Chapter 6 - Work, Energy + Power

§6-1 Work

- work is not energy but it is the transfer of energy
- work is done if a force acts in the direction of the displacement

$$W = F_{\parallel} \Delta d \quad \text{(scalar)}$$

where W is the work done ($1J = 1N \cdot m$)

$F_{\parallel}$ is the force in the direction of the displacement (N)

Δd is the displacement (m)

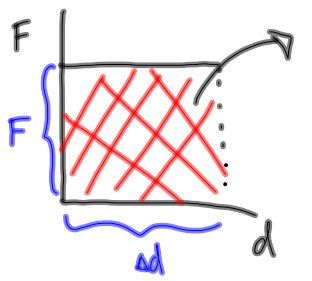
No work is done when: (See p222-223)

① there is no displacement ($\Delta d = 0$)

② there is no force (constant velocity) ($F_{\parallel} = 0$)

③ the force is perpendicular to Δd

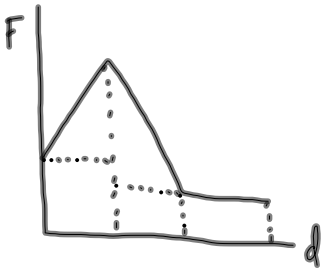
Consider a F-d graph:

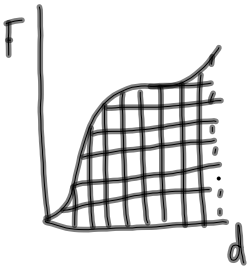


area of rectangle = l x w

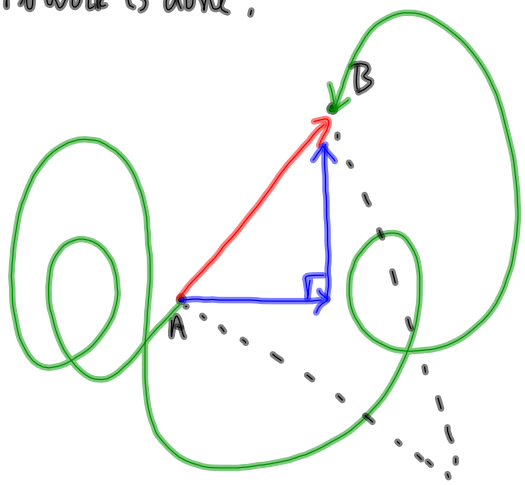
area = $F \Delta d$

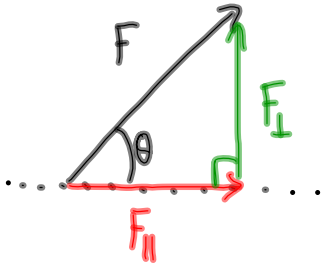
∴ W = area under a F-d graph





What if the force acts at an angle? Does this mean that no work is done?





$\cos\theta = \frac{adj}{hyp}$

$\cos\theta = \frac{F_{||}}{F}$

Recall: $W = F_{||}\Delta d$ $\quad$ $F_{||} = F\cos\theta$

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

$\boxed{W = F\Delta d\cos\theta}$

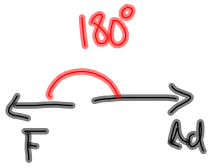
If $\theta = 0°$ $\quad$ $\theta = 0°$ F, Δd (F is in the same direction as Δd)

Maximum work.

If $\theta = 90°$ 

(F is perpendicular to Δd)

ZERO WORK.

If $\theta = 180°$ 

(F is opposite the Δd)

NEGATIVE WORK.

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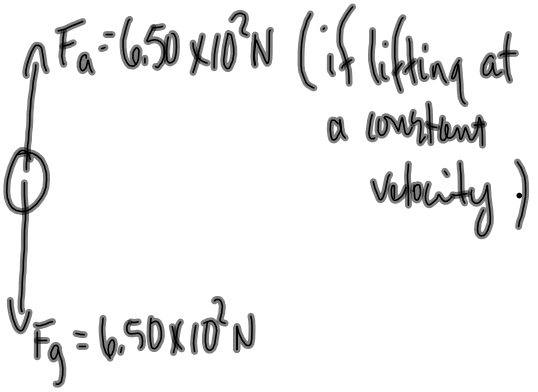
$F_g = 6.50 \times 10^2 N$

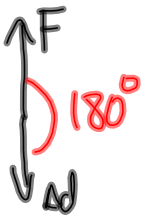
$\Delta d = 0.55 m$

a) W = ? (lifting)

b) W = ? (lowering)



a)  $\theta = 0°$ (lifting)

b) lowering: 

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

$W = (6.50 \times 10^2 N)(0.55 m)$

$W = 3.6 \times 10^2 J$ POSITIVE WORK.

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

$W = (6.50 \times 10^2 N)(0.55 m)\cos 180°$

$W = -3.6 \times 10^2 J$ NEGATIVE WORK

TO DO:

① PP|225

② Look over MP|227

③ PP|229|11

④ PP|235