Structure of Atom

Q 1.

Naturally occurring consists of two isotopes whose atomic weights are 10.01 and 11.01. The atomic weight of natural boron is 10.81. Calculate the percentage of each isotope in natural boron. **(IIT JEE 1978)**

Q 2.

Account for the following. Limit your answer to two sentences: **(IIT JEE 1979)**

Q 3.

The energy of the electron in the second and the third Bohr's orbits of the hydrogen atom is $-5.42 * 10^{-12}$ erg and $-2.41 * 10^{-12}$ erg respectively. Calculate the wavelength of the emitted radiation when the electron drops from the third to the second orbit.

(IIT JEE 1981 – 3 Marks)

Q 4.

Calculate the wavelength in Angstrom of the photon that is emitted when an electron in the Bohr orbit, n = 2 returns to the orbit, n = 1 in the hydrogen atom. The ionization potential of the ground state hydrogen atom is $2.17 * 10^{-11}$ erg per atom. **(IIT JEE 1982 – 4 Marks)**

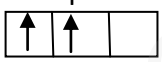
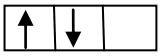
Q 5.

The electron energy in hydrogen atom is given by $E = (-2.17 * 10^{=12})/n^2$ ergs. Calculate the energy required to remove an electron completely from the n = 2 orbit. What is the longest wavelength (in cm) of light that can be used to cause this transition?

(IIT JEE 1984 – 3 Marks)

Q 6.

Give reasons why the ground state outermost electronic configuration of silicon is:

2s  3p  and not 3s  3p 

(IIT JEE 1985 – 2 Marks)

Q 7.

What is the maximum number of electrons that may be present in all the atomic orbital with principal quantum number 3 and azimuthally quantum number 2? **(IIT JEE 1985 – 2 Marks)**

Q 8.

According to Bohr's theory, the electronic energy of hydrogen atom in the nth Bohr's orbit is given by $E_n = -21 * 10^{-19}/n^{-2}$ J. Calculate the longest wavelength of light that will be needed to remove an electron from the third Bohr orbit of the He^+ ion. **(IIT JEE 1990 – 3 Marks)**

Q 9.

Estimate the difference in energy between 1st and 2nd Bohr orbit for a hydrogen atom. At what minimum atomic number, a transition from n = 2 to n = 1 energy level would result in the emission of X-rays with $\lambda = 3.0 * 10^{-8}$m? Which hydrogen atom – like species does this atomic number correspond to? **(IIT JEE 1993 – 5 Marks)**

Q 10.

What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition n = 4 to n = 2 of He^+ spectrum? **(IIT JEE 1993 – 3 Marks)**

Q 11.

Find out the number of waves made by a Bohr electron in one complete revolution in its 3rd orbit. **(IIT JEE 1994 – 3 Marks)**

Q 12.

Iodine molecule dissociates into atoms after absorbing light of 4500 Å. If one quantum of radiation is absorbed by each molecule, calculate the kinetic energy of iodine atoms. (Bond energy of I_2 = 240 kJ mol^{-1}) **(IIT JEE 1995 – 2 Marks)**

Q 13.

Calculate the wave number for the shortest wavelength transition in the Balmer series of atomic hydrogen. **(IIT JEE 1996 – 1 Marks)**

Q 14.

Consider the hydrogen atom to be a proton embedded in a cavity of radius a_o (Bohr radius) whose charge in neutralized by the addition of an electron to the cavity in vacuum, infinitely slowly. Estimate the average total energy of an electron in its ground state in a hydr5ogen atom as the work done in the above neutralization process. Also, if the magnitude of the average kinetic energy is half the magnitude of the average potential energy, find the average potential energy. **(IIT JEE 1996 – 2 Marks)**

Q 15.

With what velocity should a ∝-particle travel towards the nucleus of a copper atom so as to arrive at a distance 10^{-13} metre from the nucleus of the copper atom?

(IIT JEE 1997C – 3 Marks)

Q 16.

An electron beam can undergo diffraction by crystals. Through what potential should a beam of electrons be accelerated so that its wavelength becomes equal to 1.54 Å?

(IIT JEE 1997 – 2 Marks)

Q 17.

Calculate the energy required to excite on litre of hydrogen gas at 1 atm and 298 K to the first excited state of atomic hydrogen. The energy for the dissociation of H-H bond is 436 kJ mol^1.

(IIT JEE 2000 – 4 Marks)

Q 18.

Wavelength of high energy transition of H-atoms is 91.2nm. Calculate the corresponding wavelength of he atoms. **(IIT JEE 2003 – 2 Marks)**

Q 19.

The Schrodinger wave equation for hydrogen atom is $\Psi_{2s} = \frac{1}{4\sqrt{\pi}} \left(\frac{1}{a_0}\right)^{3/2} \left(2 - \frac{r_0}{a_0}\right) e^{-r_0/a_0}$

Where a_0 is Bohr's radius. If the radial node in 2s be at r_0, then find r_0 in terms of a_0.

(IIT JEE 2004 – 1 Marks)

Q 20.

A ball of mass 100 g is moving with 100 ms^{-1}. Find its wavelength. Find out atomic number and mass number of the element X. Also identify the element. **(IIT JEE 2004 – 1 Marks)**

Q 21.

Find the velocity (ms^{-1}) of electron in first Bohr's orbit of radius a_0. Also find the de Broglie's wavelength (in m). Find the orbital angular momentum of 2P orbital of hydrogen atom in units of units of $h/2\pi$. **(IIT JEE 2005 – 2 Marks)**