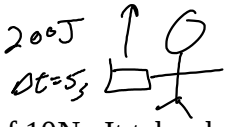
Name: KEY 11/29/11

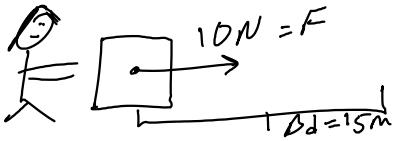
Assignment #13: Power!

1. Victoria does 200 Joules of work lifting a dictionary in 5 seconds. What was her power?

$P = \frac{W}{\Delta t} = \frac{200J}{5s} = \boxed{40\ W}$

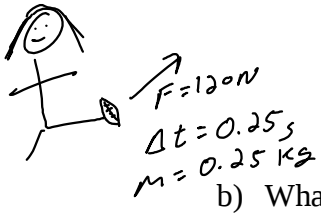



2. Desiree pushes a box 15 meters across the floor using a force of 10N. It takes her 20 seconds to push the box. What is her power output?




$P = \frac{W}{\Delta t} = \frac{F \cdot \Delta d \cdot \cos\theta^{2}}{\Delta t} = \frac{10N \cdot 15m}{20s} = \boxed{7.5\ W}$

3. Diana kicks a 0.25 kg football. Her foot exerts a force of 120N on the ball, and is in contact with it for 0.25 seconds. During that time, the football moves a distance of 1.2 meters.
   a) What is the amount of Power that she uses?




$P = \frac{W}{\Delta t} = \frac{F \cdot \Delta d \cdot \cos\theta^{1}}{\Delta t} = \frac{120N \cdot 1.2m}{0.25} = \boxed{576\ W}$

   b) What is the impulse delivered to the football?

$I = F \cdot \Delta t = \boxed{30\ kg\,m/s}$

   c) What is the final speed of the football?

$KE_i^{0} + KE_i^{0} + W = PE_f^{0} + KE_f$

$W = KE_f$

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

$W = P \cdot \Delta t = KE_f$

$P \cdot \Delta t = \frac{1}{2} m v_f^2$

$v_f = \sqrt{\frac{2P \cdot \Delta t}{m}} = \sqrt{\frac{2(576W)(0.25s)}{0.25kg}} = \boxed{33.94\ m/s}$

4. Julinn crushes a soda can under her foot, using a force of 40N. She takes 0.5 second to crush the can. Her power was 1.2 Watts. What was the distance that the can collapsed?


$P = \frac{W}{\Delta t} = \frac{F \cdot \Delta d}{\Delta t}$

$\frac{P}{F} \cdot \Delta t = \Delta d = \frac{1.2W}{40N} \cdot 0.5s = \boxed{0.015\ m}$

5. Christina pushes a box with a force of 50N directly to the right. It travels along a ramp that is 15 degrees above horizontal. If the box moves 2 meters to the right, and it takes her 5 seconds,
   a) What is the amount of work that Christina did?

$W = F \cdot \Delta d \cdot \cos\theta = 50N \cdot 2m \cdot \cos 15^\circ = 96.593\ J$

   b) What is Christina's power output?

$P = \frac{W}{\Delta t} = \frac{96.593\ J}{5s} = 19.319\ W$

6. Jasmin pushes a 5 kg box 20 meters in 15 seconds, using a constant force. How much power does she use?

Assume $V_i = 0\ m/s$

$V_{avg} = \frac{\Delta d}{\Delta t} = \frac{20m}{15s} = 1.33\bar{3}\ m/s$

$V_{avg} = \frac{V_f + V_i}{2} \rightarrow V_f = 2V_{avg}$

$V_f = 2.66\bar{6}\ m/s$

$a = \frac{V_f - V_i}{\Delta t} = \frac{2.66\bar{6}\ m/s - 0\ m/s}{15s} = 0.17\bar{7}\ m/s^2$

$F = ma = 5kg \cdot 0.17\bar{7}\ m/s^2 = 0.88\bar{8}\ N$

$W = F \cdot d \cdot \cos 0^\circ = 0.88\bar{8}N \cdot 20m = 17.77\bar{7}\ J$

$P = \frac{W}{\Delta t} = \frac{17.77\bar{7}\ J}{15s} = 1.185\ W$

7. Roger wants to put all his exercise energy to good use. He rides her stationary bicycle for a distance of 3 km. It takes him 10 minutes to go this far. He uses an average force of 200 N.
   a) What is the amount of work he did?

$W = F \cdot \Delta d \cdot \cos\theta = 200N \cdot 3000m = 600{,}000\ J$

   b) What was Roger's power output?

$P = \frac{W}{\Delta t} = \frac{600{,}000\ J}{600s} = 1000\ W$

   c) If he captured all of the energy he used in a battery, how long could he run his 100-watt light bulb for?

$P = \frac{W}{\Delta t} \qquad \Delta t = \frac{W}{P} = \frac{600{,}000\ J}{100\ W} = 6000s = 1\ hr\ 40\ min$

   d) How long could he run his 2000 Watt refrigerator?

$P = \frac{W}{\Delta t} \qquad \Delta t = \frac{600{,}000\ J}{2000\ W} = 300s = 5\ min$