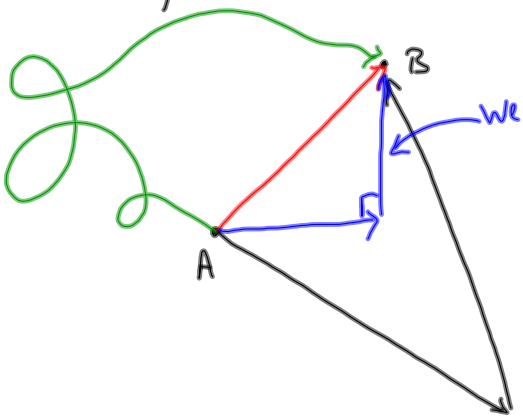
Work

- $W = F_{\parallel} \Delta d$
- W is area under F-d graph
- Situations when no work is done.

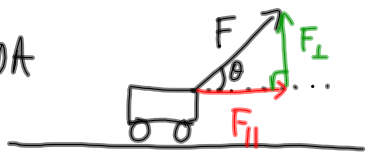
What happens when the force is acting at an angle?

Consider that you want to go from A to B:



Consider a force that acts at angle θ to horizontal:

SOH CAH TOA



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

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

$F_{\parallel} = F\cos\theta$

Recall: $W = F_{\parallel} \Delta d$

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

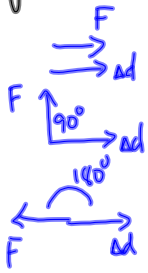
$W = F\Delta d\cos\theta$

A more general expression for work.

Maximum work occurs when $\theta = 0°$

Zero work occurs when $\theta = 90°$

Negative work is done when $\theta = 180°$



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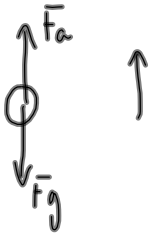
$F_g = 6.50 \times 10^2 N$

$\Delta d = 0.55 m$

a) $W = ?$ (lifting)

b) $W = ?$ (lowering)

a)



$F_a = F_g$

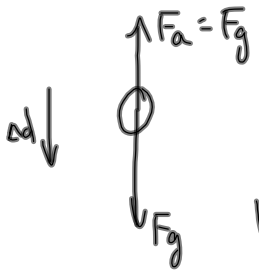
$W = F_{\parallel} \Delta d$

$W = F_g \Delta d$

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

$W = 3.6 \times 10^2 J$

b) lowering:

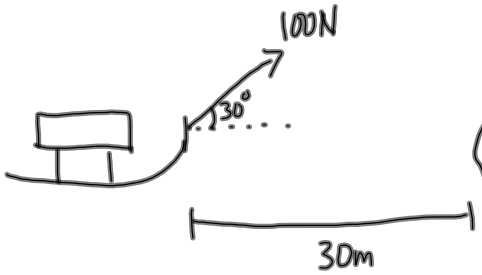


$W = F \Delta d \cos\theta$

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

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

Example



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

$W = (100N)(30m)\cos 30^\circ$

$W = 2.6 \times 10^3 J$

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