Addition to Kepler's 3rd law

$\Sigma F = ma$

$G\frac{mM}{r^2} = m\frac{v^2}{r}$

$v = \frac{2\pi r}{T}$

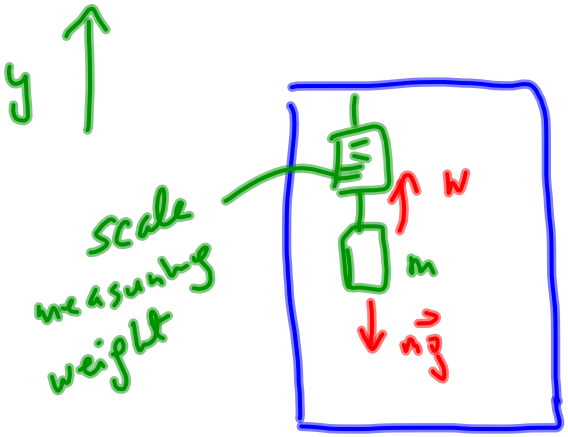
$G\frac{M}{r^2} = \frac{4\pi^2 r}{T^2}$

$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$

- planet 2 repeat $\Rightarrow$ $\frac{T_1^2}{T_2^2} = \frac{r_1^3}{r_2^3}$

M sun
m planet
T period
r distance

Weightlessness



$\sum \vec{F} = m\vec{a}$

1) $a = \frac{1}{2}g \uparrow$

$W - mg = m \cdot \frac{1}{2}g$

$W = \frac{3}{2}gm$

2) $a = 0$

$W = mg$

3) $a = -\frac{1}{2}g \downarrow$

$W - mg = -m \cdot \frac{1}{2}g$

$W = \frac{1}{2}mg$

4) $a = -g$

$W = 0$

$W - mg = -mg$

$W = 0$

apparent weightlessness

Work

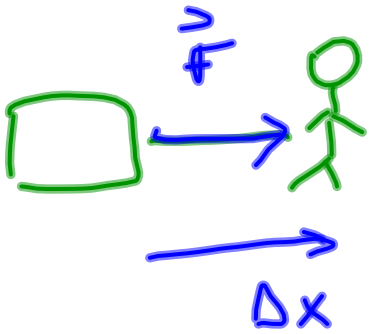
Work - carrying furniture
pushing / moving furniture
- heavier the furniture => more work we need to do

1D (dimensional) work done on the object by constant applied force is:

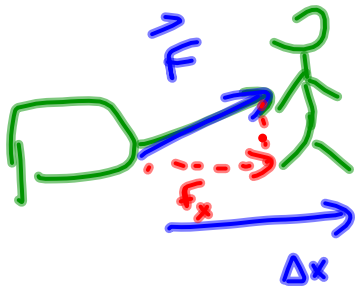
$$W = F_x \Delta x$$

Δx object's displacement

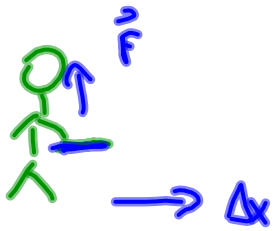
[Nm = J] Joule 19th century British scientist



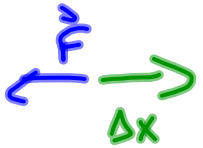
$W = F_x \Delta x$



$W = F_x \Delta x \qquad F_x \neq F$



$W = 0$ because $F \perp \Delta x$



$W < 0$

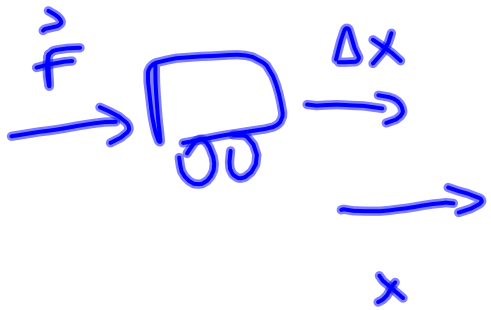
Force acting in the same direction as an object's motion does the positive work $W > 0$

Force acting in the opposite direction does the negative work $W < 0$

If $\vec{F} \perp \Delta x$ no work

Example

The person pushes with a force of 650 N moving the car a distance of 4.3 m. How much work does he do?

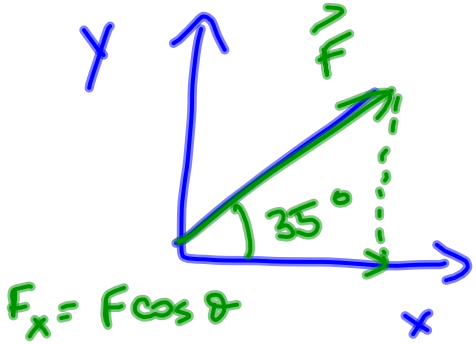


$$W = F_x \Delta x = 650\,N \cdot 4.3\,m$$
$$= 2.8\,kJ$$

kilo 10^3

Ex 2

The airline passenger exerts 60 N force on her suitcase pulling at 35° degree angle to the horizontal. How much work does she do in pulling the suitcase 45 m on a level floor?



$$W = F\cos\theta \cdot \Delta x$$
$$= 60\,N \cdot \cos 35^\circ \cdot 45\,m$$
$$= 2.2\,kJ$$

W - Speare $W = F \cdot \Delta x$

$\Delta x = 150\ m$

$W = 92\ kJ$

W - office

$W = 96\ kJ$

W - Statue & back

$W = 0$

$\Delta x = 48\ m$

$W = 35\ kJ$

W - bk ....

$\Delta x = 85\ m$

$W = 59.5\ kJ$

W - Fidel & back $\boxed{W = 0}$!!!