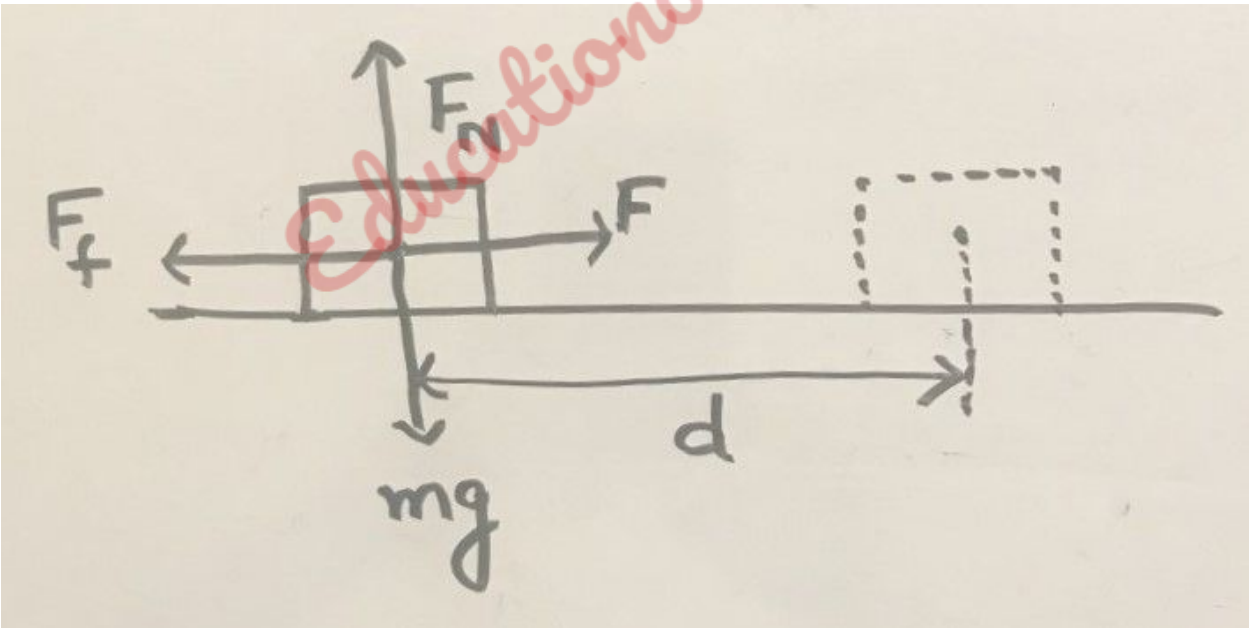
A 25 kg box is dragged 20-m across the floor. If the coefficient of kinetic friction between the floor and box is 0.12, calculate the magnitude of thermal energy that is created?



Given:

Mass of the box: $m = 25$ kg

Distance moved by the box: $d = 20$ m

Coefficient of kinetic friction; $\mu_k = 0.12$

Angle between the frictional force and direction of displacement: $\theta = 180^o$

Known:

Acceleration due to gravity: $g = -9.8\ m/s^2$

Determine: magnitude of thermal energy: E_T

Work done by the frictional force is dissipated as the thermal energy by the system.

Work done by frictional force:

$$W_f = \boldsymbol{F_f} \cdot \boldsymbol{d} = F_f \times d \times (\cos\theta) \text{ ---------- (1)}$$

$\boldsymbol{F_f} \cdot \boldsymbol{d}$ is the scalar product of frictional force vector $\boldsymbol{F_f}$ and displacement vector $\boldsymbol{d}$.

Frictional force F_f:

$$F_f = \mu_k F_N = \mu_k mg \text{ ----------(2)}$$

Then (1) becomes:

$$W_f = \mu_k \times m \times g \times d \times (\cos\theta) = 0.12 \times 25 \times |-9.8| \times 20 \times (\cos 180^o) = -588 \text{ J}$$

Magnitude of thermal energy generated by the box moving over the floor is:

$$\mathbf{E_T = |\, W_f \,| = |\, -588 \,| = 588 \text{ J}}$$