NAME Key 2013-2014 DATE _____ CLASS _____

# Section 3.2
# Energy and the Conservation of Energy

Without **energy**, nothing could ever change. Although energy can't be heard, smelled, tasted, touched or seen, it appears in forms like motion and heat. Energy flows from place to place and back from one form to another.

Energy is a quantity that measures the ability to cause change in a physical variable.

Give 3 examples of energy:

- gust of wind
- wood in fireplace
- A moving body
- batteries
- gasoline
- ball down hill

The unit of measurement for energy is the Joule (J). One Joule is the energy needed to push with a force of 1 Newton over a distance of 1 meter. A **Joule** is equivalent to a Newton meter (N·m).

## WORK

**Work** is the transfer of energy that results from applying a force over a distance. Both work and energy are measured in the same units. Work is done on an object. The formula for work is $W = Fd$. The force applied to an object MUST be in the same direction as the distance the object moves.

### Potential Energy

**Potential Energy** is energy due to position. Potential means something is capable of becoming active. The most common type of potential energy in physics is gravitational. Multiplying the force by the height will give you potential energy. The formula is $E_p = mgh$ where h = height.

### Kinetic Energy

**Kinetic energy** is energy of motion. Kinetic energy can easily be changed to potential energy. Kinetic energy is equal to the amount of work an object can do by exerting a force as it stops. Kinetic energy is related to both an objects mass and velocity. Write the formula for kinetic energy below $E_K = 1/2 mv^2$. Kinetic energy increases as the increase of the speed. If you go twice as fast, your energy will increase by 4 times. If you move 4 times as fast your energy will increase by 16 times.

Complete practice problems a & b on page 69. see notes

a.

| Looking for | Solution |
|---|---|
| $E_p$ | $=4kg(9.8m/s^2)(3m)$ |
| Given: $4kg = m$, $3m = h$ | $=117.6J$ |
| Relationships: $E_p = mgh$ | |

b.

| Looking for | Solution |
|---|---|
| $E_k$ | $=1/2(4kg)(5m/s)^2$ |
| Given: $m = 4kg$, $v = 5m/s$ | $=2kg(25m^2/s^2)$ |
| Relationships: $E_k = 1/2mv^2$ | $=50J$ |

## Conservation of Energy

When you throw a ball up it has kinetic energy, as it slows down, the energy is converted into potential. The increase in potential energy is equal to ~~as~~ the loss of kinetic energy. Therefore, the ball's total energy remains the same.

The **Law of Conservation of Energy** is energy cannot be created nor destroyed, just converted from one form into another.

If gravity is the only force acting on the ball, when it returns to your hand, it will have the same potential and kinetic energy as it started with.

**Copy the information in Figure 3.15 below**

Before change → change → after change

Total energy = total energy

Carefully study the example problem on page 71. Complete practice problems a & b.

a.

| Looking for | Solution |
|---|---|
| $E_p$ | $=500kg(9.8m/s^2)(30m)$<br>$=147{,}000\,J$ |
| **Given**<br>$500kg = m$<br>$30m = h$ (halfway) | |
| **Relationships**<br>$E_p = mgh$ | |

b.

| Looking for | Solution |
|---|---|
| $h$ | $196\,J = 1kg(9.8m/s^2)(h)$<br>$\frac{196\,kg\cdot m^2/s^2}{9.8\,kg\cdot m/s^2} = \frac{9.8\,kg\cdot m/s^2\,(h)}{9.8\,kg\cdot m/s^2}$<br>$20m = h$ |
| **Given**<br>$m = 1kg$<br>$E_k = 196J = E_p$ | |
| **Relationships**<br>$E_p = mgh$ | |

When we "use energy" we are really converting energy into another form.

Explain what is meant by "power plants don't make energy" energy can't be created. Converts chemical, solar, nuclear into electrical energy.

**Section Review**

1. What are the units of energy and what do they mean?

Joules, N·m, or $kg\cdot m^2/s^2$

2. What is work in physics and what is the relationship between work and energy?

apply force over a distance

both measured in joules

3. How can you increase an object's potential or kinetic energy?

↑ m

4. What happens to the potential and kinetic energy of a ball as it falls toward the ground?

$E_k$ changes into $E_p$

5. Explain what it means to say energy is conserved.

transferred into different forms