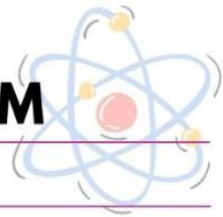
Chapter 2

STRUCTURE OF ATOM



INTRODUCTION

1. Cathode rays originate from cathode. T/F
2. Charge to mass ratio was determined by the scientist -
3. Oil drop experiment was devised by the scientist -
4. Neutron was discovered by the scientist -
5. Charge of electron is -
6. Mass of electron is -
7. Mass of proton is -
8. Rutherford gold foil was _____ atoms thick.
9. Define isobars.
10. All the isotopes of a given element show same chemical behaviour. T/F
11. The radius of nucleus are usually expressed in terms of _____ unit.
12. Define wave number.
13. SI unit of wave number is -
14. Wavelength of visible spectrum of light varies from ____ nm to ____ nm.
15. What is a black body ?
16. Planck constant value -
17. Work function is equal to -
18. Planck's law -
19. Photoelectric effect equation -
20. Balmar series is described by the formula -
21. Rydberg constant value -
22. The name of respective series for n_1 = 1, 2, 3, 4, 5, 6 is -
23. Which series of transitions in the spectrum of H atom falls in visible region ? (NEET)

BOHR MODEL

24. According to Bohr, the angular momentum of an electron in a given stationary state can be expressed as -
25. r_n =
26. E_n =
27. velocity: V_n =
28. $K.E_n$ =

29. P.E.$_n$ =

30. frequency: ν_n =

31. (Wave number)$_n$ =

32. Time taken to complete one revolution is proportional to which powers of n & Z ?

33. Total number of spectral lines obtained in H atom (when electron jump from n_2 to n_1) equal to -

34. The Bohr model could not explain the ability of atoms to form molecules by chemical bonds. T/F

35. Splitting of spectral lines in the presence of magnetic field is called -

36. Splitting of spectral lines in the presence of electric field is called -

37. Bohr was able to explain the occurrence of Zeeman and Stark effect. T/F

38. Describe Heisenberg's Uncertainty Principle and write its equation.

QUANTUM MECHANICAL MODEL OF ATOM

39. When an electron is in any energy state, the wave function corresponding to that energy state contains all information about the electron. T/F

40. The energy of electrons in atoms is not quantized. T/F

41. The number which identifies the shell is -

42. Azimuthal quantum number is also called _____ or _____.

43. _____ identifies the three dimensional shape of the orbital.

44. For n = 3, tell the possible values of l.

45. For any subshell l, _____ values of m are possible.

46. _____ number refers to the orientation of spin of electrons.

47. Spin angular momentum of the electron is a vector quantity. T/F

48. _____ gives information about the spatial orientation of the orbital with respect to standard set of co-ordinate axis. (NEET)

49. For l = 2, m can be -

50. Subsidiary quantum number also determine the energy of the orbital to some extent. T/F

51. What is the total no. of orbitals associated with n = 3 ?

52. A 4s orbital have _____ number of nodes.

53. Boundary surface diagrams enclose the area where probability of finding electrons is ___ %.

54. Electron is located further away from the nucleus as the principal quantum number increases. T/F

55. There is no simple relation between the values of m (−l, 0 and +l) and the x, y and z directions. T/F

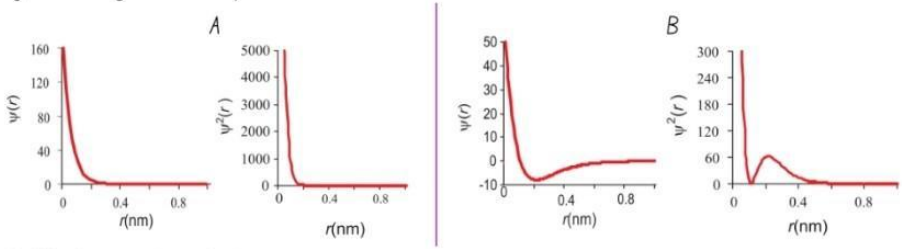
56. Maximum no. of electrons in a subshell l = (NEET)

57. Total no. of nodes =

58. Angular nodes =

59. Radial nodes =

DigaQ. 1 Identify which one is plot of 1s and which one is of 2s.



60. What are angular nodes ?

61. Angular momentum of the electron in an orbital = (NEET)

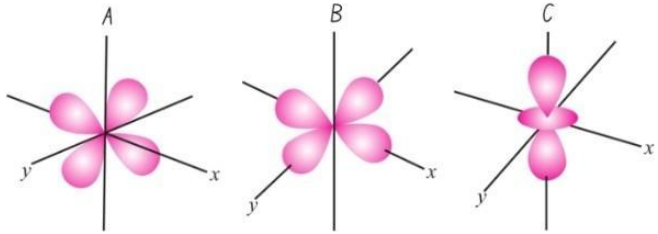
62. Spin angular momentum of the electron =

63. Spin multiplicity =

64. No. of sub shells in nth shells =

65. No. of orbitals in nth shell =

DigaQ. 2 This is the boundary surface diagram of -



ENERGIES OF ORBITALS

66. What is the main reason for having different energies of the subshells in multi-electron species ?

67. In general, the repulsive interaction of the electrons in the outer shell with the electrons in the inner shell are more important. T/F

68. Despite the shielding of the outer electrons from the nucleus by the inner shell electrons, the attractive force experienced by the outer shell electrons increases with increase of nuclear charge. T/F

69. p-orbital electron spends more time close to the nucleus in comparison to s orbital. T/F

70. The Zeff experienced by the electron increases with increase of azimuthal quantum number (l). T/F

71. If two orbitals have same value of (n + l), then how will we decide when one is lower in energy ?

72. Energies of the orbitals in the same subshell decrease with increase in the atomic number (Zeff). T/F

73. In the H atom, 4s have less energy than 3d. T/F

74. Energy of 2s orbital of hydrogen atom is greater than that of 2s orbital of lithium. T/F

FILLING OF ORBITALS

75. Aufbau principle is based on - (3)
76. Write order of filling orbitals till 7s orbital.
77. What is Pauli Exclusion Principle ? (NEET)
78. The maximum number of electrons in the shell with principal quantum number n is equal to -
79. What is Hund's Rule ?
80. What are valence electrons ?
81. Write electronic configuration of Cr.
82. Write electronic configuration of Cu.
83. Fully filled orbitals and half filled orbitals have extra stability. T/F
84. Causes of stability of completely filled and half filled subshells are - (2)

ANSWERS

• INTRODUCTION

1. T
2. J.J. Thomson
3. R.A. Milikan
4. Chadwick
5. -1.6×10^{-19} C
6. 9.1×10^{-31} kg
7. 1.67×10^{-27} kg
8. 1000
9. atoms with same mass number but different atomic number
10. T
11. fermi
12. $1/\lambda$
13. m^{-1}
14. 400-750
15. The ideal body, which emits and absorbs radiations of all frequencies, is called a black body
16. 6.626×10^{-34} Js
17. hv_0
18. $E = hv$
19. $hv = hv_0 + mv^2/2$
20. $\bar{\nu} = 109{,}677 \left(\frac{1}{2^2} - \frac{1}{n^2}\right) \text{cm}^{-1}$
21. 109,677 cm^{-1} or 2.18×10^{-18} J
22. Lyman, Balmer, Paschen, Bracket, Pfund, Humphrey
23. Balmar

• BOHR MODEL

24. $mvr = nh/2\pi$
25. $r_n = a_0 n^2/Z$ where $a_0 = 52.9$ pm
26. $-2.18 \times 10^{-18} (Z^2/n^2)$
27. $2.18 \times 10^6 (Z/n)$
28. $2.18 \times 10^{-18} (Z^2/n^2)$
29. $4.36 \times 10^{-18} (Z^2/n^2)$
30. $\nu = 3.29 \times 10^{15} \left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) \text{Hz}$
31. $\bar{\nu} = 1.09677 \times 10^7 \, Z^2 \left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) \text{m}^{-1}$
32. n^3/Z^2
33. $(n_2 - n_1)(n_2 - n_1 + 1)/2$
34. T
35. Zeeman effect
36. Stark effect
37. F
38. It states that it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron.

$$\Delta x \, \Delta p_x \geq \frac{h}{4\pi} \quad \text{or} \quad \Delta x \, \Delta v_x \geq \frac{h}{4\pi m}$$

• QUANTUM MECHANICAL MODEL OF ATOM

39. T
40. F
41. Principal quantum number
42. orbital angular momentum or subsidiary quantum number
43. Azimuthal quantum number
44. $l = 0, 1, 2$
45. $2l + 1$
46. Spin quantum number
47. T
48. Magnetic orbital quantum number
49. +2, +1, 0, -1, -2
50. T

51. Total no. of orbitals = n^2. Hence $3^2 = 9$

52. 3

53. 90%

54. T

55. T

56. 4l + 2

57. n - l

58. l

59. n - l - l

60. Nodal planes passing through origin which have zero probability of electrons

61. $(h/2\pi) \sqrt{[l(l + l)]}$

62. $(h/2\pi) \sqrt{[s(s + l)]}$

63. 2s + l

64. n

65. n^2

• ENERGIES OF ORBITALS

66. Mutual repulsion among the electrons

67. T

68. T

69. F

70. F

71. The one with lower value of n will have lower energy

72. T

73. F

74. T

• FILLING OF ORBITALS

75. Pauli's exclusion principle, the Hund's rule of maximum multiplicity and the relative energies of the orbitals

76. 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s

[Trick - Remember this sequence - S SP SP SDP SDP SFDP SFDP (which implies - 1s(S) 2s2p(SP) 3s3p(SP) 4s3d4p(SDP) ...) Using this, you will not have to make that hard diagram of Order of filling every time]

77. No two electrons in an atom can have the same set of four quantum numbers

78. $2n^2$

79. pairing of electrons in the orbitals belonging to the same subshell (p, d or f) does not take place until each orbital belonging to that subshell has got one electron each i.e., it is singly occupied

80. electrons that are added to the electronic shell with the highest principal quantum number are called valence electrons

81. [Ar] $3d^5 4s^1$

82. [Ar] $3d^{10} 4s^1$

83. T

84. Causes of stability of completely filled and half filled subshells are

(i) Symmetrical distribution of electrons

(ii) exchange energy

• DigaQs

DigaQ. 1

A - 1s

B - 2s

DigaQ. 2 - Boundary surface diagrams of 3d orbitals

A - $d(yz)$

B - $d(x^2 - y^2)$

C - $d(z^2)$