$$W = ma\Delta S \rightarrow m = \frac{W}{a\Delta S}$$

WORK-ENERGY PROBLEM WORKSHEET

$$m = \frac{W}{a\Delta S}$$

1. The third floor of a house is 8 m above street level. How much work is needed to move a 150 kg refrigerator to the third floor?

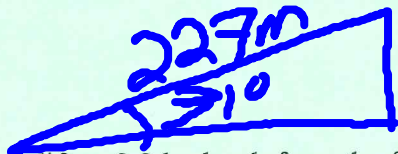$$W = F\Delta S = W_{lbs}\Delta S = mg\Delta S = (150 kg)(9.8 \frac{m}{s^2})(8m) = \boxed{\quad J}$$

2. If Stan does 176 J of work lifting himself 0.30 m, what is Stan's mass?

$$W = F\Delta S = ma\Delta S$$

3. Lee pushes a 20 kg box 10 m across the floor with a horizontal force of 80 N. How much work does Lee do?

$$W = F\Delta S \cos\theta = (80N)(10m)$$
$$W = 800 N \cdot m$$
$$W = \boxed{800 J}$$

80 N   10 M

4. Sau-Lan, with a mass of 52 kg, rides the up escalator at Ocean Park in Hong Kong, the world's longest. If the escalator has a length of 227 m and angle of 31°, calculate the work done by the escalator to lift Sau-Lan.

227 m   31°   h $\sin\theta = \frac{o}{h}$ $W = F\Delta S = mg\Delta S$

$$= (52 kg)(9.8 \frac{m}{s})$$

5. A librarian lifts a 2.2 kg book from the floor to a height of 1.25 m, carries the book 8.0 m to the stacks, and places the book on a shelf 0.35 m above the floor. How much work is done on the book?

$$W = PE = mgh$$

$$227 \sin 31$$

6. A horizontal force of 805 N is needed to drag a crate across the floor with a constant speed. If the rope used to drag the crate makes an angle of 32° with the floor:

a. Calculate the force applied along the rope.

$$\cos 32° = \frac{805 N}{b}$$

h   32°   805 N
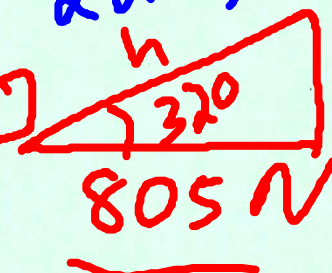
b. Calculate the work done to pull the crate a distance of 22m.

$$W = F\Delta S = 805N(22m)$$

c. If the job is done in 8 seconds, how much power is developed?

$$P = \frac{W}{\Delta t} = \frac{part B}{8.0 s}$$

7. Mary weighs 505 N. If she walks down a flight of stairs to a level 5.5 m below, what is the change in her potential energy?

$$PE = mgh = (505N)(-5.5m) = \boxed{\quad J}$$

8. Toni has a mass of 45 kg and is moving with a speed of 10 m/s.

a. Calculate her kinetic energy.

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(45 kg)(10 m/s)^2 = \boxed{\quad J}$$

b. If Toni's speed changes to 5 m/s, what is her kinetic energy? Compare to part a answer.

$$\boxed{\quad J}$$

$$a) \quad KE = \frac{1}{2}m(2)^2 = 4$$
$$b) \quad KE = \frac{1}{2}m(1)^2 = 1$$

9. 1000 g of copper pellets (c = .092 cal/g-°C) are continually dropped in a 1 m-long PVC tube 200 times. Calculate the temperature rise (°C) in the pellets due to the work done on them.

$$PE = Q \qquad mgh = Cm\Delta t \rightarrow \Delta t = \frac{mgh}{CM}$$

10. An experimental train with a mass of 2.5 x 10^4 kg is powered by a jet engine with a thrust of 5.0 x 10^5 N over a track length of 509 m.

    a. Calculate the work done on the train.

$$\frac{(200\,m)(1.0\,kg)(9.81\,m/s^2)}{(0.092\frac{cal}{g\cdot°c})(1000g)}\left(\frac{1.48J}{1\,cal}\right)$$

    b. Calculate the final velocity of the train (assume no friction).

11. A 20 kg rock is on the edge of a 100 m tall vertical cliff.

    a. What is the rock's potential energy relative to the base of the cliff?

$$PE = mgh = (20\,kg)(9.80\,m/s^2)(100\,m)$$

    b. If the rock falls off the cliff, what is its speed just before it strikes the ground?

$$V = \sqrt{2gh}$$

12. A bow hunter places a 60 g arrow on the bowstring and exerts an average force of 180 N to pull the bowstring back 0.45 m.

    a. How much work has she done?

$$W = FAS = (180N)(0.45m) = \boxed{81\,J}$$

    b. If the bow is 80% efficient, at what speed does the arrow leave the bow?

$$W = KE = \frac{1}{2}mv^2 \rightarrow V = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2W(0.80)}{m}} = 46.5\frac{m}{s}$$

    c. If fired vertically into the air, what height would the arrow achieve (assume 80% efficiency)?

$$W = PE \rightarrow (0.80)(81\,J) = mgh \rightarrow h = \frac{(0.80)(81J)}{(9.80\frac{m}{s^2})(0.060m)}$$

13. A 3.0 kg gun, resting on a frictionless surface, fires a 12 g bullet with a muzzle velocity of 465 m/s.

    a. Calculate the momenta of the bullet and gun after firing. Is momentum conserved?

    b. Calculate the kinetic energy of the bullet and gun after firing. Is mechanical energy conserved?

14. A superball has a coefficient of restitution of 0.78. If it is dropped from a height of 2 m above the floor, to what height will it rebound?

$$C.O.R = \sqrt{\frac{h_f}{h_i}} \rightarrow 0.78 = \sqrt{\frac{h_f}{2m}} \rightarrow \boxed{1.2\,m}$$

15. If you could convert matter to energy with 1% efficiency, how much energy would 1 g of water produce?