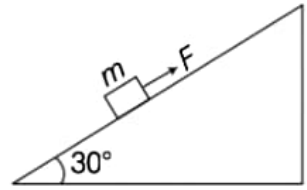
Q. A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 30° by a force of 10 N parallel to the inclined surface (figure). The coefficient of friction between block and the incline is 0.1. If the block is pushed up by 10 m along the incline, calculate



(a) work done against gravity

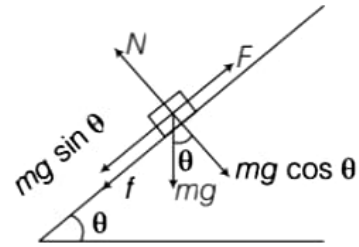
(b) work done against force of friction

(c) increases in potential energy

(d) increase in kinetic energy

(e) work done by applied force

Ans. Consider the adjacent diagram the block is pushed up by applying a force F.



Normal reaction (N) and frictional force (f) is shown.

Given, mass = m = 1 kg, $\theta = 30°$

F = 10 N, μ = 0.1 and s = distance moved by the block along the inclined plane = 10 m

(a) Work done against gravity = Increase in PE of the block

$= mg \times$ Vertical distance travelled

$= mg \times s (\sin \theta) = (mgs) \sin \theta$

$= 1 \times 10 \times 10 \times \sin 30° = 50$ J $\quad (\because g \leq 10 \text{ m/s}^2)$

(b) Work done against friction

$$wf = f \times s = \mu N \times s = \mu\, mg \cos \theta \times s$$
$$= 0.1 \times 1 \times 10 \times \cos 30° \times 10$$
$$= 10 \times 0.866 = 8.66 \text{ J}$$

(c) Increase in PE = $mgh = mg\ (s \sin \theta)$

$$= 1 \times 10 \times 10 \times \sin 30°$$
$$= 100 \times \frac{1}{2} = 50 \text{ J}$$

(d) By work-energy theorem, we know that work done by all the forces = change in KE

$$(W) = \Delta K$$
$$\Delta k = W_g + W_f + W_f$$
$$\Rightarrow \quad = -mgh - fs + FS$$
$$= -50 - 8.66 + 10 \times 10$$
$$= 50 - 8.66 = 41.34 \text{ J}$$

(e) Work done by applied force, $F = FS$

$= (10)(10) = 100$ J