

# Kinetic Energy + the Work-Energy Theorem.

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

$$W = \Delta E_k \quad (\text{Work-Energy Theorem})$$

$$W = F \Delta d \cos \theta$$

PP|245-46

26.  $m = 1250 \text{ kg}$

$v_1 = 25 \text{ km/h} \times \frac{1000}{3600} = 6.9 \text{ m/s}$

$v_2 = 0$

$\Delta d = 10 \text{ m}$

$F_f = ?$

$$W = \Delta E_k$$

$$F \Delta d \cos \theta = E_{k2} - E_{k1}$$

$$F \Delta d \cos \theta = -E_{k1}$$

$$F \Delta d \cos \theta = -\frac{1}{2}mv^2$$

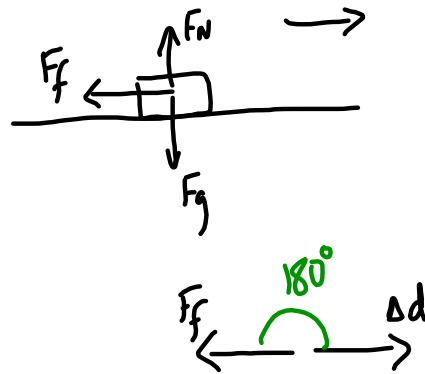
$$F(10\text{m}) \cos 180^\circ = -\frac{1}{2}(1250\text{kg})(6.9\text{m/s})^2$$

$$F(10) \cancel{(-1)} = \cancel{30140\text{J}}$$

$$F = 3.0 \times 10^3 \text{ N}$$

↑ magnitude of frictional force.

If you double the speed  
 then you quadruple the energy  
 which means you need 4 times the frictional force  
 or  
 4 times the distance for braking.



## 96-3 Potential Energy + the Work-Energy Theorem

### Gravitational Potential Energy

$$E_g = mgh$$

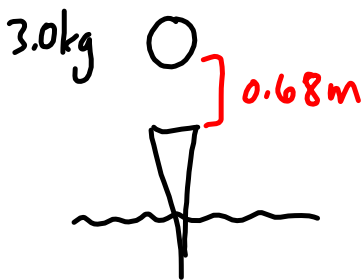
Where  $E_g$  is the gravitational potential energy (J)

$m$  is the mass (kg)

$h$  is the height above a certain reference level (m)

$g$  is the acceleration due to gravity ( $9.81 \text{ m/s}^2$ )

MP/249



$$E_g = mgh$$

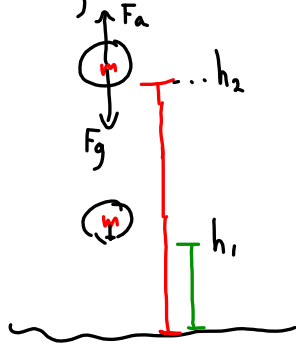
$$E_g = (3.0 \text{ kg})(9.81 \text{ m/s}^2)(0.68 \text{ m})$$

$$E_g = 2.0 \times 10^1 \text{ J}$$

The gravitational potential energy is  $2.0 \times 10^1 \text{ J}$  relative to the tent peg.

Consider the work done in order to change an object's potential energy.

Lifting a mass:



$$W = F_{||} \Delta d$$

$$W = F_a \Delta d$$

$$W = F_g \Delta d$$

$$W = mg(h_2 - h_1)$$

$$W = mgh_2 - mgh_1$$

$$W = E_{g2} - E_{g1}$$

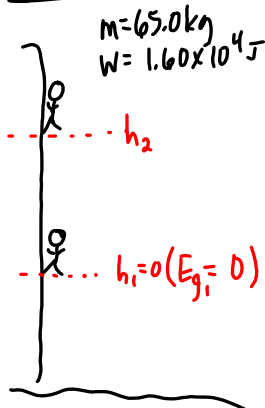
$$W = \Delta E_g$$

Work-Energy Theorem

$W = 25J$  {  $E_{g2} = 75J$   
 $E_{g1} = 50J$

The work is equal to the change in gravitational potential energy.

MP|252



$$W = \Delta E_g$$

$$W = E_{g2} - E_{g1}$$

$$W = mgh_2$$

$$h_2 = \frac{W}{mg}$$

$$h_2 = \frac{1.60 \times 10^4 \text{ J}}{(65.0 \text{ kg})(9.81 \text{ m/s}^2)}$$

$$h_2 = 25.1 \text{ m}$$

The rock climber ascended 25.1m. (i.e. they are 25.1m higher than where they started)

TO DO

① PP|250 → Hint:

② PP|254

$$1 \text{ cm}^3 = 1 \text{ mL} = 1 \text{ g}$$

