To determine potential energy of a body at a point, we first define a **reference point** at which the potential energy of the body is zero.

"The amount of potential energy possessed by a body at a point is the negative of the amount of work done by the conservative force to move the body from the reference point to the final point, where the body is present".

i.e.

$$U_p = - W_c \text{ (from ref. Point O to point P)} \quad ....(11)$$

or,

$$U_p = - \int_{x_0}^{x_p} F_C \cdot dx \quad ....(12)$$

Where x_0 is the position of the reference point

The amount of change in potential energy of a body between final position (f) and initial position (i) is equal to the negative of the work done by the conservative force to move the body from initial to final position.

i.e.

$$U_f - U_i = - - \int_{x_i}^{x_f} F_C \cdot dx ....(13)$$

$$\text{Or} \qquad F_c = -\frac{dU}{dx} \quad ....(14)$$

1. Gravitational Potential Energy:

The potential energy possessed by a body due to its presence in the gravitational field of earth is known as gravitational potential energy.

Generally for small height [h << Radius of earth], we consider the surface of earth as the reference level.

So, gravitational potential energy of a body at height a above surface of earth.