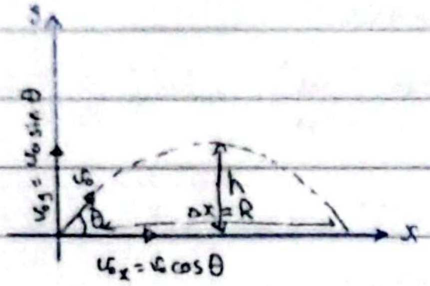
Monday 27/10/2025

* Projectile Motion [حركة المقذوفات] *



* $a_x = 0$
* $a_y = -g$

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x

$$\Delta x = v_{0x} t + \frac{1}{2} \cancel{\overset{(0)}{a_x} t^2}$$

$$\Delta x = v_{0x} t$$

$$\boxed{\Delta x = v_0 t \cos\theta} \qquad \boxed{t = \frac{\Delta x}{v_0 \cos\theta}}$$

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y

$$\Delta y = v_{0y} t - \frac{1}{2} g t^2$$

الإزاحة على محور y دائماً تساوي صفر ←

$$0 = \underset{v_0 \sin\theta}{v_{0y}} t - \frac{1}{2} g t^2$$

$$v_0 \cancel{t} \sin\theta = \frac{1}{2} g t^{\cancel{2}}$$

$$\boxed{v_0 \sin\theta = \frac{1}{2} g t} \qquad \boxed{t = \frac{2 v_0 \sin\theta}{g}}$$

$$t_x = t_y$$

$$\frac{\Delta x}{v_0 \cos\theta} = \frac{2 v_0 \sin\theta}{g}$$

$$\Delta x = \frac{2 v_0^2 \sin\theta \cos\theta}{g}$$

$\sin 2\theta = 2 \sin\theta \cos\theta$ maximum

$$\boxed{\Delta x = R = \frac{v_0^2 \sin 2\theta}{g}}$$ Range

* لا تستخدم لتقدير الزمن

Hight (max hight)

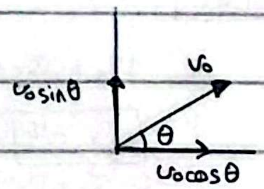
$$\Delta y = v_{0y} t - \frac{1}{2} g t^2$$

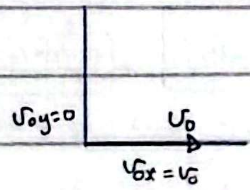
$$h = v_0 t \sin\theta - \frac{1}{2} g t^2 \quad \leftarrow \quad t = \frac{v_0 \sin\theta}{g}$$

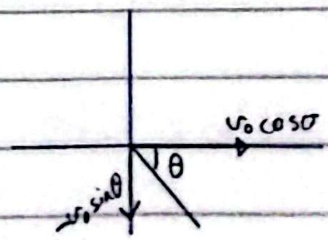
$$h = (v_0 \sin\theta)\left(\frac{v_0 \sin\theta}{g}\right) - \frac{g}{2}\left(\frac{v_0 \sin\theta}{g}\right)^2$$

$$= \frac{v_0^2 \sin^2\theta}{g} - \frac{1}{2} \frac{v_0^2 \sin^2\theta}{g}$$

$$\boxed{h = \frac{v_0^2 \sin^2\theta}{2g}}$$







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* maximum Range *

$$\boxed{R = \frac{v_0^2 \sin 2\theta}{g}}$$

we need to make $R_{max} \Rightarrow \sin 2\theta = 1$

$2\theta = 90$

$\boxed{\theta = 45^\circ}$

* ملاحظة مهم

الزاوية ومكملتها لـ 90 بيعطوا نفس Range .

problems

$\boxed{Q_{15}}$ page : 102

قذيفة / اطلقت

• A projectile is fired in such a way that its horizontal range is equal to three times its maximum height. what is the angle of projection? (زاوية)

$R = 3 h_{max}$

$$\boxed{h_{max} = \frac{v_0^2 \sin^2\theta}{2g}} \qquad \boxed{R = \frac{v_0^2 \sin 2\theta}{g}}$$

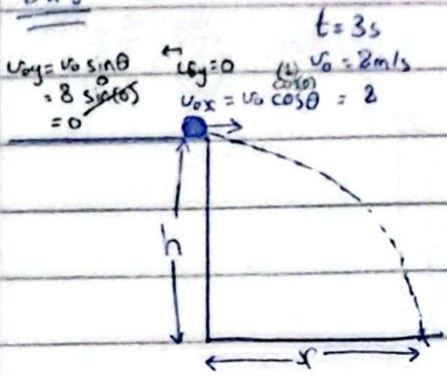
$$\frac{\cancel{v_0^2}\, 2 \sin\theta \cos\theta}{\cancel{g}} = \frac{3 \cancel{v_0^2} \sin^{\cancel{2}}\theta}{2 \cancel{g}}$$

$$\frac{\sin\theta}{\cos\theta} = \frac{4}{3} \Rightarrow \tan\theta = \frac{4}{3}$$

$$\theta = \tan^{-1}\frac{4}{3} \Rightarrow \boxed{\theta = 53.13^\circ}$$

ملاحظة

Ex :



① $x = ??$

② $h = ??$

① $\Delta x = v_{ox} t$

$= 8(3)$

$\boxed{\Delta x = 24 \text{ m}}$

② $h = \Delta y$

$\Delta y = \cancel{v_{oy}}^{(0)} t - \frac{1}{2} g t^2$

$= -\frac{1}{2}(9.8)(3)^2$

$\boxed{\Delta y = -44.1 \text{ m}}$

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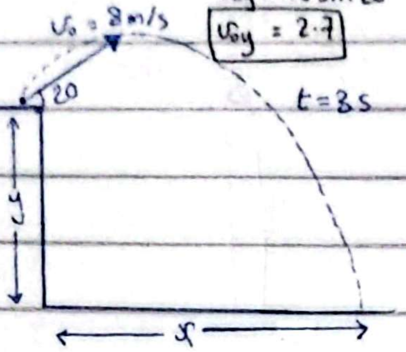
*** Homework ***

$v_{0x} = v_0 \cos 20$
$= (8)(0.93)$
$\boxed{v_{0x} = 7.5}$

$v_{0y} = v_0 \sin 20$
$\boxed{v_{0y} = 2.7}$

$\boxed{1}$



$x = ??$ / $y = ??$

① $\Delta x = v_{0x} t$

$= 7.5(3)$

$\boxed{\Delta x = 22.5}$

② $\Delta y = v_{0y} t - \frac{1}{2} g t^2$

$= (2.7)(3) - \frac{1}{2}(9.8)(3)^2$

$= 8.1 - 44.1$

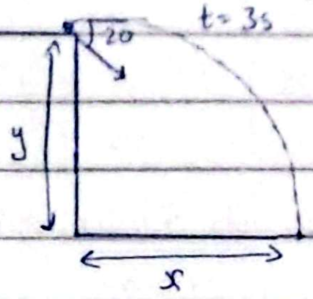
$\boxed{\Delta y = -36}$

$v_{0x} = v_0 \cos 20 = 7.5$

$v_{0y} = - v_0 \sin \theta = -2.7$

$V_0 = 8\ m/s$
$t = 3s$

$\boxed{2}$



$x = ??$ / $y = ??$

① $\Delta x = v_{0x} t = 22.5$

② $\Delta y = v_{0y} t - \frac{1}{2} g t^2$

$= (-2.7)(3) - \frac{1}{2} g t^2$

$\boxed{\Delta y = -52.2}$

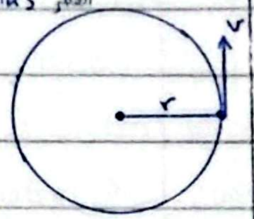
Subject Wednesday 29/10/2025

[جسيم في حركة دائرية منتظمة]

* Particle in A uniform Circular motion

r = radius نصف القطر

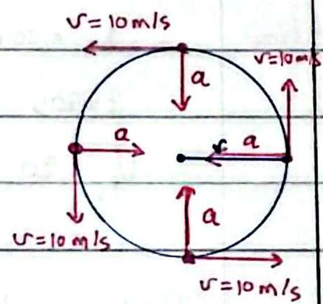
$\boxed{\vec{v}}$ → magnitude, direction



* Change in magnitude or/and direction ⇒ acceleration

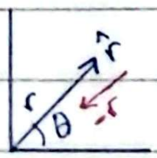
① magnitud is const

$|\vec{v}|$ is const.



a point يشير to the center

$$\boxed{|a_r| = \frac{v^2}{r}} \leftarrow a_c = \text{centripital}$$ مركزي



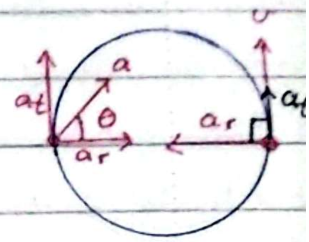
$$\boxed{a_r = -\frac{v^2}{r}\hat{r}}$$

اتجاه

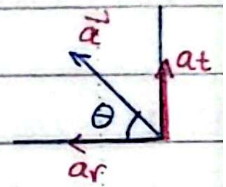
نحو المركز

② magnitud of v is variable متغير

a_t = tangential acceleration مماس



$$a = \sqrt{(a_t)^2 + (a_r)^2}$$



$$\theta = \tan^{-1}\left(\frac{a_t}{a_r}\right)$$

NOTEBOOK

Wednesday 29/10/2025

problems
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$\boxed{Q5}$ A golf ball is hit off a tee at the edge of cliff. It's x and y coordinates as functions of time are given by $x = 18t$ and $y = 4t - 4.9t^2$ t is in seconds.

(a) write a vector expression for the ball's position as a function of time, using the unit vectors $\hat{i}$ and $\hat{j}$.

position : $\vec{r} = x\hat{i} + y\hat{j}$

$\vec{r}(t) = (18t)\hat{i} + (4t - 4.9t^2)\hat{j}$

b) the velocity vector $\vec{v}$ as a function of time.

* velocity vector :

$\vec{v} = \frac{d\vec{r}}{dt}$

$\vec{v}(t) = 18\hat{i} + (4 - 9.8t)\hat{j}$

c) the acceleration vector $\vec{a}$ as a function of time.

* acceleration vector : $\vec{a} = \frac{d\vec{v}}{dt}$

$\vec{a}(t) = 0\hat{i} + (0 - 9.8)\hat{j}$

$\vec{a}(t) = -9.8\hat{j}$

d) Next use unit-vector notation to write expressions for the position, the velocity, and the acceleration of the golf at $t = 3s$.

$\vec{v}(3) = 18\hat{i} + -2.54\hat{j}$ / $\vec{r}(3) = 54\hat{i} + -32.1\hat{j}$

$\vec{a}(t) = -29.4\hat{j}$

problems
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$\boxed{Q9}$ A fish swimming in a horizontal plane has velocity $\vec{v}_o = (\overset{v_{ox}}{4}\hat{i} + \overset{v_{oy}}{1}\hat{j})$ m/s at a point in ocean where position relative to a certain rock is $\vec{r}_o = \overset{x_o}{10}\hat{i} - \overset{y_o}{4}\hat{j}$ m. After the fish swims with constant acceleration for 20 s, its velocity is $\vec{v}_f = 20\hat{i} - 5\hat{j}$.

$\boxed{x}$	$\boxed{y}$
$v_{ox} = 4$ m/s	$v_{oy} = 1$ m/s
$x_o = 10$ m	$y_o = -4$ m
$t = 20s$	$t = 20s$
$v_{fx} = 20$ m/s	$v_{fy} = -5$ m/s

(a) what are the components of the acceleration?

$\vec{a} = ??$

$\boxed{v_{fx} = v_{ix} + a_x t} \Rightarrow a_x = \frac{v_{fx} - v_{ix}}{t}$

$a_x = \frac{20 - 4}{20} = 0.8 \text{ m/s}^2$

$a_y = \frac{v_{fy} - v_{iy}}{t} = \frac{-5 - 1}{20} = -0.3 \text{ m/s}$

$\boxed{\vec{a} = a_x\hat{i} + a_y\hat{j}}$

$\vec{a} = 0.8\hat{i} - 0.3\hat{j}$

(b) what is the direction of its acceleration with respect to unit vector? $(0.8, -0.3)$ ع ١ / ١١

$\phi = \tan^{-1}\left(\frac{0.3}{0.8}\right) = 20.5$

$\theta = 360 - 20.5 = 339.5°$

wednesday 29/10/2025

(c) If the fish maintains constant acceleration, where is it at $t=25s$ and in what direction is it moving? $\vec{r}_f = ??$

$\Delta x = v_{0x} t + \frac{1}{2} a_x t^2$

$x_f - \overset{(10)}{x_0} = (4)(20) + \frac{1}{2}(0.8)(20)^2$

$\boxed{x_f = 250m}$

$\Delta y = v_{0y} t + \frac{1}{2} a_y t^2$

$y_f - \overset{(-4)}{y_i} = 1(20) + \frac{1}{2}(-0.3)(20)^2$

$\boxed{y_f = -44\ m}$

$\vec{r}_f = x_f \hat{i} + y_f \hat{j}$

$\boxed{\vec{r}_f = 250\hat{i} - 44\hat{j}}$

$v_{ix} = v_i$

$v_{iy} = 0$

$\Delta y = \cancel{\overset{(0)}{v_{iy}}} t - \frac{1}{2} g t^2$

$-40 = -(\frac{1}{2})(9.8) t^2$

$\boxed{t_p = 2.86s}$

$t_s = t - t_p$

$= 3 - 2.86$

$\boxed{t_s = 0.14s}$

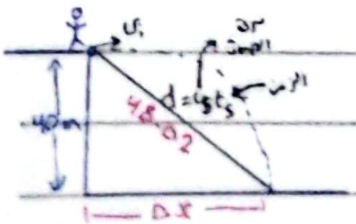
$d = \overset{v_s}{343}\ \overset{t_s}{(0.14)} = 48.02\ m$

problems
page 103+104

$v_{iy}=0$
$v_{ix}=v_i$

Q27 A soccer player kicks a rock horizontally off a 40 m high cliff into a pool of water. If the player hears the sound of splash 3s later, what was the initial speed given to the rock? Assume the speed of sound in air is $\boxed{343}$ m/s

$t = t_s + t_p$
sound projectil



$\Delta x = \sqrt{d^2 - y^2} = \sqrt{(48.02)^2 - (40)^2} = \sqrt{705}$

$\Delta x = 26.6\ m$

$v_i = ??$ المطلوب *

$\Delta x = v_{ix} t_p + \cancel{\frac{1}{2} \overset{(0)}{a_x} t^2}$

$26.6 = v_0\ 2.86$

$\boxed{v_0 = 9.3\ m/s}$