Atomic Structure

DPP-4

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1. For the hydrogen atom, $E_n = -(1/n^2)R_H$, where $R_H = 2.179 \times 10^{-18}$ J. Find the wavelength of the transition from the ground state to the n = 2 state.

2. Calculate the frequency of light emitted for an electron transition from the sixth to the second orbit of the hydrogen atom. In what region of the spectrum does this light occur?

3. The third line in the Balmer series corresponds to an electronic transition between which Bohr orbits in hydrogen?

4. Calculate the wavelengths of the first line and the series limit for the Lyman series for hydrogen.

5. A single electron orbits around a stationary nucleus of charge+Ze, where Z is a constant and e is the magnitude of electronic charge. It requires 47.2 eV to excite the electron from second Bohr orbit to the third Bohr orbit. Find :

(a) the value of Z

(b) the energy required to excite the electron from n = 3 to n = 4

(c) the wavelength of radiation required to remove electron from 2nd Bohr's orbit to infinity

(d) the kinetic energy, potential energy and angular momentum of the electron in the first obrit.

(e) the ionisation energy of above one electron system in eV.

6. The Rydberg constant for deuterium (^2H) is 109 707 cm^{-1}. Calculate

(a) the shortest wavelength in the absorption spectrum of deuterium

(b) the ionization potential of deuterium, and

(c) the radii of the first three Bohr orbits.

7. A hydrogen like ion, He^+ (Z = 2) is exposed to electromagnetic waves of 256.38Å. The excited electron gives out induced radiations. Find the wavelength of these induced radiations. $R = 1.097 \times 10^7\ m^{-1}$.

8. Emission transitions in the Paschen series end at orbit n = 3 and start from orbit n and can be represented as $\nu = 3.29 \times 10^{15}\ (HZ)\ [1/3^2 - 1/n^2]$

Calculate the value of n if the transition is observed at 1285 nm. Find the region of the spectrum. **(NCERT Problem)**

9. An element with mass number 81 contains 31.7% more neutrons as compared to protons. Assign the atomic symbol. **(NCERT Problem)**

10. An ion with mass number 37 possesses one unit of negative charge. If the ion contains 11.1% more neutrons than the electrons, find the symbol of the ion. **(NCERT Problem)**

11. An ion with mass number 56 contains 3 units of positive charge and 30.4% more neutrons than electrons. Assign the symbol to this ion. **(NCERT Problem)**

12. The ionization energy of the ground state hydrogen atom is 2.18×10^{-18} J. The energy of an electron in second orbit of He^+ will be

(a) -1.09×10^{-18}J (b) -4.36×10^{-18}J (c) 2.18×10^{-18}J (d) -2.18×10^{-18}J

13. For ionising an excited hydrogen atom, the energy required in eV will be

(a) 3.4 or less (b) more than 13.6 (c) little less than 13.6 (d) 13.6

14. Electromagnetic radiation (photon) with highest wavelength results when an electron in the hydrogen atom falls from n = 5 to

(a) n = 1 (b) n = 2 (c) n = 3 (d) n = 4

15. The wave number of the first emission line in the atomic spectrum of hydrogen in the Balmer series is

(a) $\frac{9R}{400}$ cm^{-1} (b) $\frac{7R}{144}$ cm^{-1} (c) $\frac{3R}{4}$ cm^{-1} (d) $\frac{5R}{36}$ cm^{-1}

16. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jump of the electron for Bohr orbits in an atom of hydrogen ?

(a) $3 \rightarrow 2$ (b) $5 \rightarrow 2$ (c) $4 \rightarrow 1$ (d) $2 \rightarrow 5$

ANSWERS

1. 1215Å **2.** 7.31×10^{14} Hz, visible spectrum

3. $5 \rightarrow 2$.

4. $\lambda = 1.2157 \times 10^{-7}$m, $\lambda = 9.1176 \times 10^{-8}$m

5. **(a)** Z = 5, **(b)** 16.53 eV, **(c)** 146.25 Å, **(d)** KE = 340 eV, PE = –680 eV,

$l = 1.056 \times 10^{-34}$ J-s, **(e)** 340 eV.

6. **(a)** 9.115×10^{-8}m **(b)** 13.601 eV, **(c)** the radii are 0.529, 2.116, and 4.76 Å.

7. $\lambda\ (3 \rightarrow 1) = 256.38$ Å, $\lambda\ (3 \rightarrow 2) = 1640.8$ Å, $\lambda\ (2 \rightarrow 1) = 303.85$ Å

8. infrared, 5 **9.** $^{81}_{35}Br$ **10.** $^{37}_{17}Cl^{-1}$ **11.** $^{56}_{26}Fe^{3+}$

12. (d) **13.** (a) **14.** (d) **15.** (d)

16. (b)