Work, energy, and power

SPH3U

Mechanical work (W)

- applying a force on an object that displaces the object in the direction of the force or a component of the force

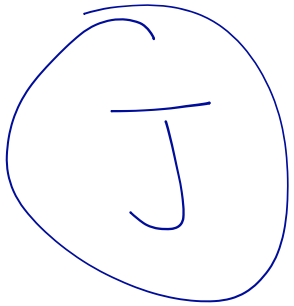
$$W = F \triangle d$$

- when describing work mention the object that does the work and the object that work is done on

Units of work

$$W = F \Delta d$$

$1\ J = 1\ N \cdot 1\ m$



- Force – N
- distance – m
- N x m = Nm
- 1 Nm = 1 Joule
- Joule – J
- the amount of energy required to accelerate an object of mass 1 kg by 1 m/s^2 over a distance of 1m

Work done (force and displacement in same direction)

- A curler applies a force of 15.0 N on curling stone and accelerates the stone from rest to a speed of 8.00 m/s in 3.50 s. Assume friction to be negligible. How much work does the curler do on the stone?

Given: $F = 15.0\ N$

$v_1 = 0\ m/s$

$v_2 = 8.00\ m/s$

$\Delta t = 3.50\ s$

Required: W = Work

Analysis: $W = F\Delta d$

$\Delta d = \left(\frac{v_2 + v_1}{2}\right)\Delta t$

Steps: $\Delta d = \left(\frac{8\ m/s + 0\ m/s}{2}\right)3.50\ s$

$\Delta d = (4\ m/s)(3.50\ s)$

$\Delta d = 14\ m$

$W = F\Delta d$

$= (15\ N)(14\ m)$

$= 210\ Nm$

$W = 210\ J$

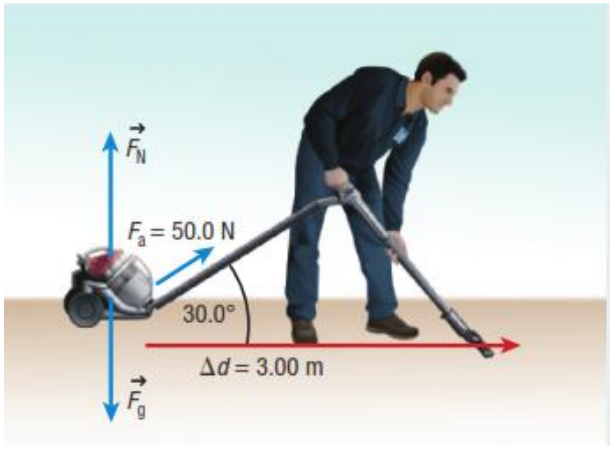
Work done (force and displacement different directions)

- an object may experience a force in one direction but move in a different direction

$\cos 90^0 = 0$

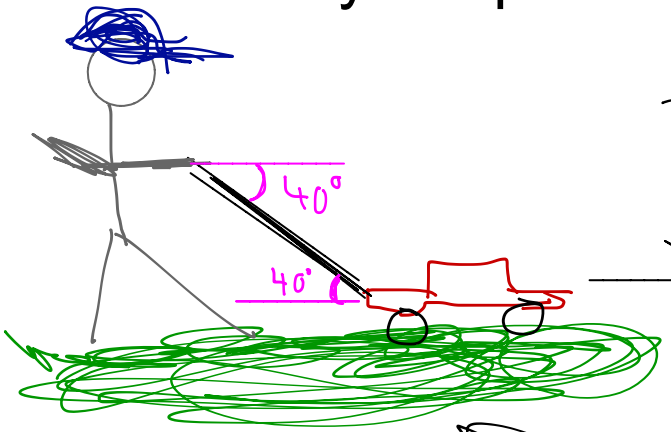
- the work done by a force is zero when the force's direction is perpendicular to the object's displacement

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



Work Done (Force and displacement in different directions)

- A person cutting a flat lawn pushes a lawnmower with a force of 125 N at an angle of 40.0^0 below the horizontal for 12.0m. Determine the mechanical work done by the person on the lawnmower.



Given: $F = 125\ N$

$\Delta d = 12.0\ m$

$\theta = 40.0^0$

Required: $W = Work$

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

$W = (125\ N)(\cos 40^\circ)(12m)$

$W = 1149\ Nm$

$W = 1150\ J$

Positive and negative work

- Objects can experience several forces at the same time.
- Total work done is equal to the algebraic sum of the work done by all of the forces acting on the object

Positive and Negative work

- Adam pushes a bowl of cereal along a level counter a distance of 1.3 m. What is the net work done on the bowl if Adam pushes the bowl with a force of 4.5 N and the force of friction between the bowl and the counter is 2.8 N ?

Questions

- Pg. 229 #1-5,7,11

Read pgs 222-228