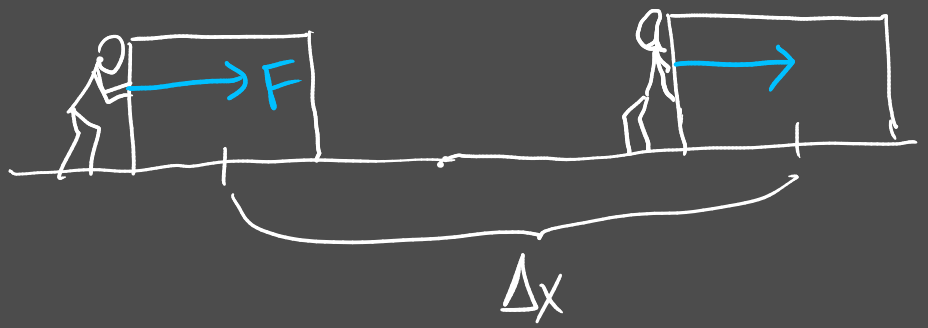
Chapter 6 - Work, Energy, Oscillations

→ Work = Force x distance → transfer of energy from one system to another

$W = F \cdot \Delta x$



$[N][m]$

$\left[\frac{kgm}{s^2}\right][m] = \left[\frac{kgm^2}{s^2}\right]$

= Joule

Energy - capacity to do work.

forms that energy can take:

* energy of motion - kinetic energy
* energy stored as the result of an interaction - potential energy
  * gravitational potential energy
  * spring potential energy
  * chemical potential energy - fuel, food
  * electric potential energy
* heat
* ~~light~~
* nuclear energy

Conservation of Energy

slight amendment

Total Energy before = Total Energy after

Total Energy before + Work in or out = Total Energy after

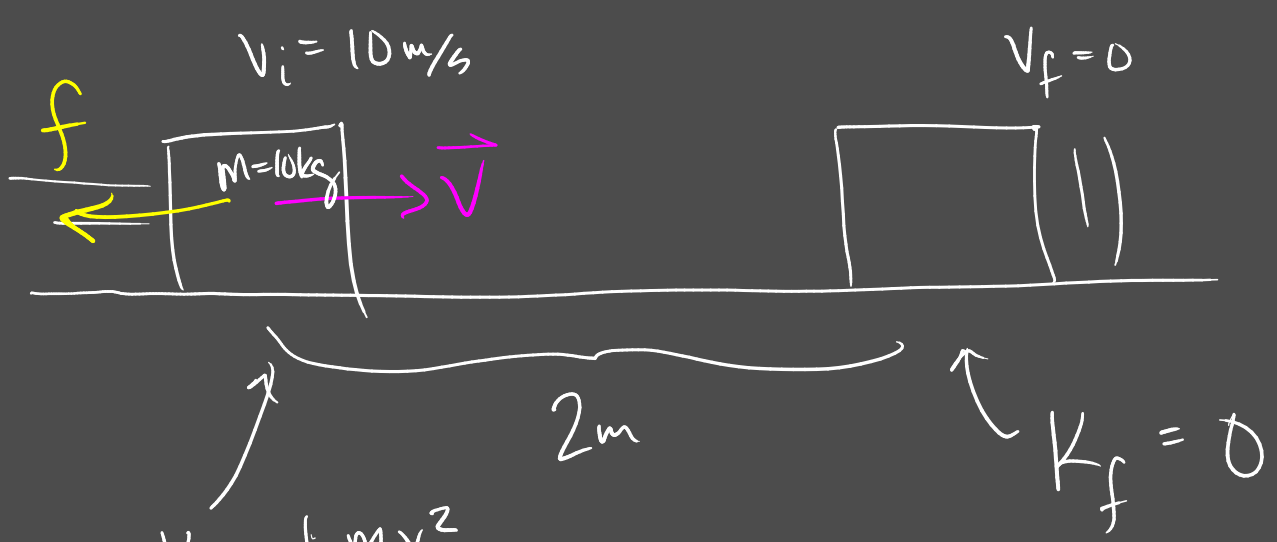
Kinetic Energy

Kinetic Energy = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$

$$K = \frac{1}{2}mv^2$$

$$[kg] \cdot \left[\frac{m}{s}\right]^2 = \left[\frac{kgm^2}{s^2}\right] = [\text{Joule}]$$

another unit [Calorie]



$K_i = \frac{1}{2} m v^2$

$= \frac{1}{2}(10kg)(10\ m/s)^2$

$K_i = 500\ J$

$E_i + W_{in/out} = E_f$ ← conservation of energy

$500J + W = 0$

$W = -500\ J$

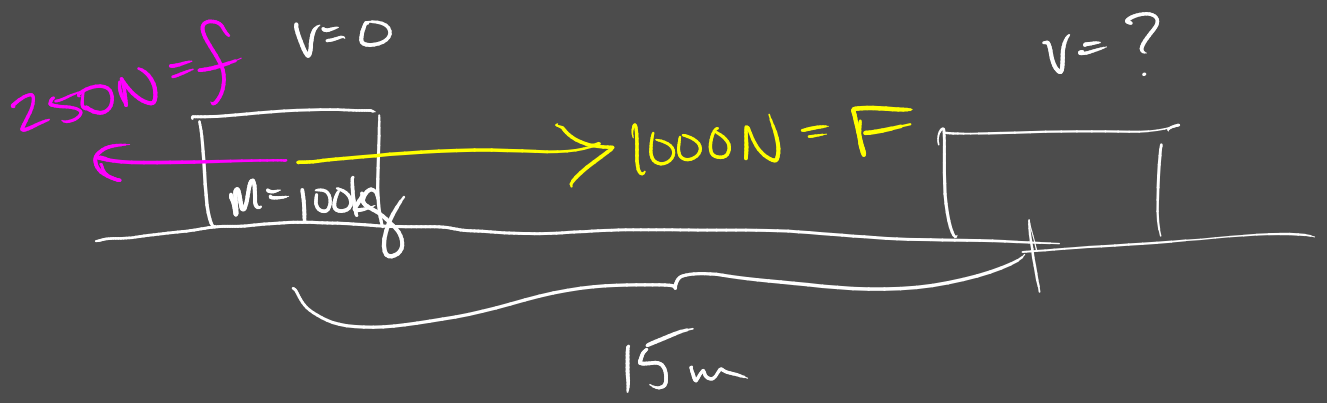
what frictional force does this?

$W = F \cdot \Delta x = -500J = f \cdot 2m$

$f = -250N$

500 J of energy has been removed from the system

friction always removes energy



$$\cancel{E_i}^{\,0} + W_{in/out} = E_f$$

$$W_{in} = 1000N \cdot 15m = 15000J$$

$$W_{out} = -250N \cdot 15m = -3750J$$

$$0J + 15000J - 3750J = E_f$$

$$11{,}250J = E_f = K_f$$

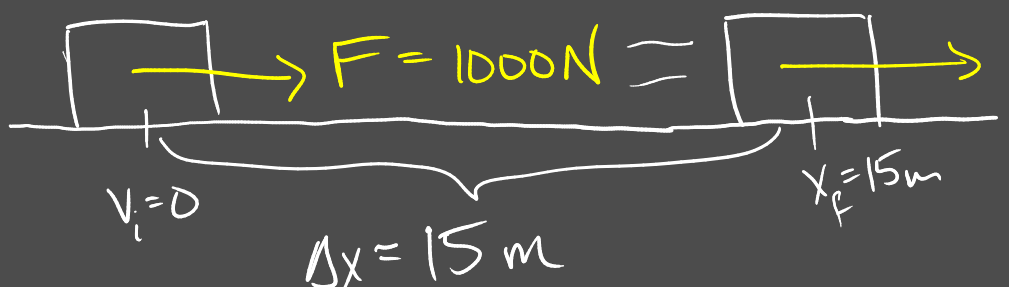
$$11{,}250J = \frac{1}{2}mv_f^2$$

$$11{,}250J = \frac{1}{2}(100kg)v_f^2$$

$$\sqrt{225} = \sqrt{v_f^2}$$

$$\boxed{v_f = 15\ m/s}$$

$m = 100\,kg$ $\qquad$ $v_f = ?$



$$K = \frac{1}{2}mv^2$$

$$E_i + W = E_f$$

$E_i = 0$

$$W = E_f - \cancel{E_i}^{\,0}$$

$$W = E_f$$

$$W = F \cdot \Delta x = 1000\,N \cdot 15\,m$$

$$W = 15{,}000\ J$$

$$15000J = E_f = K_f$$

$$15000\,J = \frac{1}{2}mv_f^2$$

$$15000J = \frac{1}{2}(100kg)v^2$$

$$\frac{1500\cancel{0}}{5\cancel{0}} = \frac{50\,v^2}{\cancel{50}}$$

$$\sqrt{300} = \sqrt{v^2}$$

$$\boxed{v = 17.3\,m/s}$$