Day 1 1-6b. Pd 1

# 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?

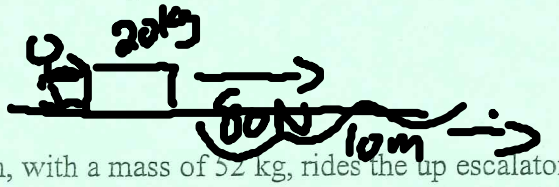

$F = W = mg = (150\text{kg})(9.8\text{ m/s}^2)$

$W = F\Delta s = mg\Delta s$

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

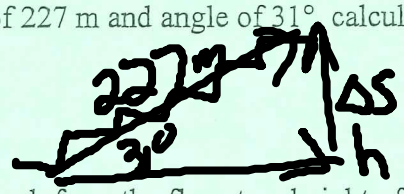
$W = mg\Delta s$ so $m = \frac{W}{g\Delta s} = \frac{176\text{ J}}{(9.8\text{ m/s}^2)(.3\text{ m})} = ?$

1st 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?




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

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.




$\sin 31° = \frac{h}{227}$

$h = 227 \sin 31°$

$PE = W = mgh =$

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?

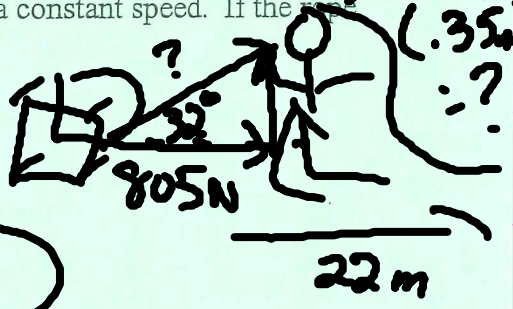

$W = P.E._{end} = mgh$

$= (2.2\text{kg})(9.8\text{m/s}^2)(.35\text{m}) = ?$

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.

$\cos 32° = \frac{805\text{N}}{x}$ so $x = \frac{805\text{N}}{\cos 32°} = ?$




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

$W = F\Delta s = (805\text{N})(22\text{m})$

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

$P = \frac{W}{\Delta T} = \frac{\quad}{8\text{s}}$

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?

$F = W = mg = 505\text{N}$

$P.E. = W = F\Delta s = (505\text{N})(5.5\text{m}) = \quad\text{J}$

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

a. Calculate her kinetic energy.

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

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

$K.E. = \frac{1}{2}mv^2$ ($\frac{1}{4}$ 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.

1kg h=200m

P.E. = mgh = (1kg)(9.8 m/s²)(200m) = 1960 J

Q = C m ΔT so ΔT = Q / Cm = 1960 J / (.092 cal/g·°C)(1000 g)(4.18 J/cal) = ΔT = 5.1°C

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 = FΔs = (5.0x10⁵ N)(509 m) = 25.45x10⁷ J = 2.5x10⁸ J

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

$\frac{1}{2}mv^2 = W$ ; $v^2 = \frac{2W}{m}$ ; $v = \sqrt{\frac{2W}{m}}$ ; $v = \sqrt{\frac{2(2.5\times10^8\ J)}{2.5\times10^4\ kg}}$

$v = \sqrt{2\times10^4}$ $\frac{m^2}{s^2}$

v = 1.4x10² m/s

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/s²)(100m)

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

20kg 100m

$v = \sqrt{2gh} = \sqrt{2\cdot(9.8\ m/s^2)(100\ m)}$ =

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?

3.14
1.41