

الحركة في خط مستقيم

- Motion with constant acceleration الحركه مع ثبات العجله

$$F = \frac{dv}{dt} = a \rightarrow \text{constant}$$

$$\text{في كل حال} \quad dv = a dt$$

$$v = at + C_1 \quad t=0$$

$$C_1 = v_0 \quad v = v_0$$

قانون نيوتن

$$v = v_0 + at \rightarrow \textcircled{1}$$

$$\frac{dx}{dt} = v_0 + at$$

$$\int dx = \int (v_0 + at) dt$$

$$x = v_0 t + \frac{1}{2} at^2 + C_2$$

$$t=0, \quad x=0, \quad C_2=0$$

$$x = x_0 + v_0 t + \frac{1}{2} at^2 \rightarrow \textcircled{2}$$

$$C = x_0$$

$$F = \frac{v dv}{dx} = a$$

$$v dv = a dx$$

$$\frac{1}{2} v^2 = ax + C_3$$

$$v^2 = 2ax + 2C_3$$

$$\begin{aligned} t &= 0 \\ x &= 0 \\ v &= v_0 \end{aligned}$$

$$C_3 = v_0^2$$

$$v^2 = v_0^2 + 2ax \rightarrow \textcircled{3}$$

ex. A body moving with constant acceleration has a velocity of 12 m/s when  $x$  is 3 m if it moves a distance -5 m in a time 2 what the magnitude of its acceleration.

Solution

$$v = 12$$

$$x_0 = 3$$

$$x = -5$$

$$t = 2$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$-5 = 3 + 12 \times 2 + \frac{1}{2} a \times 4$$

$$a = -16 \quad \#$$

ex. A ball of mass 200 gm Falls Freely under gravity From a height of 50 m Find the time taken to Fall through a distance of 30 m that the acceleration  $g = 10 \text{ m/s}^2$



Solution

$$x = 30$$

$$x_0 = 0$$

$$t = ?$$

$$v_0 = 0$$

$$a = g$$

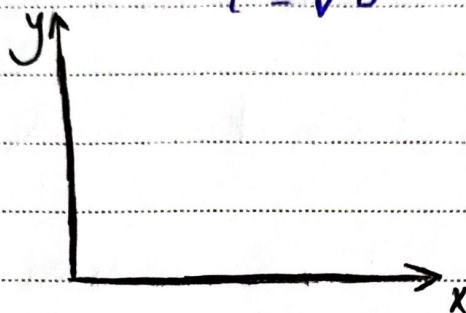
$$x = \frac{1}{2} a t^2$$

$$30 = \frac{1}{2} \times 10 t^2$$

$$t = \sqrt{\frac{30}{5}}$$

$$t = \sqrt{6} \quad *$$

Circle



$$r = x i + y j$$

$$|r| = \sqrt{x^2 + y^2}$$

$$v = x i + y j$$

$$x' = \frac{dx}{dt} \quad , \quad y' = \frac{dy}{dt}$$

المقدار  
Magnitude

$$|v| = \sqrt{x'^2 + y'^2}$$

الاتجاه direction

$$\tan^{-1} \frac{y'}{x'}$$

$$F = x'' i + y'' j$$

$$|F| = \sqrt{(x'')^2 + (y'')^2}$$

$$\tan^{-1} = \frac{y''}{x''}$$

ex<sub>3</sub> if the Parametric equation  $x = a(1 - \cos 2t)$

Prove that this Particle move with a constant acceleration

Solution

$$x' = 2a + 2a \cos 2t$$

$$y' = 2a \sin 2t$$

$$x'' = -4a \sin 2t$$

$$y'' = 4a \cos 2t$$

$$F = \sqrt{(-4a \sin 2t)^2 + (4a \cos 2t)^2}$$

$$F = \sqrt{16a^2 (\sin^2 2t + \cos^2 2t)} = \sqrt{16a^2} = 4a$$

ex<sub>4</sub> if the Parametric equation  $x = 5$ ,  $y = 20 - 5t^2$

Find the trajectory equation and Find the initial

velocity and the velocity when Passes through

the x-axis Finally Calculate the acceleration

Solution

$$t = \frac{x}{5}$$

$$y = 20 - \frac{x^2}{5} \rightarrow \text{is a parabola}$$



$$V = \dot{x}i + \dot{y}j$$

$$= 5i + -10tj$$

$$\therefore t = 2 \text{ s}$$

$$V = 5i$$

$$|V| = 5 \text{ — المطلوب الثاني}$$

$$20 + 5t^2 = 0$$

$$t = 2$$

$$V = 5i + -10tj$$

$$F = \ddot{x}i + \ddot{y}j$$

$$F = -10j$$

$$|F| = 10 \text{ — المطلوب الثالث}$$