

Car 6

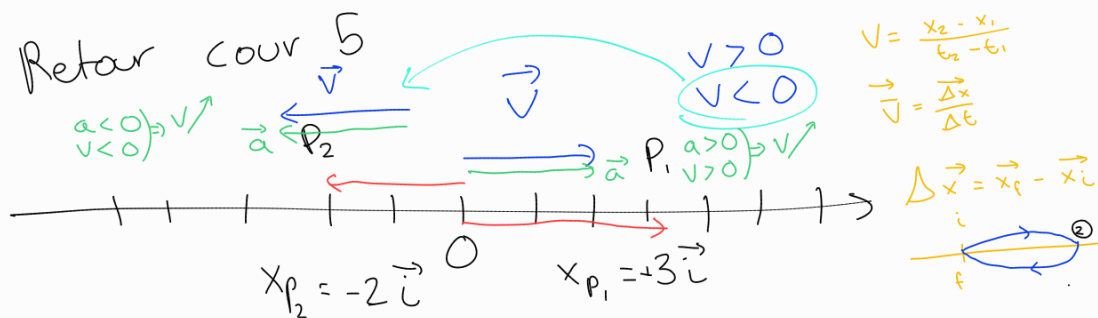
Cinématique

* Chute libre

* projectile

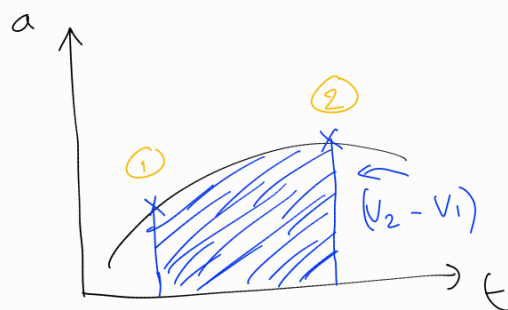
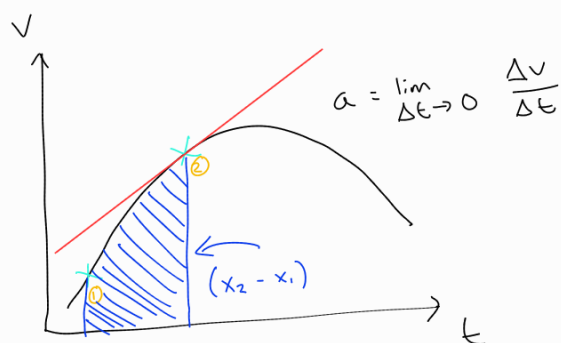
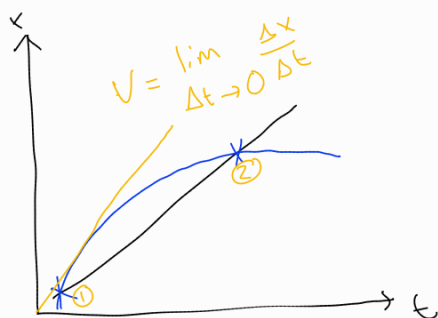
* application

Retour cour 5



$$x_{P_1} = +3\text{m}$$

$$x_{P_2} = -2\text{m}$$



MRU : $v = c^t \Rightarrow a = 0$

(1) $x_2 = x_1 + v_i(t_2 - t_1)$

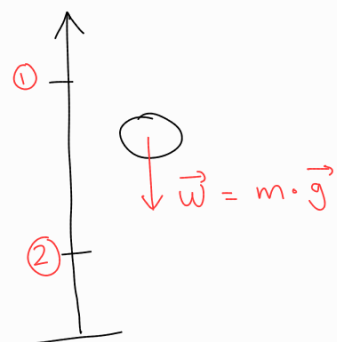
MRUA : $a = c^t$

$$\left. \begin{aligned} (1) \quad x_2 &= x_1 + v_i(t_2 - t_1) + \frac{a}{2}(t_2 - t_1)^2 \\ (2) \quad v_2 &= v_1 + a(t_2 - t_1) \end{aligned} \right\}$$

$$v_2^2 = v_1^2 + 2a(x_2 - x_1)$$

Cour 6

$$\sum \vec{F}_{\text{ext.}} = m \cdot \vec{a}$$



$$\sum F_y = m \cdot a_y$$

$$-mg = m \cdot a_y$$

$$\boxed{-g = a_y} = \underline{\underline{c^t}} \Rightarrow \underline{\underline{MRUA}}$$

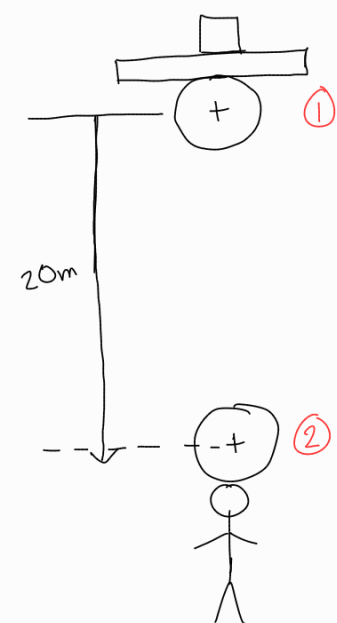
Chute Libre

$$y_2 = y_1 + (v_y)_1(t_2 - t_1) - \frac{1}{2}g(t_2 - t_1)^2$$

$$(v_y)_2 = (v_y)_1 - g(t_2 - t_1)$$

Exemple #1

$$a_y = g = -9.81 \text{ m/s}^2$$



	①	②
y	$y_1 = 20$	$y_2 = 0$
v_y	$v_{y1} = 0$	$v_{y2} = ?$
t	$t_1 = 0$	$t_2 = ?$

$$y_2 = y_1 + (v_y)_1(t_2 - t_1) - \frac{1}{2}g(t_2 - t_1)^2$$

$$\textcircled{1} 0 = 20 + (0)(t_2 - 0) - \frac{1}{2}(9.81)(t_2 - 0)^2$$

$$(v_y)_2 = (v_y)_1 - g(t_2 - t_1)$$

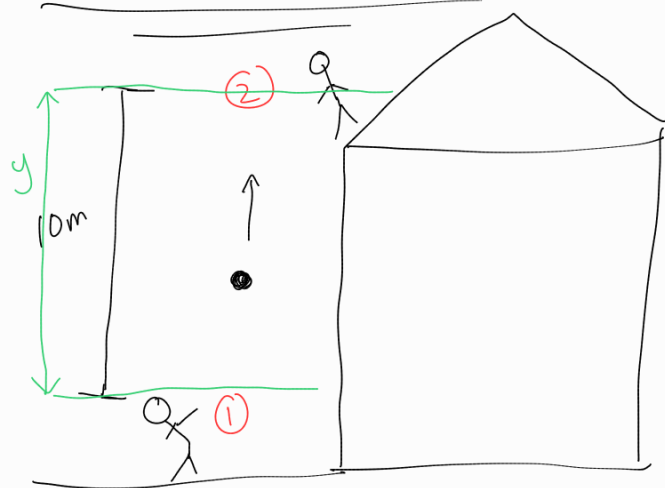
2 eq 2 inconnue

$$\textcircled{2} (v_y)_2 = 0 - (9.81)(t_2 - 0)$$

$$t_2 = 2.02 \text{ sec}$$

$$v_{y2} = -19.81 \text{ m/s}$$

Exemple #2



①	②
$y_1 = 0$	$y_2 = 10$
$v_{y1} = ?$	$v_{y2} = 0$
$t_1 = 0$	$t_2 = ?$

○ car vitesse
initial minimal

$$y_2 = y_1 + (v_y)_1(t_2 - t_1) - \frac{1}{2}g(t_2 - t_1)^2$$

① $10 = 0 + v_{y1}(t_2 - 0) - \frac{1}{2}(9.81)(t_2 - 0)^2$

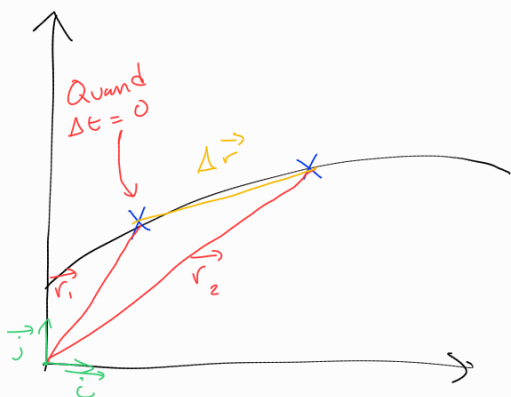
$$(v_y)_2 = (v_y)_1 - g(t_2 - t_1)$$

② $0 = v_{y1} - (9.81)(t_2 - 0)$

$$t_2 = 1.43 \text{ sec}$$

$$v_{y1} = 14.01 \text{ m/s}$$

Mouvement curviligne



$$\vec{v} = \lim_{\Delta t \rightarrow 0} \frac{\Delta \vec{r}}{\Delta t}$$

$$\vec{a} = \lim_{\Delta t \rightarrow 0} \frac{\Delta \vec{v}}{\Delta t}$$

$$v = \sqrt{v_x^2 + v_y^2}$$

$$\vec{r}_1 + \Delta \vec{r} = \vec{r}_2$$

$$\Delta \vec{r} = \vec{r}_2 - \vec{r}_1$$

Projectile

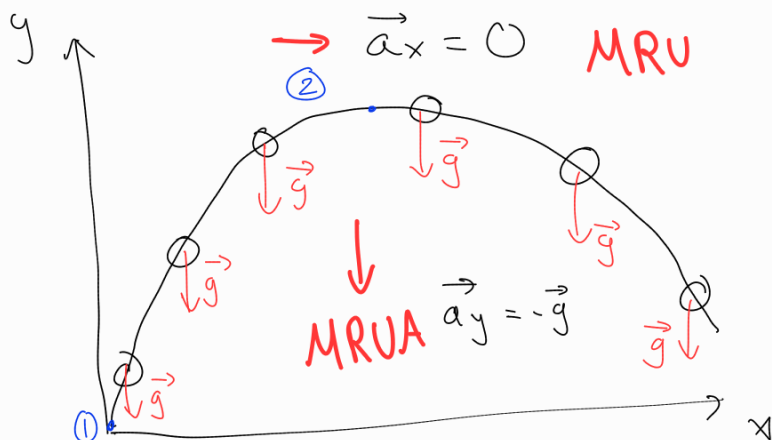
$$V = \frac{\Delta x}{\Delta t} = \text{cte}$$

MRU

$$a_x = 0$$

MRUA

$$a_y = -g$$



Projectile equations

$$\textcircled{1} x_2 = x_1 + v_{x1}(t_2 - t_1) \Rightarrow (t_2 - t_1) = \frac{x_2 - x_1}{v_{x1}}$$

$$\textcircled{2} y_2 = y_1 + (v_{y1})(t_2 - t_1) - \frac{1}{2}g(t_2 - t_1)^2$$

$$\textcircled{3} v_{y2} = v_{y1} - g(t_2 - t_1)$$

$$\textcircled{2} y_2 = y_1 + v_{y1} \left(\frac{x_2 - x_1}{v_{x1}} \right) - \frac{1}{2}g \left(\frac{(x_2 - x_1)^2}{(v_{x1})^2} \right)$$

$$y = Ax^2 + Bx + C$$

$$x = x_2 - x_1$$

$$y_2 = y_1 + \left(\frac{v_{y1}}{v_{x1}} \right) x - \left(\frac{g}{2v_{x1}^2} \right) x^2$$

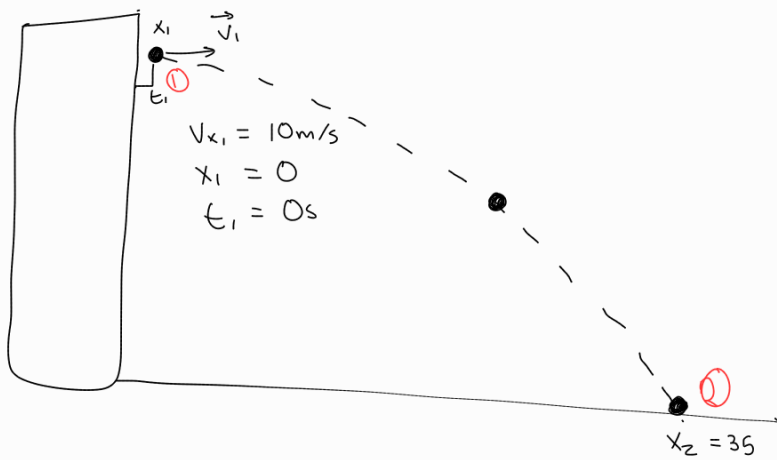
①

②

$$\begin{cases} x_1 = 0 \\ y_1 = 0 \\ v_{x1} = \\ v_{y1} = \\ t_1 = \end{cases}$$

$$\begin{cases} x_2 = ? \\ y_2 = ? \\ v_{x2} = v_{x1} \\ v_{y2} = 0 \text{ hauteur max} \\ t_2 = \end{cases}$$

Exemple #1 Projectile



①	②
$x_1 = 0$	$x_2 = 35$
$y_1 = H?$	$y_2 = 0$ <u>sol</u>
$v_{x1} = 10 \text{ m/s}$	$v_{x2} = v_{x1}$ <u>Const</u>
$v_{y1} = 0$ <u>horizontal</u>	$v_{y2} = ?$
$t_1 = 0$	$t_2 = ?$

$$\textcircled{1} x_2 = x_1 + v_{x1}(t_2 - t_1)$$

$$\textcircled{2} y_2 = y_1 + (v_y)_1(t_2 - t_1) - \frac{1}{2}g(t_2 - t_1)^2$$

$$\textcircled{3} v_{y2} = v_{y1} - g(t_2 - t_1)$$

$$\textcircled{1} 0 = 35 + 10(t_2 - 0)$$

$$\textcircled{2} 0 = H + 0(t_2 - 0) - \frac{1}{2}(9.81)(t_2 - 0)^2$$

$$\textcircled{3} v_{y2} = 0 - (9.81)(t_2 - 0)$$

$$H = 60.1 \text{ m}$$

$$t_2 = 3.5 \text{ sec}$$

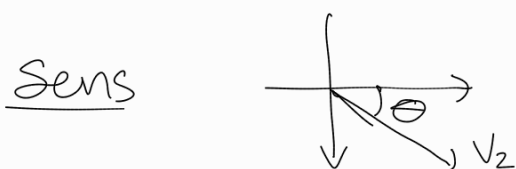
$$v_{y2} = -34.34 \text{ m/s}$$

$$Q_1 = 3.5 \text{ secondes}$$

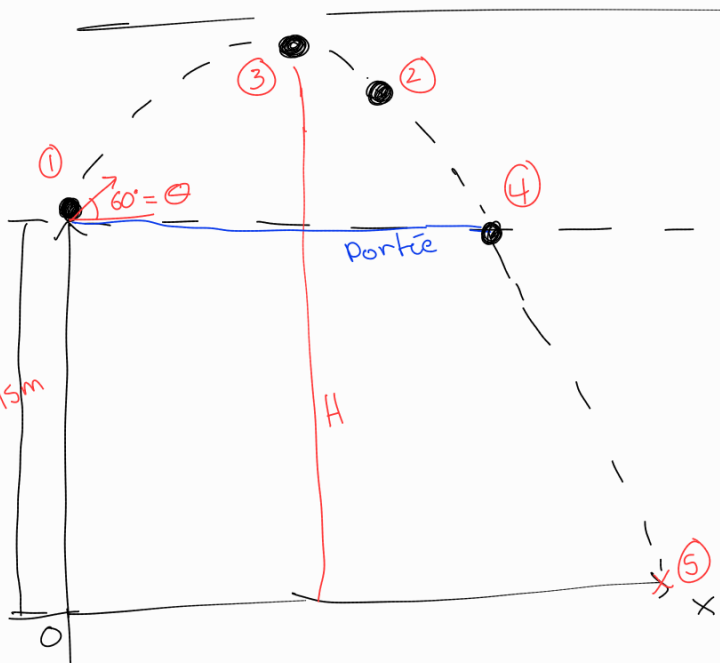
$$Q_2 = 60.1 \text{ m}$$

$$Q_3: v_2 = \sqrt{(v_{x2})^2 + (v_{y2})^2}$$

$$\text{direction} \quad \tan \theta = \frac{v_{y2}}{v_{x2}}$$



Exemple #3 Projectile



Données

$$V_0 = 30 \text{ km/s} = 10 \text{ m/s}$$

$$\theta = 60^\circ$$

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

	$t = 3 \text{ s}$	h_{max}	Portée	sol
①	②	③	④	⑤

$$\begin{array}{lllll} x_1 = 0 & x_2 = ? & x_3 = ? & x_4 = ? & x_5 = ? \\ y_1 = 15 & y_2 = ? & y_3 = ? & y_4 = y_1 & y_5 = 0 \end{array}$$

$$V_{x1} = V_0 \cos \theta \quad V_{x2} = V_{x1} \quad V_{x3} = V_{x1} \quad V_{x4} = V_{x1} \quad V_{x5} = V_{x1}$$

$$V_{y1} = V_0 \sin \theta \quad V_{y2} = ? \quad V_{y3} = 0 \quad V_{y4} = ? \quad V_{y5} = ?$$

$$t_1 = 0 \quad t_2 = 3 \text{ s} \quad t_3 = ? \quad t_4 = ? \quad t_5 = ?$$

3eq Zinc

Oinc

3inc

3inc

3inc

3inc

hauteur max