Q. 1. How does the free electron gas differ from the ordinary gas containing molecules ?

Ans. In the free electron gas we deal with electrons which are negatively charged whereas th gas molecules are neutral. Also, the number density of free electrons is quite large a compared to number density of molecules of the gas.

Q. 2. Name some properties which can be explained using free electron gas theory.

Ans. A few properties which can be explained using free electron theory are :

(1) Ohm's law

(2) Electrical and Thermal conduction

(3) Weidemann Franz Law

(4) Lustre and opacity of metals.

Q. 3. What are the assumptions of Sommerfeld model ?

Ans. According to Sommerfeld model, the electrons move inside a potential box where the potential is everywhere constant, so that no force acts on the electrons. According to the model, the free electrons are those which are the valence electrons of the metal atom.

Q. 4. What is Fermi energy ?

Ans. According to Sommerfeld model, at 0 K, all the electronic states below a certain level are completely filled and above this level, all the states are empty. This level is called Fermi level and the energy corresponding to this level is called Fermi energy.

Q. 5. What is the physical meaning of Fermi energy ?

(G.N.D.U. 2003 S ; P.U. 2002, 2002 S, 2005)

Ans. The Fermi energy represents the electrochemical or partial molar energy of free electrons. It depends upon the density of free electrons. The Fermi level is that where the probability of finding the electrons is 50%.

Q. 6. What is meant by density of states ?

OR

Define density of states.

Ans. The density of states is defined as the number of electronic states per unit energy range at the given value of energy. It is denoted by Z(E). *(P.U. 2005)*

Q. 7. What is Fermi velocity ?

Ans. According to Sommerfeld model, the electronic motion does not stop at absolute zero. The electrons do possess some energy even at 0 K. The velocity of electrons at 0 K corresponding to Fermi energy is given by

$$v_F = \frac{\hbar}{m}\left[3\pi^2 \frac{N}{V}\right]^{\frac{1}{3}}$$ and is called Fermi velocity.

Q. 8. What are conduction electrons ?

Ans. In metals, the valence electrons are responsible for the electric conduction and are thus named as conduction electrons.

Q. 9. What are static and transport properties for free electron gas model ? *(P.U. 2004)*

Ans. The properties which are due to excitation of electrons from one energy level to other in the metal atoms are called static properties. For example, electron emission, heat capacity, magnetic properties etc.

The properties which are explained by considering the detailed response of electrons to an external field are called transport properties. For example, thermal and electrical conductivity.