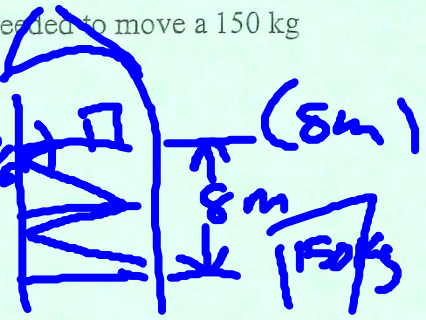
WORK-ENERGY PROBLEM WORKSHEET

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?

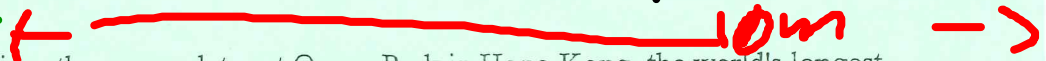
$W = F\Delta s = W\Delta s = mg\Delta s = (45kg)(9.8\frac{m}{s^2})(8m)$



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

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?

$W = F\Delta s = (80N)(10m) = 800Nm = 800J$



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.

done

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?

done

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.

$W = F\Delta s\cos\theta$ done

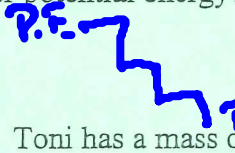
b. Calculate the work done to pull the crate a distance of 22m.

done

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

done

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?



$\Delta PE = mgh = wh = (505N)(5.5m)$

$\Delta PE = -$ J

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

a. Calculate her kinetic energy.

$K.E. = \frac{1}{2}mv^2 = \frac{1}{2}(45kg)(10\frac{m}{s})^2 = 2,250J$

$(Nm = kg\frac{m}{s^2})$

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

$K.E. \propto mv^2$

$(5_2)^2$

$\frac{1}{4}$ as much

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.

$P.E. = mgh = (1kg)(9.8 m/s^2)(200 m) = 1960 J \cdot \frac{1 cal}{4.185} = 468 cal$

$Q = cm\Delta T$ so $\Delta T = \frac{Q}{cm} = \frac{468 cal}{(.092 \frac{cal}{g°C})(1000g)} = 5.09°C$

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

a. Calculate the work done on the train.

$W = F\Delta s = (5.0 \times 10^5 N)(5.09 \times 10^2 m) = 25.45 \times 10^7 m$

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

$K.E. = W = \frac{1}{2}mv^2$

$v = \sqrt{\frac{2W}{m}} = \sqrt{\frac{2(2.5 \times 10^8 J)}{2.5 \times 10^5 kg}}$

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?

$P.E. = mgh = (20kg)(9.8 m/s^2)(100m)$

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

$v = \sqrt{2gh}$

$v = \sqrt{2 \times 10^3 \frac{m^2}{s^2}}$

$v = 1.41 \times 10^2 m/s$

$v = 1.4 \times 10^2 m/s$

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?

$W = F\Delta s = (180 N)(0.45 m) = 81 J$

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

$W_n = 81 J \times .80 = 64.8 J = KE = \frac{1}{2}mv^2$ $\quad 2W = mv^2 \rightarrow v^2 = \frac{2W}{m}$

$v = \sqrt{\frac{2W}{m}}$

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

$v = \sqrt{2gh} \rightarrow h = \frac{v^2}{2g}$

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?

$C.O.R. = \sqrt{\frac{h_f}{h_i}} \rightarrow COR^2 = \frac{h_f}{h_i}$ $\quad h_i \cdot COR^2 = h_f = (2m)(0.78)^2$

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

$E = mc^2 = (0.001 kg)(3.0 \times 10^8 m/s)^2 (0.01)$

10^{-3} $\quad 10^8$ $\quad 1 \times 10^{-2}$