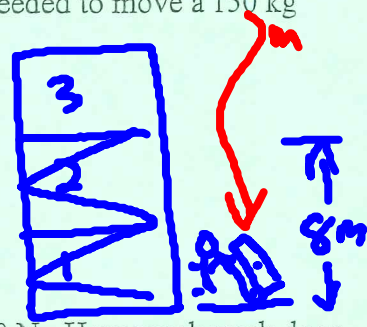# WORK-ENERGY PROBLEM WORKSHEET

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?
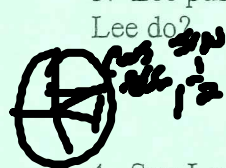
$$W_n = F \Delta S = W_{no} \Delta S = mg \Delta S =$$

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

$$W = mgh \quad so \quad m = \frac{W}{gh} = \frac{176 N \cdot m}{(9.8 m/s^2)(.3m)} = 59.9 kg$$

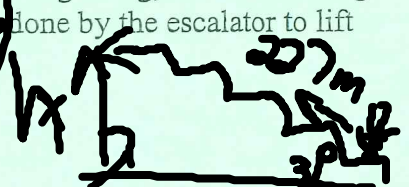3. Lee pushes a 20 kg box 10 m across the floor with a horizontal force of 80 N. How much work does Lee do?

$$W = F \Delta S = (80N)(10m) = 800 N \cdot m = 800 J$$

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.

$$W = F \Delta S$$
$$W = (mg)(116.9m)$$
$$\sin 31° = \frac{h}{227m} \qquad S \cdot h = 227 \sin 31° \qquad h = 116.9m$$

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?

$$W = PE = mgh = (2.2 kg)(9.80 m/s)(0.35)$$

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:
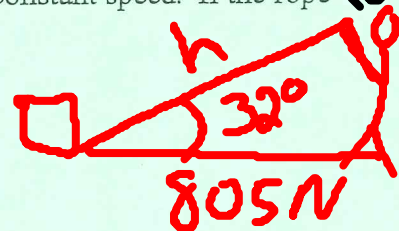
   a. Calculate the force applied along the rope.

$$\cos 32° = \frac{805N}{h}$$

   b. Calculate the work done to pull the crate a distance of 22m.

$$W = F \Delta S$$

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

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?

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

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

   a. Calculate her kinetic energy.

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(45 kg)(10 m/s)^2 = 2250 J$$

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

$$KE = \frac{1}{2}(45 kg)(5 m/s)^2 = 562.5$$

$$\frac{2250\,J}{562.5\,J} = Y$$

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.

$$PE = Q \rightarrow mgh = C_m \Delta t \qquad \Delta t = \frac{mgh}{(4.1)C_m} \nearrow kg \atop \searrow g$$

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.

$$W = F\Delta s = (5.0 \times 10^5 N)(509m) \qquad \frac{m}{\cancel{00}}$$
$$509m$$

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

$$W = KE = \tfrac{1}{2}mv^2 \Rightarrow 2KE = mv^2 \rightarrow \sqrt{v^2} = \sqrt{\frac{2KE}{m}}$$
$$V = \sqrt{\frac{2KE}{m}}$$

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?

$$PE = mgh = (20kg)(9.80\%^2)(100.n) =$$

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

$$PE_i = KE_r \qquad PE_a = \tfrac{1}{2}mv^2$$

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?

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

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

13. A 3.0 kg gun, resting on a frictionless surface, fires a 12 g bullet with a muzzle velocity of 410 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?

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