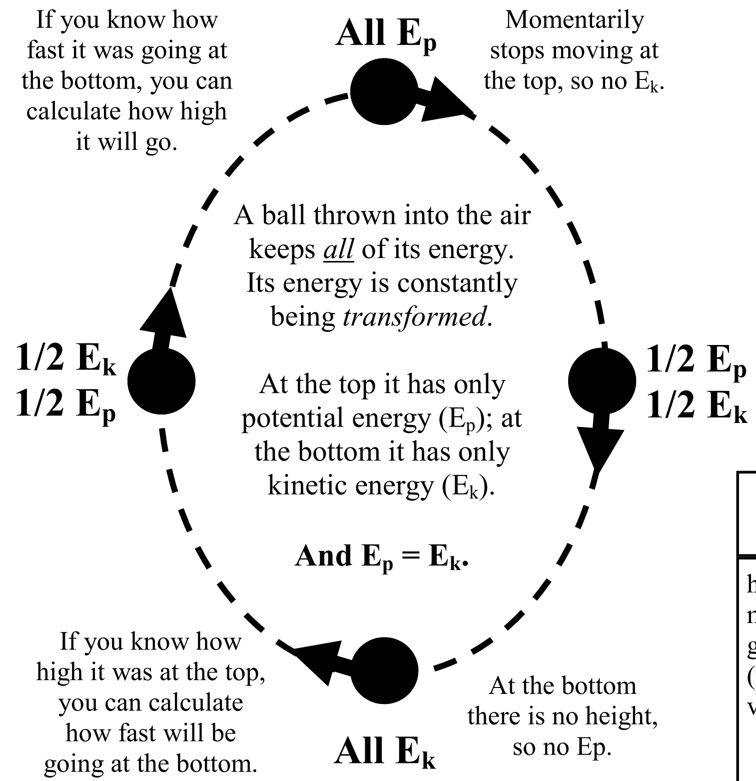
Name: ____________________

Period: ____________________

Conservation of Energy



Law of Conservation of Energy:
"Energy is never created nor destroyed, just transformed into other forms of energy."

If energy can only be transformed, then, for any object being thrown into the air or dropped:

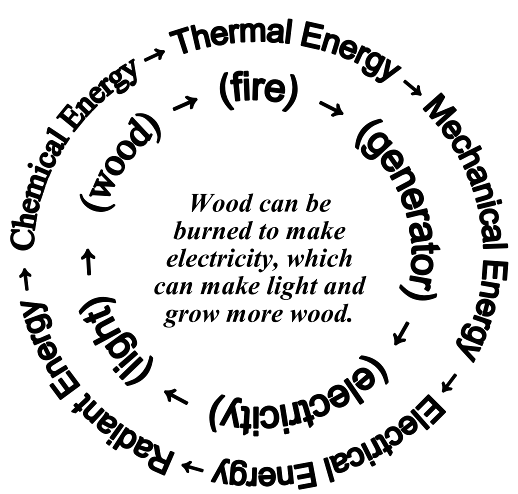
$$E_p = E_k \text{ OR}$$
$$mgh = (1/2)mv^2$$

The potential energy at the top equals the kinetic energy at the bottom.

Ex. A 4 kg ball is thrown into the air. It reaches a height of 1.8 meters. How fast was it going when thrown into the air?	
h = 1.8 m m = 4 kg g = 9.8 m/s² (use g = 10) v = ?	The Law of Conservation of Energy says that the E_p at the top = E_k at the bottom. $E_p = E_k$ $\cancel{m}gh = (1/2)\cancel{m}v^2$ $gh = (1/2)v^2$ $2gh = v^2$ → $2gh = v^2$ $2(10)(1.8) = v^2$ $2(18) = v^2 = 36$ $v = \sqrt{36}$ $v = 6$ m/s

Energy Transformations

No one really "makes" energy: it has to come from somewhere. And no one really "uses up" energy: it has to go somewhere. The energy is transformed from one form to another.



Although this diagram may lead you to think that energy can be changed from one form to another perfectly, that is not true. Some energy always ends up as forms we don't want, so it seems to be "lost", as in friction. This is known as "*inefficiency*".

Chemical Energy—Stored in chemical bonds; includes food, plants, and batteries (which produce electricity by combining chemicals).

Thermal Energy—Heat energy; the end product of many transformations.

Nuclear Energy—Energy from radiation (atom decay), fission (splitting atom), or fusion (fusing atoms); makes huge amounts of energy.

Mechanical Energy—Energy of an object's motion (Ek) or position (Ep), which can become work.

Electrical Energy—Energy from moving electrons; what we generally think of as "energy".

Radiant Energy—Light energy; actually electromagnetic *radiation* from light bulbs or the sun (actually the source of most power on earth).

Efficiency

Input work is always less than the output work. Friction always takes a portion. A perfect machine would be 100% efficient, but it doesn't exist. Cars are around 15% efficient; bicycles are around 95%.

$$\text{Eff} = \frac{W_{out}}{W_{in}} \times 100$$

Efficiency (in %); W_{out}: Work out (in J); W_{in}: Work in (in J)

Efficiency equals the Work (or Energy) out divided by the Work (or Energy) in multiplied by 100.

Ex. If you use 20 N to push a 15 N object 3 meters, how efficient was your work?	F_{in} = 20 N; F_{out} = 15 N; d = 3m $W_{in} = F_{in}(d)$ = (20 N)(3 m) W_{in} = 60 J $W_{out} = F_{out}(d)$ = (15 N)(3 m) W_{out} = 45 J	Eff = W_{out}/W_{in} x 100 Eff = (45 J/60 J) x 100 Eff = (.75) x 100 Eff = 75% efficient (friction took 25%)

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1. Efficiency 2. Law of Conservation of Energy 3. Percent 4. Transformation	A. Units for efficiency. B. Ratio of work out to work in (how good a machine or energy transformation is). C. Energy can never be lost or gain, just transformed. D. Changing from one form to another.	1. Thermal 2. Nuclear 3. Radiant 4. Mechanical 5. Chemical 6. Electrical	A. Energy of the atom being split or fused. B. Energy of moving electrons. C. Heat energy. Also caused by friction. D. Light energy—electromagnetic radiation. E. Energy (kinetic or potential) stored in object and can do work. F. Energy of molecular bonds.

What kind of Energy?
Thermal; Nuclear; Radiant; Mechanical; Chemical; Electrical

____ A ball on top of a hill.	___ Stored in food.
____ The energy in hydrogen.	___ Given off by the sun.
____ Used to run a clock.	___ A car going 50 mph.
____ A hot stove.	___ A fire's heat.
____ Uranium in reactors.	___ A fire's light.

What energy is used or given off by a fire?

What energy is transformed from what to what when you turn on a flashlight?

A ball is thrown up into the air. When it gets to the very top, what kind of energy does it have?

When it falls half-way back, what kind of energy does it have?

Just before it reaches the ground, what kind of energy does it have?

What does the Law of Conservation of Energy say about the energy at the top and at the bottom?

A 10 kg ball is thrown into the air. It is going 3 m/s when thrown. How much potential energy will it have at the top?

A 4 kg ball is on a 5 m ledge. If it is pushed off the ledge, how much kinetic energy will it have just before hitting the ground?

A 25 kg ball is thrown into the air. When thrown it is going 10 m/s. Calculate how high it travels.

A 3 kg rock sits on a 0.8 meter ledge. If it is pushed off, how fast will it be going at the bottom?

You are pushing a 20 N object for 3 meters. If you have to push with 30 N to do this, how efficient is your work?