

## SOME ENERGY/WORK QUESTIONS (Energy2Probs)

- 1) What are some different units for energy?

*See notes*

- 2) What are the types of energy and how are they measured?

*See notes*

- 3) What are the types of mechanical energy?

*Gravitational Potential, Elastic Potential, Kinetic.*

- 4) Describe the energy changes in a jack in a box ( a bobble head on a spring with friction). How would this look on a graph?

- 5) Which type of mechanical energy does NOT depend on position?

*Kinetic Energy depends only on mass and speed.*

- 6) Give a typical amount of Calories of mechanical energy likely to be used by a typical teenager per week. How would this be calculated?

*Anywhere from 12,000 Cal to 30,000 Calories.*

*Energy =Kinetic plus GPE plus Work or add up all activities.*

- 7) What is the work done if I lift a 20 kg object 3 meters, then carry it at a constant speed horizontally for 5 meters?

*Work is Force times Dis in direction of motion. Force of Gravity=Weight=  $20 \times 9.8 = 196N$   
Work =  $196N \times 3 m = 588 \text{ Joules}$ . No work is done by carrying it horizontally.*

- 8) What is the purpose of a simple machine?

*To multiply force (or sometimes to multiply time/distance). Work in usually equals work out.*

- 9) Explain why all simple machines are really either levers or ramps:

*Ramps: Planes, Screws, Wedges*

*Levers: :levers, wheel/axle, pulley, gear*

- 10) A parachutist with a mass of 40.0 kg jumps out of an airplane at an altitude of 5000 m. After the parachute deploys, the parachutist lands with a velocity of 6.00 m/s. Using the work–kinetic energy theorem, find the energy that was lost to air resistance during this jump.

$$GPE + KE = GPE + KE$$

$$Mgb + \frac{1}{2}mv^2 = mgb + \frac{1}{2}mv^2$$

$$40 \cdot 9.8 \cdot 5000 + 0 = 0 + \frac{1}{2}(40)(6)^2$$

1,960,000 Joules start, 720 Joules end, lost 1959280 Joules!

- 11) A lever with an effort arm of 4 cm, and a resistance arm of 8 cm is attached to a 2 string pulley holding a 4 kg mass. If it takes 60 Newtons of force to push on the lever to lift the mass then find:

Work In:            Work Out:            Ideal mech Advantage:    Actual Mech Advantage:

Efficiency

$$\text{Lever IMA} = 4/8 = .5, \text{ Pulley IMA} = 2:1, \text{ machine IMA} = 1:1$$

$$\text{Actual Mech Advant} = F_{out}/F_{in} = (4) \cdot 9.8 / 60 = 39.2/60 = .6533$$

$$\text{Efficiency} = \text{AMA/IMA} = .6533/1 = 65.33 \%$$

- 12) A force of 1250 N is needed to move a crate weighing 3270 N up a ramp that is 4.55 m long. If the elevated end of the ramp is 0.750 m high, what is the efficiency of the ramp?

$$\text{Efficiency} = \text{WorkOut/WorkIn} = (3270 \cdot .75) / (1250 \cdot 4.55) = 2452.5 J / 5687.5 J = 43.1\%$$

- 13) A spring is pulled back from rest 20 cm with 40 N of force. If it hits a 3 kg mass, what is its starting elastic energy? How fast is it going when it leaves the spring? (no friction). How high does it go?

$$X = .2 \text{ m}, F = 40 \text{ N } k = F/x = 200 \text{ N/m}, \text{ EPE} = 1/2 Kx^2 = 1/2 \cdot (200) \cdot (.2)^2 = 4 \text{ Joules}$$

$$4 \text{ Joules} = KE = 1/2 mv^2 = 1/2 \cdot (3) \cdot v^2, v = \text{sqrt}(2 \cdot 4/3) = 1.633 \text{ m/s} = v$$

$$4 \text{ Joules} = GPE = 4 = mgh = 3 \cdot 9.8 \cdot h, h = 4 / (3 \cdot 9.8) = 4/29.4 = .136 \text{ m} = h$$

- 14) ) A still person with a mass of 156 kilogram catches a 9 kilogram ball going 30 meters/second, which causes him to roll down a hill (starting at 1.636 m/s) . What is the total energy after the collision? If they are on the top of a 2 meter tall hill, what is the velocity at the bottom of the hill?

$$\text{Before collision } E = GPE_{ball} + KE_{ball} + GPE_{person} = 156 \cdot 9.8 \cdot 2 + 9 \cdot 9.8 \cdot 2 + 1/2 \cdot 9 \cdot 30^2$$

$$= 3057.6 + 176.4 + 4050 = 7284 \text{ Joules}$$

$$\text{AFTER collision } E = GPE + KE = 165 \cdot 9.8 \cdot 2 + 1/2 \cdot 165 \cdot 1.636^2 = 3234 J + 220.8 =$$

$$3454.8 \text{ Joules}$$

$$\text{At bottom } E = 3454.8 J = KE = 1/2 mv^2 = 1/2 \cdot 165 \cdot v^2,$$

$$V = \text{sqrt}(2 \cdot 3454.8 / 165) = 6.47 \text{ m/s}$$