WORK, ENERGY AND POWER

Work is defined as the product of force and a distance

If the force acts at an angle to the horizontal, and the distance is in the horizontal direction,

ENERGY

This is defined as the ability to do work

RELATIONSHIP BETWEEN WORK AND KINETIC ENERGY

From newton’s second law of motion,

on integrating,

Consider a body of mass m trying to move upwards from to .

There is work done by the force R to move the body upwards. However, there is an opposive gravitational force to that meaning a negative work done. The total work done is given by

From our above,

THERMODYNAMIC WORK

Thermodynamic definition of work says. Work is done by a system on its surrounding if the sole effect on everything external to the system could have been the raising of a weight.

Energy is transferred and stored when work is done

In thermodynamics, work is a means for transferring energy. It does not refer to what is being transferred between systems or to what is being stored within systems.

NB: Work is not a property of system or surroundings. Work is also a path function i.e. it needs details of the paths and processes taken to get to the final.

On the other hand, temperature, pressure, and volume are state functions. They only depend on the initial and final state of the system.

POWER

Power is defined as the rate at which work is done. The rate of energy transfer by work is called power.

Power is defined as the product of the force and the velocity at the point of application force

**WAYS OF TRANSFERRING ENERGY**

1. Mechanical work: Applying a force through a distance will increase kinetic energy

2. Heat Energy: Applying heat will increase KE of its molecules as temperature increases.

SIGN CONVENTIONS

when heat flows into system

when heat flows out of the system

An increase in heat energy increases the internal energy of the system

Work Output,

Work Input,

When you do work (your work output), your internal energy decreases

Work output = Work done by the system, therefore internal energy decrease

Work input = Work done on the system, internal energy increases

When you hear compression,

Compression is work done on the system:

Expansion is work done by the system:

**SPECIFIC WORK AND ENERGY**

The specific work is work done per unit mass. Its unit is kJ/kg. To find the work done, we multiply the unit work my mass.

Similarly, the internal energy of a system can be expressed in terms of its specific internal energy

EXPANSION AND COMPRESSION WORK

Given a gas (or liquid) contained in a piston-cylinder assembly as the gas expands. During the process, the gas pressure exerts a normal force on the piston. The force exerted by the gas on the piston is given as

The work done by the system as the piston is displaced a distance dx is

A gas piston-cylinder assembly undergoes compression and expansion process for which the relationship between pressure and volume is given by a polytropic process

C and n are both constants

On solving,

The kind of process in a piston cylinder is called a polytropic process.

For a polytropic process , ,

Note the following of polytropic processes:

1. When ,

2. When ,

3. When, , Constant pressure,

4. When, , Constant Volume (Isometric),

Note: The area under a P-V graph is the work done