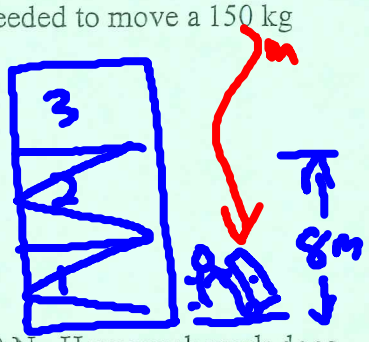
WORK-ENERGY PROBLEM WORKSHEET

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?

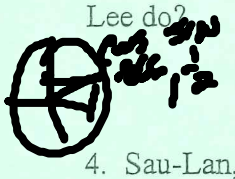
$W_A = F\Delta S = W\Delta S = mg\Delta S =$

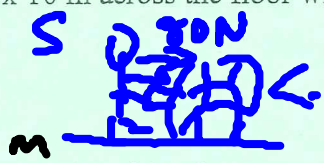


2. If Stan does 176 J of work lifting himself 0.30 m, what is Stan's mass?

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

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?





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

10m

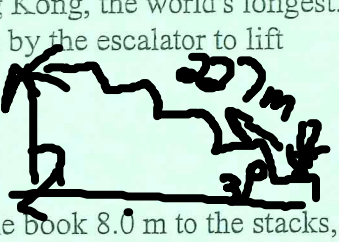
4. Sau-Lan, with a mass of 52 kg, rides the up escalator at Ocean Park in Hong Kong, the world's longest. If the escalator has a length of 227 m and angle of 31°, calculate the work done by the escalator to lift Sau-Lan.

$W = F\Delta S$

$W = (509\,N)(116.9m)$

$\sin 31^\circ = \frac{h}{227m}$ so $h = (227m)(\sin 31^\circ)$

$h = 116.9m$



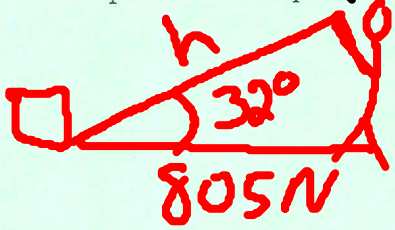
5. A librarian lifts a 2.2 kg book from the floor to a height of 1.25 m, carries the book 8.0 m to the stacks, and places the book on a shelf 0.35 m above the floor. How much work is done on the book?

$W = PE = mgh = (2.2\,kg)(9.80\,m/s^2)(0.35m)$

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.

$\cos 32^\circ = \frac{805\,N}{h}$



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?

$P = \frac{W}{\Delta t} = \frac{\text{ans b}}{8}$

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?

$PE = mgh = (505\,N)(-5.5m) =$ J

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

a. Calculate her kinetic energy.

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

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

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

$\frac{2250\ J}{562.5\ J} = 4$

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.

$PE = Q \rightarrow mgh = Cm\Delta t$

$\Delta t = \frac{mgh}{(4.18)Cm}$ kg → g

10. An experimental train with a mass of 2.5×10^4 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.

$W = F\Delta s = (5.0 \times 10^5 N)(509 m)$

$\frac{m}{00}$

509 m

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

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

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?

$PE = mgh = (20kg)(9.80 m/s^2)(100.m) =$ J

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

$V = \sqrt{\frac{2KE}{m}}$

$PE_i = KE_f \quad PE_a = \frac{1}{2}mv^2$

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?

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

$\sqrt{\frac{(0.80)2W}{m}}$

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

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

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

$v_f^2 - v_i^2 = 2a\Delta s \rightarrow -v_i^2 = 2gh \rightarrow h = -\frac{v_i^2}{2g}$

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?

$P_b = m_b v_b = (0.012kg)(410 m/s) = 4.92 \frac{kg\,m}{s}$ Yes

$P_b = P_g$

$P_b = m_g v_g$

$v_g = \frac{4.92\ kg\frac{m}{s}}{3.0 kg}$

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

$KE_b = \frac{1}{2}mv^2 = \frac{1}{2}(0.012kg)(410 m/s)^2 =$ J

$KE_g = \frac{1}{2}m_g v_g^2 =$

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?

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

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

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