Chapter- 12

# Atom

***Very Short Answer Type Questions***

***1 marks questions***

**01.** Would the Bohr formula for the H-atom remain unchanged if proton had a charge $(\frac{-4}{3})$e and electron a charge $(\frac{-3}{4})$e, where 1.6 x $10^{-19}$ C. Give reasons for your answer.

**02.** What is the Bhor quantization condition for the angular momentum of an electron in the third orbit?

**03.** Name the series of hydrogen spectrum which has the least wavelength. ***[1995]***

**04.** The wavelengths of some of the spectral lines obtained in the hydrogen spectrum are $9546\,\overset{0}{A}, 6463\,\overset{0}{A}\,and\,1216\,\overset{0}{A}$. which one of these wavelengths belongs to Lyman series? ***[1997]***

**05.** Why are the electrons revolving around the nucleus of an atom ***[1998]***

**06.** What is the diameter of a hydrogen atom? ***[1995]***

**07.** Consider two different hydrogen atoms. The electron in each atom is in an excited state. Is it possible for the electrons to have different energies but the same orbital angular momentum according to the Bohr model?

**08.** What is the significance of the negative energy of the electron in the orbit? ***[1998]***

**09.** The radius of the first electron orbit of a hydrogen atom is $5.3\times10^{-11}m$. What is the radius of the second orbit of H-atom? What is the radius of 1st orbit of $He^{+}$? ***[1996]***

**10.** The total energy of an electron in the first excited state of the hydrogen atom is about -3.4eV. what is the potential energy of the electron in this state? ***[1995]***

**11.** The ground state energy of hydrogen atom is -13.6 eV. What are the kinetic and potential energies of electron in this state?

***2 and 3 Marks questions***

**12.** Show that the radius of the orbit in hydrogen atom varies as $n^2$, where n is the principal quantum number of the atom.

**13.** Calculate the shortest wavelength in the Balmer series of a hydrogen atom. In which region (infrared, visible, ultraviolet) of hydrogen spectrum does this wavelength lie?

**14.** Using the Rutherford model of the atom, derive the expression for the total energy of the electron in a hydrogen atom. What is the significance of total negative energy possessed by the electron?

**15.** A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. Up to which energy level the hydrogen atoms would be excited? Calculate the wavelengths of the first members of Lyman and the first member of Balmer series.

**16.** In the ground state of a hydrogen atom, its Bohr radius is given as $5.3\times10^{-11}m$. The atom is excited such that the radius becomes $21.2\times10^{-11}m$. Find (a) the value of

the principal quantum number and (b) the total energy of the atom in this excited state, if in ground state E = -13.6eV.

**17.** State the postulates of Bohr's atomic model. Obtain the Bohr's quantization condition of angular momentum based on the wave picture of an electron. ***[1990,1991]***

**18.** The short wavelength limits of Lyman, Paschen and Balmer series in the hydrogen spectrum are denoted by $\lambda_L, \lambda_P \text{ and } \lambda_B$ respectively. Arrange these in increasing order. ***[1994]***

**19.** Sketch the energy level diagram for a Hydrogen atom. Mark the transitions corresponding to Lyman and Balmer series.

**20.** The energy of the electron in the ground state of the hydrogen atom is -13.6 eV. (a) What does the negative sign signify? (b) How much energy is required to take an electron in this atom from the ground state to the first excited state?

**21.** Explain, the brief, why Rutherford's model cannot account for the stability of an atom.

**22.** (a) Using Bohr's total postulates, derive the expression for the total energy of the electron in the stationary states of a hydrogen atom (b) Using Rydberg's formula, calculate the wavelength of spectral lines of the first members of the Lyman series and the Balmer series.

**23.** (a) Using Bohr's second postulate of quantisation of orbital angular momentum show that the circumference of the electron in the nth orbital state in a hydrogen atom is n-times the de-Broglie wavelength associated with it. (b) The electron in the

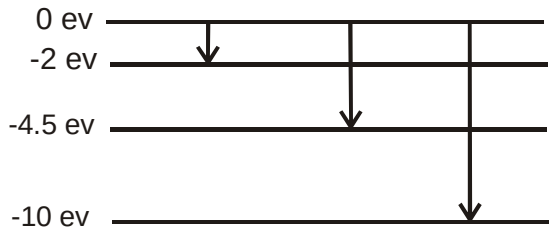
hydrogen atom is initially in the third excited state. What is the maximum number of spectral lines which can be emitted when it finally moves to the ground state?

**24.** The ground state energy of hydrogen atom is -13.6 eV. If an electron makes a transition from an energy level -0.85 eV to -1.51 eV, calculate the wavelength of the spectral line emitted. To which series of hydrogen spectrum does this wavelength belong?

**25.** In a Geiger-Marsden experiment, calculate the distance of closest approach to the nucleus of Z=80, when an - particle of 8 MeV energy impinges on it before it comes to momentarily rest and reverses its direction. How will the distance of closest approach be affected when the kinetic energy of the -particle is doubled?

**26.** Using the postulates of Bohr's model of a hydrogen atom, obtain an expression for the frequency of radiation emitted when the atom makes a transition from the higher energy state with quantum number $n_f$ to the lower energy state with quantum number $n_i$ ($n_i < n_f$).

**27.** Which of these transitions correspond to the emission of radiation of (i) maximum and (ii) minimum wavelength? Explain. ***[1999]***



**28.** (a) Which transition corresponds to the emission of radiation of maximum wavelength?

(b) The energy levels of an atom are as shown in the figure below. Which of them will result in the transition of a photon of wavelength 275 nm?

**29.** Show that the energy of the first excited state of $He^+$ atom is equal to the energy of the ground state of hydrogen tom.

**30.** Show that the first few frequencies of light that are emitted when electrons fall to the nth level from levels higher than n are approximate harmonics (i.e in the ratio 1:2:3....) when n >> 1.