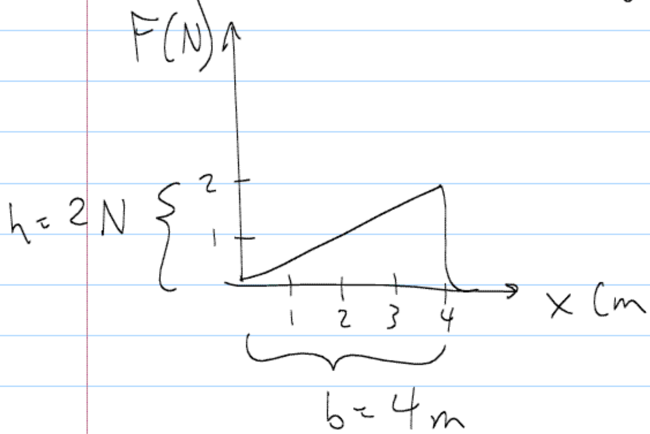
PHY131 - Class 16 - Wed. Nov. 9, 2011

Work is transfer of mechanical energy via forces.

Side note → Heat is transfer of thermal energy from hot to cool objects.



$$W = \int_{x_i}^{x_f} F\,dx$$

= area under curve of F vs. x.

Triangle: $a = \frac{1}{2} b h$

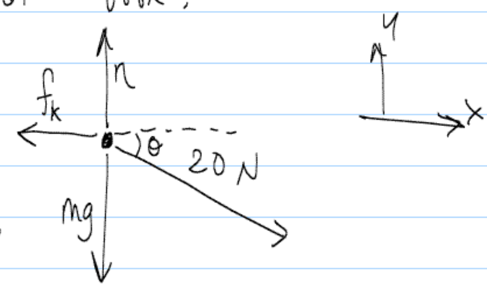
$$W = \frac{1}{2}(4m)(2N)$$

$$= 4\ N\cdot m = 4\ J$$

For constant force on a moving object: $W = F \cdot \cos\theta \cdot \Delta r$

<u>Example</u>

f.b.d. of book:



<u>Note:</u>

$a_y = 0$

$\Rightarrow (F_{Net})_y = 0$

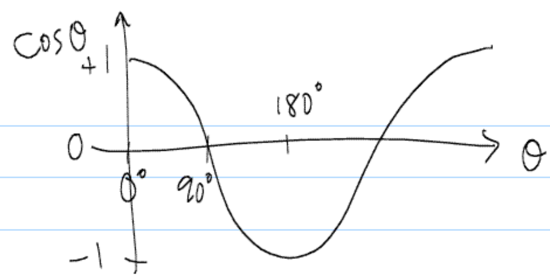
$0 = n - mg - 20 \sin 30°$

$\Rightarrow n = mg + 20 \sin 30°$ $\quad n \neq mg!!$

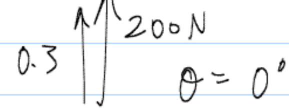
→ We want work done by Harlow's push.

$W = F \cos\theta$ or $= 20 \cos 30° (0.8m)$

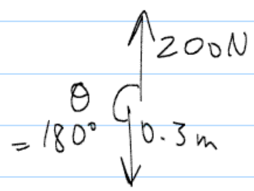
$W = 14\ J$, → $W = 10\ J$ to 1 sig. fig.



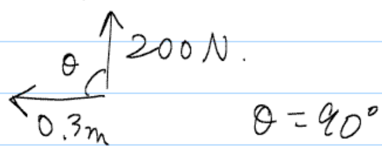
Ex. 1



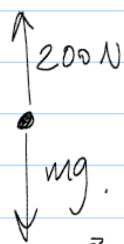
Ex. 2



Ex. 3



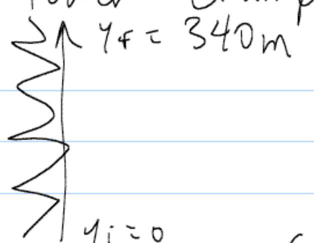
fbd of barbell:



$\vec{a} = 0 \Rightarrow \vec{F}_{net} = 0$

$\Rightarrow mg = 200N.$

CN Tower Example.



Minimum energy required to climb is

$\Delta U_g = mg(y_f y_i)$

(This neglects losses due to heat).

$\Delta U_g = (70\text{ kg})(9.8\,\text{m/s}^2)(340 - 0)$

$E_{min} = 2.3 \times 10^5\,\text{J} \left(\dfrac{1\text{ Calorie}}{4186\text{ J}}\right)$

$= 56$ food Calories.

$m_{fat} = E_{min} \left(\dfrac{1\text{g}}{9.4\text{ Calories}}\right)$

$= 5.9$ grams $= 5.9 \times 10^{-3}$ kg

$\left[\dfrac{2.2\text{ lbs}}{1\text{ kg}}\right] = 0.01$ lbs.

Work - Kinetic energy theorem.

$$\Delta K = W_c + W_{diss} + W_{ext.}$$

W_c: work done by conservative forces (ie gravity)

W_{diss}: work done by dissipative forces (ie friction)

$$P_{avg.} = \frac{\Delta E}{\Delta t}$$

S.I. units Watt = $\frac{\text{Joules}}{\text{second}}$

$$\Delta E = P \cdot \Delta t$$

1 kWhr = 1000 W (60 s)(60 m)
= 3.6×10^6 Joules. ← this costs 10 cents!

Example

Dryer runs at 1500 Watts for 1 hour. How much does this cost?

$$\$ = \Delta E \times \frac{10¢}{\text{kWh}} = 1.5\,\text{kW} \cdot 1\,\text{hr} \cdot 10¢$$

15 ¢ . . .