Mr. Flasch

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?

$W = F\Delta S = mg\Delta S$

$= (150\text{ kg})(9.80\text{ m/s}^2)(8\text{ m})$

$= \boxed{11,760\text{ J}}$

note: $\text{kg} \times \frac{\text{m}}{\text{s}^2} \times \text{m} \rightarrow \frac{\text{kg m}^2}{\text{s}^2} = \text{Joule}$

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

$W = F\Delta S = mg\Delta S \rightarrow$ solve for $m \rightarrow m = \frac{W}{g\Delta S} = \frac{176\text{ J}}{(9.80\text{m/s}^2)(0.30\text{m})} = \boxed{59.9\text{ kg}}$

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?

$W = F\Delta S = mg\Delta S$

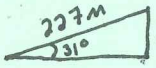
note: since force is horizontal and known, we do not need the 20 kg information

$W = F\Delta S$

$= (80\text{N})(10\text{m}) = \boxed{800\text{ J}}$

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.

$W = F\Delta S = mg\Delta S = (52\text{kg})(9.80\text{m/s}^2)(227\text{m} \cdot \sin 31^\circ) = 59,579.19\text{ J} = \boxed{59,600\text{ J}}$



$\Delta S = 227\text{m} \cdot \sin 31$ $\left[\sin\theta = \frac{O}{H} \therefore O = H\sin\theta\right]$

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?

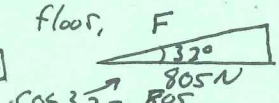
$W = F\Delta S = mg\Delta S = (2.2\text{kg})(9.80\text{m/s}^2)(0.35\text{m}) = 7.546\text{ J} = \boxed{7.5\text{ J}}$

$\Delta S = 1.25\text{m}$ to carry, but ends up a 0.35m above the floor $\therefore \Delta s = 0.35\text{m}$

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.

Isn't force in Newtons? Yes, but since it is at 32° w.r.t. floor, $F = \frac{805\text{ N}}{\cos 32^\circ} = 949.2\text{N} = \boxed{950\text{N}}$



$\cos 32 = \frac{805}{F}$

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

$W = F\Delta S = (805\text{ N})(22\text{m}) = 17710\text{ J} = \boxed{17,700\text{ J}}$

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

$\text{Power} = \frac{\text{Rate (work)}}{\text{time}} = \frac{W}{\Delta t} = \frac{17,700\text{ J}}{8\text{s}} = 2212.5\text{ W} = \boxed{2200\text{ W}}$

(optional → what if we solved algebrically?)

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?

$\Delta PE = mg\Delta h = (505\text{N})(-5.5\text{m}) = -2777.5\text{ J} = \boxed{-2778\text{J}}$

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

a. Calculate her kinetic energy.

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

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

$KE = \frac{1}{2}mv^2 = (\frac{1}{2})(45\text{kg})(5\text{m/s})^2 = 562.5\text{ J}$ $\quad \frac{2250\text{ J}}{562.5\text{ J}} = 4$

4:1 ratio! Doubling speed quadruples KE!