Thermodyanmic Systems And Concepts

9.1.1 Explain what is meant by thermodynamic system

Thermodynamics treats the transformation of heat energy into mechanical energy or and the reverse mechanical energy into heat.

A thermodynamic system is basically anything that is being studied. It can be a piston, a tank of gas, a banana, anything really. The surroundings of a thermodynamic system is everything but the system, shocking, try to contain your excitement. We sometimes refer to a closed system, in this case we are referring to a system where no mass is exchanged with the surroundings. An isolated system is one in which no energy is exchanged with the surroundings. In general all systems are open and none are isolated.

9.1.2 Describe the concepts heat, work and internal energy

Heat is the movement of thermal energy due only to a difference in temperature. Heat is measured in Joules (J).

Work can be done on or by a thermodynamic system. The simplest example of work being done on a system is a piston compressing a gas (air conditioner or refrigerator). Or vice versa, if the gas expands and moves the piston (such as in a piston engine) then work is being done by the system.

Internal energy of a thermodynamic system is the sum of the kinetic and potential energy of the particles in the system. The internal energy of a system is changed if work is done on or by a system or if the thermal energy is added or removed from the system. Internal energy is a property of the system and is dependent on the state of the system, pressure, temperature and volume.

9.1.3 Deduce an expression for the work involved in a volume change of a gas at constant pressure.

As mentioned earlier a thermodynamic system can do work on its surroundings, a common and useful example is the expansion of gas and thus pushing a piston. If the gas expands at a constant pressure (which doesn't happen but greatly simplifies the calculations) and thus moves the piston then the force on the piston is equal to the pressure times the area of the piston. Thus the work done on the piston is:

(1)
$$\Delta W = F\Delta x = PA\Delta x$$

Where is the distance moved by the piston. is equal to the change in the volume of the gas. So we can write the work done by the gas as:

(2)
$$\Delta W = P\Delta V$$

Be careful to remember this expression is only valid if the expansion occurs with constant pressure.

If the a plot of pressure vs. volume is created, a straight line will be formed. The area under the curve (line) is equal to the work done by the gas. This is true whether the pressure is constant or not.

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