Work, Kinetic Energy and Gravitational Energy:

We have already established a formula relating work and energy. It is a very simple formula:

W = ΔE

It states that “*the change in energy of any system is equal to the work done to that system by any object OUTSIDE of the system”*. This sounds kind of fancy, but it really just means that if the system loses energy, that energy is transferred out, if the system gains energy, that energy was transferred in.

This equation can be re-written in few different ways, but here are my favorites:

1. Eo + W = E

2. Ko + Uo + W = K + U

3. W = ΔK + ΔU

In these equations: W is work done to the system

Eo, E is TOTAL ENERGY of the system

Ko, K is KINETIC ENERGY of the system

Uo, U is POTENTIAL ENERGY of the system (usually gravitational and spring)

Work

Work is done to an object any time a **FORCE** is applied that causes the object to move. A force is simply defined as any push or pull. So if you push or pull on object *and the object moves* you have done work.

Work will be positive if the push or pull is in the same direction as motion

Work will be negative if the push or pull is opposite the direction of motion

The formula for calculating work is:

W = F d

**W** is the work done in JOULES **(J)**

**F** is the force applied in NEWTONS **(N)**

**d** is the distance (or displacement) the object moves in METERS **(m)**

In words: Work is equal to the product of the Force and the Distance the object moves, while the force is applied.

Kinetic Energy

Kinetic energy is the energy of a moving object. How much kinetic energy depends on two factors:

1. How \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the object is moving ( \_\_\_\_\_\_\_\_\_\_ )

2. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the object

The formula that allows us to calculate kinetic energy is:

K = ½ mν2

**K** is **kinetic energy** in JOULES **(J)**

**m** is the **mass** of the moving object in KILOGRAMS **(kg)**

**ν** is the speed of the moving object in METERS per SECOND **(m/s)**

In words: Kinetic Energy is one half Mass multiplied by Speed squared.

Gravitational Energy:

Gravitational energy is the energy a massive object has when it is lifted above the surface of the Earth (or Mars, or the Moon, or Saturn, or …). It depends on 3 factors:

1. How strong the gravitational field is (this depends on the planet or moon)

2. The \_\_\_\_\_\_\_\_\_\_\_\_\_ of the object

3. How \_\_\_\_\_\_\_\_\_\_\_ the object is from the surface or ground

The formula for gravitational energy is very simple:

Ug = mgh

**Ug** is the **gravitational energy** of the object in JOULES **(J)**

**m** is the mass of the object in KILOGRAMS **(kg)**

**g** is the gravitational field strength in NEWTONS per KILOGRAM **(N/kg)**

**h** is the height of the object, measured from an arbitrary zero, in METERS **(m)**

In words: Gravitational energy is the product of the object’s Mass, the Gravitational Field Strength and the object’s Height.

* ON EARTH THE GRAVITATIONAL FIELD STRENGTH IS 10N/kg