Unit 4 Energy, Work and Power

TOPIC 4A
Skill 28: Identifying forms of energy

An object with energy has the ability to "work" on another object. In order to obtain energy, work must be done on an object.

WORK DONE becomes ENERGY GAINED

Forms of energy fit into two general categories

POTENTIAL ENERGY= STORED FORMS

[gravitational and spring (elastic) potential]

KINETIC ENERGY = MOTION RELATED

ENERGY IS MEASURED IN

$$\text{JOULES} = \text{Nm} = \frac{kg\ m^2}{s^2}$$

WHICH IS EQUIVALENT TO

ENERGY CAN BE LOST OR GAINED BUT DOES NOT HAVE DIRECTION. THEREFORE ENERGY (ALL FORMS) AND WORK ARE <u>SCALAR</u> QUANTITIES.

- **Potential Energy (gravitation) PE**– Related to **vertical position (height)** or position in the gravitational field (Think of it as energy gained when work is done against the gravitational field or work/ energy stored in the field)

$$PE = mg\Delta h$$
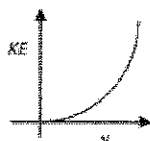
PE and h have a direct relationship:
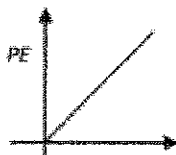
If the height (h) or d_y doubles the amount of (gravitational) potential energy will double.

- **Kinetic Energy** (KE)– Related to **velocity** of the object. Energy gained when work is done to accelerate an object ($F_{net}d = mad = m\ \frac{1}{2}\ v^2$)

$$KE = \frac{1}{2}mv^2$$

KE and v have a direct square relationship:

If the velocity of an object triples, the energy of the object will be multiplied by 9

If the mass of an object triples, the energy of the object will triple.

- **Elastic Potential or Spring Potential Energy** (PE_s)– Energy stored in an elastic object such as a spring. Energy gained when work is done to stretch a spring

$$PEs = \frac{1}{2}kx^2$$

PE$_s$ and x have a direct square relationship:
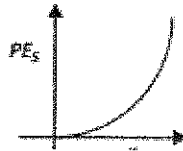
If the spring constant doubles, the energy stored in the spring doubles

If the stretch (or compression) doubles, the energy stored in the spring quadruples

- **Internal Energy** - (Q) – Heat that builds up in the system due to friction or other internal forces. ONLY PRESENT IN SYSTEMS THAT INCLUDE FRICTION. Internal Energy (Q) is energy that is transferred from an object to the surroundings. It is the **difference** between the total energy (work done on the object) and the amount present at the end of a scenario.

- **Total (mechanical) energy (E_T)** – The sum of all the kinetic and potential (gravitational or elastic). For systems that possess more than one form of energy you determine each energy and add them together REMEMBER ALL THE EQUATIONS ON THE BACK OF THE REFERENCE TABLE FIT INTO THE CATEGORY "MECHANICS" SO THIS IS TOTAL MECHANICAL ENERGY.

  For systems with FRICTION

  $$E_T = PE + KE + Q$$

  $$Q = E_T - (PE + KE)$$

  For FRICTIONLESS (vertical, horizontal or elastic) systems

  $$E_T = PE + KE$$

  (PE could be elastic or spring)

For a review of graphical relationships refer to Skill 19.