successes and failures of these theories. (P.U. U. 2002, 2000, 1999, ...

Ans. (a) Free electron gas model. A number of important physical properties of metals can be explained in terms of '*free electron model*'. According to this model the *most weakly bound* electrons of the constituent atoms move about freely through the volume of the metal. Thus the *valence electrons* of the metal become the *conduction electrons*. The forces between the conduction electrons and ion cores are neglected. The total energy is all kinetic, the potential energy is also neglected. Hence the conduction electrons move about within the metal freely without any collisions similar to the molecules of an ideal gas.

It should be, however, noted that the '*electron gas*' is charged while ordinary gas is generally neutral. Secondly, the electron concentration in metals is much higher than that in ordinary gas.

The simplest metals are alkali metals. For example, in *Na* atom ($1s^2\ 2s^2\ 2p^6\ 3s^1$) the valence electron is in a $3s$ state. In the metal this electron becomes a conduction electron moving throughout the metal crystal. The remaining 10 electrons of Na^+ ion core fill the $1s$, $2s$ and $2p$ states having 2, 2 and 6 electrons respectively in the free ion, the distribution of core electrons being *essentially* the *same* in the free ion as in the metal.

The *metal crystal* is thus supposed to consist of positive metal ions with free electron gas of valence electrons of the atom *permeating* the space between the positive ions. These free electrons behave like the atoms or molecules in a perfect gas and are, therefore, sometimes known as '*free electron gas*' or '*fermi gas*' or '*Electron cloud*'.

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