PROBLEM SOLVING TECHNIQUES OF PHYSICAL CHEMISTRY FOR NEET

BY

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ATOMIC STRUCTURE

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BASIC EXERCISE

Introduction

1. A and B are two elements which have same atomic weight and are having atomic number 27 and 30 respectively. If the atomic weight of A is 57 then number of neutron in B is :-

(1) 27 (2) 33 (3) 30 (4) 40

Ans. **(1)**

2. Find out the nucleus which are isoneutronic :

(1) ${}^{14}_{6}C$, ${}^{15}_{7}N$, ${}^{17}_{9}F$ (2) ${}^{12}_{6}C$, ${}^{14}_{7}N$, ${}^{19}_{9}F$ (3) ${}^{14}_{6}C$, ${}^{14}_{7}N$, ${}^{17}_{9}F$ (4) ${}^{14}_{6}C$, ${}^{14}_{7}N$, ${}^{19}_{9}F$

Ans. **(1)**

3. Species which are isoelectric to one another are

(a) CN^- (b) OH^- (c) CH_3^+ (d) N_2

(e) CO

Correct answer is

(1) a, b, c (2) a, c, d (3) a, d, e (4) b, c, d

Ans. **(3)**

4. Which of the following pairs is correctly matched

(1) Isotopes ${}^{40}_{20}Ca, {}^{40}_{19}K$ (2) Isotones ${}^{30}_{14}Si, {}^{31}_{15}P, {}^{32}_{16}S$

(3) Isobars ${}^{16}_{8}O, {}^{17}_{8}O, {}^{18}_{8}S$ (4) Isoelectronic N^{-3}, O^{-2}, Cr^{+3}

Ans. **(2)**

5. The e/m ratio is maximum for

(1) D^+ (2) He^+ (3) H^+ (4) He^{2+}

Ans. **(3)**

6. If change in energy (ΔE) = 3×10^{-8} J, h = 6.64×10^{-34} J-s and c = 3×10^8 m/s, then wavelength of the light is

(1) 6.64×10^3 Å (2) 6.64×10^5 Å (3) 6.64×10^{-8} Å (4) 6.64×10^{18} Å

Ans. **(3)**

7. The atom A, B, C have the configuration

$A \rightarrow [Z(90) + n(146)]$, $B \rightarrow [Z(92) + n(146)]$, $C \rightarrow [Z(90) + n(148)]$ So that :-

(a) A and C - Isotones (b) A and C - Isotopes (c) A and B - Isobars (d) B and C - Isobars

(e) B and C - Isotopes

The wrong statement's are:-

(1) a, b only (2) c, d, e only (3) a, c, d only (4) a, c, e only

Ans. **(1)**

8. (i) $_{26}Fe^{54}$,$_{26}Fe^{56}$,$_{26}Fe^{57}$,$_{26}Fe^{28}$ (a) Isotopes

(ii) $_1H^3$, $_2He^3$ (b) Isotones

(iii) $_{32}Ge^{76}$, $_{33}As^{77}$ (c) Isodiaphers

(iv) $_{92}U^{235}$, $_{90}Th^{231}$ (d) Isobars

(v) $_1H^1$, $_1D^2$, $_1T^3$

Match the above correct terms:-

(1) [(i), - a], [(ii) - d], [(iii) - b], [(iv) - c], [(v) - a]

(2) [(i) - a] [(ii) - d], [(iii) - d] [(iv) - c] [v - a]

(3) [v -a] [(iv) - c]. [(iii) - d] [(ii) - b] [(i) - a]

(4) None of them

Ans. **(1)**

9. Choose the false statement about deuterium :-

(1) It is an isotope of hydrogen

(2) It contains [(1 e^-) + (1 p^+) + (1 (n)]

(3) It contains only [(1 (p^+) + (1 (n)]

(4) D_2O is called the heavy water

Ans. **(3)**

10. If the table of atomic masses were established with the oxygen atom and assigned value of 200, then the mass of carbon atom would be, approximately:-

(1) 24 (2) 150 (3) 50 (4) 112

Ans. **(2)**

11. The relative abundance of two rubidium isotopes of atomic weights 85 and 87 are 75% and 25% respectively. The average atomic wt. of rubidium is:–

(1) 75.5 (2) 85.5 (3) 86.5 (4) 87.5

Ans. **(2)**

12. The ratio of specific charge of a proton and an α–particle is :–

(1) 2 : 1 (2) 1 : 2 (3) 1 : 4 (4) 1 : 1

Ans. **(1)**

13. Atomic weight of Ne is 20.2. Ne is mixture of Ne^{20} and Ne^{22}, Relative abundance of heavier isotope is :-

(1) 90 (2) 20 (3) 40 (4) 10

Ans. **(4)**

14. Number of protons, neutrons & electrons in the element $_{89}Y^{231}$ is :-

(1) 89, 231, 89 (2) 89, 89, 242 (3) 89, 142, 89 (4) 89, 71, 89

Ans. **(3)**

15. Let mass of electron is half, mass of proton is two times and mass of neutron is three fourth of original. The find out new atomic wt. of O^{16} atom :-

(1) increases by 37.5% (2) Remain constant (3) increases by 12.5% (4) decreases by 25%

Ans. **(1)**

Bohr Atomic Model

16. Angular momentum is second Bohr orbit of H-atom is x. Then find out angular momentum in Ist excited state of Li^{+2} ion :

(1) 3x (2) 9x (3) $\frac{x}{2}$ (4) x

Ans. **(4)**

17. Multiplication of electron velocity and radius for a orbit in an atom is :

(1) Proportional to mass of electron

(2) Proportional to square of mass of electron

(3) Inversely proportional to mass of electron

(4) Does not depend upon mass of electron

Ans. **(3)**

18. In Bohr's atomic model radius of 1st orbit of Hydrogen is 0.053 nm then radius of 3rd orbit of Li^{+2} is :

(1) 0.159 (2) 0.053 (3) 0.023 (4) 0.026

Ans. **(1)**

19. For Li^{+2} ion, $r_2 : r_5$ will be :

(1) 9 : 25 (2) 4 : 25 (3) 25 : 4 (4) 25 : 9

Ans. **(2)**

20. The velocity of electron in third excited state of Be^{3+} ion will be :-

(1) $\frac{3}{4}(2.188\times10^{8})ms^{-1}$ (2) $\frac{3}{4}(2.188\times10^{6})ms^{-1}$ (3) $(2.188\times10^{6})Kms^{-1}$ (4) $(2.188\times10^{3})Kms^{-1}$

Ans. **(4)**

21. According to Bohr theory, the radius (r) and velocity (v) of an electron vary with increasing principal quantum number 'n' as :-

(1) r increases, v decreases (2) r & v both increases

(3) r & v both decreases (4) r decreases, v increases

Ans. **(1)**

22. The ratio between kinetic energy and the total energy of the electrons of hydrogen atom according to Bohr's model is :-

(1) 2 : 1 (2) 1 : 1 (3) 1 : –1 (4) 1 : 2

Ans. **(3)**

23. The energy levels of ${}_zA^{(+Z-1)}$ can be given by :-

(1) E_n for $A^{(+Z-1)} = Z^2 \times E_n$ for H

(2) E_n for $A^{(+Z-1)} = Z \times E_n$ for H

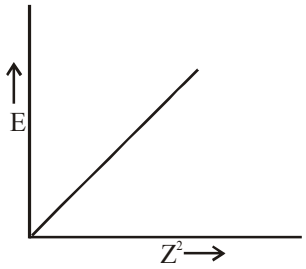
(3) E_n for $A^{(+Z-1)} = \frac{1}{Z^2} \times E_n$ for H

(4) E_n for $A^{(+Z-1)} = \frac{1}{Z} \times E_n$ for H

Ans. **(1)**

24. The graphical representation of energy of e^- and atomic number is :

(1)



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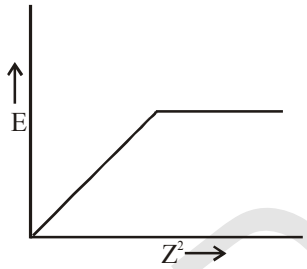

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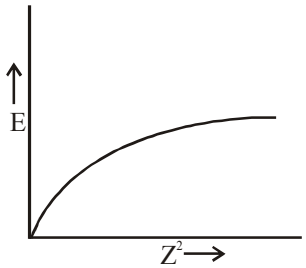
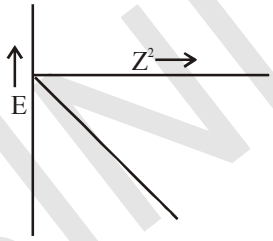


(4)



Ans. **(4)**

25. Maximum frequency of emission is obtained for the transition :-

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

Ans. **(1)**

26. If the ionization energy of hydrogen is 313.8 K cal per mole, then the energy of the electron in 2nd excited state will be :-

(1) –113.2 Kcal/mole (2) –78.45 Kcal/mole (3) –313.8 Kcal/mole (4) –35 Kcal/mole

Ans. **(4)**

27. If the potential energy (PE) of hydrogen electron is –3.02 eV then in which of the following excited level is electron present :-

(1) 1st (2) 2nd (3) 3rd (4) 4th

Ans. **(2)**

28. A single electron orbits a stationary nucleus (z = 5). The energy required to excite the electron from third to fourth Bohr orbit will be :-

(1) 4.5 eV (2) 8.53 eV (3) 25 eV (4) 16.53 eV

Ans. **(3)**

29. The ratio of potential energy and total energy of an electron in a Bohr orbit of hydrogen like species is :-

(1) 2 (2) –2 (3) 1 (4) –1

Ans. **(1)**

30. Which is not a correct order of energy for 1, 2nd & 3rd orbit :-

(1) $E_1 > E_2 > E_3$ (2) $(PE)_1 > (PE)_2 > (PE)_3$ (3) $(KE)_1 > (KE)_2 > (KE)_3$ (4) '1' & '3' both

Ans. **(1)**

31. Which of the following is a correct relationship :-

(1) E_1 of H = 1/2 E_2 of He^+ = 1/3 E_3 of Li^{+2} = 1/4 E_4 of Be^{+3}

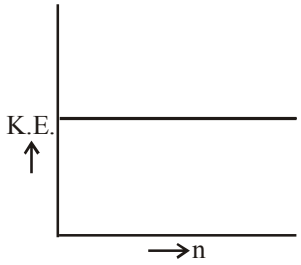
(2) $E_1(H) = E_2(He^+) = E_3(Li^{+2}) = E_4(Be^{+3})$

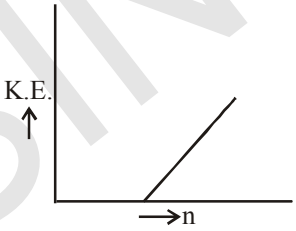
(3) $E_1(H) = 2E_2(He^+) = 3E_3(Li^{+2}) = 4E_4(Be^{+3})$

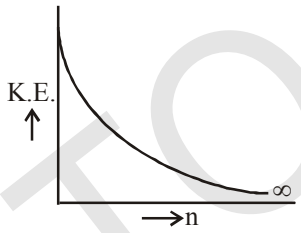
(4) No relation

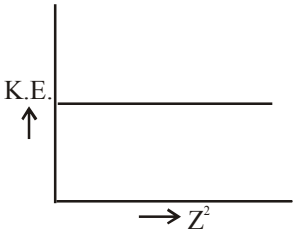
Ans. **(2)**

32. Which of the following is a correct graph :-

(1) 

(2) 

(3) 

(4) 

Ans. **(3)**

33. The energy required to excite an electron of H-atom from first orbit to second orbit is :-

(1) $\frac{3}{4}$ of its ionisation energy (2) $\frac{1}{2}$ of its ionisation energy

(3) $\frac{1}{2}$ of its ionisation energy (4) None

Ans. **(1)**

34. The ionisation potential of a singly ionised helium ion is equivalent to :-

(1) Kinetic Energy of first orbit (2) Energy of last orbit

(3) Average energy in orbits (4) Maximum energy in orbits

Ans. **(1)**

Spectrum and Spectral Lines

35. Third line of Balmer series is produced by which transition in spectrum of H-atom

(1) 5 to 2 (2) 5 to 1 (3) 4 to 2 (4) 4 to 1

Ans. **(1)**

36. Which one of the following electron transitions between energy levels produces the line of shortest wavelength in hydrogen spectrum ?

(1) $n_2 \to n_1$ (2) $n_3 \to n_1$ (3) $n_4 \to n_1$ (4) $n_4 \to n_3$

Ans. **(3)**

37. The ratio of minimum frequency of Lyman & Balmer series will be :-

(1) 1.25 (2) 0.25 (3) 5.4 (4) 10

Ans. **(3)**

38. Which transition emits photon of maximum frequency :-

(1) Second spectral line of Balmer series

(2) Second spectral line of Pashchen series

(3) Fifth spectral line of Humphery series

(4) First spectral line of Lyman series

Ans. **(4)**

39. The wavelength of photon obtained by electron transition between two levels in H-atom and singly ionised He are λ_1 and λ_2 respectively, then :-

(1) $\lambda_2 = \lambda_1$ (2) $\lambda_2 = 2\lambda_1$ (3) $\lambda_2 = \lambda_1/2$ (4) $\lambda_2 = \lambda_1/4$

Ans. **(4)**

40. Find out ratio of following for photon $(v_{max})_{Lyman} : (v_{max})_{Brakett}$

(1) 1 : 16 (2) 16 : 1 (3) 4 : 1 (4) 1 : 4

Ans. **(2)**

41. The ratio of wavelengths of first line of Lyman series in Li^{2+} and first line of Lyman series in deuterium ($_1H^2$) is :

(1) 1 : 9 (2) 9 : 1 (3) 1 : 4 (4) 4 : 1

Ans. **(1)**

42. In an electron transition atom cannot emit :

(1) Visible light (2) γ-rays (3) Infra red light (4) Ultra violet light

Ans. **(2)**

43. The first Lyman transition in the hydrogen spectrum has $\Delta E = 10.2$ eV. The same energy change is observed in the second Balmer transition of :-

(1) Li^{2+} (2) Li^{+} (3) He^{+} (4) Be^{3+}

Ans. **(3)**

44. The limiting line in Balmer series will have a frequency of :-

(1) $3.65 \times 10^{14}\ sec^{-1}$ (2) $3.29 \times 10^{15} sec^{-1}$ (3) $8.22 \times 10^{14}\ sec^{-1}$ (4) $-8.22 \times 10^{14}\ sec^{-1}$

Ans. **(3)**

45. If the shortest wavelength of Lyman series of H atom is x, then the wave length of first line of Balmer series of H atom will be :-

(1) $\frac{9x}{5}$ (2) $\frac{36x}{5}$ (3) $\frac{5x}{9}$ (4) $\frac{5x}{36}$

Ans. **(2)**

46. In H-atom, electron transits from 6^{th} orbit to 2^{nd} orbit in multi step. The total spectral lines (without Balmer series) will be :-

(1) 6 (2) 10 (3) 4 (4) 0

Ans. **(1)**

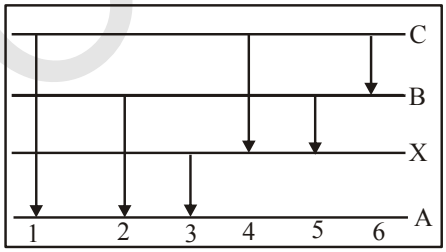
47. An atom has x energy level, then total number of lines in its spectrum are :-

(1) $1+2+3 \ldots\ldots\ldots\ldots (x+1)$ (2) $1+2+3 \ldots\ldots\ldots\ldots (x^2)$

(3) $1+2+3 \ldots\ldots\ldots\ldots (x-1)$ (4) $(x+1)(x+2)(x+4)$

Ans. **(3)**

48. The figure indicates the energy level diagram for the origin of six spectral lines in emission spectrum (e.g. line no. 5 arise from the transition from level B to X) which of the following spectral lines will not occur in the absorption spectrum :-



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

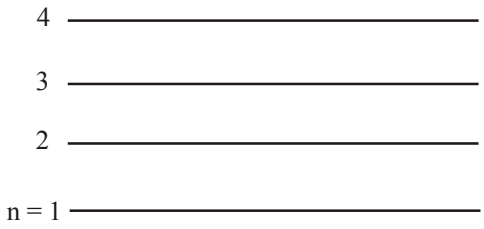
Ans. **(3)**

49. A certain electronic transition from an excited state to ground state of the H_2 atom in one or more step gives rise to three lines in the ultra violet region of the spectrum. How many lines does this transition produce in the infrared region of the spectrum :-

(1) 1 (2) 2 (3) 3 (4) 4

Ans. **(3)**

50. Four lowest energy levels of H–atom are shown in the figure. The number of emission lines could be:-



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

Ans. **(4)**

51. In the above problem, the number of absorption lines could be :-

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

Ans. **(1)**

52. If 9.9 eV energy is supplied to H atom, the no. of spectral lines emitted is equal to :-

(1) 0 (2) 1 (3) 2 (4) 3

Ans. **(1)**

De-Broglie Concept and Heisenberg Principle

53. An electron has kinetic energy 2.8×10^{-23} J. de-Broglie wavelength will be nearly :- ($m_e = 9.1 \times 10^{-31}$ kg)

(1) 9.28×10^{-24} m (2) 9.28×10^{-7} m (3) 9.28×10^{-8} m (4) 9.28×10^{-10} m

Ans. **(3)**

54. What is the de-Broglie wavelength associated with the hydrogen electron in its third orbit :-

(1) 9.96×10^{-10} cm (2) 9.96×10^{-8} cm (3) 9.96×10^{4} cm (4) 9.96×10^{8} cm

Ans. **(2)**

55. If the de-Broglie wavelength of the fourth Bohr orbit of hydrogen atom is 4 Å, the circumference of the orbit will be:-

(1) 4Å (2) 4 nm (3) 16 Å (4) 16 nm

Ans. **(3)**

56. What is the ratio of the de-Broglie wave lengths for electrons accelerated through 200 volts and 50 volts :

(1) 1 : 2 (2) 2 : 1 (3) 3 : 10 (4) 10 : 3

Ans. **(1)**

57. What should be the momentum (in gram centimeter per second) of a particle if its de-Broglie wavelength is 1Å and the value of h is 6.6252×10^{-27} erg second ?

(1) 6.6252×10^{-19} gcm/s (2) 6.6252×10^{-21} gcm/s

(3) 6.6252×10^{-24} gcm/s (4) 6.6252×10^{-27} gcm/s

Ans. **(1)**

58. What should be the mass of the photon of sodium if its wavelength is 5894 Å, the velocity of light is 3×10^8 meter/second and the value of h is 6.6252×10^{-34} kg m^2/s?

(1) 3.746×10^{-26} kg (2) 3.746×10^{-30} kg (3) 3.746×10^{-34} kg (4) 3.746×10^{-36} kg

Ans. **(4)**

59. The uncertainity in position of an electron & helium atom are same. If the uncertainity in momentum for the electron is 32×10^5 , then the uncertainity in momentum of helium atom will be

(1) 32×10^5 (2) 16×10^5 (3) 8×10^5 (4) None

Ans. **(1)**

60. The uncertainty in the position of an electron (mass 9.1×10^{-28}gm) moving with a velocity of 3×10^4 cm sec^{-1}, uncertainity in velocity is 0.011% will be:-

(1) 1.92 cm (2) 7.68 cm (3) 0.175 cm (4) 3.84 cm

Ans. **(3)**

61. A particle X moving with a certain velocity has a debroglie wavelength of 1Å. If particle Y has a mass of 25% that of X and velocity 75% that of X, debroglies wavelength of Y will be :-

(1) 3Å (2) 5.33 Å (3) 6.88 Å (4) 48Å

Ans. **(2)**

62. Heisenberg Uncertainity principle is not valid for

(1) Moving electron (2) Motor car (3) Stationary particles (4) 2 & 3 both

Ans. **(4)**

63. The number of waves made by a Bohr electron in an orbit of maximum magnetic quantum number +2:-

(1) 3 (2) 4 (3) 2 (4) 1

Ans. **(1)**

Quantum Numbers

64. The following quantum no. are possible for how many orbitals n = 3, $\ell = 2$, m = +2

(1) 1 (2) 2 (3) 3 (4) 4

Ans. **(1)**

65. Number of possible orbitals (all types) in n = 3 energy level is :

(1) 1 (2) 3 (3) 4 (4) 9

Ans. **(4)**

66. Which sub-shell is not permissible :

(1) 2d (2) 4f (3) 6p (4) 3s

Ans. **(1)**

67. Nodal plane is found in which orbital.

(1) $n = 2, l = 0$ (2) $n = 3, l = 0$ (3) $n = 2, l = 1$ (4) $n = 1, l = 0$

Ans. **(3)**

68. No. of nodal surface in 2s orbital

(1) 0 (2) 1 (3) 2 (4) 3

Ans. **(4)**

69. Which orbital is represented by the complete wave function Ψ_{420} :-

(1) 4d (2) 3d (3) 4p (4) 4s

Ans. **(1)**

70. Which of the following is correct for a 4d–electron

(1) $n = 4, \ell = 2, s = +\frac{1}{2}$ (2) $n = 4, \ell = 2, s = 0$

(3) $n = 4, \ell = 3, s = 0$ (4) $n = 4, \ell = 3, s = +\frac{1}{2}$

Ans. **(1)**

71. Energy of atomic orbitals in a particular shell is in order:-

(1) $s < p < d < f$ (2) $s > p > d > f$ (3) $p < d < f < s$ (4) $f > d > s > p$

Ans. **(1)**

72. Spin angular momentum for electron :-

(1) $\sqrt{s(s+1)}\ \frac{h}{2\pi}$ (2) $\sqrt{2s(s+1)}\ \frac{h}{2\pi}$ (3) $\sqrt{s(s+2)}\ \frac{h}{2\pi}$ (4) None

Ans. **(1)**

73. Which statement is not correct for n = 5, m = 2 :-

(1) $\ell = 4$ (2) $\ell = 0, 1, 2, 3$; $s = +1/2$ (3) $\ell = 3$ (4) $\ell = 2, 3, 4$

Ans. **(2)**

74. An electron is in one of 4d orbital. Which of the following orbital quantum number value is not possible :-

(1) $n = 4$ (2) $\ell = 1$ (3) $m = 1$ (4) $m = 2$

Ans. **(2)**

75. A neutral atom of an element has 2K, 8L, 11 M and 2N electrons. The number of s-electron in the atom are

(1) 2 (2) 8 (3) 10 (4) 6

Ans. **(2)**

76. n, ℓ and m values of an electron in $3p_y$ orbital are :-

(1) n = 3 ; ℓ = 1 and m = 1 (2) n = 3 ; ℓ = 1 and m = –1

(3) Both 1 and 2 are correct (4) None of these

Ans. **(3)**

77. In an atom, for how many electrons, the quantum numbers will be , n = 3, ℓ = 2, m = + 2, s = + $\frac{1}{2}$:-

(1) 18 (2) 6 (3) 24 (4) 1

Ans. **(4)**

78. $_{36}Kr$ has the electronic configuration ($_{18}Ar$) $4s^2\ 3d^{10}\ 4p^6$. The 39th electron will go into which one of the following sub-levels :-

(1) 4f (2) 4d (3) 3p (4) 5s

Ans. **(2)**

79. The maximum probability of finding an electron in the d_{xy} orbital is :-

(1) Along the x-axis (2) Along the y-axis

(3) At an angle of 45° from the x and y axis (4) At an angle of 90° from the x and y axis

Ans. **(3)**

80. Which orbital has two angular nodal planes :-

(1) s (2) p (3) d (4) f

Ans. **(3)**

81. In n & ℓ are principal and azimuthal quantum no. respectively then the expression for calculating the total no. of electron in any energy level is :-

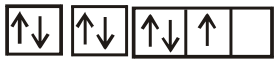
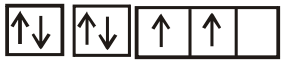
(1) $\sum_{\ell=0}^{\ell=n} 2(2\ell+1)$ (2) $\sum_{\ell=1}^{\ell=n-1} 2(2\ell+1)$ (3) $\sum_{\ell=0}^{\ell=n+1} 2(2\ell+1)$ (4) $\sum_{\ell=0}^{\ell=n-1} 2(2\ell+1)$

Ans. **(4)**

Rules for Filling of Orbitals

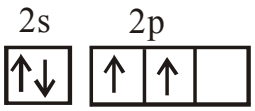
82. Which configuration does not obey pauli's exclusion principle :-

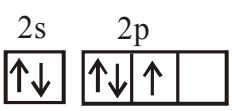
(1)  (2) 

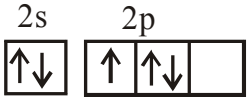
(3)  (4) 

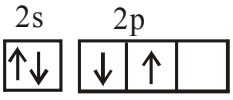
Ans. **(2)**

83. Which of the following configuration follows the Hund's rule :-

(1) [He] 

(2) [He] 

(3) [He] 

(4) [He] 

Ans. **(3)**

84. The orbital with maximum energy is

(1) 3d (2) 5p (3) 4s (4) 6d

Ans. **(4)**

85. In ground state of Cr_{24}, number of orbitals with paired and unpaired electron :-

(1) 10 (2) 12 (3) 15 (4) 18

Ans. **(3)**

86. Which of the following set of quantum numbers is correct for the 19th electron of Chromium

	n	l	m	s
(1)	3	0	0	1/2
(2)	3	2	–2	1/2
(3)	4	0	0	1/2
(4)	4	1	–1	1/2

Ans. **(3)**

87. Which set of quantum number is correct for an electron in 3p orbital

(1) $n=3, l=2, m=0, s=+\frac{1}{2}$ (2) $n=3, l=0, m=+1, S=+\frac{1}{2}$

(3) $n=3, l=-2, m=-1, s=+\frac{1}{2}$ (4) $n=3, l=1, m=0, s=+\frac{1}{2}$

Ans. **(4)**

88. The four quantum numbers for the valence shell electron or last electron of sodium (Z = 11) is

(1) $n=2, \ell=1, m=-1, s=-\frac{1}{2}$ (2) $n=3, \ell=0, m=0, s=+\frac{1}{2}$

(3) $n=3, \ell=0, m=-0, s=\pm\frac{1}{2}$ (4) $n=3, \ell=2, m=2, s=+\frac{1}{2}$

Ans. **(2)**

89. The atomic number of an element is 17, the number of orbitals containing electron pairs in the valency shell is:-

(1) 8 (2) 2 (3) 3 (4) 6

Ans. **(3)**

90. The total spin resulting from a d^9 configuration is:-

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

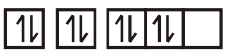
Ans. **(1)**

91. n and ℓ values of an orbital 'A' are 3 and 2, of another orbital 'B' are 5 and 0. The energy of

(1) B is more than A (2) A is more than B

(3) A and B are of same energy (4) None

Ans. **(1)**

92. Electronic configuration  has violated :–

(1) Hund's rule (2) Pauli's principle (3) Aufbau principle (4) $(n + \ell)$ rule

Ans. **(1)**

93. Sum of the paired electrons present in the orbital with $\ell = 2$ in all the species Fe^{2+}, Co^{2+} and Ni^{+2} are:–

(1) 9 (2) 12 (3) 6 (4) 15

Ans. **(2)**

94. What is the electronic configuration of an element in its first excited state which is isoelectronic with O_2

(1) [Ne] $3s^2\ 3p^3\ 3d^1$ (2) [Ne] $3s^2\ 3p^4$ (3) [Ne] $3s^1\ 3p^3\ 3d^2$ (4) [Ne] $3s^1\ 3p^5$

Ans. **(1)**

95. The quantum number of 20th electron of Fe(Z = 26) ion would be :–

(1) 3, 2, – 2, – ½ (2) 3, 2, 0, ½ (3) 4, 0, 0, + ½ (4) 4, 1, – 1, + ½

Ans. **(3)**

96. Which of the following transition neither shows absorption nor emission of energy in case of Hydrogen atom :–

(1) $3p_x \rightarrow 3s$ (2) $3d_{xy} \rightarrow 3d_{yz}$ (3) $3s \rightarrow 3d_{xy}$ (4) All the above

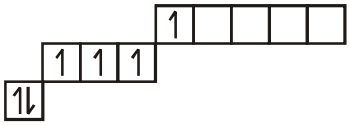
Ans. **(4)**

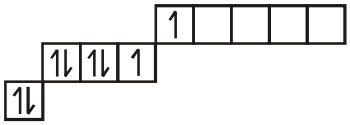
97. The atomic number of the element having maximum number of unpaired 3p electrons is (in ground state):-

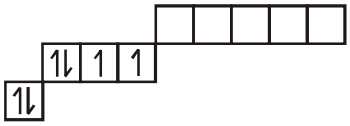
(1) 15 (2) 10 (3) 12 (4) 8

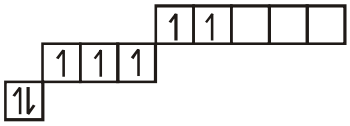
Ans. **(1)**

98. Which one represent is in ground state configuration

(1) 

(2) 

(3) 

(4) 

Ans. **(3)**

99. The electronic configuration of a dipositive metal ion M^{2+} is 2, 8, 14 and its ionic weight is 58 a.m.u. The number of neutrons in its nucleus would be :–

(1) 30 (2) 32 (3) 34 (4) 42

Ans. **(2)**

100. In an atom having 2K, 8L, 8M and 2N electrons, the number of electrons with m = 0; S = $+\frac{1}{2}$ are

(1) 6 (2) 2 (3) 8 (4) 16

Ans. **(1)**

ANALYTICAL EXERCISE

1. A certain negative ion X^{-2} has in its nucleus 18 neutrons and 18 electrons in its extra nuclear structure. What is the mass number of the most abundant isotope of 'X' :-

(1) 35.46 (2) 32 (3) 36 (4) 39

Ans. **(2)**

2. In P-atom find out the no. of paired electrons for $\ell = 1$ and $m = 0$:-

(1) 3 (2) 1 (3) 2 (4) 0

Ans. **(3)**

3. For the azimuthal quantum number (ℓ), the total number of magnetic quantum number is given by:-

(1) $\ell = \frac{(m+1)}{2}$ (2) $\ell = \frac{(m-1)}{2}$ (3) $\ell = \frac{(2m+1)}{2}$ (4) $\ell = \frac{(2m-1)}{2}$

Ans. **(2)**

4. When the value of principal quantum number n is 3, the permitted value of azimuthal quantum numbers ℓ and magnetic quantum numbers 'm' are:-

(1)

ℓ	m
0	0
1	+1, 0, –1
2	+2, +1, 0, –1, –2

(2)

ℓ	m
0	1
2	+2, 1, –2
3	+3, +3, +2, 1, –2, –3

(3)

ℓ	m
0	0
1	1 2 3 2 0, 1, 2
2	+3, +2, 1, –2, –3

(4)

ℓ	m
1	0, 1
2	0, 1, 2
3	0, 1, 2, 3

Ans. **(1)**

5. A filled or half-filled set of p or d orbitals is spherically symmetric. Point out the species which has spherical symmetry :-

(1) Na (2) C (3) Cl^- (4) Fe

Ans. **(3)**

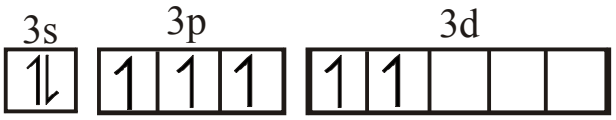
6. Radius of H-atom in its ground state is 5.3×10^{-11} m. After collision with an electron it is found to have a radius of 21.2×10^{-11}m. What is the principal quantum no. 'n' of the final state of the atom:-

(1) n = 2 (2) n = 3 (3) n = 4 (4) n = 16

Ans. **(1)**

7. Which of the following has maximum energy :-

(1) 

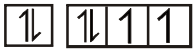
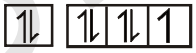
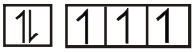
(2) 

(3) 

(4) 

Ans. **(2)**

8. Which orbital diagram does not obey Aufbau principle :-

(1)  (2)  (3)  (4) 

Ans. **(2)**

9. Quantum number which can not be calculated by schrodinger wave equation is :

(1) n (2) ℓ (3) m (4) s

Ans. **(4)**

10. First shell energy of He^+ ion is –54.4 eV. Then energy of its second shell is :-

(1) –54.4 eV (2) –13.6 eV (3) –27.2 eV (4) +27.2 eV

Ans. **(2)**

11. If l = 2 and n = 3 for any atom then maximum number of electron is

(1) 2 (2) 6 (3) 12 (4) 10

Ans. **(4)**

12. A metal in its dipositive state has the electronic configuration 2, 8, 14 and has the atomic weight equal to 56. Number of neutrons in its nucleus would be

(1) 30 (2) 32 (3) 34 (4) 28

Ans. **(1)**

13. What is the maximum number of electrons which can be accommodated in an atom in which the highest principal quantum number value is 4.

(1) 10 (2) 18 (3) 36 (4) 54

Ans. **(3)**

14. The quantum numbers +1/2 and –1/2 for the electron spin represent.

(1) Rotation of the electron in clockwise and an ticlockwise direction respectively.

(2) Rotation of the electron in anti clockwise and clockwise direction respectively.

(3) Magnetic moment of the electron pointing up and down respectively.

(4) Two quantum mechanical spin states which have no classical analogue.

Ans. **(4)**

15. Uncertainity in position of a 0.25 g particle is 10^{-5} m. Then uncertainity in its velocity will be :-
($h = 6.6 \times 10^{-34}$ Js)

(1) 1.2×10^{34} (2) 2.1×10^{-26} (3) 1.6×10^{-20} (4) 1.7×10^{-9}

Ans. **(2)**

16. The wavelength of radiation emitted when an electron in a hydrogen atom makes a transition from an energy level with n = 3 to a level with n = 2 is : [Given that $E_n = \frac{-1312}{n^2}$ kJ mol^{-1}]

(1) 6.56×10^{-7} m (2) 65.6 nm (3) 65.6×10^{-7} m (4) n only

Ans. **(1)**

17. A gas absorbs a photon of 355 nm and emits two wavelengths. If one of the emission is at 680 nm, the other is at

(1) 743 nm (2) 518 nm (3) 1035 nm (4) 325 nm

Ans. **(1)**

18. The frequency of light emitted for the transition n = 4 to n = 2 of He^+ is equal to the transition in H atom corresponding to which of the following :-

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

Ans. **(2)**

19. Energy of an electron is given by $E = -2.178 \times 10^{-18}$ J$\left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom from level n = 1 to n = 2 will be :- ($h = 6.62 \times 10^{-34}$ Js and $c = 3.0 \times 10^8$ ms^{-1})

(1) 1.214×10^{-7} m (2) 2.816×10^{-7} m (3) 6.500×10^{-7} m (4) 8.500×10^{-7} m

Ans. **(1)**

20. If the ionisation potential of an atom is 20V, its first excitation potential will be :-

(1) 5 V (2) 10 V (3) 15 V (4) 20 V

Ans. **(3)**

21. A single electron orbits a stationary nucleus of charge +Ze, where Z is a constant. It requires 47.2 eV to excite electron from second Bohr orbit to third Bohr orbit, find the value of Z :-

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

Ans. **(3)**

22. If a photon of energy 14 eV is incident on an H-atom, what is true :-

(1) Atom will be ionised and electron will have a kinetic energy of 14 eV

(2) Atom will be ionised and electron will have a kinetic energy of 0.4 eV

(3) Photon passes through atom without interacting with it

(4) More than one electrons will make transitions

Ans. **(2)**

23. An electron of energy 10.8 eV is incident on an H^- atom then :-

(1) The electron will come out with 10.8 eV energy.

(2) The electron will be completely absorbed

(3) 10.2 eV of the electron would be absorbed by H atom and it would come out with 0.6 eV energy.

(4) None

Ans. **(3)**

24. The ratio of the difference in energy between the first and second Bohr orbit to that between second and third Bohr orbit in H-atom is :-

(1) 4/9 (2) 1/3 (3) 27/5 (4) 1/2

Ans. **(3)**

25. Match the following :-

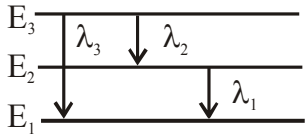
(A) Energy of ground state of He^+	(i) + 6.04 eV
(B) Potential energy of I orbit of H-atom	(ii) –27.2 eV
(C) Kinetic energy of II excited state of He^+	(iii) 8.72×10^{-18} J
(D) Ionisation potential of He^+	(iv) –54.4 eV

(1) A-(i), B-(ii), C-(iii), D-(iv) (2) A-(iv), B-(iii), C-(ii), D-(i)

(3) A-(iv), B-(ii), C-(i), D-(iii) (4) A-(ii), B-(iii), C-(i), D-(iv)

Ans. **(3)**

26. In the following transition which statement is correct



(1) $E_{3-1} = E_{3-2} - E_{2-1}$ (2) $\lambda_3 = \lambda_1 + \lambda_2$ (3) $v_3 = v_2 + v_1$ (4) All of these

Ans. **(3)**

27. When a hydrogen sample in ground state is bombarded then what potential is required to accelerate electron so that first Paschen line is emitted :-

(1) 2.55 V (2) 0.65 V (3) 12.09 V (4) 12.75 V

Ans. **(4)**

28. The binding energy of e^- in ground state of hydrogen atom is 13.6 eV. The energies required to eject out an electron from three lowest states of He^+ atom will be - (in eV)

(1) 13.6, 10.2, 3.4 (2) 13.6, 3.4, 1.5 (3) 13.6, 27.2, 40.8 (4) 54.4, 13.6, 6

Ans. **(4)**

29. Given that in the H–atom the transition energy for n = 1 to n = 2. Rydberg states is 10.2eV. The energy for the same transition in Be^{3+} is :-

(1) 20.4 eV (2) 163.2 eV (3) 30.6 eV (4) 40.8 eV

Ans. **(2)**

30. When a electron in H- atom jumps from n = 4 to n = 1, ultra violet light is emitted, if the transition corresponds to n = 4 to n = 2, which of the following colours will be emitted :-

(1) Ultra violet (2) Green (3) Infra red (4) No colour

Ans. **(2)**

31. The wavelength of first line of Lyman series for hydrogen is 1216 A°. The wavelength for the first line of this series for a 10 time ionised sodium atom (z = 11) will be :-

(1) 1000 Å (2) 100 Å (3) 10 Å (4) 1 Å

Ans. **(3)**

32. A certain electronic transition from an excited state to the ground state of the H atom in one or more steps gives rise to four lines in the ultra violet region of the spectrum, how many lines does this transition produce in the infrared region of the spectrum :-

(1) 1 (2) 2 (3) 3 (4) 4

Ans. **(3)**

33. The uncertainty in momentum of an electron is 1×10^{-5} kg-m/s. The uncertainty in its position will be ($h=6.62 \times 10^{-34}$ kg-m^2/s)

(1) 5.27×10^{-30} m (2) 1.05×10^{-26} m (3) 1.05×10^{-28} m (4) 5.25×10^{-28} m

Ans. **(1)**

34. In hydrogen atom, energy of first excited state is –3.4 eV. Then find out KE of same orbit of hydrogen atom

(1) +3.4 V (2) + 6.8 V (3) –13.6 V (4) 13.6 V

Ans. **(1)**

35. Maximum number of electrons in a subshell with l = 3 and n = 4

(1) 10 (2) 12 (3) 14 (4) 16

Ans. **(3)**

36. For which of the following sets of four quantum numbers, an electron will have the highest energy?

	n	l	m	s
(1)	3	2	1	+1/2
(2)	4	2	–1	+1/2
(3)	4	1	0	–1/2
(4)	5	0	0	–1/2

Ans. **(2)**

37. Isoelectronic species are

(1) CO, CN^-, NO^+, C_2^{2-} (2) CO^-, CN, NO, C_2^- (3) CO^+, CN^+, NO^-, C_2 (4) CO, CN, NO, C_2

Ans. **(1)**

38. Two particles A and B are in motion. If the wavelength associated with particle A is 5×10^{-8} m; calculate the wavelength associated with particle B if its momentum is half of A.

(1) 5×10^{-8} m (2) 10^{-5} cm (3) 10^{-7} cm (4) 5×10^{-8} cm

Ans. **(2)**

39. Total number of spectral lines in UV region, during transition from 5th excited state to 1st excited state

(1) 10 (2) 3 (3) 4 (4) Zero

Ans. **(4)**

40. For principal quantum number n = 5, the total number of orbitals having l = 3 is

(1) 7 (2) 14 (3) 9 (4) 18

Ans. **(4)**

41. The first emission line in the atomic spectrum of hydrogen in the Balmer series appears at

(1) $\frac{5R}{36}cm^{-1}$ (2) $\frac{3R}{4}cm^{-1}$ (3) $\frac{7R}{144}cm^{-1}$ (4) $\frac{9R}{400}cm^{-1}$

Ans. **(1)**

42. The four quantum numbers of valence electron of potassium are

(1) $4, 0, 1, \frac{1}{2}$ (2) $4, 1, 0, \frac{1}{2}$ (3) $4, 0, 0, \frac{1}{2}$ (4) $4,1, 1, \frac{1}{2}$

Ans. **(3)**

43. In a hydrogen atom, if the energy of electron in the ground state is –x eV., then that in the 2nd excited state of He^+ is

(1) –x eV (2) $-\frac{4}{9}x$ eV (3) +2x eV (4) $-\frac{9}{4}x$ eV

Ans. **(2)**

44. The wavelength of radiation emitted, when in He^+ electron falls from infinity to stationary state would be ($R = 1.097 \times 10^7\ m^{-1}$)

(1) 2.2×10^{-8} m (2) 2.2×10^{-9} m (3) 120 m (4) 22×10^7 m

Ans. **(1)**

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

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

Ans. **(2)**

46. The correct order of energy difference between adjacent energy levels in H atom

(1) $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$ (2) $E_2 - E_1 > E_4 - E_3 > E_3 - E_2$

(3) $E_4 - E_3 > E_3 - E_2 > E_2 - E_1$ (4) $E_3 - E_2 > E_4 - E_3 > E_2 - E_1$

Ans. **(1)**

47. Which combinations of quantum numbers n, l, m and s for the electron in an atom does not provide a permissible solutions of the wave equation?

(1) $3,2,-2,\frac{1}{2}$ (2) $3,3,1,-\frac{1}{2}$ (3) $3,2,1,\frac{1}{2}$ (4) $3,1,1,-\frac{1}{2}$

Ans. **(2)**

48. The orbital angular momentum of electron in 4s orbital is

(1) $\frac{1}{2}\cdot\frac{h}{2\pi}$ (2) zero (3) $\frac{h}{2\pi}$ (4) $(2.5)\frac{h}{2\pi}$

Ans. **(2)**

49. Radial nodes present in 3s and 3p-orbitals are respectively

(1) 0, 2 (2) 2, 1 (3) 1, 1 (4) 2, 2

Ans. **(2)**

50. Quantum numbers for some electrons are given below :

A : n = 4, l = 1 B : n = 4, l = 0 C : n = 3, l = 2 D : n = 3, l = 1

The correct increasing order of energy of electrons

(1) A < B < C < D (2) D < C < B < A (3) D < B < C < A (4) C < B < A < D

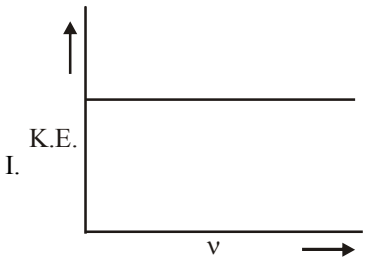
Ans. **(3)**

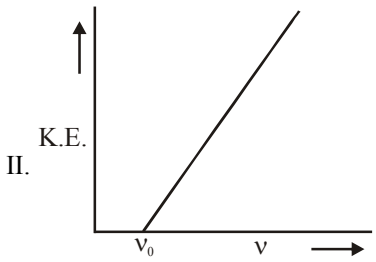
51. For which of the following options m = 0 for all orbitals ?

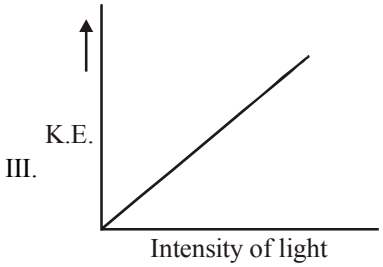
(1) 2s, $2p_x$, $3d_{xy}$ (2) 3s, $2p_z$, $3d_{z^2}$ (3) 2s, $2p_z$, $3d_{x^2-y^2}$ (4) 3s, $3p_x$, $3d_{yz}$

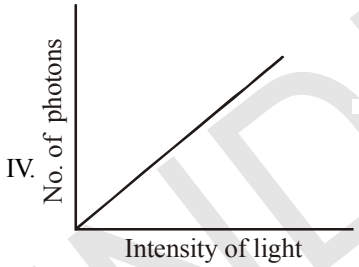
Ans. **(2)**

52. Which is the correct graphical representation based on photoeletcric effect ?

I.


II.


III.


IV.


(1) I & II (2) II & III (3) III & IV (4) II & IV

Ans. **(4)**

53. The time taken by the electron in one complete revolution in the n^{th} Bohr's orbit of the hydrogen atom is

(1) Inversely proportional to n^2

(2) Directly proportional to n^3

(3) Directly proportional to $\frac{h}{2\pi}$

(4) Inversely proportional to $\frac{n}{h}$

Ans. **(2)**

54. What will be the ratio of the wavelength of the first line to that of the second line of Paschen series of H atom?

(1) 256 : 175 (2) 175 : 256 (3) 15 : 16 (4) 24 : 27

Ans. **(1)**

55. For the transition from n = 2 → n = 1, which of the following will produce shortest wavelength ?

(1) H atom (2) D atom (3) He^+ ion (4) Li^{2+} ion

Ans. **(4)**

ASSERTION & REASON

These questions consist of two statements each, printed as *Assertion* and *Reason.* While answering these Questions you are required to choose any one of the following four responses.

A. **If both *Assertion* & *Reason* are True & the *Reason* is a correct explanation of the *Assertion*.**

B. **If both *Assertion* & *Reason* are True but *Reason* is not a correct explanation of the Assertion.**

C. **If *Assertion* is True but the *Reason* is False.**

D. **If both *Assertion* & *Reason* are False.**

1. ***Assertion :*** In Rutherford's gold foil experiment, very few α - particles are deflected back.

Reason : Nucleus present inside the atom is heavy.

Ans. **(B)**

2. ***Assertion :*** Limiting line in the Balmer series has a wavelength of 364.7 nm.

Reason : Limiting line is obtained for a jump of electron from $n = \infty$ to $n = 2$ for Balmer series.

Ans. **(A)**

3. ***Assertion :*** A spectral line will be seen for a $2p_x - 2p_y$ transition.

Reason : Only Balmer lines are observed in the visible region.

Ans. **(D)**

4. ***Assertion :*** Number of radial and angular node for 3p-orbital are 1,1 respectively.

Reason : No. of radial and angular node depends only on principal quantum no.

Ans. **(C)**

5. ***Assertion :*** For hydrogen 2s & 2p have same energy.

Reason : For an atom of same principal quantum number. s, p, d & f have same energy.

Ans. **(C)**

6. ***Assertion :–*** Nodal plane of p_x atomic orbital is yz plane.

Reason :– In p_x atomic orbital, electron density is zero in the yz plane.

Ans. **(A)**

7. ***Assertion :–*** No two electrons in an atom can have the same values of four quantum numbers.

Reason :– No two electrons in an atom can be simultaneously in the same shell, same subshell, same orbitals and have same spin.

Ans. **(A)**

8. ***Assertion :–*** p-orbital has dumb-bell shape.

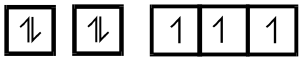
Reason :– Electrons present in p-orbital can have one of three values for 'm', i.e. 0, +1, –1

Ans. **(B)**

9. ***Assertion :–*** The ground state configuration of Cr is $3d^5$. $4s^1$.
Reason :– A set of exactly half filled orbitals containing parallel spin arrangement provide extra stability.
Ans. **(A)**

10. ***Assertion :–*** Mass numbers of most of the elements are fractional.
Reason :– Mass numbers are obtained by comparing with the mass number of carbon taken as 12.
Ans. **(D)**

11. ***Assertion :–*** The electronic configuration of nitrogen atom is represented as :



not as

Reason :– The configuration of ground state of an atom is the one which has the greatest multiplicity.
Ans. **(A)**

12. ***Assertion :–*** An orbital cannot have more than two electrons.
Reason :– The two electrons with opposite spin in an orbital create opposite magnetic field.
Ans. **(A)**

13. ***Assertion :–*** The configuration of B atom cannot be $1s^2\ 2s^3$.
Reason :– Hund's rule demands that the configuration should display maximum multiplicity.
Ans. **(B)**

14. ***Assertion :–*** In hydrogen energy of 4s is more than 3d.
Reason :– An orbital with lower value of $(n+\ell)$ has smaller energy than the orbital with higher value of $(n+\ell)$.
Ans. **(B)**

15. ***Assertion :–*** 2p orbitals do not have spherical nodes.
Reason :– The number of spherical nodes in p-orbitals is given by (n-2).
Ans. **(A)**

16. ***Assertion :–*** There are two spherical nodes in 3s-orbital.
Reason :– There is no angular node in 3s-orbital.
Ans. **(B)**

17. ***Assertion :–*** In an atom, the velocity of electron in the higher orbits keeps on decreasing.
Reason :– Velocity of electron is inversely proportional to radius of the orbit.
Ans. **(C)**

18. **Assertion :-** Bohr model fails in case of multielectron species.
Reason :- It does not mention electron-electron intercation.
Ans. **(D)**

19. **Assertion :-** Total energy of electron in hydrogen atom is negative.
Reason :- It is in bound state.
Ans. **(A)**