Unit 3: Circular Motion, Work and Energy

3.9 Work and Power

We know work is the change in energy but what is power?

Power - the rate of change of work

Recall from Math 10C that "rate of change" means slope.

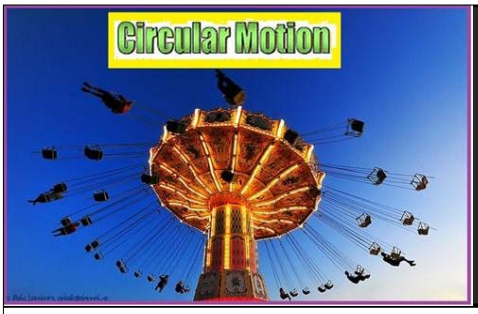
Another way to describe power is "the amount of energy per second applied."

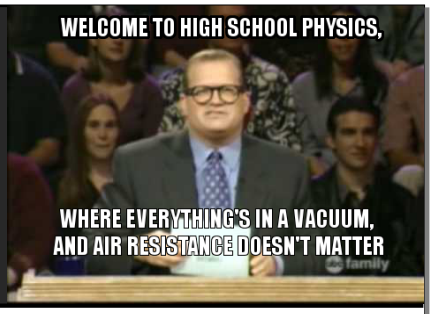
$$P = \frac{\Delta E}{\Delta t} = \frac{W}{\Delta t}$$

P = power (J/s = Watt(W))
W = work (J)
E = energy (J)
t = time (s)

Power was traditionally measure with the unit: horsepower (I'm sure you can imagine why) but this was cumbersome and thus replaced with the Watt.

1 hp = 746 W



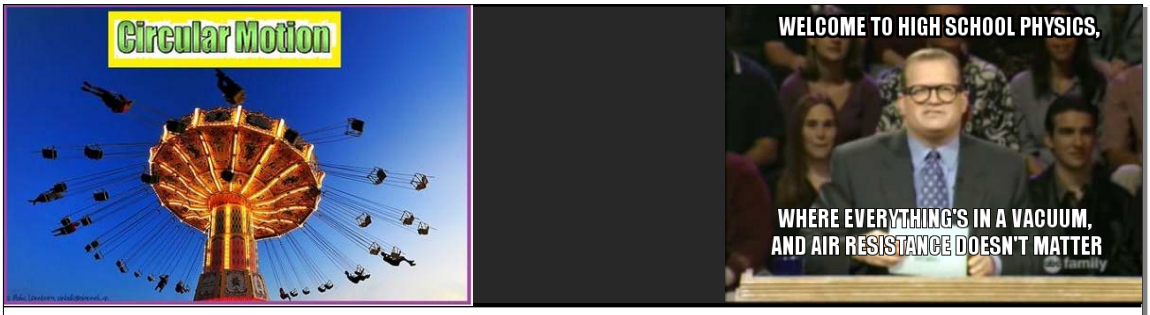


Note that when you are given the Power formula; P = W/Δt, you can derive different formulas not on the formulas sheet. This is because we have a couple formulas for work; W = Fd, W = mad. One useful derivation is shown:

$$P = \frac{W}{\Delta t}$$

$$P = \frac{\vec{F}\vec{d}}{\Delta t}$$

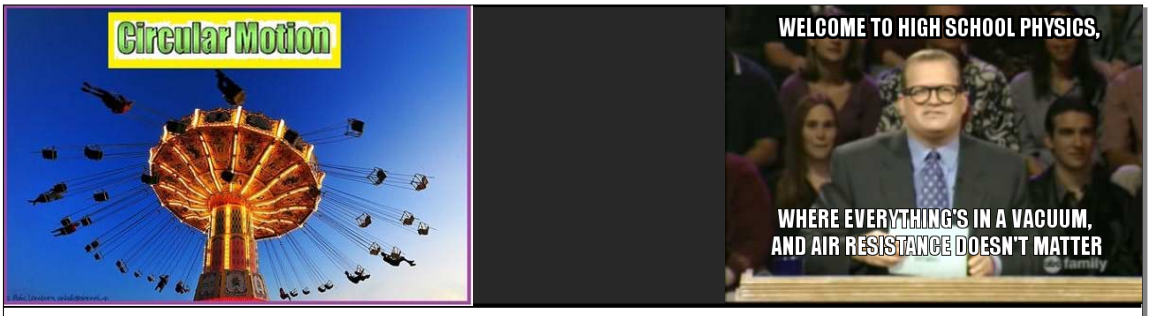
$$P = \vec{F}\vec{v}$$



Ex.) You lift a 25.0 kg box to your waist (0.800 m) in 1.20 s. What is your power output?

$$P = \frac{W}{\Delta t} = \frac{Fd}{\Delta t} = \frac{mad}{\Delta t} = \frac{(25.0)(9.81)(0.800)}{1.20\text{s}}$$

$$= \boxed{164\text{ W}}$$



Ex.) A plane's engine exerts a thrust of 1.20×10^4 N to maintain a speed of 450 km/h. What power is the engine generating?

125 m/s

$$P = \frac{W}{\Delta t} = \frac{Fd}{\Delta t} = Fv = (1.20 \times 10^4)(125)$$

$$= \boxed{1.50 \times 10^6\text{ W}}$$