$

→ and for some value we use

$V_{fy} = V_{iy} - gt$

$V_y^2 = V_i^2 - 2gH$

$H = V_{y_i} t - \frac{1}{2} g t^2$

عند طلب أزمنة معينة