Kinetics of Particles-Work-Energy method

Work of a force = Component of force in the direction of motion × Distance moved

Work done = $F \times S$

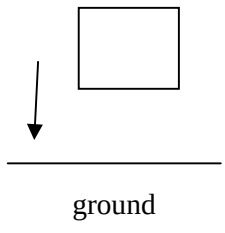
Energy

Energy is defined as the capacity to do the work. The energy is classified as

1. Potential Energy
2. Kinetic Energy

Potential Energy (P.E)

Potential Energy is the capacity to do work done to the position of the body.



Work done = Force × Distance

=Weight × Distance

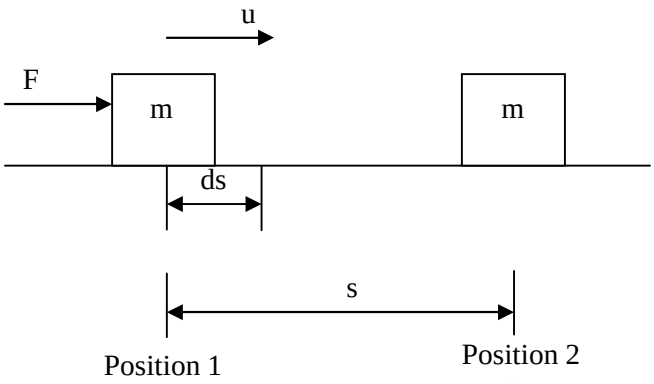
=mgh

Kinetic Energy (K.E)

Kinetic Energy is the capacity to do work due to the motion of the body.

$$K.E = \frac{1}{2} m v^2$$

Work-Energy Equation



$$U_{1-2} = \frac{1}{2} m v_2^2 - \frac{1}{2} m v_1^2$$

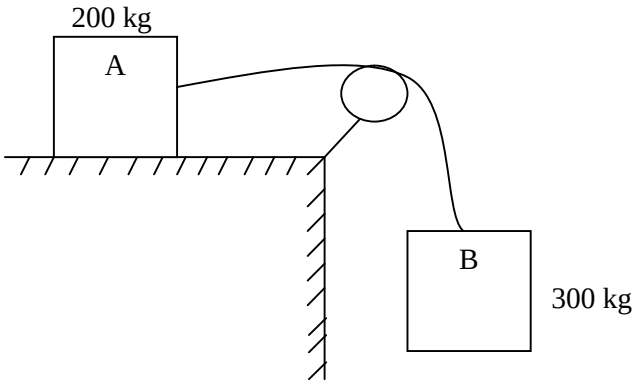
$$= \frac{1}{2} m (v_2^2 - v_1^2)$$

$U_{1-2} = T_2 - T_1$

T_1 – Initial Kinetic Energy
T_2 – Final Kinetic Energy

Problem:

Two blocks are joined by an inextensible cable. If the system is released from rest, it has moved 2m. Assume μ between block A and plane is 0.25.



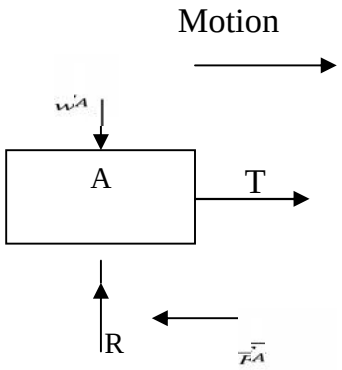
Solution:

FBD of block A

Resolving forces vertically

$$R = W_A$$

$$R = 200 \times 9.81 = 1962N$$



Applying Work Energy equation

$$U_{1-2} = T_2 - T_1$$

Work done U_{1-2}= Work done by T+ Work done by F

$$= (T \times 2) - (F_A \times 2)$$

$$= 2T - 2\mu R$$

$$= 2T - 2 \times 0.25 \times 9962$$

$$U_{1-2} = 2T - 981 \rightarrow (1)$$

Initial velocity of block A=0

Initial Kinetic energy $T_1 = \frac{1}{2}mv^2 = 0$

$$\text{Final Kinetic energy} = \frac{1}{2} \times 200 \times v^2 \rightarrow (2)$$

(1)=(2)

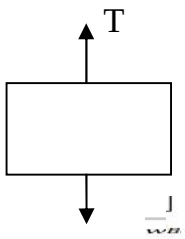
$$2T - 981 = 100v^2 \rightarrow (3)$$

FBD of block B

Resolving forces vertically

$$T = W_B$$

$$T = 300 \times 9.81 = 2940N$$



Applying work-energy equation

$$U_{1-2} = T_2 - T_1$$

$$U_{1-2} = work\ of\ W_B + Work\ of\ T$$

$$= 2W_B - 2T$$

Initial Kinetic energy $T_1 = 0$

Final Kinetic energy $T_2 = \frac{1}{2} m_B v^2$

$$2940 - 2T = \frac{1}{2} 300\ v^2 = 150v^2 \rightarrow (4)$$

Solving (3) and (4)

$$2[\quad 981 = 100$$

$$-2[\quad 5880 = 150$$

$$4900 = 250v^2$$

$$v = 4.43\ m/s$$