MODERN PHYSICS

CET questions from Bohr's atom model, Lasers and Scattering

1. **For the electron to revolve around the atomic nucleus without radiating energy, the electronic orbit should be :**
   (1) Circular
   (2) elliptical
   (3) such as the angular momentum of the electron is integral multiple of the Plank's constant.
   (4) such as to contain integral number of the de Broglie wavelengths of the electron.

2. **The difference in angular momentum associated with the electron in the two successive orbits of hydrogen atom is**
   1 $\frac{h}{\pi}$ (2) $\frac{h}{2\pi}$ (3) $\frac{h}{2}$ (4) $(n-1)\frac{h}{2\pi}$

3. **What will be the angular momentum in fourth orbit if L is the angular momentum of the electron in the second orbit of hydrogen atom ?**
   1 $\frac{2}{3}$ $\boldsymbol{L}$ (2) $\frac{L}{2}$ (3) 2L (4) $\frac{3}{2}$ $\boldsymbol{L}$

4. **When a hydrogen atom is raised from the ground state to an exited state**
   1) P.E. increases and K.E. decreses
   (2) P.E. decrerases and K.E. increases
   (3) both kinetic energy (K.E) and potential energy (P.E) increases
   (4) both K.E. and P.E. decreases.

5. **How does the energy difference between the consecutive energy level vary as the quantum number 'n' increases ?**
   1 Increases (2) Decreases
   (3) Remains unchanged (4) First increases and then decreases

6. **The frequency of the first line of the Lyman series in the hydrogen atom is v. What will be the frequency of the corresponding line for the singly ionized helium atom ?**
   1 v (2) 2*v* (3) 4*v* (4) 8*v*

7. **The transition of the electron takes place from n = 2 orbit to n = 1 orbit. Which of the following gives the shortest wavelength ?**
   1 Hydrogen atom (2) Deutrium atom
   (3) Singly ionized helium (4) Doubly ionized Lithium

8. **The orbital electron of the hydrogen atom jumps from the ground state to a higher energy state and its orbital velocity is reduced to one third of its initial value. If the radius of the orbit in the ground state is r, then what is the radius of the new orbit ?**
   1 2r (2) 3r (3) 4r (4) 9r

9. **The radius of Bohr's first orbit is r. What is the radius of the first orbit in the singly ionized helium atom ?**
   1 4r (2) 2r (3) r / 2 (4) r / 4

10. **The wavelength of the first line of Balmer series of hydrogen atom is λ . What will be the wavelength of the same line in doubly ionized lithium ?**
   1 $\frac{\lambda}{2}$ (2) $\frac{\lambda}{9}$ **3**) $\frac{\lambda}{8}$ (4) $\frac{\lambda}{27}$

11. **Energy levels A,B,C of a certain atom correspond to increasing values of energy i.e., $E_A < E_B < E_C$. If λ_1 , λ_2 , λ_3 are the wavelengths of radiation corresponding to the transitions C to B, B to A and C to A respectively, which of the following relations is correct ?**
   1 $\lambda_3 = \lambda_1 + \lambda_2$ (2) $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$
   (3) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (4) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

12. **As the electron in Bohr orbit of hydrogen atom passes from state n = 2 to n= 1, the kinetic energy K and potential energy U change as**
   1 K two-fold, U also two-fold (2) K four-fold, U also four-fold
   (3) K four-fold, U two-fold (4) K two-fold, U four-fold.

13. **In Bohr's model of hydrogen atom let PE represent potential energy, and TE the total energy. In going to a higher orbit.**
   1 PE increases, TE decreases (2) PE decreases, TE increases
   (3) PE increases, TE increases (4) PE decreases, TE decreases.

14. **In a hypothetical Bohr hydrogen, the mass of the electron is doubled. The energy E_0 and the radius r_0 of the first orbit will be (a_0 is the Bohr radius)**
   1 $E_0 = -27.2$ eV ; $r_0 = a_0/2$ (3) $E_0 = -27.2$ eV ; $r_0 = a_0$
   2 $E_0 = -13.6$ eV ; $r_0 = a_0/2$ (4) $E_0 = -13.6$ eV ; $r_0 = a_0$

15. **Hydrogen atoms are excited from ground state to the principal quantum number 4. Then the number of spectral lines observed will be**
   1 3 (2) 6 (3) 5 (4) 2

16. **Ionisation potential of Hydrogen atom ia 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. The spectral lines emitted by Hydrogen atoms according to Bohr's theory will be**
   1 one (2) two (3) three (4) four.

17. **The ratio of the frequencies of the long wavelength limits of the Lyman and Balmer series of hydrogen is**
   1 27 : 5 (2) 5 : 27 (3) 4 : 1 (4) 1 : 4

18. **Which of the following statements are true regarding Bohr's model of hydrogen atom ?**

I. **Orbiting speed of electron decreases as it shifts to discrete orbits away from the nucleus.**

II. **Radii of allowed orbits of electron are proportional to the principal quantum number.**

III. **Frequency with electron orbits around the nucleus in discrete orbits is inversely proportional to cube of principal quantum number.**

IV. **Binding force with which the electron is bound to the nucleus increases as it shifts to outer orbits.**

Select the correct answer using the codes given below codes.

1 I and III (2) II and IV (3) I, II and III (4) II, III and IV

19. **The wavelength of radiation emitted is λ_0 when an electron jumps from the third to the second orbit of hydrogen atom. For the electron jump from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be**

1 $\frac{16}{25}\lambda_0$ (2) $\frac{20}{27}\lambda_0$ (3) $\frac{27}{20}\lambda_0$ (4) $\frac{25}{16}\lambda_0$

20. **Frequency of the series limit of Balmer series of hydrogen atom in terms of Rydberg constant R and velocity of light C is :**

1 RC (2) $\frac{RC}{4}$ (3) 4RC (4) $\frac{4}{RC}$

21. **The absorption transitions between the first and the fourth energy states of hydrogen atom are 3. The emission transitions between these states will be**

1 3 (2) 4 (3) 5 (4) 6

22. **If elements with principal quantum n > 4 was not found in nature, possible number of elements would have been**

1 60 (2) 32 (3) 16 (4) 4

23. **The velocity of an electron in the second orbit of sodium atom (Atomic number = 11) is *v*. The velocity of an electron in its fifth orbit will be**

1 $\boldsymbol{v}$ (2) $\frac{22}{5}\boldsymbol{v}$ (3) $\frac{5}{2}\boldsymbol{v}$ (4) $\frac{2}{5}\boldsymbol{v}$

24. **According to Bohr's theory, the moment of momentum of an electron revolving in second orbit of hydrogen atom will be**

1 $2\pi h$ (2) πh (3) $\frac{h}{\pi}$ (4) $\frac{2h}{\pi}$

25. **Imagine an atom made up of a proton and a hypothetical particle of double the mass of the electron but having the same charge as the electron. Apply the Bohr atom model and consider all possible transitions of this longest wavelength photon that will be emitted has wavelength λ (given in terms of the Rydberg constant R for the hydrogen atom) equal to**

1 9 / (5R) (2) 36 / (5R) (3) 18 / (5R) (4) 4/R

26. **The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true ?**
    1. Its kinetic energy increases and its potential and total energies decrease.
    2. Its kinetic energy decreases, potential energy increases and its total energy remains the same.
    3. Its kinetic and total energies decrease and its potential energy increases
    4. Its kinetic, potential and total energies decrease.

27. **Shortest wavelength of Lymen series is 911 $\dot{A}$, then that of Paschen series is**
    1 4600 $\dot{A}$ (2) 5500 $\dot{A}$ (3) 7300 $\dot{A}$ (4) 8200 $\dot{A}$

28. **When an electron jumps from the fourth orbit to the second orbit, one gets the**
    1 Second line of Paschen series (2) second line of Lyman series
    (3) second line of Balmer series (4) first line of Pfund series.

29. **Which of the following is not correct ? In Bohr model of hydrogen atom**
    1. The radius of n^{th} orbit is proportional to n^2
    2. The total energy of electron in n^{th} orbit is proportional to n
    3. The angular momentum of an electron in an orbit is an integral multiple of h/2 π
    4. The magnitude of the potential energy of an electron in any orbit is greater than its kinetic energy.

30. **In Bohr model the atomic radius of 1^{st} orbit is r_0. Then the radius of 3^{rd} orbit is**
    1 $\frac{r_0}{a}$ (2) $3r_0$ (3) $9r_0$ (4) r_0

31. **Match list I with II and select the correct answer using the codes given below the lists :**

List I (Quantum jump of electron)		List II (Spectral series)
I.	n = 3 to n = 1	(A) Balmer
II.	n = 3 to n = 2	(B) Lyman
III.	n = 4 to n = 3	(C) Brackett
IV.	n = 5 to n = 4	(D) Paschen
		(E) P fund

Codes :

1 I - B, II - A, III - E, IV – C (2) I – C, II – D, III – A, IV – B
(3) I – D, II – A, III – B, IV – E (4) I – B, II – A, III – D, IV - C

32. **Consider the following properties of an electron in the Bohr orbit of a hydrogen atom corresponding to n = 3**
    I. Its angular momentum is 3h.
    II. Its energy is – 1. 51 eV.
    III. Its orbital velocity is 1.1 X10^6 m/s
    IV. Its orbit radius is 4.11 $\dot{A}$
    Which of the above statements are not correct ?
    1 I and III (2) I and IV (3) I, II and IV (4) II and IV.

33. **Which of the following transitions emits light of lower frequency ?**

1 n = 1 to n = 2 (2) n = 2 to n = 6

(3) n = 2 to n = 1 (4) n = 6 to n = 2

34. **The transition form the state n = 4 to n = 3 in a hydrogen – like atom results in ultraviolet radiation. Infra-red radiation will be obtained in the transition.**

1 2 ⟶ 1 (2) 3 ⟶ 2 (3) 4 ⟶ 2 (4) 5 ⟶ 4

35. **If we consider electrons and photons of the same wavelength, then they will have same**

1 energy (2) velocity

(3) momentum (4) angular momentum

36. **Find the correct statement about Bohr atom model.**

1. It could not explain about the spectral lines of hydrogen atoms.
2. Electrostatic force of attraction between the nucleus and the electron is - $\frac{Z^2me^4}{8\epsilon_0^2n^2h^2}$
3. Bohr used for Plank's constant to explain his two postulates.
4. The centripetal force on the electron is $\frac{Ze^2}{4\pi\epsilon_0\, r_n^2}$

37. **Whenever a hydrogen atom emits a photon in the Balmer series, it**

1. May emit another photon in the Paschen series
2. Need not emit any more photon
3. may emit another photon in the Balmer series
4. must emit another photon in the Lyman series.

38. **In the Bohr model of the hydrogen atom, let R, V and E represent the radius of the orbit, the speed of electron and the total energy of the electron respectively. Which of the following quantities is proportional to the quantum number n ?**

1 E/V (2) R/E (3) VR (4) RE.

39. **A hydrogen atom and a Li $^{++}$ ion are both in the second excited state. If I_H and I_{Li} are their respective electronic angular momenta, and E_H and E_{Li} their respective energies, then**

1 $I_H > I_{Li}$ and $|E_H| > |E_{Li}|$ (2) $I_H = I_{Li}$ and $|E_H| < |E_{Li}|$

(3) $I_H = I_{Li}$ and $|E_H| > |E_{Li}|$ (4) $I_H < I_{Li}$ and $|E_H| < |E_{Li}|$

40. **In the Bohr's model of hydrogen atom, the ratio of the kinetic energy to the total energy of the electron in nth quantum state is**

1 –1 (2) + 1 (3) – 2 (4) +2

41. **Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be**

1 One (2) two (3) three (4) four

42. **An electron is moving in an orbit of a hydrogen atom from which there can be a maximum of six transitions. An electron is moving in an orbit of another hydrogen atom from which there can be a maximum of three transitions. The ratio of the velocity of the electron in these two orbit is**

1 $\frac{1}{2}$ (2) $\frac{2}{1}$ (3) $\frac{5}{4}$ (4) $\frac{3}{4}$

43. **Suppose an electron is attracted towards the origin by a force k/r, where k is a constant and r is the distance of the electron from the origin. By applying Bohr model to this system, the radius of nth orbit of the electron is found to be r_n and the kinetic energy of the electron is found to be T_n . Then which of the following is true ?**

1. $T_n \propto \frac{1}{n^2}$
2. $T_n \propto \frac{1}{n}$; $r_n \propto n$
3. T_n is independent of n ; r_n ; $\propto n$
4. $T_n \propto \frac{1}{n}$ and $r_n \propto n^2$

44. **The ionisation energy of the electron in the hydrogen atom in its ground state is 13.6 eV. The atoms are excited to higher energy levels to emit radiations of 6 wavelengths. Maximum wavelength of emitted radiation corresponds to the transition between.**

1 n = 3 to n = 1 states (2) n = 2 to n = 1 states
(3) n = 4 to n = 3 states (4) n = 3 to n = 2 states

45. **v_1 is the frequency of the series limit of Lyman series, v_2 is the frequency of the first line of Lyman series and v_3 is the frequency of the series limit of the Balmer series. Then**.

1 $v_1 - v_2 = v_3$ (2) $v_1 = v_2 - v_3$
(3) $\frac{1}{v_2} = \frac{1}{v_1} + \frac{1}{v_3}$ (4)) $\frac{1}{v_1} = \frac{1}{v_2} + \frac{1}{v_3}$

46. **An electron is in an excited state in a hydrogen like atom. It has a total energy of – 3.4 eV. The kinetic energy of the electron is E and its de-Broglie wavelength is λ. Then**

1 E = 6.8 eV, λ = 6.6 x 10^{-10} m (2) E = 3.4 eV, λ = 6.6 x 10^{-10} m
(3) E = 3.4 eV, λ = 6.6 x 10^{-10} (4) E = 6.8 eV, λ = 6.6 x 10^{-10}

47. **An electron in a hydrogen atom makes a transition from n = n_1 to n = n_2 . The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are**

1 n_1 = 4, n_2 = 2 (2) n_1 = 8, n_2 = 2 (3) n_1 = 8, n_2 = 1 (4) n_1 = 6, n_2 = 2

48. **The intensity of light scattered by unit volume of the medium in a direction making an angle θ with the direction of propagation of incident light varies with wavelength (λ) of light as**

1 λ^2 (2) $\frac{1}{\lambda^2}$ (3) λ^4 (4) $\frac{1}{\lambda^4}$

49. **Pick out the wrong statement from the following :**
    1. Red light is used in danger signals as it can be seen at large distances
    2. Infrared photograph are clearer than those taken with visible light in a fine mist
    3. Sky appears white in the direction of the sum
    4. Rayleigh's law of scattering is applicable to dust and water droplets in the atmosphere

50. **If f_1 , f and f_2 are the frequencies of strokes lines, incident light and antistokes lines respectively then**
    1 $f_1 = f = f_2$ (2) $f_1 < f < f_2$ (3) $f_1 > f > f_2$ (4) $f_1 < f_2 < f$

51. **Pick out the incorrect statement from the following :**
    1. Strokes lines have wavelengths greater than that of the incident light
    2. Strokes lines are more intense than the antistokes lines
    3. The intensity of stokes lines is found to depend on temperature
    4. Stokes and antistokes lines are polarized

52. **Pick out the incorrect statement from the following :**
    1. Rayleigh scattering is coherent scattering
    2. Raman effect is incoherent scattering
    3. Raman spectrum is not the same as fluorescent spectrum
    4. Both Raman lines and fluorescent lines are polarized

53. **Pick out the incorrect statement from the following :**
    1. LASER stands for light amplification by simulated emission of radiation
    2. LASER light is coherent
    3. LASER beam is highly collimated
    4. LASER light consists of several selected wavelength

54. **The construction and working of a laser is based on**
    1 Digital electronic systems (2) nuclear reactions
    (3) interaction between atomic systems and electromagnetic radiation
    (4) transistor amplifiers

55. **In the process of stimulated absorption**
    1. the atom will be initially in an excited state
    2. a photon is emitted
    3. atom is brought to a lower energy state
    4. a photon is absorbed by the atom

56. **The life time of an atom in a stable state in about**
    1 1 μs (2) 1 ns (3) 10 ns (4) 10 μs

57. **The life time of an atom in a metastable excited state in about**
    1 1 ms (2) 10 ms (3) 0.1 s (4) unpredictable

58. **In the process of stimulated emission triggered by a photon**
    1. two photons of different frequencies are emitted
    2. many photons of the same frequency are emitted
    3. two photons of the same frequency as that of the incident photon are emitted
    4. two photons of the same frequency different from that of the incident photon are emitted.
59. **The following is not a characteristic of stimulated emission**
    1. The induced photon propagates in the same direction as that of stimulating photon
    2. The induced photon has the same energy as that of the stimulating photon
    3. The process of stimulated emission is uncontrollable
    4. There is the multiplication of photons

60. **The wavelength of light emitted by a Ruby laser is**

    1 589 . 3 nm (2) 594 . 3 nm (3) 694 . 3 nm (4) 650 nm