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# Energy

## 1- Definition:

Energy is never used up. It's just transfers from one form to another form.  
The unit of energy is Joule (J)

## 2- Types of energy:

There are 8 different types of energy these are listed below

- I. Thermal energy
- II. Kinetic energy
- III. Gravitational potential energy
- IV. Elastic potential energy
- V. Chemical energy
- VI. Magnetic energy
- VII. Electrostatic energy
- VIII. Nuclear energy

### Note:

Energy is transferred mechanically (by force ) in one form to another. Figure shows how energy transfer from one form to another.



1- Kinetic Energy:

➤ **Defination:**

Anything that is in moving position has an energy which is known as Kinetic energy

➤ Energy in Kinetic energy store depends on object's mass and speed

**Greater object mass= fastest speed = more energy store in object**

➤ Formula of Kinetic Energy

$$\text{K.E.} = \frac{1}{2} m v^2.$$

K.E= kinetic energy(joule), m= mass (kg) , V= (speed)<sup>2</sup> ( m/s)<sup>2</sup>



## Kinetic Energy



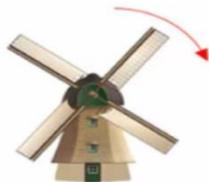
Airplane flying



Woman cycling



Car moving



Windmill rotating



Boy skateboarding



Boy kicking a ball



**Q: A car of mass 2500 kg in travelling at 20 m/s.  
Calculate energy in its kinetic energy store?**

**Solution:**

Mass (m) = 2500 kg , speed (v)= 20 m/s , K.E= ?

$$\text{K.E.} = \frac{1}{2} m v^2.$$

$$\text{K.E} = \frac{1}{2} (2500) * (20)^2$$

$$\text{K.E} = 500,000 \text{ J}$$

## 2- Chemical Energy:

➤ **Definition:**

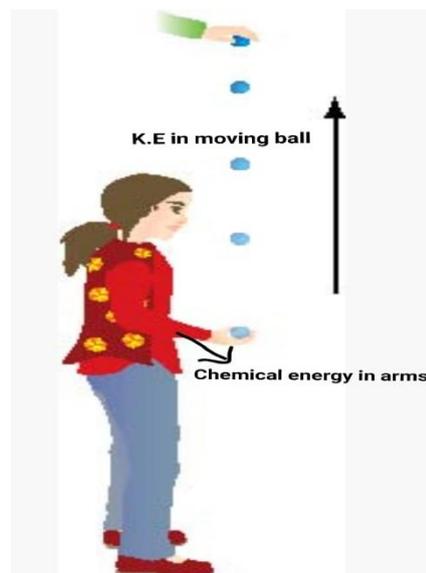
The initial force exerted by a person to throw something upward. The work done by a person. The energy in person's arm known as chemical energy is transferred into kinetic energy (moving ball).



- When u throw ball upward, the energy in hand/ arm transferred to ball

chemical energy (arms) —→ kinetic energy (moving ball)

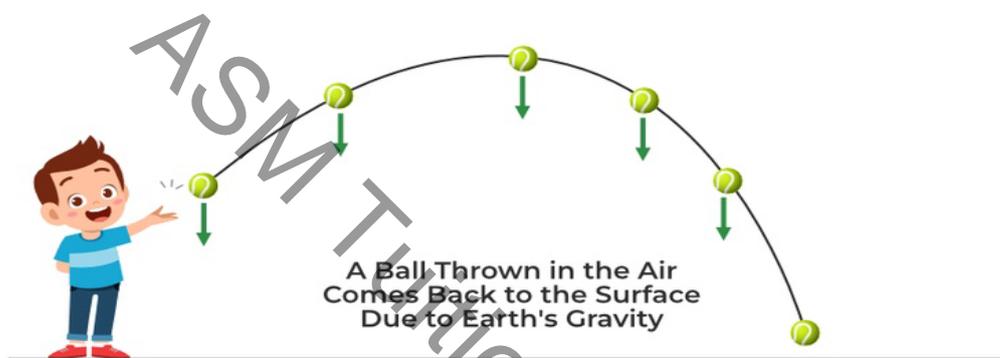
below picture demonstrated how energy transferred from one form to another.



### 3- Gravitational potential energy:

➤ **Definition:**

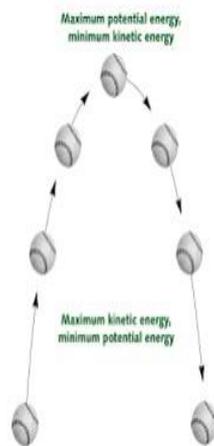
When something dropped from the height, a force acting on object which pull the object to downward this force is known as **Gravitational force**.



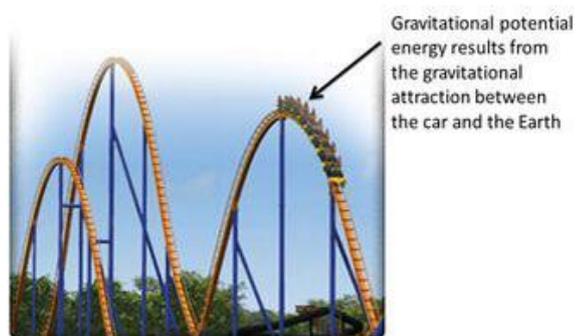
➤ As a object falls from height the energy in the object known as Gravitational potential energy is transferred into Kinetic energy.

➤ When there is no air resistance then

Energy lost in Gravitational potential energy=energy gained in kinetic energy form



#### Example of gravitational potential energy



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➤ **Formula** for measuring Gravitational potential energy:

①  $E_p = mgh$

$E_p$  = gravitational potential energy (j) ,  $m$  = mass (kg),  $h$  = height (m)

$g$  = gravity ( N/kg)

② If u want to find  $m$ ,  $h$ , and  $g$  then these are the formulas

\*  $M = E_p/gh$

\*  $g = E_p/mH$

\*  $h = E_p/mg$

### 4- Elastic potential Energy:

➤ **Definition:**

Elastic potential energy is the potential energy stored in an object when it is stretched or compressed.

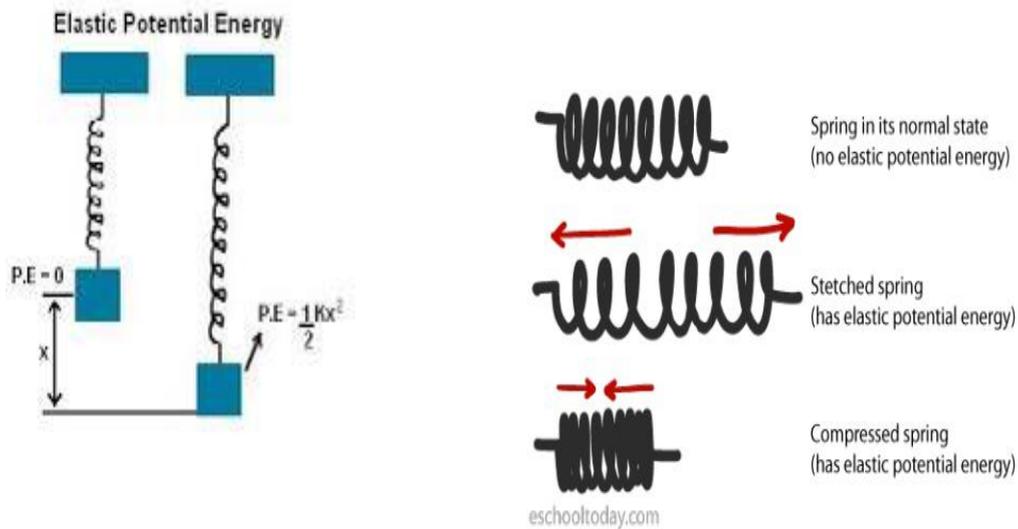
➤ **Formula**

$$E_e = 1/2ke^2$$

$E_e$  = elastic energy (j) ,  $k$  = constant,  $e$  = extension



When u stretched or compressed an elastic band, rubber band or spring. The displacement occurs when external force applied. The extension in its original position is measure as elastic potential energy. Below figure demonstrated the elastic potential energy



### 5- Thermal Energy:

➤ **Definition:**

It is the form of Energy that transferred from one object to another due to the difference in temperature is known as Thermal energy.

➤ Heat is the flow of energy between systems.

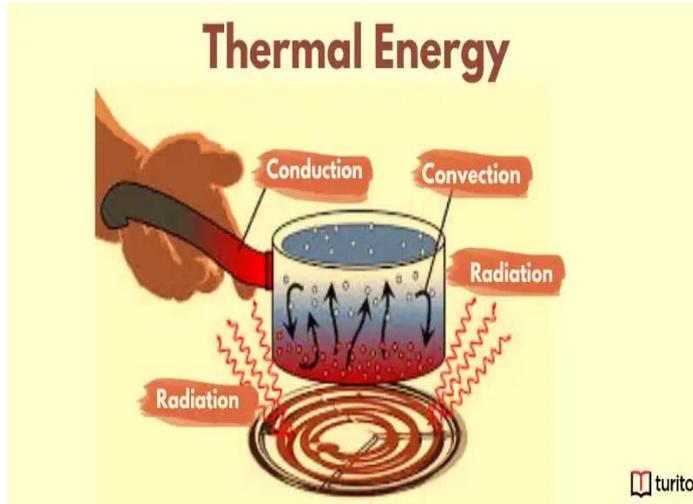
➤ For 1kg substance require 1C temperature.

➤ **Note: change in temperature can lead the change in phase. e.g. Liquid to gas**

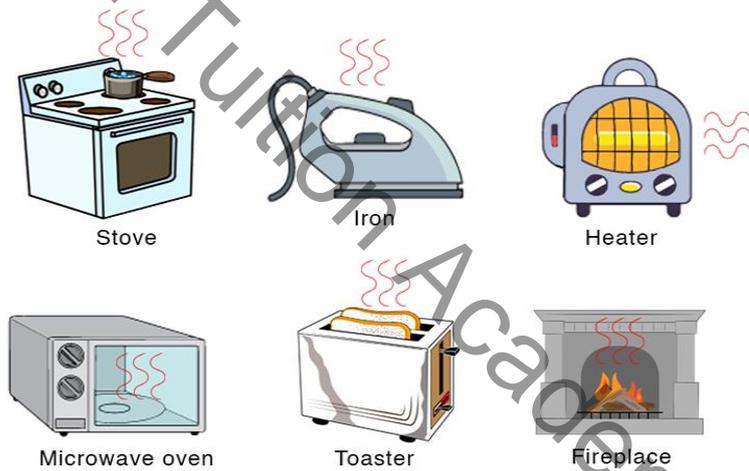
**Higher the temperature = higher the speed of atoms of substance**



when we heat water in a pot, energy is transferred from fire to the pot and then transfer to the Water. Given figure shows how energy transferred from one to another.



### Thermal Energy Examples

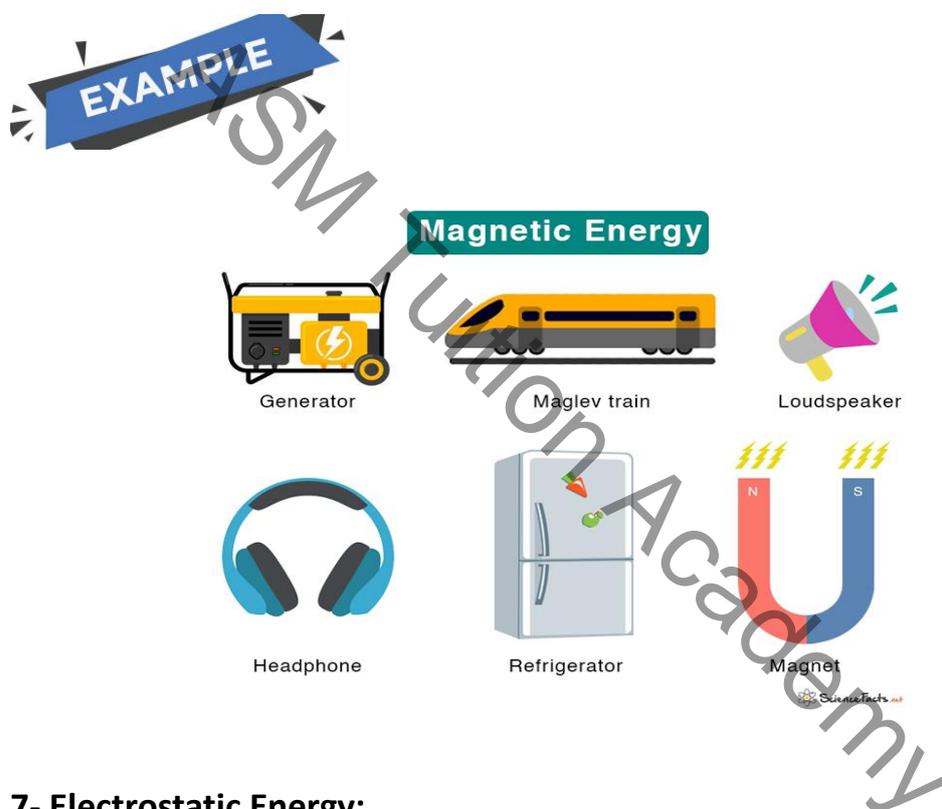


## 6- Magnetic Energy:

➤ **Definition:**

Magnetic energy is the form of energy which is associated with the magnetic field.

- Magnetic fields are generated by permanent magnets and electromagnets to produce electricity
- Magnetic energy is the form of potential energy.

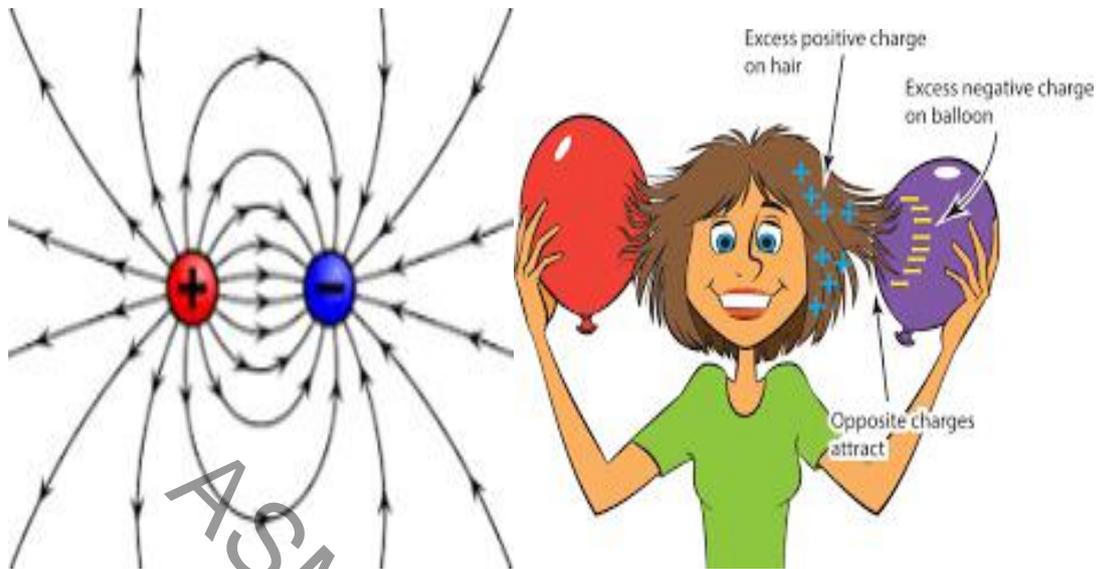


## 7- Electrostatic Energy:

➤ **Definition:**

Electrostatic energy is the form of potential energy of the system of charged particle. It is the energy stored in the electric field that is created by charged particle.





### 8- Nuclear Energy:

➤ **Defination**

It is the form of energy released from the nucleus which is made up of protons and neutrons.

➤ **Formula**

$$E = mc^2$$

E = nuclear energy , m= mass ( kg), C= speed of light



## NUCLEAR ENERGY EXAMPLES



Nuclear Power  
Plants



Nuclear Medicine



Sun's Energy



Atomic Bombs



Smoke Detectors



Nuclear Batteries



Geothermal  
Energy



Spacecraft Propulsion  
for Deep Space  
Exploration

EXAMPLES.COM

## Examples of Nuclear Energy



Nuclear Reactor



Nuclear Weapon

### Specific Heat capacity

Specific heat capacity is the amount of energy needed to raise the Temperature of 1kg of a substance by 1° C.

Formula:

$$\Delta E = mc\Delta T \text{ or } \Delta E = mc \Delta \delta$$

Where

- $\Delta E$  is the heat capacity in Joules
- $m$  is the mass in grams/ kg
- $c$  is the specific heat of an object in J/g °C
- $\Delta T$  or  $\Delta \delta$  is the change in the temperature in °C



Determine the heat capacity of copper of mass 70 g and the temperature difference is 20°C if 300 J of heat is lost.

Solution:

Given parameters are,

Mass  $m = 70$  g,

Temperature difference  $T = 20$ °C,

Heat lost  $\Delta Q = 300$  J

the Heat capacity formula is given by

$$\Delta E = mc \Delta T$$

$$c = 300 / 20$$

$$c = 15 \text{ J/°C}$$



**Q. How much energy is needed to heat the 2.00 kg of water from 10C to 100C ? The specific heat capacity of water is 4200 j/kgC**

**Solution:**

Given parameters are

M= 2 kg

Specific heat capacity= 4200 j/kgC

First find change in Temperature  $\Delta T = 100 - 10 = 90 \text{ C}$

Now find Energy

$$\Delta E = mc \Delta T$$

$$\Delta E = 2 * 4200 * 90$$

$$\Delta E = 756000 \text{ j}$$

### Investigating Specific heat capacity (Practical)

- 1) To can investigate a solid material, you will need a block with two holes in it (for the heater and thermometer).
- 2) Measure the mass of block and then wrap with an insulating layer to reduce the energy transfer from the blocks to surroundings.
- 3) Measure the initial temperature of the block and set the potential difference V of the power supply to be 10V
- 4) Turn a power supply and start a stop watch.

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- 5) When you turn on the power supply, the current on the circuit start working on heater which transfer energy from electrical energy to thermal energy causing material temperature to increase.
- 6) When you take at least 10 readings turn off the power supply.
- 7) Then calculate some calculations to find material's specific heat capacity of material.

**Formulas to check the power and energy transfer**

- Power =  $VI$

where  $V$  = potential difference and  $I$  = current.

- Energy =  $Pt$

Where  $P$  = power and  $t$  = time (sec)

To calculate the **specific heat capacity**

$$\Delta E = mc\Delta T \text{ or } \Delta E = mc \Delta \theta$$

## Efficiency

- Useful devices are only useful because these devices transfer energy in one form to another.
- Some of the input energy is usually wasted in the form of thermal energy.
- The less energy wasted, that device is called more efficient.

Less energy wasted = more efficiency of device

- we can improve the device efficiency by insulation and lubrication.
- Efficiency can be calculated using this formula

**Efficiency = useful output energy transfer**

**Total power input**

- Useful Energy output is not usually equal to total energy input. No device is 100% efficient. But in some cases some devices are 100% efficient

### **For Example:**

1- electric heaters and electric drill which transfer energy to thermal energy store. No energy wasted means these machines have 100% efficiency.