Summary Chapter 20

I. Objective :

① Understand the concept of heat, internal energy, and thermodynamic process.

② Define the heat capacity, specific heat, and latent heat.

③ Describe different types of phase changes and the change in energy associat

④ Understand the concept of conduction of heat (heat transfer between a system and its surroundings).

⑤ Work associated with a system that undergoes a change in state.

⑥ State the first law of thermodynamics ($\Delta U = Q - W$)

⑦ Discuss the different types of processes (adiabatic, isothermal, etc....)

⑧ Calculate the Work for isothermal process.

II. Summary of major points :

① When two systems at different temperatures are in contact, energy will flow between them until they reach the same temperature.
The internal energy of a substance increases with increasing temperature.

② The heat capacity, C, of any substance is defined as the amount of heat required to increase the temp. of that substance by one degree Celsius.

$\boxed{Q = m\,C\,\Delta T}$ heat required to change the temp. of a substance by ΔT.

m: mass; C: specific heat; ΔT: change in temp.

The heat required for phase change is $Q = \begin{cases} m L_f & \text{latent heat of fusion} \\ m L_v & \text{latent heat of vaporization.} \end{cases}$

m: mass of the substance.

③ The Work done by a gas when its volume expands from V_i to V_f is;

$\boxed{W = \int_{V_i}^{V_f} P\,dV}$ It is the area under the P vs. V diagram

(4) The first Law of thermodynamics is stated as follows;

$$\boxed{\Delta U = Q - W}$$

- ΔU: Change in internal energy.
- Q: heat added to the system
- W: Work done by the system.

By convention:

$Q > 0$ when heat enters the system

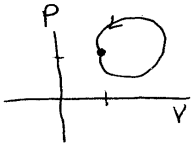
$Q < 0$ " " is removed from "

If the gas is compressed $V_f < V_i \Rightarrow W < 0$

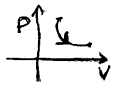
" " expands $V_f > V_i \Rightarrow W > 0$

(5) For isolated system : $Q = 0 = W \Rightarrow \boxed{\Delta U = 0}$

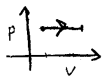
For cyclic process : $\Delta U = 0 \Longrightarrow \boxed{Q = W}$



For adiabatic process : $Q = 0$ $\boxed{\Delta U = -W}$



For isobaric process : pressure P = Const. $\boxed{W = P\Delta V}$



For isovolumic process : $dV = 0 \Rightarrow W = 0 \Rightarrow \boxed{\Delta U = Q}$ (V = Constant)