Pd 2

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 = P.E. = mgh = (150\,kg)(9.8\,m/s^2)(8\,m) = $ (J)

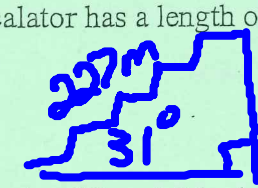
2. If Stan does 176 J of work lifting himself 0.30 m, what is Stan's mass?

If $W = mgh$ Then $m = \frac{W}{gh} = \frac{176\,J\;(N\cdot m)\;(kg\,m^2/s^2)}{(9.8\,m/s^2)(.3\,m)} = $ (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 = (80\,N)(10\,m) = $ (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.



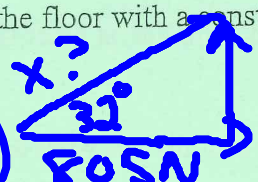
$h = (227\,m)(\sin 31°)$

$W = mgh = (\quad kg)(\quad m/s^2)(\quad m) = $ (J)

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 = P.E._{final} = mgh_{final} = (2.2\,kg)(9.8\,m/s^2)(.35\,m) = $ (J)

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.

$\cos 32° = \frac{805\,N}{x}$; $x = (805\,N)(\cos 32°)$

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

$W = F\Delta s$ in same direction $= (805\,N)(22\,m) = $ (J)

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

$P = \frac{W}{t} = \frac{J}{8\,s} = $ (W)

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?

If up is + Then down is −

$P.E. = W = F\Delta s$

$P.E. = (505\,N)(-5.5\,m) = $ (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{mv^2}{2} = \frac{(45\,kg)(10\,m/s)^2}{2} = $ (J)

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

$KE. = \frac{mv^2}{2} = \frac{(45\,kg)(5\,m/s)^2}{2} = $ (J)

$K.E. \propto mv^2$

$1 = (1)(1)^2$

$? = (1)(\frac{1}{2})^2 = ($

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.

$W = mgh = (1\,kg)(9.8\,m/s^2)(200\,m) =$ ___ J

$W = Q = cm\Delta T$; $\Delta T = \frac{W}{cm} = \frac{}{(.092\,cal/g\,°C)(1000\,g)} =$ ___ °C

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.

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?

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

$m = .06\,kg$

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?

$W = F\Delta s = (180\,N)(.45\,m) =$ ___ J

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

$W = K.E. = \frac{1}{2}mv^2$; $v^2 = \frac{2W}{m}$; $v = \sqrt{\frac{2W(.8)}{m}} =$ ___ m/s

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

$.8W = K.E. = P.E. = mgh$; $h = \frac{.8W}{mg} =$ ___ m

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? YES, Newton's 3rd; gun same

$P_{bullet} = mv = (.012\,kg)(410\,m/s) = 4.92\,kg\,m/s$

$P_{gun} = mv$; $v = \frac{P}{m} = \frac{4.92\,kg\,m/s}{3\,kg}$

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

$K.E._{bullet} = \frac{1}{2}mv^2 = \frac{1}{2}(.012\,kg)(410\,m/s)^2 =$ ___ J

$K.E._{gun} = \frac{1}{2}(3\,kg)(1.64\,m/s)^2 =$ ___ J

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?

$C.O.R. = \sqrt{\frac{h_f}{h_i}}$; $h_i(C.O.R.)^2 = h_f = (2\,m)(.78)^2 =$ ___ m

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

$E = mc^2$ $c = 3 \times 10^8\,m/s$

$E = (1 \times 10^{-3}\,kg)(3 \times 10^8\,m/s)^2 = 9 \times 10^{13}\,J$; 1% eff → $9 \times 10^{11}\,J$