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## Motion with constant acceleration

$$\Rightarrow F = \frac{dv}{dt} = a$$

$$\int dv = \int a dt$$

$$\begin{aligned} dv &= a dt & t=0 \\ v &= at + c_1 & v=v_0 \\ \therefore c_1 &= v_0 \end{aligned}$$

$$\Rightarrow v = v_0 + at$$

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

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

$$x = v_0 t + \frac{1}{2} at^2 + c_2$$

$$x_0 = 0 \quad t=0 \quad \therefore c_2 = 0$$

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

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

$$\int v dv = \int a dx$$

$$\frac{1}{2} v^2 = ax + c_3$$

$$v^2 = 2ax + c_3 \quad \therefore c_3 = v_0^2$$

$$\Rightarrow v^2 = v_0^2 + 2ax$$

EX]1  $v_0 = 12 \text{ m/s}$   $x_0 = 3 \text{ m}$   $x = -5$   $t = 2$

Find acceleration (a).

Soluz

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

$$-5 = 3 + (12 \times 2) + \frac{1}{2} a (2)^2$$

$$-5 = 3 + 24 + 2a \quad |a = -16|$$

EX]2  $m = 200 \text{ g}$   $h = 50 \text{ m}$   $x = 30 \text{ m}$   $g = 10 \text{ m/s}^2$

$v_0 = 0$   $x_0 = 0$  Find the time.

Soluz

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

$$30 = 0 + 0 + \frac{1}{2} 10 t^2$$

$$t^2 = \frac{70}{5}$$

$$t = \sqrt{14} \text{ s}$$