$$W = \int_{x_i}^{x_f} fx.dx \quad .....(4)$$

Important Cases:

Case 1. If θ is less than 90°, then cos θ = + ve and by(2) W = +ive

In this case work is said to be done by the force

Case 2. If θ is the equal to 90° , then cos θ = 0 and by(2) W = 0

If the force acting on the body is perpendicular to the displacement, no work is done by the force.

Case 3. If θ is more than 90° but $\theta \leq 180$, cos θ = -ve,

W = -ve

In this case work is said to be done against the force or it is done on the force.

Example 1: A particle is move by a force $\vec{F} = (3\hat{i} + 4\hat{j})$ N form point (2m, 3m) to (3m, 0m) in xy plane. Find the work done by the force on the particle? **Ans:** $-9J$

Solution: Let's first find out the displacement vector as

$$\vec{S} = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k} = (3-2)\hat{i} + (0-3)\hat{j}$$

Or $\vec{S} = \hat{i} - 3\hat{j}$

So, $W = \vec{F}.\vec{S} = (3\hat{i} + 4\hat{j}).(\hat{i} - 3\hat{j}) = 3 - 12 = -9J$

Example 2: A force acting on a body depends upon its position as F = 3x + 4N. Determine the work done by the force in moving the body from x = 2m to x = 4m. **Ans:** $W = 26J$