Energy and Power Notes

The following discussion is from:

http://www.edinformatics.com/math_science/work_energy_power.htm

What is Work, Energy and Power?

Definitions

Work can be defined as transfer of energy. In physics we say that work is done on an object when you transfer energy to that object. If one object transfers (gives) energy to a second object, then the first object does work on the second object.

Work is the application of a force over a distance. Lifting a weight from the ground and putting it on a shelf is a good example of work. The force is equal to the weight of the object, and the distance is equal to the height of the shelf (W= Fxd).

Work-Energy Principle --The change in the kinetic energy of an object is equal to the net work done on the object.

Energy can be defined as the capacity for doing work. The simplest case of mechanical work is when an object is standing still and we force it to move. The energy of a moving object is called kinetic energy. For an object of mass m, moving with velocity of magnitude v, this energy can be calculated from the formula $E= 1/2\ mv^2$.

Types of Energy

There are two types of energy in many forms:

Kinetic Energy = Energy of Motion

Potential Energy = Stored Energy

Forms of Energy

Solar Radiation -- Infrared Heat, Radio Waves, Gamma Rays, Microwaves, Ultraviolet Light

Atomic/Nuclear Energy -energy released in nuclear reactions. When a neutron splits an atom's nucleus into smaller pieces it is called fission. When two nuclei are joined together under millions of degrees of heat it is called fusion

Electrical Energy --The generation or use of electric power over a period of time expressed in kilowatt-hours (kWh), megawatt-hours (NM) or gigawatt-hours (GWh).

Chemical Energy --Chemical energy is a form of potential energy related to the breaking and forming of chemical bonds. It is stored in food, fuels and batteries, and is released as other forms of energy during chemical reactions.

Mechanical Energy -- Energy of the moving parts of a machine. Also refers to movements in humans

Heat Energy -- a form of energy that is transferred by a difference in temperature

SI Mechanical Energy

Newton

https://en.wikipedia.org/wiki/Newton_(unit)

The **newton** (symbol: **N**) is the International System of Units (SI) derived unit of force. It is named after Isaac Newton in recognition of his work on classical mechanics, specifically Newton's second law of motion.

Newton's second law of motion states that $F = ma$, where F is the force applied, m is the mass of the object receiving the force, and a is the acceleration of the object. The newton is therefore:[2]

$$F = m \cdot a$$
$$1\ \text{N} = 1\ \text{kg} \cdot \text{m/s}^2$$

N = newton, kg = kilogram, m = meter, s = second

At average gravity on earth, (conventionally $g = 9.80665$ m/s^2),

1 kilogram mass exerts a force of about 9.8 newtons.

1 N = 1 kg × 9.80665 m/s^2

Example: 220 lb. person or 100 kg (2.2 lbs/kg)

100 kg × 9.80665 m/s^2 = 980 N

Electrical Energy

Coulomb -Atomic charge

https://en.wikipedia.org/wiki/Coulomb

−1 C is equivalent to the charge of approximately 6.242×10^{18} electrons.

Volt

https://en.wikipedia.org/wiki/Volt**Amp**

https://en.wikipedia.org/wiki/Ampere

coulomb , "is the quantity of electricity carried in 1 second by a current of 1 ampere"

1A = 1 C/s

What is Power ?

Power is the work done in a unit of time. In other words, power is a measure of how quickly work can be done.

POWER (P) is the rate of energy generation (or absorption) over time: P = E/t

Power's SI unit of measurement is the Watt, representing the generation or absorption of energy at the rate of 1 Joule/sec.

1 Watt = 1 Joule/ 1 second.

One joule can also be defined as:

The work required to move an electric charge of one coulomb through an electrical potential difference of one volt, or one '"coulomb volt" (C·V). This relationship can be used to define the volt.

1 Joule = 12.390×10^{-4} kcal (food calories)

1 Joule = 2.7778×10^{-4} W·h

1 Joule = 1 Watt . second

1 horsepower = 735.7 Watts

Refrigeration Energy

1 BTU = 1055.05585 joules
One refrigeration ton (RT) is equal to 12000 BTUs per hour:

$P_{(BTU/hr)} = 3.412141633 \times P_{(W)}$

1W = 3.412141633 BTU/hr

1 ton TNT = 4.184 x10^9 joules

Reference https://www.physicsforums.com/threads/energy-vs-force-vs-work-vs-power.768295/

http://www.cuug.ab.ca/branderr/nuclear/petajoule.html

Nuclear Weapons

The Little Boy atomic bomb dropped on Hiroshima on August 6, 1945, exploded with an energy of about 15 kilotons of TNT (63 TJ), and the Fat Man atomic bomb dropped on Nagasaki on August 9, 1945, exploded with an energy of about 20 kilotons of TNT (84 TJ).

https://en.wikipedia.org/wiki/TNT_equivalent

1 ton TNT equivalent is approximately:

- 1.0×10^9 calories
- 4.184×10^9 joules
- 3.96831×10^6 British thermal units
- 3.08802×10^9 foot pounds
- 1.162×10^3 kilowatt hours

Unit Conversion Tables and References

https://www.its.caltech.edu/~culick/documents/Roschke.pdf

https://www.isa.org/uploadedFiles/Content/Training_and_Certifications/ISA_Certification/CCST-Conversions-document.pdf

http://www2.beaufortccc.edu/learning-enhancement-center/docs/resources/math/conversion_chart.pdf

https://www.nist.gov/sites/default/files/documents/pml/wmd/metric/SP1038.pdf

http://www.pgccphy.net/ref/unittbl.pdf