MOTION UNDER GRAVITY

The most important example of motion in a straight line with constant acceleration is motion under gravity.

The acceleration due to gravity can be considered constant ($g = 9.8\ m/s^2$) if the height of the body above ground is very small in comparison to the radius of esrth. As radius of earth is 6400km, in most of the cases in kinematics value of acceleration of gravity is taken constant.

Here we neglect the force due to air resistance i.e., viscous force and the thrust generated by air on the body.

For simplicity we will still use the basic equations of unifrmly accelerated one dimensional motion as:

(i) $v = u + at$ or $v = v_0 + at$:

(ii) $S = ut + (1/2)\,at^2$ or $x - x_0 = v_0\,t + (1/2)\,at^2$

(iii) $V^2 = u^2 + 2aS$ or $V^2 = v_0^{\,2} + 2a\,(x - x_0)$

(iv) $S_{nth} = u + (1/2)\,a(2n-1)$

[1] Body falling freely under gravity :

Taking initial position as origin and downward direction of motion as positive, we have

$u = 0$ [as body starts from rest]

$a = +g$ [as acceleration is in the direction of motion]

So, if the body acquires velocity v after falling a distance h in time t, equations of motion, viz.

$v = u + at$; $s = ut + \frac{1}{2}at^2$ and $v^2 = u^2 + 2as$

reduces to $v = gt$ ... (1) $h = \frac{1}{2}gt^2$ ..... (2) and $v^2 = 2gh$ ..... (3)

These equations can be used to solve most of the problems of freely falling bodies as if.