P6

Energy transformations & energy transfers

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Learning objectives

1. describing energy conversions and understanding the meaning of energy efficiency
2. Identifying different forms of energy
3. applying the principle of conservation of energy
4. calculating potential energy, kinetic energy and percentage efficiency

Forms of Energy

thermal

Thermal energy is created by the vibration of atoms and molecules within substances.

chemical

Chemical energy is stored in the bonds of atoms and molecules - it is the energy that holds these particles together.

nuclear

Nuclear energy is the energy that holds together the nucleus of atoms

light

Light is electromagnetic radiation that shows properties of both waves and particles

electrical

Electrical energy is the form of energy resulting from the flow of electric charge

sound

A sound wave is a disturbance that travels through some medium.

Energy Conversions

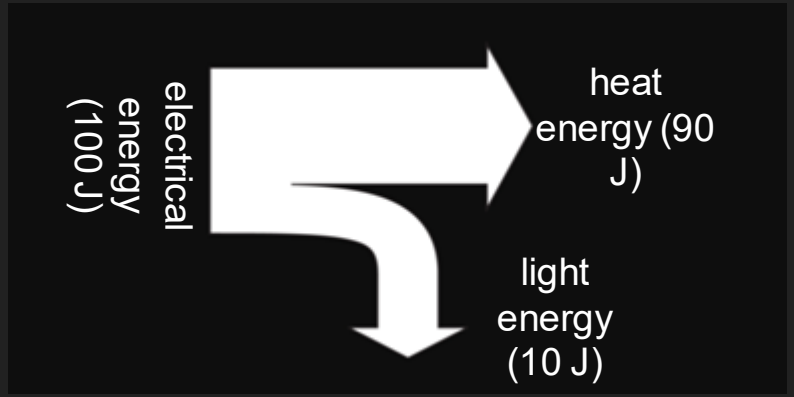
When energy changes from one form to another, we say that it has been converted or transformed.

For example

CHEMICAL ENERGY ➡ k.e. + g.p.e + thermal energy + light energy + sound energy

The two most common types of waste energy are thermal energy and sound energy

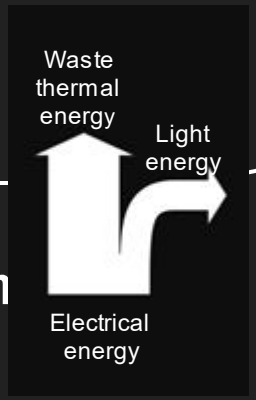
Conservation of energy

- In any energy conversion, the total amount of energy before and after the conversion is constant
- It tells us that energy can neither be created or destroyed
- 

Energy efficiency

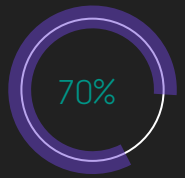
The efficiency of an energy conversion is the fraction of the energy that ends up in the desired form

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{energy input}} \times 100$$

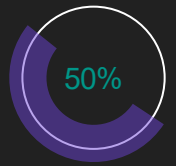


Typical efficiency

electric heater



washing machine motor



gas-fired power station

Energy Calculations

Gravitational potential energy = weight × height

G.p.e = mg x h

height and weight of an object are directly proportional to its g.p.e.

Kinetic energy = $\frac{1}{2}$ × mass × speed^2

k.e. = ½mv^2.

speed and mass of an object are directly proportional to its k.e.

Solved example 1

An athlete of mass 50 kg runs up a hill. The foot of the hill is 400 m above sea-level. By how much does the athlete's g.p.e. increase?

STEP 1

Assume that g.p.e is zero at the foot of the hill. Calculate the increase in height.

h = 1200 m - 400 m = 800 m

STEP 2

Write down the equation for g.p.e., substitute values and solve.

g.p.e. = weight x height
= mg x h
= 50 kg x 10m/s^2 x 800 m
= 400000J
= 400kJ

Solved example 2

A van of mass 2000 kg is travelling at 10m/s. Calculate its kinetic energy. If its speed increases to 20 m/s, by how much does its kinetic energy increase?

STEP 1

Calculate the van's k.e. at 10m/s

k.e. = ½ mv2
= ½ x 2000 kg x (10 m/s)^2
= 100000 J or 100 kJ

STEP 2

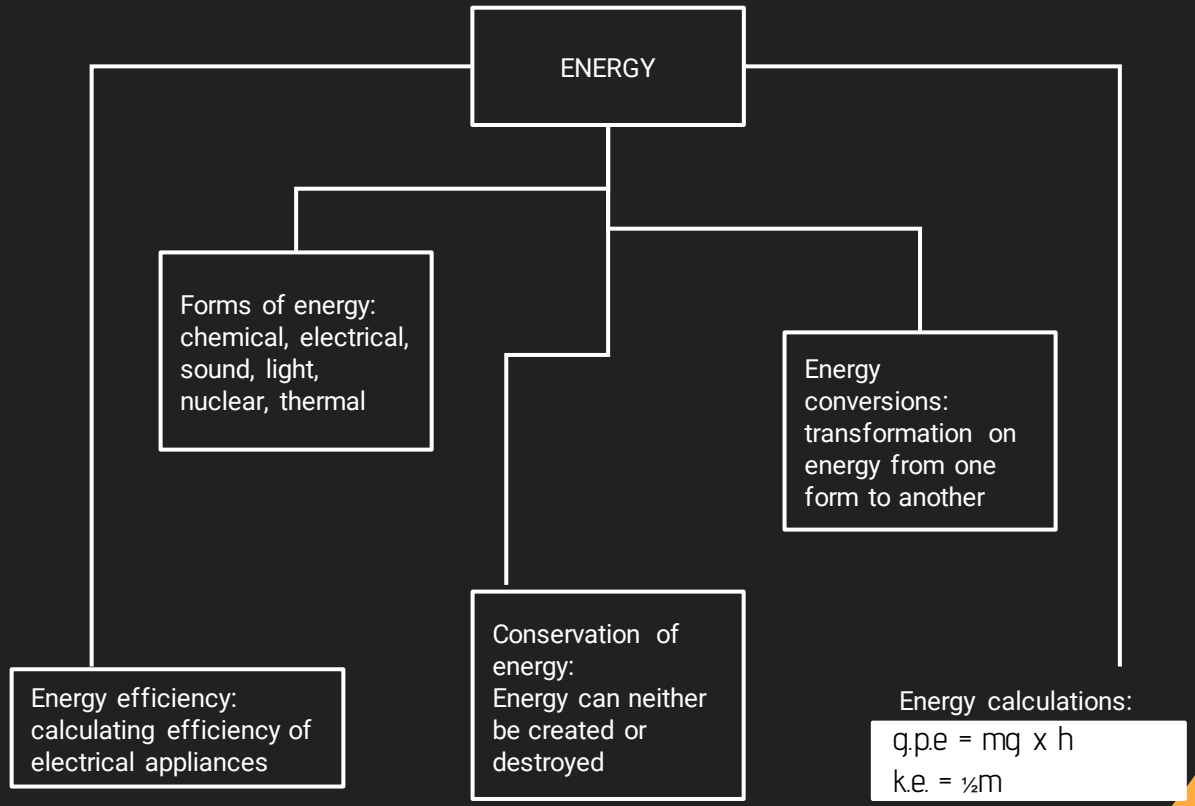
Calculate the van's k.e. at 20 m/s

k.e. = ½ mv2
= ½ x 2000 kg x (20 m/s)^2
= 400000 J or 400 kJ

STEP 3

Calculate the change in the van's k.e.

= 400 kJ - 100 kJ
= 300 kJ


ENERGY
Forms of energy: chemical, electrical, sound, light, nuclear, thermal
Energy conversions: transformation on energy from one form to another
Conservation of energy: Energy can neither be created or destroyed
Energy efficiency: calculating efficiency of electrical appliances
Energy calculations:
g.p.e = mg x h
k.e. = ½m


ENERGY STORES
AND
SYSTEMS