Atoms

1. The transition from the state n = 4 to n = 3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from **[AIEEE-2009]**

   (1) $3 \rightarrow 2$ (2) $4 \rightarrow 2$

   (3) $5 \rightarrow 4$ (4) $2 \rightarrow 1$

2. A diatomic molecule is made of two masses m_1 and m_2 which are separated by a distance r. If we calculate its rotational energy by applying Bohr's rule of angular momentum quantization, its energy will be given by (n is an integer) **[AIEEE-2012]**

   (1) $\dfrac{n^2h^2}{2(m_1+m_2)r^2}$ (2) $\dfrac{2n^2h^2}{(m_1+m_2)r^2}$

   (3) $\dfrac{(m_1+m_2)n^2h^2}{2m_1m_2r^2}$ (4) $\dfrac{(m_1+m_2)^2n^2h^2}{2m_1^2m_2^2r^2}$

3. Hydrogen atom is excited from ground state to another state with principal quantum number equal to 4. Then the number of spectral lines in the emission spectra will be **[AIEEE-2012]**

   (1) 3 (2) 5

   (3) 6 (4) 2

4. In a hydrogen like atom electron makes transition from an energy level with quantum number n to another with quantum number (n – 1). If n >> 1, the frequency of radiation emitted is proportional to **[JEE (Main)-2013]**

   (1) $\dfrac{1}{n}$ (2) $\dfrac{1}{n^2}$

   (3) $\dfrac{1}{n^{3/2}}$ (4) $\dfrac{1}{n^3}$

5. Hydrogen ($_1H^1$), Deuterium ($_1H^2$), singly ionised Helium $(_2He^4)^+$ and doubly ionised lithium $(_3Li^6)^{++}$ all have one electron around the nucleus. Consider an electron transition from n = 2 to n = 1. If the wave lengths of emitted radiation are λ_1, λ_2, λ_3 and λ_4 respectively then approximately which one of the following is correct? **[JEE (Main)-2014]**

   (1) $4\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

   (2) $\lambda_1 = 2\lambda_2 = 2\lambda_3 = \lambda_4$

   (3) $\lambda_1 = \lambda_2 = 4\lambda_3 = 9\lambda_4$

   (4) $\lambda_1 = 2\lambda_2 = 3\lambda_3 = 4\lambda_4$

6. As an electron makes a transition from an excited state to the ground state of a hydrogen-like atom/ion **[JEE (Main)-2015]**

   (1) Its kinetic energy increases but potential energy and total energy decrease

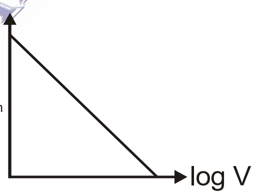
   (2) Kinetic energy, potential energy and total energy decrease

   (3) Kinetic energy decreases, potential energy increases but total energy remains same

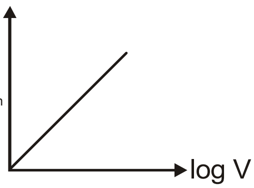
   (4) Kinetic energy and total energy decrease but potential energy increases

7. An electron beam is accelerated by a potential difference V to hit a metallic target to produce X-rays. It produces continuous as well as characteristic X-rays. If λ_{min} is the smallest possible wavelength of X-ray in the spectrum, the variation of log λ_{min} with log V is correctly represented in **[JEE (Main)-2017]**

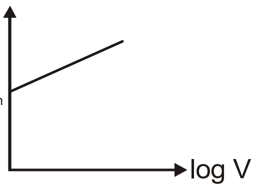
   (1) log λ_{min}



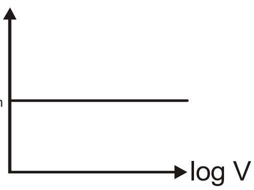
   (2) log λ_{min}



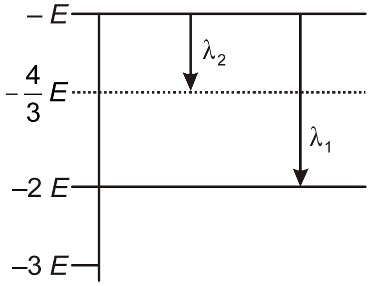
   (3) log λ_{min}



   (4) log λ_{min}



8. Some energy levels of a molecule are shown in the figure. The ratio of the wavelengths $r = \lambda_1/\lambda_2$, is given by **[JEE (Main)-2017]**



(1) $r = \frac{4}{3}$ (2) $r = \frac{2}{3}$

(3) $r = \frac{3}{4}$ (4) $r = \frac{1}{3}$

9. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants) **[JEE (Main)-2018]**

(1) $\Lambda_n \approx A + \frac{B}{\lambda_n^2}$ (2) $\Lambda_n \approx A + B\lambda_n$

(3) $\Lambda_n^2 \approx A + B\lambda_n^2$ (4) $\Lambda_n^2 \approx \lambda$

10. If the series limit frequency of the Lyman series is ν_L, then the series limit frequency of the Pfund series is **[JEE (Main)-2018]**

(1) 25 ν_L (2) 16 ν_L

(3) $\nu_L/16$ (4) $\nu_L/25$

11. A hydrogen atom, initially in the ground state is excited by absorbing a photon of wavelength 980 Å. The radius of the atom in the excited state, in terms of Bohr radius a_0, will be

(hc = 12500 eV-Å) **[JEE (Main)-2019]**

(1) $4a_0$ (2) $9a_0$

(3) $25a_0$ (4) $16a_0$

12. In a hydrogen like atom, when an electron jumps from the M-shell to the L-shell, the wavelength of emitted radiation is λ. If an electron jumps from N-shell to the L-shell, the wavelength of emitted radiation will be **[JEE (Main)-2019]**

(1) $\frac{25}{16}\lambda$ (2) $\frac{16}{25}\lambda$

(3) $\frac{20}{27}\lambda$ (4) $\frac{27}{20}\lambda$

13. A particle of mass m moves in a circular orbit in a central potential field $U(r) = \frac{1}{2}kr^2$. If Bohr's quantization conditions are applied, radii of possible orbitals and energy levels vary with quantum number n as **[JEE (Main)-2019]**

(1) $r_n \propto n, E_n \propto n$ (2) $r_n \propto \sqrt{n}, E_n \propto n$

(3) $r_n \propto \sqrt{n}, E_n \propto \frac{1}{n}$ (4) $r_n \propto n^2, E_n \propto \frac{1}{n^2}$

14. Radiation coming from transitions n = 2 to n = 1 of hydrogen atoms fall on He^+ ions in n = 1 and n = 2 states. The possible transition of helium ions as they absorb energy from the radiation is

[JEE (Main)-2019]

(1) n = 2 → n = 4 (2) n = 2 → n = 5

(3) n = 2 → n = 3 (4) n = 1 → n = 4

15. Taking the wavelength of first Balmer line in hydrogen spectrum (n = 3 to n = 2) as 660 nm, the wavelength of the 2nd Balmer line (n = 4 to n = 2) will be **[JEE (Main)-2019]**

(1) 889.2 nm (2) 488.9 nm

(3) 388.9 nm (4) 642.7 nm

16. A He^+ ion is in its first excited state. Its ionization energy is **[JEE (Main)-2019]**

(1) 13.60 eV (2) 6.04 eV

(3) 48.36 eV (4) 54.40 eV

17. A proton, an electron, and a Helium nucleus, have the same energy. They are in circular orbits in a plane due to magnetic field perpendicular to the plane. Let r_p, r_e and r_{He} be their respective radii, then, **[JEE (Main)-2019]**

(1) $r_e < r_p < r_{He}$

(2) $r_e > r_p = r_{He}$

(3) $r_e < r_p = r_{He}$

(4) $r_e > r_p > r_{He}$

18. In Li^{++}, electron in first Bohr orbit is excited to a level by a radiation of wavelength λ. When the ion gets deexcited to the ground state in all possible ways (including intermediate emissions), a total of six spectral lines are observed. What is the value of λ?

(Given: $h = 6.63 \times 10^{-34}$ Js; $c = 3 \times 10^8$ ms^{-1})

[JEE (Main)-2019]

(1) 11.4 nm (2) 12.3 nm

(3) 9.4 nm (4) 10.8 nm

19. An excited He^+ ion emits two photons in succession, with wavelengths 108.5 nm and 30.4 nm, in making a transition to ground state. The quantum number n, corresponding to its initial excited state is (for photon of wavelength λ, energy $E = \frac{1240 \text{ eV}}{\lambda(\text{in nm})}$): **[JEE (Main)-2019]**

(1) $n = 5$ (2) $n = 7$

(3) $n = 4$ (4) $n = 6$

20. The electron in a hydrogen atom first jumps from the third excited state to the second excited state and subsequently to the first excited state. The ratio of the respective wavelengths, λ_1/λ_2, of the photons emitted in this process is **[JEE (Main)-2019]**

(1) 7/5 (2) 27/5

(3) 9/7 (4) 20/7

21. Consider an electron in a hydrogen atom, revolving in its second excited state (having radius 4.65 Å). The de-Broglie wavelength of this electron is : **[JEE (Main)-2019]**

(1) 3.5 Å (2) 12.9 Å

(3) 9.7 Å (4) 6.6 Å

22. The time period of revolution of electron in its ground state orbit in a hydrogen atom is 1.6×10^{-16} s. The frequency of revolution of the electron in its first excited state (in s^{-1}) is **[JEE (Main)-2020]**

(1) 1.6×10^{14} (2) 7.8×10^{14}

(3) 5.6×10^{12} (4) 6.2×10^{15}

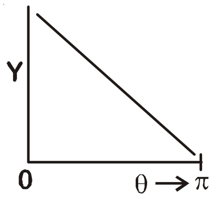
23. The graph which depicts the results of Rutherford gold foil experiment with α-particle is

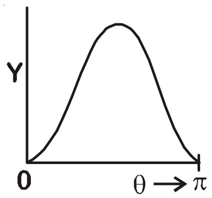
θ : Scattering angle

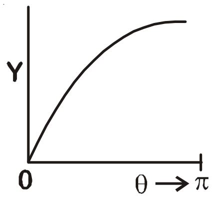
Y : Number of scattered α-particles detected

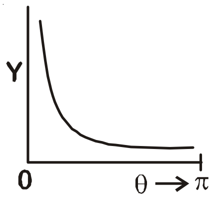
(Plots are schematic and not to scale)

[JEE (Main)-2020]

(1) 

(2) 

(3) 

(4) 

24. The energy required to ionise a hydrogen like ion in its ground state is 9 Rydbergs. What is the Wavelength of the radiation emitted when the electron in this ion jumps from the second excited state to the ground state? **[JEE (Main)-2020]**

(1) 11.4 nm (2) 24.2 nm

(3) 35.8 nm (4) 8.6 nm

25. In a hydrogen atom the electron makes a transition from $(n + 1)^{th}$ level to the n^{th} level. If $n >> 1$, the frequency of radiation emitted is proportional to

(1) $\frac{1}{n}$ (2) $\frac{1}{n^2}$

(3) $\frac{1}{n^3}$ (4) $\frac{1}{n^4}$

26. The first member of the Balmer series of hydrogen atom has a wavelength of 6561 Å. The wavelength of the second member of the Balmer series (in nm) is _______. **[JEE (Main)-2020]**

27. In the line spectra of hydrogen atom, difference between the largest and the shortest wavelengths of the Lyman series is 304 Å. The corresponding difference for the Paschen series in Å is _______.

[JEE (Main)-2020]

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