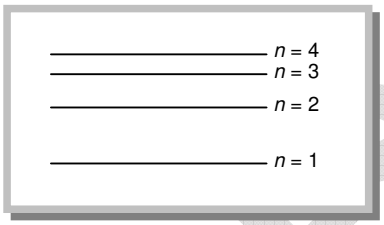
Atomic Structure Assignment (II)

1. The first line in the Lyman series has wavelength λ. The wavelength of the first line in Balmer series is

(a) $\frac{2}{9}\lambda$ (b) $\frac{9}{2}\lambda$ (c) $\frac{5}{27}\lambda$ (d) $\frac{27}{5}\lambda$

2. Four lowest energy levels of *H*-atom are shown in the figure. The number of possible emission lines would be



(a) 3
(b) 4
(c) 5
(d) 6

3. The energy of hydrogen atom in its ground state is – 13.6 *eV*. The energy of the level corresponding to the quantum number *n* is equal 5 is

(a) – 5.40 *eV* (b) – 2.72 *eV* (c) – 0.85 *eV* (d) – 0.54 *eV*

4. The ionisation potential of hydrogen is 13.6*eV*. Then the energy released when an electron jumps from *n* = 3 to *n* = 2 orbit, is

(a) 2.89 *eV* (b) 1.89 *eV* (c) 3.89 *eV* (d) 4.89 *eV*

5. 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

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

6. Orbital acceleration of electron is

(a) $\frac{n^2h^2}{4\pi^2m^2r^3}$ (b) $\frac{n^2h^2}{2n^2r^3}$ (c) $\frac{4n^2h^2}{\pi^2m^2r^3}$ (d) $\frac{4n^2h^2}{4\pi^2m^2r^3}$

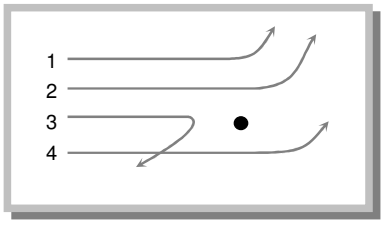
7. Which of the following transitions in a hydrogen atom emits photon of the highest frequency

(a) *n* = 1 to *n* = 2 (b) *n* = 2 to *n* = 1 (c) *n* = 2 to *n* = 6 (d) *n* = 6 to *n* = 2

8. Radius of the first orbit of the electron in a hydrogen atom is 0.53 *Å*. So, the radius of the third orbit will be

(a) 2.12 *Å* (b) 4.77 *Å* (c) 1.06 *Å* (d) 1.59 *Å*

9. The diagram shows the path of four α-particles of the same energy being scattered by the nucleus of an atom simultaneously. Which of these are/is not physically possible



(a) 3 and 4
(b) 2 and 3
(c) 1 and 4
(d) 4 only

10. An electron jumps from 5th orbit to 4th orbit of hydrogen atom. Taking the Rydberg constant as 10^7 *per metre*. What will be the frequency of radiation emitted

(a) $6.75\times10^{12}\ Hz$ (b) $6.75\times10^{14}\ Hz$ (c) $6.75\times10^{13}\ Hz$ (d) None of these

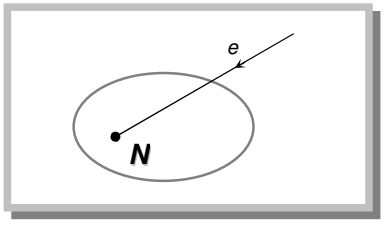
11. The electron in a hydrogen atom makes a transition $n_1 \to n_2$ where n_1 and n_2 are the principal quantum numbers of the two states. Assume the Bohr model to be valid. The time period of the electron in the initial state is eight times that in the final state. The possible values of n_1 and n_2 are

(a) $n_1 = 4, n_2 = 2$ (b) $n_1 = 8, n_2 = 2$ (c) $n_1 = 8, . n_2 = 1$ (d) $n_1 = 6, n_2 = 3$

12. For principal quantum number $n = 3$, the possible values of orbital quantum number '*l*' are

(a) 1, 2, 3 (b) 0, 1, 2, 3 (c) 0, 1, 2 (d) – 1, 0, + 1

13. An electron moves towards a nucleus at the focus of a an elliptical orbit with velocity *V*. Its angular momentum with respect to nucleus is



(a) Always zero
(b) Always remains constant
(c) Changes with time
(d) Can not determined

14. The total energy of the electron in the hydrogen atom in the ground state is –13.6 *eV*. The kinetic energy of this electron is

(a) – 13.6 *eV* (b) 0 (c) 6.8 *eV* (d) 13.6 *eV*

15. What change in energy per mole of atoms will be associated with an atomic transition giving rise to radiation at 1 *Hz*

(a) $0.399 \times 10^{-10}\ J\ mol^{-1}$ (b) $9.390 \times 10^{-10}\ J\ mol^{-1}$ (c) $3.990 \times 10^{-10}\ J\ mol^{-1}$ (d) None of these

16. According to Bohr's theory the radius of electron orbit is proportional to

(a) $Z^2 n^2$ (b) $\frac{Z^2}{n^2}$ (c) $\frac{Z^2}{n}$ (d) $\frac{n^2}{Z}$

17. According to Bohr's postulate which of the following take discrete values

(a) Kinetic energy (b) Potential energy (c) Angular momentum (d) Linear momentum

18. Who indirectly determined of the mass of the electron by measuring the charge of the electrons

(a) Rutherford (b) Einstein (c) Thomson (d) Millikan

19. Who discovered spin quantum number

(a) Unlenbeck and Goudsmit (b) Neil's Bohr

(c) Zeeman (d) Sommerfield

20. In Rutherford scattering experiment, what will be the correct angle for α scattering for an impact parameter $b = 0$

(a) 90^o (b) 270^o (c) 0^o (d) 180^o

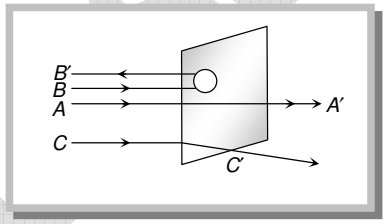
21. A beam of fast moving alpha particles were directed towards a thin film of gold. The parts *A′*, *B′* and *C′* of the transmitted and reflected beams corresponding to the incident parts *A*, *B* and *C* of the beam, are shown in the adjoining diagram. The number of alpha particles in

(a) *B′* will be minimum and in *C′* maximum

(b) *A′* will be maximum and in *B′* minimum

(c) *A′* will be minimum and in *B′* maximum

(d) *C′* will be minimum and in *B′* maximum



22. The radius of hydrogen atom in its ground state is $5.3 \times 10^{-11}\ m$. After collision with an electron it is found to have a radius of $21.2 \times 10^{-11}\ m$. What is the principal quantum number *n* of the final state of the atom

(a) $n = 4$ (b) $n = 2$ (c) $n = 16$ (d) $n = 3$

23. The de-Broglie wavelength of thermal neutrons is of the order of the

(a) Distance between atoms in crystals (b) Size of the nucleus

(c) Bohr's radius (d) Size of a grain

24. As per Bohr model the minimum energy required to remove an electron from the ground state of doubly ionised $Li^{(z=3)}$ atom is

(a) 1.51 *eV* (b) 13.6 *eV* (c) 4.08 *eV* (d) 122.4 *eV*

25. The concept of stationary orbits was proposed by

(a) Neil Bohr (b) J.J. Thomson (c) Rutherford (d) I. Newton

26. The electron in a hydrogen atom makes a transition from an excited state to ground state. Which of the following statements is true

(a) Its kinetic energy increases and its potential and total energies decrease

(b) Its kinetic energy decreases, potential energy increases and its total energy remains same

(c) Its kinetic and total energies decrease and its potential energy increases

(d) Its kinetic, potential and total energies decrease

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

(a) 9/5 *R* (b) 36/5 *R* (c) 18/5 *R* (d) 4/*R*

28. According to the Rutherford's atomic model, the electrons inside the atom are

(a) Stationary (b) Not stationary (c) Centralized (d) None of these

29. The radius of hydrogen atom in ground state is of the order

(a) $10^{-8}\ cm$ (b) $10^{-6}\ cm$ (c) $10^{-4}\ cm$ (d) $10^{-7}\ cm$

30. The radius of the Bohr orbit in the ground state of hydrogen atom is 0.5 *Å*. The radius of the orbit of the electron in the third excited state of He^+ will be

(a) 8 *Å* (b) 4 *Å* (c) 0.5 *Å* (d) 0.25 *Å*

31. What will be the angular momentum of a electron, if energy of this electron in *H*-atom is 1.5 *eV* (in *J-sec*)

(a) 1.05×10^{-34} (b) 2.1×10^{-34} (c) 3.15×10^{-34} (d) -2.1×10^{-34}

32. The ratio of the longest to shortest wavelengths in Brackett series of hydrogen spectra is

(a) $\frac{25}{9}$ (b) $\frac{17}{6}$ (c) $\frac{9}{5}$ (d) $\frac{4}{3}$

33. The ratio of minimum to maximum wavelength in Balmer series is

(a) 5 : 9 (b) 5 : 36 (c) 1 : 4 (d) 3 : 4

34. When an electron jumps from the fourth orbit to the second orbit, one gets the

(a) Second line of Lyman series (b) Second line of Paschen series

(c) Second line of Balmer series (d) First line of Pfund series

35. Calculate the series limit of the Lyman series of hydrogen atom

(a) $9.1176\times10^{-6}\,cm$ (b) 10968 *cm* (c) $1.2157\times10^{-5}\,cm$ (d) 82259 *cm*

36. Which of the following phenomena suggests the presence of electron energy levels in atoms

(a) Radio active decay (b) Isotopes (c) Spectral lines (d) α -particles scattering

37. The ionisation potential of *H*-atom is 13.6 V when it is excited from ground state by monochromatic radiations of 970.6 Å, the number of emission lines will be (according to Bohr's theory)

(a) 10 (b) 8 (c) 6 (d) 4

38. Which of the following spectral series in hydrogen atom give spectral line of 4860 Å

(a) Lyman (b) Balmer (c) Paschen (d) Bracket

39. The energy required to excite an electron from the ground state of hydrogen atom to the first excited state, is

(a) $1.602\times10^{-14}\,J$ (b) $1.619\times10^{-16}\,J$ (c) $1.632\times10^{-18}\,J$ (d) $1.656\times10^{-20}\,J$

40. The ratio of longest wavelength and the shortest wavelength observed in the five spectral series of emission spectrum of hydrogen is

(a) $\frac{4}{3}$ (b) $\frac{525}{376}$ (c) 25 (d) $\frac{900}{11}$

41. If in Rutherford's experiment, the number of particles scattered at 90° angle are 28 per *min*, then number of scattered particles at an angle 60° and 120° will be

(a) 112/*min*., 12.5/*min* (b) 100/*min*., 200/*min* (c) 50/*min*., 12.5/*min* (d) 117/*min*., 25/*min*

42. When the hydrogen atom is changed from its ground state to excited state

(a) P.E. increases but K.E. decreases (b) K.E. increases but P.E. decreases

(c) P.E. increases (d) K.E. increases

43. 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

(a) *v* (b) $\frac{22}{5}v$ (c) $\frac{5}{2}v$ (d) $\frac{2}{5}v$

44. The ratio between potential energy and kinetic energy of the electron in $(n-1)^{th}$ orbit of hydrogen atom is

(a) – 2 (b) 2 (c) 1 (d) – 1

45. Which of the following transitions in hydrogen atom emits a photon of lowest frequency (*n* = quantum number)

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

46. In hydrogen spectrum the shortest wavelength in Balmer series is λ. The shortest wavelength in Bracket series will be

(a) 2λ (b) 4λ (c) 9λ (d) 16λ

47. Which of the following statements is true regarding Bohr's model of hydrogen atom.

(I) Orbiting speed of electrons decreases as it falls to discrete orbits away from the nucleus.

(II) Radii of allowed orbits of electrons are proportional to the principal quantum number.

(III) Frequency with which electrons orbit around the nucleus in discrete orbits is inversely proportional to the 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

(a) I and III (b) II and IV (c) I, II and III (d) II, III and IV

48. The Rydberg constant *R* for hydrogen is

(a) $R=\left(\frac{1}{4\pi\varepsilon_0}\right)\frac{2\pi^2me^2}{ch^2}$ (b) $R=\left(\frac{1}{4\pi\varepsilon_0}\right)\frac{2\pi^2me^4}{ch^2}$ (c) $R=\left(\frac{1}{4\pi\varepsilon_0}\right)^2\frac{2\pi^2me^4}{c^2h^2}$ (d) $R=\left(\frac{1}{4\pi\varepsilon_0}\right)^2\frac{2\pi^2me^4}{ch^3}$

49. In the Bohr model of a hydrogen atom, the centripetal force is furnished by the coulomb attraction between the proton and the electron. If a_0 is the radius of the ground state orbit, *m* is the mass and *e* is charge on the electron and ε_0 is the vacuum permittivity, the speed of the electron is

(a) 0 (b) $\frac{e}{\sqrt{\varepsilon_0 a_0 m}}$ (c) $\frac{e}{\sqrt{4\pi\varepsilon_0 a_0 m}}$ (d) $\sqrt{\frac{4\pi\varepsilon_0 a_0 m}{e}}$

50. The 21 *cm* radio wave emitted by hydrogen in interstellar space is due to the interaction called the hyperline interaction in atomic hydrogen. The energy of the emitted wave is nearly

(a) 10^{-17} *Joule* (b) 1 *Joule* (c) 7×10^{-8} *Joule* (d) 10^{-24} *Joule*