STRUCTURE OF ATOM

CHEMISTRY

Single Correct Answer Type

1. Choose the incorrect relation on the basis of Bohr's theory
a) Velocity of electron $\propto \frac{1}{n}$
b) Frequency of revolution $\propto \frac{1}{n^2}$
c) Radius of orbit $\propto n^2Z$
d) Force on electron $\propto \frac{1}{n^4}$
2. X-rays were discovered by :
a) Becquerel
b) Roentgen
c) Mme. Curie
d) Van Laue
3. Two electrons in the same orbital may be identified with:
a) n
b) l
c) m
d) s
4. An electron has principal quantum number 3. The number of its (i) subshells and (ii) orbitals would be respectively:
a) 3 and 5
b) 3 and 7
c) 3 and 9
d) 2 and 5
5. Maximum number of electrons in a subshell of an atom is determined by the following:
a) $2n^2$
b) $4l + 2$
c) $2l + 1$
d) $4l - 2$
6. Particle having mass 200 times that of an electron is:
a) Proton
b) Positron
c) Meson
d) Neutron
7. Which of the following has the maximum number of unpaired electrons?
a) Mg^{2+}
b) Ti^{3+}
c) Fe^{2+}
d) V^{3+}
8. An electron from one Bohr stationary orbit can go to next higher orbit
a) By emission of electromagnetic radiation
b) By absorption of any electromagnetic radiation
c) By absorption of electromagnetic radiation of particular frequency
d) Without emission or absorption of electromagnetic radiation
9. How many neutrons are present in tritium nucleus?
a) 2
b) 3
c) 1
d) 0
10. The number of wave made by an electron moving in an orbit having maximum magnetic quantum number +3 is :
a) 4
b) 3
c) 5
d) 6
11. The wavelength of a spectral line emitted by hydrogen atom in the Lyman series is $\frac{16}{15R}$ cm. What is the value of n_2?(R=Rydberg constant)
a) 2
b) 3
c) 4
d) 1
12. The statements, which is/are correct:
a) Number of total nodes in an orbital $= n - 1$
b) Number of radial nodes in an orbital $= n - l - 1$
c) Number of angular nodes in an orbital $= l$
d) All of the above
13. If the wavelength of an electromagnetic radiation is 2000Å, what is its energy in ergs?
a) 9.94×10^{-12}
b) 9.94×10^{-19}
c) 4.97×10^{-12}
d) 4.97×10^{-19}
14. Number of unpaired electrons in the electronic configuration $1s^2, 2s^2 2p^4$:
a) 2
b) 3
c) 4
d) 6
15. A strong argument for the particle nature of cathode rays is that they:
a) Produce fluorescence
b) Travel through vacuum

c) Get deflected by electric and magnetic fields
d) Cast shadow

16. The electronic configuration $1s^2, 2s^2 2p^6, 3s^1 3p^1$ correctly describes:
a) Ground state of Na b) Ground state of Si^+ c) Excited state of Mg d) Excited state of Al^{3+}

17. What accelerating potential is needed to produce an electron beam with an effective wavelength of 0.090Å?
a) 1.86×10^4eV b) 1.86×10^2eV c) 2.86×10^4eV d) 2.86×10^2eV

18. Which of the following pairs have identical values of e/m?
a) A proton and a neutron b) A proton and deuterium
c) Deuterium and an α-particles d) An electron and γ-rays

19. Positive charge in an atom is:
a) Scattered all over the atom
b) Concentrated in the nucleus
c) Revolving around the nucleus
d) None is true

20. $[Cr(H_2O)_6]Cl_3$ (at. No. of Cr = 24) has a magnetic moment of 3.83 B.M. The correct distribution of $3d$ electrons in the chromium of the complex:
a) $3d_{xy}^1, 3d_{yz}^1, 3d_{xz}^1$
b) $3s_{xy}^1, 3d_{yz}^1, 3d_{z^2}^1$
c) $\left(3d_{x^2-y^2}^1\right), 3d_{z^2}^1, 3d_{xz}^1$
d) $3d_{xy}^1, \left(3d_{x^2-y^2}^1\right), 3d_{yz}^1$

21. The mass of an electron is m, its charge is e and it is accelerated from rest through a potential difference, V. The velocity of electron will be calculated by formula
a) $\sqrt{\frac{V}{m}}$ b) $\sqrt{\frac{eV}{m}}$ c) $\sqrt{\left(\frac{2eV}{m}\right)}$ d) None of these

22. The present atomic weight scale is:
a) C^{12} b) O^{16} c) H^1 d) C^{13}

23. Which one of the following set of quantum numbers is not possible for electron in the ground state of an atom with atomic number 19?
a) $n = 2, l = 0, m = 0$ b) $n = 2, l = 1, m = 0$ c) $n = 3, l = 1, m = -1$ d) $n = 3, l = 2, m = +2$

24. Oxygen consists of O^{16}, O^{17} and O^{18} isotopes and carbon consists of isotopes of C^{12} and C^{13}. Total number of CO_2 molecules possible are:
a) 6 b) 12 c) 18 d) 1

25. In order to designate an orbital n in an atom, the number of quantum number required are:
a) 1 b) 2 c) 3 d) 4

26. For a given value of azimuthal quantum number l, the total number of values for the magnetic quantum number m are given by:
a) $l + 1$ b) $2l + 1$ c) $2l - 1$ d) $l + 2$

27. Magnetic quantum number for the last electron in sodium is:
a) 3 b) 1 c) 2 d) Zero

28. The Heisenberg's uncertainty principle can be applied to:
a) A cricket ball b) A football c) A jet aeroplane d) An electron

29. Isotopes are
a) Atoms of different elements having same mass number
b) Atoms of same elements having same mass number
c) Atoms of same elements having different mass number
d) Atoms of different elements having same number of neutrons

30. Which element possess non-spherical shells?

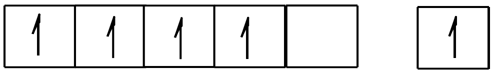
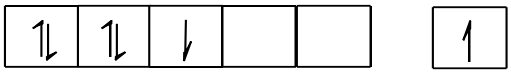
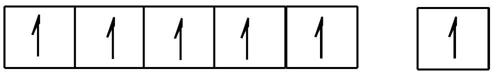
a) He b) B c) Be d) Li

31. Splitting of spherical lines when atoms are subjected to strong electric field is called:
a) Zeeman effect b) Stark effect c) Decay d) Disintegration

32. An orbital in which $n = 4$ and $l = 2$ is expressed by
a) $4s$ b) $4p$ c) $4d$ d) $5p$

33. Which wave property is directly proportional to energy of electromagnetic radiation:
a) Velocity b) Frequency c) Wave number d) All of these

34. Mass of an electron is :
a) 9.1×10^{-28}g b) 9.1×10^{-25}g c) 9.1×10^{-10}g d) 9.1×10^{-18}g

35. Which is the correct outermost shell configuration of chromium?
a) 
b) 
c) 
d) 

36. Which of the following ion will show colour in aqueous solution?
a) $La^{3+}(Z = 57)$ b) $Ti^{3+}(Z = 22)$ c) $Lu^{3+}(Z = 71)$ d) $Sc^{3+}(Z = 21)$

37. The electric configuration of element with atomic number 24 is
a) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^4, 4s^2$
b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}$
c) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6$
d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

38. What is the maximum number of electrons in an atom that can have the following quantum numbers $n = 4, m_1 = +1$?
a) 4 b) 15 c) 3 d) 6

39. The principal quantum number of an atom represents:
a) Size and energy of the orbit
b) Spin angular momentum
c) Orbital angular momentum
d) Space orientation of the orbitals

40. The specific charge for positive rays is much less than the specific charge for cathode rays. This is because:
a) Positive rays are positively charged
b) Charge on positive rays is less
c) Positive rays comprise ionised atoms, whose mass is much higher
d) Experimental method for determination is wrong

41. The magnetic moment of electron in an atom (excluding orbital magnetic moment) is given by:
a) $\sqrt{n(n+2)}$ Bohr Magneton (or B.M) b) $\sqrt{n(n+1)}$ B. M. c) $\sqrt{n(n+3)}$ B. M. d) None of the above

42. de Broglie equation is a relationship between:
a) Position of an electron and its momentum
b) Wavelength of an electron and its momentum
c) Mass of an electron and its energy
d) Wavelength of an electron and its frequency

43. Which electromagnetic radiation has extremely small wavelength?
a) Radiowave b) Cosmic rays c) Infrared rays d) Microwaves

44. Dimensions of Planck's constant are:
a) force × time b) energy × distance c) energy/time d) energy × time

45. Given : The mass of electron is 9.11×10^{-31}kg and
Planck constant is 6.626×10^{-34} Js,

the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is:

a) 5.79×10^8 m s^{-1} b) 5.79×10^5 m s^{-1} c) 5.79×10^6 m s^{-1} d) 5.79×10^7 m s^{-1}

46. If helium atom and hydrogen molecules are moving with the same velocity, their wavelength ratio will be

a) 4: 1 b) 1: 2 c) 2: 1 d) 1: 4

47. The energy required to break one mode of Cl − Cl bonds in Cl_2 is 242kJmol^{-1}. The longest wavelength of light capable of breaking a single Cl − Cl bond is

a) 594 nm b) 640 nm c) 700 nm d) 494 nm

48. 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)

a) 2.36×10^{-28}m b) 5.25×10^{-28}m c) 2.27×10^{-30}m d) 5.27×10^{-30}m

49. All types of electromagnetic radiations possess same:

a) Energy b) Velocity c) Frequency d) Wavelength

50. The values of four quantum numbers of valence electron of an element are

$n = 4, l = 0, m = 0$ and $s = +\frac{1}{2}$.

The element is

a) K b) Ti c) Na d) Sc

51. Ground state electronic configuration of nitrogen atom can be represented as

a) [↑↓] [↑↓] [↑ | ↑ | ↑] b) [↑↓] [↑↓] [↑ | ↓ | ↑] c) [↑↓] [↑↓] [↑ | ↓ | ↓] d) [↑↓] [↑↓] [↓ | ↑ | ↓]

52. The value of charge on the oil droplets experimentally observed were -1.6×10^{-19} and -4×10^{-19} coulomb. The value of the electronic charge, indicated by these results is:

a) 1.6×10^{-19} b) -2.4×10^{-19} c) -4×10^{-19} d) -0.8×10^{-19}

53. Transition from $n = 4,5,6$ to $n = 3$ in hydrogen spectrum gives:

a) Lyman series b) Paschen series c) Balmer series d) Pfund series

54. The atomic numbers of elements X, Y and Z are 19, 21 and 25 respectively. The number of electrons present in the M-shell of these elements follow the order

a) $Z > X > Y$ b) $X > Y > Z$ c) $Z > Y > X$ d) $Y > Z > X$

55. The mass number of an element is 23 and atomic number is 11. The number of protons, electrons and neutrons respectively present in the atom of the elements are:

a) 11, 11, 12 b) 12, 12, 11 c) 11, 12, 11 d) 12, 11, 12

56. In photoelectric emission the energy of the emitted electrons is:

a) Larger than that of incident photon

b) Smaller than that of incident photo

c) Same as that of incident photon

d) Proportional to intensity of incident light

57. Angular momentum of an electron in an orbital is given by :

a) $n\frac{h}{2\pi}$ b) $\frac{h}{2\pi} \times \sqrt{l(l+1)}$ c) $n\frac{h}{4\pi}$ d) None of these

58. What is the mass of a photon of sodium light with a wavelength of 5890 Å?($h = 6.63 \times 10^{-27}$ erg-s)

a) 5.685×10^{-33} g b) 6.256×10^{-33} g c) 4.256×10^{-33} g d) 3.752×10^{-33} g

59. Consider the ground state of ($Z = 24$). The numbers of electrons with the azimuthal quantum numbers, $l = 1$ and 2 are respectively

a) 12 and 4 b) 12 and 5 c) 16 and 4 d) 16 and 5

60. The charge on an electron was discovered by

a) J.J. Thomson b) Neil Bohr c) James Chadwick d) Mullikan

61. If an electron has spin quantum number of $+\frac{1}{2}$ and a magnetic quantum number of −1, it cannot be represented in an

a) s −orbital b) p −orbital c) d −orbital d) f −orbital

62. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)}\frac{h}{2\pi}$. This momentum for an s-electron will be given by

a) $+\frac{1}{2}.\frac{h}{2\pi}$ b) Zero c) $\frac{h}{2\pi}$ d) $\sqrt{2}.\frac{h}{2\pi}$

63. A heavy element has atomic number X and mass number Y. Correct relationship between X and Y is
a) $X\ Y$ b) $X\ Y$ c) $X\ Y$ d) $X\ Z\ (1\ Y)^2$

64. Proton is :
a) Nucleus of deuterium
b) Ionised hydrogen molecule
c) Ionised hydrogen atom
d) An α-particle

65. An isotone of ${}^{76}_{32}Ge$ is
a) ${}^{77}_{32}Ge$ b) ${}^{77}_{33}As$ c) ${}^{77}_{34}Se$ d) ${}^{78}_{36}Sc$

66. Which principle/rule limits the maximum number of electrons in an orbital to two?
a) Aufbau principle
b) Pauli's exclusion principle
c) Hund's rule of maximum multiplicity
d) Heisenberg's uncertainty principle

67. Magnitude of kinetic energy in an orbit is equal to
a) Half of the potential energy b) Twice of the potential energy
c) One fourth of the potential energy d) None of the above

68. The shortest λ for the Lyman series is: (Given $R_H = 109678\ cm^{-1}$)
a) 991 Å b) 700 Å c) 600 Å d) 811 Å

69. The maximum number of atomic orbitals associated with a principal quantum number 5 is:
a) 9 b) 12 c) 16 d) 25

70. The number of orbitals present in the shell with $n = 4$ is
a) 16 b) 8 c) 18 d) 32

71. Which one of the following is the set of correct quantum numbers of an electron in $3d$ orbital?
a) $n = 3, l = 0, m = 0, s = -1/2$ b) $n = 2, l = 3, m = 0, s = +1/2$
c) $n = 3, l = 1, m = 0, s = -1/2$ d) $n = 3, l = 2, m = 1, s = +1/2$

72. Different lines in Lyman series of hydrogen spectrum lie in …. region
a) Ultraviolet b) Infrared c) Visible d) Far infrared

73. The first energy level that can have d-orbitals is:
a) 2 b) 3 c) 4 d) All are correct

74. The uncertainty in the momentum of an electron is $1.0 \times 10^{-5} kg\ ms^{-1}$. The uncertainty in its position will be
a) 1.50×10^{-28}m b) 1.05×10^{-26}m c) 5.27×10^{-30}m d) 5.25×10^{-28}m

75. Which of the following particles moving with same velocity would be associated with smaller de-Broglie wavelength?
a) Helium molecule b) Oxygen molecule c) Hydrogen molecule d) Carbon molecule

76. Stark effect refers to the
a) Splitting up of the lines in an emission spectrum in the presence of an external electrostatic field
b) Random scattering of light by colloidal particles
c) Splitting up of the lines in an emission spectrum in a magnetic field
d) Emission of electrons from metals when light falls upon them

77. For which species, Bohr's theory does not apply:
a) H b) Be c) He^+ d) Li^{2+}

78. The energy of electron in first orbit of He^+ is ($R_H = -871.6 \times 10^{-20}$ J). The energy of electron in the first orbit of H is:
a) -871.6×10^{-20} J b) -435.8×10^{-20} J c) -217.9×10^{-20} J d) -108.9×10^{-20} J

79. The quantum levels upto $n = 3$ has:
a) s and p-levels b) s, p, d, f-levels c) s, p, d-levels d) s-level

80. Which of the subshell has double dumb-bell shape?
a) s b) p c) d d) f

81. The lightest particle is
a) -particle b) Positron c) Proton d) Neutron

82. The ratio of speed of γ-rays and X-rays is:
a) 1 b) < 1 c) > 1 d) None of these

83. The radius of second Bohr's orbit of hydrogen atom is
a) 0.053 nm b) 0.106 nm c) 0.2116 nm d) 0.4256 nm

84. Which set of phenomenon shown by the radiation proves the dual nature of radiation?
a) Scintillation
b) Interference and diffraction
c) Interference and photoelectric effect
d) None of the above

85. The hydrogen spectrum from an incandescent source of hydrogen is:
a) A band spectrum in emission
b) A line spectrum in emission
c) A band spectrum in absorption
d) A line spectrum in absorption

86. The total spin resulting from a d^7 configuration is:
a) $\pm 1/2$ b) ± 2 c) ± 1 d) $\pm 3/2$

87. The path of deflection of electron beam is:
a) Directly proportional to the magnitude of applied magnetic field
b) Inversely proportional to the magnitude of applied magnetic field
c) Inversely proportional to the velocity of electron
d) Directly proportional to the e/m value

88. Which one of the following groupings represents a collection of isoelectronic species? (At. no. Cs=55, Br=35)
a) Na, Ca^2, Mg^2 b) N^3, F, Na c) Be, Al^3, Cl d) Ca^2, Cs, Br

89. Which particle may be removed from a stable neutral atom with least energy change?
a) An α-particle b) A neutron c) A proton d) An electron

90. Visible spectrum of hydrogen shows that it exists in two different forms which are based on direction of spin of the:
a) Molecule of hydrogen
b) Nuclei of hydrogen atoms
c) Electrons of hydrogen
d) Atoms of hydrogen molecule

91. Evidence for the existence of different energy levels in atom is supplied by:
a) Spectral lines b) Mass defects c) Atomic numbers d) Atomic radii

92. Rutherford's experiment on the scattering of α −particles showed for the first time that the atom has
a) Electrons b) Protons c) Nucleus d) Neutrons

93. The longest λ for the Lyman series is : (Given $R_H = 109678 \text{ cm}^{-1}$)
a) 1215 Å b) 1315 Å c) 1415 Å d) 1515 Å

94. The angular momentum of electron in nth orbit is given by:
a) nh b) $\frac{h}{2\pi n}$ c) $\frac{nh}{2\pi}$ d) $\frac{n^2h}{2\pi}$

95. According to Bohr′s postulates which quantity can take up only discrete values:
a) Kinetic energy b) Angular momentum c) Momentum d) Potential energy

96. When the frequency of light incident on a metallic plate is doubled, the KE of the emitted photoelectrons will be:
a) Doubled

b) Halved
c) Increased but more than doubled of the previous KE
d) Unchanged

97. The mass of one mole of electron is:
a) 0.55 mg b) 0.008 mg c) 1.008 mg d) 0.184 mg

98. The velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of their de-Broglie's wavelength is
a) 2: 1 b) 1: 4 c) 1: 1 d) l4: 1

99. Which are in the ascending order of wavelength?
a) $H_\alpha, H_\beta, H_\gamma$ ... lines in Balmer series of hydrogen atom
b) Lyman limit, Balmer limit, Paschen limit in the hydrogen spectrum
c) Blue, violet, yellow, red colours in solar spectrum
d) None of the above

100. The representation of the ground state | ↑ | ↑ | electronic configuration of He by box-diagram as
is wrong because it violates
a) Heisenberg's uncertainty principle
b) Bohr's quantization theory of angular momenta
c) Pauli exclusion principle
d) Hund's rule

101. The electronic configuration of the element which is just above the element with atomic number 43 in the same particle group is:
a) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1 4p^6$
b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^2$
c) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^1$
d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^5$

102. The order of filling of electrons in the orbital of an atom will be:
a) $3d\ 4s\ 4p\ 4d\ 5s$ b) $4s\ 3d\ 4p\ 5s\ 4d$ c) $5s\ 4p\ 3d\ 4d\ 5s$ d) $3d\ 4p\ 4s\ 4d\ 5s$

103. The Bohr's energy equation for H atom reveals that the energy level of a shell is given by $E = -13.58/n^2$ eV. The smallest amount that an H-atom will absorb, if in ground state is:
a) 1.0 eV b) 3.39 eV c) 6.79 eV d) 10.19 eV

104. The amount of energy required to remove the electron from a Li^{2+} ion in its ground state is how many times greater than the amount of energy required to remove the electron from an H atom in its ground state?
a) 9 b) 2 c) 3 d) 5

105. Compared to mass of lightest nucleus the mass of an electron is only:
a) 1/80 b) 1/360 c) 1/1800 d) 1/1000

106. Bragg's equation will have no solution, if:
a) $\lambda > 2d$ b) $\lambda < 2d$ c) $\lambda < d$ d) $\lambda = d$

107. Size of the nucleus is:
a) 10^{-15}cm b) 10^{-13}cm c) 10^{-10}cm d) 10^{-8}cm

108. The radius of Bohr's first orbit in H-atom is 0.053 nm. The radius of second orbit in He^+ would be:
a) 0.0265 nm b) 0.0530 nm c) 0.1060 nm d) 0.2120 nm

109. Splitting of spectrum lines in magnetic field is
a) Stark effect b) Raman effect c) Zeeman effect d) Rutherford effect

110. If the radius of first Bohr's orbit be a_0, then the radius of third Bohr's orbit would be:
a) $3 \times a_0$ b) $6 \times a_0$ c) $9 \times a_0$ d) $1/9 \times a_0$

111. Which of the following atoms has same number of protons and neutrons in its nucleus?
a) Carbon b) Deuterium c) Tritium d) Nitrogen

112. The ratio of the difference in energy between the first and the second Bohr orbit to that between the

second and the third Bohr orbit is

a) $\frac{1}{2}$ b) $\frac{1}{3}$ c) $\frac{4}{9}$ d) $\frac{27}{5}$

113. The wavelength of radiation emitted when electron falls from 4th Bohr's orbit to 2nd in H-atom is:
($R_{\text{H}} = -1.09678 \times 10^{-7}\text{m}^{-1}$)

a) 972 nm b) 486 nm c) 243 nm d) 182 nm

114. In an atom with atomic number 29, mass number 59, the number of electrons is:

a) 29 b) 30 c) 40 d) 59

115. The atomic transition gives rise to the radiation of frequency 10^4 MHz. The change in energy per mole of atoms taking place would be

a) 6.62×10^{-30}J b) 5.32×10^{-28}J c) 6.62×10^{-20}J d) 3.99 J

116. Uncertainty in the position of an electron (mass $= 9.1 \times 10^{-31}$kg) moving with a velocity 300 ms^{-1}, accurate upon 0.001% will be
($h = 6.63 \times 10^{-34}$ Js)

a) 19.2×10^{-2}m b) 5.76×10^{-2}m c) 1.92×10^{-2}m d) 3.84×10^{-2}m

117. Which of the following is not possible?

a) $n = 2, l = 1, m = 0$ b) $n = 2, l = 0, m = -1$ c) $n = 3, l = 0, m = 0$ d) $n = 3, l = 1, m = -1$

118. The dynamic mass of a photon of wavelength λ is:

a) Zero b) hc/λ c) $h/c\lambda$ d) h/λ

119. The atomic radius is of the order of :

a) 10^{-8} cm b) 10^{8} cm c) 10^{-10} cm d) 10^{-12} cm

120. When electronic transition occurs from higher energy state to a lower energy state with energy difference equal to ΔE expressed in electron volts, the wavelength of line emitted is approximately equal to:

a) $\frac{12375}{\Delta E}$Å b) $\frac{12375}{\Delta E} \times 10^{-8}$cm c) $\frac{12375}{\Delta E} \times 10^{-10}$m d) Either of these

121. A Mo atom in its ground state has a $4d^5, 5s^1$ configuration and a Ag atom $4d^{10}, 5s^1$ configuration. This is because a shell which is half-filled or completely filled is particularly

a) Strongly exchange destabilized b) Weakly exchange stabilized
c) Weakly exchange destabilized d) Strongly exchange destabilized

122. The ionisation enthalpy of hydrogen atom is $1.312 \times 10^6 \text{Jmol}^{-1}$. The energy required to excite the electron in the atom from $n_1 = 1$ to $n_2 = 2$ is

a) 8.51×10^5 J mol^{-1} b) 6.56×10^5 J mol^{-1} c) 7.56×10^5 J mol^{-1} d) 9.84×10^5 J mol^{-1}

123. Which of the following sets of quantum number is correct for an electron in $4f$-orbital?

a) $n = 4, l = 3, m = +4, s = +1/2$ b) $n = 4, l = 4, m = -4, s = -1/2$
c) $n = 4, l = 3, m = +1, s = +1/2$ d) $n = 3, l = 2, m = -2, s = +1/2$

124. Number of electrons in $-CONH_2$ are:

a) 24 b) 20 c) 22 d) 18

125. The ratio of radii of two nuclei with mass numbers 27 and 64 is

a) 1/2 b) 3/4 c) 3/2 d) 2/3

126. The atomic number of Ni and Cu are 28 and 29 respectively. The electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ represents

a) Cu^+ b) Cu^{2+} c) Ni^{2+} d) Ni

127. The three quantum numbers n, l and m are the outcome of:

a) Bohr's atomic theory
b) Solution of Schrödinger principle
c) Heisenberg's uncertainty principle
d) Aufbau principle

128. Which has the highest e/m ratio?

a) He^{2+} b) H^+ c) He^+ d) D^+

129. The electronic configuration of an element in ultimate and penultimate orbitals is
$(n\ \ 1)s^2(n\ \ 1)p^6(n\ \ 1)d^x\ ns^2$. If n 4 and x 5 then number of protons in the nucleus is

a) 25 b) <724 c) 25 d) 30

130. The de-Broglie wavelength of a tennis ball of mass 60g moving with a velocity of 10 m/s is approximately (Planck's constant, $h = 6.63 \times 10^{-34}$Js)

a) 10^{-33}m b) 10^{-31}m c) 10^{-16}m d) 10^{-25}m

131. The work-function for photoelectric effect :

a) Depends upon the frequency of incident light
b) Is same for all metals
c) Is different for different metals
d) None of the above

132. Line spectra is characteristic of :

a) Atoms b) Molecules c) Radicals d) Ions

133. Which of the following is the correct form of Schrodinger wave equation?

a) $\frac{\partial^2\Psi}{\partial^2 x} + \frac{\partial^2\Psi}{\partial^2 y} + \frac{\partial^2\Psi}{\partial^2 z} + \frac{8\pi^2 m}{h^2}(E - V)\Psi = 0$ b) $\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi^2 \mathrm{m}}{h^2}(E - V)\Psi = 0$

c) $\frac{\partial\Psi^2}{\partial x^2} + \frac{\partial\Psi^2}{\partial y^2} + \frac{\partial\Psi^2}{\partial z^2} + \frac{8\pi^2 \mathrm{m}}{h^2}(E - V)\Psi = 0$ d) $\frac{\partial^2\Psi}{\mathrm{d}x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi^2 \mathrm{m}^2}{h^2}(E - V)\Psi = 0$

134. If $n = 6$, the correct sequence for filling of electrons will be:

a) $ns \rightarrow np \rightarrow (n-1)d \rightarrow (n-2)f$
b) $ns \rightarrow (n-2)f \rightarrow (n-1)d \rightarrow np$
c) $ns \rightarrow (n-1)d \rightarrow (n-2)f \rightarrow np$
d) $ns \rightarrow (n-2)f \rightarrow np \rightarrow (n-1)d$

135. Which one is not true for the cathode rays?

a) They have kinetic energy
b) They cause certain substances to show fluorescence
c) They travel in straight line
d) They are electromagnetic waves

136. Which of the following ions has electronic configuration [Ar]$3d^6$:

a) ${}_{27}Ni^{3+}$ b) ${}_{25}Mn^{3+}$ c) ${}_{26}Fe^{3+}$ d) ${}_{27}Co^{3+}$

137. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainity with which the position of the electron can be located is $\left(\begin{matrix} h = 6.6 \times 10^{-34}\text{kg m}^2\text{s}^{-1}, \\ \text{mass of electron}, e_\text{m} = 9.1 \times 10^{-31}\text{kg} \end{matrix}\right)$

a) 1.52×10^{-4}m b) 5.10×10^{-3}m c) 1.92×10^{-3}m d) 3.84×10^{-3}m

138. Consider the ground state of Cr atom ($Z = 24$). The numbers of electrons with the azimuthal quantum numbers, $l = 1$ and 2 are, respectively

a) 12 and 4 b) 12 and 5 c) 16 and 4 d) 16 and 5

139. Moseley's law is : (a and b are constants, Z = atomic number, v = frequency)

a) $\sqrt{\mathrm{v}} = aZ$ b) $\mathrm{v} = c/\lambda$ c) $2d \sin\theta = n\lambda$ d) $\sqrt{\mathrm{v}} = a(Z - b)$

140. From the discharge tube experiment, it is concluded that:

a) Mass of a proton is in fraction
b) Matter contains electrons
c) Nucleus contains positive charge
d) Positive rays are heavier than protons

141. Which atom has as many as s-electrons as p-electrons?

a) H b) Mg c) N d) Na

142. The electronic configuration of Pd^{2+} (at.no.46)is:

a) [Kr]$4d^8$ b) [Kr]$5s^2 4d^6$ c) [Kr]$4d^6$ d) [Kr]$4d^8 5s^2$

143. When α −particles are sent through a thin metal foil, most of them go straight through the foil because

a) Most part of the atom is empty space
b) Alpha particles move with high speed
c) Alpha particles are much heavier than electrons

d) Alpha particles are positively charged

144. A neutral atom of an element has 2K, 8L, 11M and 2N electrons. Total number of electrons with $l = 2$ will be:

a) Zero b) 3 c) 6 d) 10

145. Mosley's name is connected with the discovery of :

a) Protons b) Neutrons c) Atomic number d) Atomic weight

146. For a Bohr atom angular momentum M of the electron is $(n = 0, 1, 2, \dots)$

a) $\frac{nh^2}{4\pi}$ b) $\frac{n^2h^2}{4\pi}$ c) $\frac{\sqrt{\pi h^2}}{4\pi}$ d) $\frac{nh}{2\pi}$

147. When $3d$-orbital is complete, the newly entering electron goes into:

a) $4f$ b) $4s$ c) $4p$ d) $4d$

148. Which of the followings sets of quantum numbers represents the highest energy of an atom?

a) $n = 3, l = 1, m = 1, s = +1/2$ b) $n = 3, l = 2, m = 1, s = +1/2$

c) $n = 4, l = 0, m = 0, s = +1/2$ d) $n = 3, l = 0, m = 0, s = +1/2$

149. When an electron jumps from L-level to M-level, there occurs:

a) Emission of energy

b) Absorption of energy

c) Emission of γ-radiations

d) Emission of X-rays

150. If the kinetic energy of an electron is increased four times, the wavelength of the de-Broglie wave associated with it would becomes

a) Half times b) $\frac{1}{4}$ times c) Four times d) Two times

151. The work function (Φ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metals is :

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
Φ(e	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

a) 2

b) 4

c) 6

d) 8

152. "Positronium" is the name given to an atom-like combination formed between:

a) A positron and a proton

b) A positron and a neutron

c) A positron and α-particle

d) A positron and an electron

153. The nucleus of helium contains:

a) Four protons

b) Four neutrons

c) Two neutrons and two protons

d) Four protons and two electrons

154. Photoelectric effect shows:

a) Particle-like behaviour of light

b) Wave-like behaviour of light

c) Both wave-like and particle-like behaviour of light

d) Neither wave-like and particle-like behaviour of light

155. When high speed electrons strike a target:

a) Only heat is produced

b) Only continuous X-rays are emitted
c) Only continuous and characteristic X-rays are emitted
d) Heat is produced and simultaneously continuous and characteristic X-rays are emitted

156. The de Broglie wavelength of a particle with mass 1 g and velocity 100 m/s is:
a) 6.63×10^{-33}m b) 6.63×10^{-34}m c) 6.63×10^{-35}m d) 6.65×10^{-35}m

157. After np^6 electronic configuration, the next orbital filled will be
a) $(n+1)d$ b) $(n+1)s$ c) $(n+1)f$ d) None of these

158. Choose the incorrect statement
a) The shape of an atomic orbital depends upon the azimuthal quantum number
b) The orientation of an atomic orbital depends upon the magnetic quantum number
c) The energy of an electron in an atomic orbital of multi-electron atom depends on principal quantum number
d) The number of degenerate atomic orbitals of one type depends on the value of azimuthal and magnetic quantum numbers

159. Photoelectric effect can be caused by :
a) Visible light but not by X-rays
b) Gamma-rays but not by X-rays
c) Ultraviolet light only
d) Visible light, ultraviolet rays, X-rays and gamma rays also

160. The number of neutrons present in $_{19}K^{39}$ is :
a) 39 b) 19 c) 20 d) None of these

161. Deflection back of a few particles on hitting thin foil of gold shows that
a) Nucleus is heavy
b) Nucleus is small
c) Both (a) and (b)
d) Electrons create hinderance in the movement of α- particles.

162. An atom has 2 electrons in K-shell, 8 electrons in L-shell and 6 electrons in M-shell. The number of s-electrons present in the element is:
a) 10 b) 7 c) 6 d) 4

163. Which orbital is represented by Ψ 4, 2, 0 ?
a) $4d$ b) $3d$ c) $4p$ d) $4s$

164. The electronic configuration of a dipositive ion M^{2+} is 2, 8, 14 and its mass number is 56. The number of neutrons present is
a) 32 b) 42 c) 30 d) 34

165. The angular momentum of an electron in 2 p-orbital is :
a) $\frac{h}{2\pi}$ b) $\frac{h}{\sqrt{2\pi}}$ c) $\frac{2h}{\pi}$ d) None of these

166. Which set has the same number of s-electrons?
a) C, Cu^{2+}, Zn b) $Cu^{2+}, Fe^{2+}, Ni^{2+}$ c) S^{2-}, Ni^{2+}, Zn d) None of these

167. The electronic configuration of P in H_3PO_4 is
a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$ b) $1s^2, 2s^2, 2p^6, 3s^2$
c) $1s^2, 2s^2, 2p^6$ d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$

168. The Bohr's orbit radius for the hydrogen atom $(n = 1)$ is approximately 0.53Å. The radius for the first excited state $(n = 2)$ orbit is
a) 0.27 Å b) 1.27 Å c) 2.12 Å d) 3.12 Å

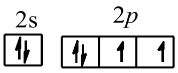
169. The threshold frequency of a metal is $4 \times 10^{14} s^{-1}$. The minimum energy of photon to cause photoelectric effect is:
a) 3.06×10^{-12} J b) 1.4×10^{-18} J c) 3.4×10^{-19} J d) 2.64×10^{-19} J

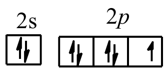
170. Which wavelength falls in a X-rays region?
a) 10,000 Å b) 1000 Å c) 1Å d) 10^{-2}Å

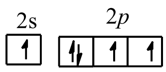
171. Choose the incorrect statement
a) Every object emits radiation whose predominant frequency depends on its temperature
b) The quantum energy of a wave is proportional to its frequency
c) Photons are quanta of light
d) The value of Planck's constant is energy dependent

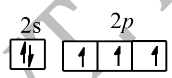
172. What is the energy (in eV) require to excite the electron from $n = 1$ to $n = 2$ state in hydrogen atom? (n=principle quantum number)
a) 13.6 b) 3.4 c) 17.0 d) 10.2

173. Of the following transitions in hydrogen atom, the one which gives an absorption line of lowest frequency is :
a) $n = 1$ to $n = 2$ b) $n = 3$ to $n = 8$ c) $n = 2$ to $n = 1$ d) $n = 8$ to $n = 3$

174. Which is not in accordance to aufbau principle?
a) 

b) 

c) 

d) 

175. Which of the following has more number of unpaired electron?
a) Zn^{+} b) Fe^{2+} c) Ni^{2+} d) Cu^{+}

176. The scientist who proposed the atomic model based on the quantization of energy for the first time is
a) Max Planck b) Niels Bohr c) De-Broglie d) Heisenberg

177. The energy per mole of photon of electromagnetic radiation of wavelength 4000 Å is:
a) 3.0×10^{-12}erg b) 4.0×10^{-12}erg c) 5.0×10^{-12}erg d) 6.0×10^{-12}erg

178. A particle A moving with a certain velocity has the de-Broglie wavelength of 1 A°. For particle B with mass 25% of A and velocity 75% of A, calculate the de-Broglie wavelength
a) 3 A° b) 5.33 A° c) 6.88 A° d) 0.48 A°

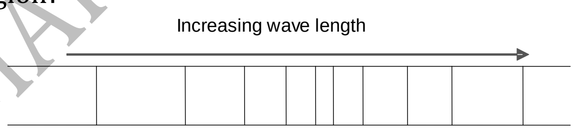
179. The correct designation of an electron with $n = 4, l = 3, m = 2$, and $s = 1/2$ is:
a) $3d$ b) $4f$ c) $5p$ d) $6s$

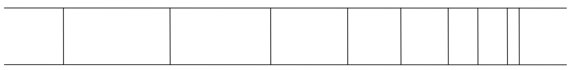
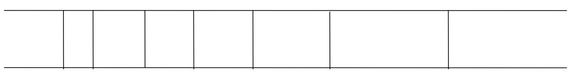
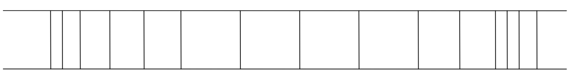
180. The energy of the electron in first Bohr's orbit is -13.6eV. The energy of the electron in its first excited state is
a) -3.4 eV b) -27.8 eV c) -6.8 eV d) -10.2 eV

181. The statement that does not belong to Bohr's model of atom, is
a) Energy of the electrons in the orbit is quantized
b) The electron in the orbit nearest to the nucleus is in lowest energy state
c) Electrons revolve in different orbits around the nucleus
d) The electrons emit energy during revolution due to the presence of Coulombic forces of attraction

182. The ratio of radius of III and IV Bohr's orbits in hydrogen atom is:
a) 3 : 4 b) 3 : 8 c) 9 : 16 d) 8 : 9

183. In the Schrödinger wave equation, ψ represents:
a) Orbitals b) Wave function c) Amplitude function d) All of these

184. Which diagram best represents the appearance of the line spectrum of atomic hydrogen in the visible region?
a) 

b) 
c) 
d) 

185. If the electron of a hydrogen atom is present in the first orbit, the total energy of the electron is
a) $\frac{-e^2}{r}$ b) $\frac{-e^2}{r^2}$ c) $\frac{-e^2}{2r}$ d) $\frac{-e^2}{2r^2}$

186. What is the charge in coulomb on Fe^{3+} ion?
a) 4.8×10^{-19}C b) 1.6×10^{-19}C c) 3.2×10^{-19}C d) 6.4×10^{-19}C

187. The ground state term symbol for an electronic state is governed by
a) Hund's rule b) Heisenberg's principle

c) Aufbau principle d) Pauli's exclusion principle

188. The number of elliptical orbits, including circular orbits in the M-shell of an atom is:
a) 3 b) 4 c) 2 d) 1

189. Wave mechanical model of the atom depends upon:
a) de Broglie concept of dual nature of electron
b) Heisenberg′s uncertainty principle
c) Schrödinger wave equation
d) All of the above

190. The velocity of a photon is:
a) Independent of its wavelength
b) Depends on its wavelength
c) Depends on its source
d) Equal to square of its amplitude

191. The frequency of radiation emitted when the electron falls from n=4 to n=1 in a hydrogen atom will be (Given, ionisation energy of
103 H=2.18×10^{-18} J atom^{-1} and $h = 6.625 \times 10^{-34}$ Js)
a) $1.54 \times 10^{15} s^{-1}$ b) $1.03 \times 10^{15} s^{-1}$ c) $3.08 \times 10^{15} s^{-1}$ d) $2.00 \times 10^{15} s^{-1}$

192. A node is a surface on which the probability of finding an electron is:
a) Zero b) > 1 c) > 10 d) > 90

193. In photoelectric effect, the photo-current:
a) Increases with increase of frequency of incident photon
b) Decreases with increase of frequency of incident photon
c) Does not depend on the frequency of photon but depends only on the intensity of incident light
d) Depends both on intensity and frequency of the incident photon

194. Possible number of orientations of a subshell is:
a) l b) n c) $2l + 1$ d) n^2

195. The orientation of an atomic orbital is governed by:
a) Magnetic quantum number
b) Principal quantum number
c) Azimuthal quantum number
d) Spin quantum number

196. The ratio of the radius of the orbit for the electron orbiting the hydrogen nucleus to that of an electron orbiting a deuterium nucleus is:
a) 1 : 1 b) 1 : 2 c) 2 : 1 d) 1 : 3

197. Which of the following sets of quantum numbers is correct for an electron in $4f$-orbital?
a) $n = 3, l = 2, m = -2, s = +\frac{1}{2}$
b) $n = 4, l = 4, m = -4, s = -\frac{1}{2}$
c) $n = 4, l = 3, m = +1, s = +\frac{1}{2}$
d) $n = 4, l = 3, m = +4, s = +\frac{1}{2}$

198. The electronic energy levels of the hydrogen atom in the Bohr′s theory are called:
a) Orbitals b) Orbits c) Rydberg levels d) Ground states

199. A photoelectric cell is a device, which :
a) Converts light into electricity
b) Converts electricity into light
c) Stores lights
d) Stores electricity

200. An f-shell containing 6 unpaired electrons can exchange

a) 6 electrons b) 9 electrons c) 12 electrons d) 15 electrons

201. Mg^{2+} is isoelectrionic with

a) Cu^{2+} b) Zn^{2+} c) Na^{+} d) Ca^{2+}

202. The first orbital of H is represented by :

$\psi = \frac{1}{\sqrt{\pi}}\left(\frac{1}{a_0}\right)^{3/2} e^{-r/a_0}$, where a_0 is Bohr's radius. The probability of finding the electron at a distance r, from the nucleus in the region dV is:

a) $\psi^2 dr$ b) $\int \psi^2 4\pi r^2 dv$ c) $\psi^2 4\pi r^2 dr$ d) $\int \psi dv$

203. The correct statement about proton is

a) It is a nucleus of deuterium b) It is an ionized hydrogen atom

c) It is an ionized hydrogen molecules d) It is an α- particle

204. The energy ΔE corresponding to intense yellow line of sodium of λ, 589 nm is:

a) 2.10 eV b) 43.37 eV c) 47.12 eV d) 2.11 kcal

205. One electron volt is:

a) 1.6×10^{-19} erg b) 1.6×10^{-12}erg c) 1.6×10^{-8} erg d) 1.6×10^{8} erg

206. The quantum number that is in no way related to other quantum number is:

a) l b) s c) n d) m

207. The de-Broglie wavelength relates to applied voltage ror α-particles as

a) $\lambda = \frac{12.3\text{A}^\circ}{\sqrt{V}}$ b) $\lambda = \frac{0.286}{\sqrt{V}}\text{A}^\circ$ c) $\lambda = \frac{0.101}{\sqrt{V}}\text{A}^\circ$ d) $\lambda = \frac{0.856}{\sqrt{V}}\text{A}^\circ$

208. Calculate the wavelength (in nanometer) associated with a proton moving at $1.0 \times 10^{3}\text{ms}^{-1}$ (Mass of proton $= 1.67 \times 10^{-27}$kg and $h = 6.63 \times 10^{-34}$ Js)

a) 0.032 nm b) 0.40 nm c) 2.5 nm d) 14.0 nm

209. The number of waves in an orbit are

a) n^2 b) n c) $n - 1$ d) $n - 2$

210. Which of the following electron transition in hydrogen atom will require largest amount of energy?

a) From $n = 1$ to $n = 2$ b) From $n = 2$ to $n = 3$

c) From $n = \infty$ to $n = 1$ d) From $n = 3$ to $n = 5$

211. The principal quantum number n can have integral values ranging from:

a) 0 to 10 b) 1 to ∞ c) 1 to $(n = l)$ d) 1 to 50

212. Electrons will first enter into the set of quantum numbers $n = 5, l = 0$ or $n = 3, l = 2$

a) $n = 5, l = 0$ b) Both possible c) $n = 3, l = 2$ d) Data insufficient

213. The relationship between the energy E_1 of the radiation with a wavelength 8000Å and the energy E_2 of the radiation with a wavelength 16000Å is

a) $E_1 = 6E_2$ b) $E_1 = 2E_2$ c) $E_1 = 4E_2$ d) $E_1 = 1/2E_2$

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

a) $3, 2, 1, \frac{1}{2}$ b) $3, 1, 1, -\frac{1}{2}$ c) $3, 3, 1, -\frac{1}{2}$ d) $3, 2, -2, \frac{1}{2}$

215. What is the lowest energy of the spectral line emitted by the hydrogen atom in the Lyman series? (h=Planck's constant, c=velocity of light, R=Rydberg's constant).

a) $\frac{5hcR}{36}$ b) $\frac{4hcR}{3}$ c) $\frac{3hcR}{4}$ d) $\frac{7hcR}{144}$

216. Which is not electromagnetic radiation?

a) Infrared rays b) X-rays c) Cathode rays d) γ-rays

217. Which one of the following sets of quantum numbers represents the highest energy level in an atom?

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

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

218. Which consists of particle of matter?

a) Alpha rays b) Beta rays c) Cathode rays d) All of these

219. If λ_1 and λ_2 are the wavelength of characteristic X-rays and gamma rays respectively, then the relation between them is:
a) $\lambda_1 = 1/\lambda_2$ b) $\lambda_1 = \lambda_2$ c) $\lambda_1 > \lambda_2$ d) $\lambda_1 < \lambda_2$

220. Which best describe the emission spectra of atomic hydrogen?
a) A series of only four lines
b) A discrete series of lines of equal intensity and equally spaced with respect to wavelength
c) Several discrete series of lines with both intensity and spacings between lines decreasing as the wave number increase within each series
d) A continuous emission of radiation of all frequencies

221. In the ground state of the H-atom, the electron is :
a) In the second shell
b) In the nucleus
c) Nearest to the nucleus
d) Farthest from the nucleus

222. Atoms consist of electrons, protons and neutrons. If the mass attributed to neutron was halved and that attributed to the electrons was doubled, the atomic mass of ${}_6C^{12}$ would be approximately:
a) Same b) Doubled c) Halved d) Reduced by 25%

223. The number of electrons in a neutral atom of an element is equal to its:
a) Atomic weight b) Atomic number c) Equivalent weight d) Electron affinity

224. Which particle contains 2 neutrons and 1 proton?
a) ${}_1H^2$ b) ${}_2He^4$ c) ${}_1T^3$ d) ${}_1D^2$

225. The highest number of unpaired electrons are in
a) Fe b) Fe^{2+}
c) Fe^{3+} d) All have equal number of unpaired electrons

226. Maximum number of electrons in an orbit is given by:
a) n^2 b) $2n^2$ c) $n^2/2$ d) None of these

227. The wave nature of electron is verified by
a) De-Broglie b) Davisson and Germer
c) Rutherford d) All of these

228. Compared to the mass of lightest nuclei, the mass of an electron is only (app.)
a) 1/80 b) 1/800 c) 1/1800 d) 1/2800

229. Which one of the following pair of atoms/atom-ion have identical ground state configuration?
a) Li^+ and He^+ b) Cl^- and Ar c) Na^+ and K^+ d) F^+ and Ne

230. The total number of orbitals in a shell with principal quantum number $'n'$ is:
a) $2n$ b) $2n^2$ c) n^2 d) $n+1$

231. Which of the following statements does not form a part of Bohr's model of hydrogen atom?
a) Energy of the electrons in the orbit is quantised
b) The electron in the orbit nearest the nucleus has the lowest energy
c) Electrons revolve in different orbits around the nucleus
d) The position and velocity of the electrons in the orbit cannot be determined simultaneously

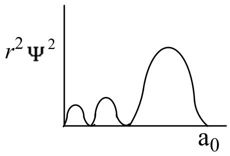
232. Penetration power of proton is:
a) Greater than e b) Less than electron c) Greater than $'n'$ d) None of these

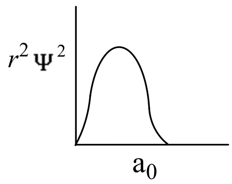
233. Bohr's theory is applicable to
a) He b) Li^{2+} c) He^{2+} d) None of these

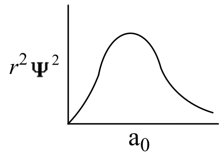
234. Which set of quantum numbers is possible for the last electron of Mg^+ ion?
a) $n = 3, l = 2, m = 0, s = +1/2$
b) $n = 2, l = 3, m = 0, s = +1/2$
c) $n = 1, l = 0, m = 0, s = +1/2$
d) $n = 3, l = 0, m = 0, s = +1/2$

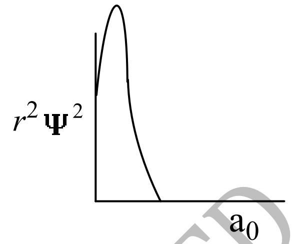
235. The electronic configuration for $_{26}Fe$ is:
a) $[Ar]3d^6, 4s^2$ b) $[Ar]3d^7, 4s^2$ c) $[Ar]3d^5, 4s^2$ d) $[Ar]3d^7, 4s^1$

236. Which of the following radial distribution graphs correspond to $n = 3, l = 2$ for an atom?

a) 

b) 

c) 

d) 

237. In which orbital electron is most tightly bound to the nucleus?
a) $5s$ b) $4p$ c) $4d$ d) $5d$

238. Ca^2 is isoelectronic with
a) Na b) Ar c) Mg^2 d) Kr

239. Threshold wavelength depends upon :
a) Frequency of incident radiation
b) Velocity of electrons
c) Work function
d) None of the above

240. The electrons identified by quantum numbers
I. $n = 4, l = 1$
II. $n = 4, l = 0$
III. $n = 3, l = 2$
IV. $n = 2, l = 1$
Can be placed in order of increasing energy from the lowest to highest as
a) IV<II<III<I b) II<IV<I<III c) I<III<II<IV d) III<I<IV<II

241. The energy of an electron in first Bohr orbit of H-atom is -13.6 eV. The possible energy value of electron in the excited state of Li^{2+} is
a) -122.4 eV b) 30.6 eV c) -30.6 eV d) 13.6 eV

242. When the azimuthal quantum number has the value of 2, the number of orbitals possible are
a) 7 b) 5 c) 3 d) 0

243. Compared to the lightest atom the heaviest atom weighs:
a) 200 times b) 238 times c) 92 times d) 16 times

244. If the following particles travel with equal speed, then for which particle the wavelength will be longest?
a) Proton b) Neutron c) α-particle d) β-particle

245. The orbital cylindrically symmetrical about x-axis is:
a) p_z b) p_y c) p_x d) d_{xz}

246. The orbital with maximum number of possible orientations is:
a) s b) p c) d d) f

247. Einstein's photoelectric equation states that $E_k = hv - W$
Here, E_k refers to
a) Kinetic energy of all ejected electrons
b) Mean kinetic energy of emitted electrons
c) Minimum kinetic energy of emitted electrons
d) Maximum kinetic energy of emitted electrons

248. The orbital closest to the nucleus is:
a) $7s$ b) $3d$ c) $6p$ d) $4s$

249. Isoelectronic pair among the following is
a) Ca and K b) Ar and Ca^{2+} c) K and Ca^{2+} d) Ar and K

250. We can say that the energy of a photon of frequency v is given by $E = hv$, where h is Planck's constant. The momentum of a photon is $p = h/\lambda$, where λ is the wavelength of photon. Then we may conclude that velocity of light I equal to:
a) $(E/p)^{1/2}$ b) E/p c) Ep d) $(E/p)^2$

251. Uncertainty in position of a particle of 25 g in space is 10^{-5}m. Hence, uncertainty in velocity (ms^{-1}) is (Planck's constant $h = 6.6 \times 10^{-34}$Js)
a) 2.1×10^{-28} b) 2.1×10^{-34} c) 0.5×10^{-34} d) 5.0×10^{-24}
252. The mass of a neutron is of the order of:
a) 10^{-23} kg b) 10^{-24} kg c) 10^{-26} kg d) 10^{-27} kg
253. The de Broglie wavelength of a 66 kg man sking down Kufri Hill in Shimla at 1×10^3m sec^{-1} is:
a) 1×10^{-36}m b) 1×10^{-37}m c) 1×10^{-38}m d) 1×10^{-39}m
254. The Z −component of angular momentum of an electron in an atomic orbital is governed by the
a) Magnetic quantum number b) Azimuthal quantum number
c) Spin quantum number d) Principal quantum number
255. An electron with values 4, 2, −2 and +1/2 for the set of four quantum numbers n, l, m_l and s respectively, belongs to
a) $4s$-orbital b) $4p$-orbital c) $4d$-orbital d) $4f$-orbital
256. Consider the following statements :
1.Electron density in xy plane in $3d_{x^2-y^2}$ orbital is zero
2.Electron density in xy plane in $3d_{z^2}$ orbital is zero
3.$2s$ orbital has only one spherical node
4.For $2p_z$ orbital yz is the nodal plane
The correct statements are
a) 2 and 3 b) 1,2,3,4 c) Only 2 d) 1 and 3
257. The maximum probability of finding electron in the d_{xy} orbital is:
a) Along the x-axis
b) Along the y-axis
c) At an angle of 45° from the x-and y-axes
d) At an angle of 90° from the x-and y-axes
258. Two electron in an atm of an element cannot have:
a) The same principle quantum number
b) The same azimuthal quantum number
c) The same magnetic quantum number
d) An identical set of quantum numbers
259. The energy of electromagnetic radiation depends on:
a) Amplitude and wavelength
b) Wavelength
c) Amplitude
d) Temperature of medium through which it passes
260. Correct electronic configuration of Cu^{2+} is:
a) $[Ar]3d^8, 4s^1$ b) $[Ar]3d^{10}, 4s^2 4p^1$ c) $[Ar]3d^{10}, 4s^1$ d) $[Ar]3d^9$
261. The difference between ions and atoms is of:
a) Relative size b) Configuration c) Presence of charge d) All of these
262. Electronic configuration of H^- is:
a) $1s^0$ b) $1s^1$ c) $1s^2$ d) $1s^1, 2s^2$
263. The ground state term symbol for an electronic state is governed by
a) Heisenberg's principle b) Hund's rule
c) Aufbau principle d) Pauli exclusion principle
264. The electronic transitions from n=2 to n=1 will produce shortest wavelength in (where n=principle quantum state)
a) Li^{2+} b) He^+ c) H d) H^+
265. The atomic number of an element is 17. The number of orbitals containing electron pairs in the valency shell is:
a) 8 b) 2 c) 3 d) 6

266. The number of electrons in an atom with atomic number 105 having $(n+l)=8$ are:
a) 30　b) 17　c) 15　d) Unpredictable

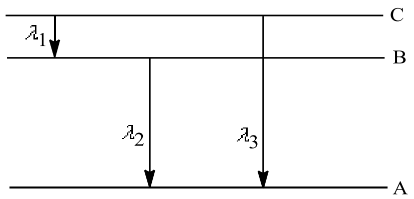
267. Three isotopes of an element have mass numbers, $m, (m+1)$ and $(m+2)$. If the mean mass number is $(m+0.5)$ then which of the following ratios may be accepted for $m, (m+1), (m+2)$ in that order:
a) 1 : 1 : 1　b) 4 : 1 : 1　c) 3 : 2 : 1　d) 2 : 1 : 1

268. According to Bohr's theory the radius of electron in an orbit described by principle quantum number n and atomic number Z is proportional to :
a) Z^2n^2　b) $\frac{Z^2}{n^2}$　c) $\frac{Z^2}{n}$　d) $\frac{n^2}{Z}$

269. The radius of the first Bohr orbit of hydrogen atom is 0.529 Å. The radius of the third orbit of H^+ will be
a) 8.46 Å　b) 0.705 Å　c) 1.59 Å　d) 4.76 Å

270. The de Broglie wavelength associated with a material particle is:
a) Inversely proportional to momentum
b) Inversely proportional to its energy
c) Directly proportional to momentum
d) Directly proportional to its energy

271. Energy levels A, B, C of a certain atom corresponds to increasing values of energy, *i.e.*, $E_A < E_B < E_C$. If λ_1, λ_2 and λ_3 are the wavelengths of radiations corresponding to the transitions C to B, B to A and C to A respectively, which of the following statements is correct?



a) $\lambda_3 = \lambda_1 + \lambda_2$　b) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$　c) $\lambda_1 + \lambda_2 + \lambda_3 = 0$　d) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

272. Naturally occurring elements are mixtures of:
a) Isotone　b) Isobars　c) Isotopes　d) Isomers

273. Krypton ($_{36}Kr$) has the electronic configuration ($_{18}Ar$)$4s^2 3d^{10} 4p^6$, the 37th electron will go into which of the following subshells?
a) $4f$　b) $4d$　c) $3p$　d) $5s$

274. 1 fermi is equal to :
a) 10^{-13} cm　b) 10^{-10} cm　c) 10^{-4} cm　d) 10^{-8} cm

275. When an electron moves from higher orbit to a lower orbit … is produced
a) Absorption spectra　b) Emission spectra　c) α-particle　d) None of these

276. A photon in X region is more energetic than in the visible region X is:
a) Infrared　b) Ultraviolet　c) Microwave　d) Radiowave

277. According to aufbau principle, the correct order of energy of $3d$, $4s$ and $4p$-orbitals is
a) $4p < 3d < 4s$　b) $4s < 4p < 3d$　c) $4s < 3d < 4p$　d) $3d < 4s < 4p$

278. The total number of valency electrons for NH_4^+ is :
a) 9　b) 8　c) 6　d) 11

279. According to Bohr's model of hydrogen atom
a) Total energy of the electron is quantized
b) Angular momentum of electron is quantised
c) Both (a) and (b)
d) None of the above

280. The H-spectrum show
a) Heisenberg's uncertainty principle
b) Diffraction
c) Polarisation
d) Presence of quantised energy level

281. The total number of protons present in all the elements upto 'Zn' in the periodic table is:
a) 300　b) 350　c) 465　d) 450

282. Time period of a wave is 5×10^{-3}s, what is the frequency?
a) $5 \times 10^{-3}s^{-1}$　b) $2 \times 10^2 s^{-1}$　c) $23 \times 10^3 s^{-1}$　d) $5 \times 10^2 s^{-1}$

283. The increasing order (lowest first) of the value of $\frac{e}{m}$ for electron (e), proton (p),neutron (n) and alpha particle (α) will be
a) n, α, p, e b) e, p, n, α c) n, p, e, α d) n, p, α, e
284. Orbitals processing the same energy are called:
a) Hybrid orbitals b) Valency orbitals c) d-orbitals d) Degenerate orbitals
285. Which set has the same number of unpaired electrons in their ground state?
a) N, P, V b) Na, P, Cl c) Na^+, Mg^{2+}, Al d) Cl^-, Fe^{3+}, Cr^{3+}
286. Wavelength of a photon is 2.0×10^{-11}m, $h = 6.6 \times 10^{-34}$ Js. The momentum of photon is:
a) 3.3×10^{-23} kg m s^{-1}
b) 3.3×10^{22} kg m s^{-1}
c) 1.452×10^{-44} kg m s^{-1}
d) 6.89×10^{43} kg m s^{-1}
287. The atomic number of an element is 35 and its mass is 81. The number of electrons in its outermost shell is
a) 3 b) 5 c) 7 d) 9
288. According to Dalton's atomic theory, the smallest particle which is capable of independent existence is:
a) Element b) Atom c) Molecule d) Ion
289. The possibility of finding an electron in an orbital was conceived by:
a) Rutherford b) Bohr c) Heisenberg d) Schrödinger
290. Which statement is/are correct?
a) Volume of proton is approximately $(4/3\,\pi\, r^3) = 1.5 \times 10^{-38}$ cm^3
b) The radius electron is 42.8×10^{-13}cm
c) The density of nucleus is 10^{14}g/cm^3
d) All of the above
291. X-rays cannot penetrate through a sheet of:
a) Wood b) Paper c) Aluminium d) Lead
292. How many electrons can fit into the orbitals that comprise the 3rd quantum shell?
a) 2 b) 8 c) 18 d) 32
293. The total values of magnetic quantum number of an electron when the value of $n = 2$ is:
a) 9 b) 6 c) 4 d) 2
294. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, n=4 to n=2 of He^+ spectrum?
a) $n = 4$ to $n = 3$ b) $n = 3$ to $n = 2$ c) $n = 4$ to $n = 2$ d) $n = 2$ to $n = 1$
295. According to $(n + l)$ rule after completing $'np'$ level the electron enters to:
a) $(n-1)d$ b) $(n+1)s$ c) nd d) $(n+1)p$
296. If the series limit of wavelength of the Lyman series for the hydrogen atom is 912 Å, then the series limit of wavelength for the Balmer series of the hydrogen atom is:
a) 912 Å b) 912 × 2 Å c) 912 × 4 Å d) 912/2 Å
297. The best metal to be used for photoemission is:
a) Potassium b) Sodium c) Cesium d) Lithium
298. The correct Schrödinger's wave equation of an electron with E as total energy and V as potential energy is:
a) $\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi^2}{mh^2}(E-V)\Psi = 0$
b) $\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi m}{h^2}(E-V)\Psi = 0$
c) $\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi^2 m}{h^2}(E-V)\Psi = 0$
d) $\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi m^2}{h}(E-V)\Psi = 0$
299. Electronic configuration of tritium is :

a) $1s^1$ b) $1s^2, 2s^2$ c) $1s^1, 2s^1$ d) None of these

300. The ratio of e/m, *i.e.*, specific charge for a cathode ray:
    a) Has the smallest value when the discharge tube is filled with H_2
    b) Is constant
    c) Varies with the atomic number of gas in the discharge tube
    d) Varies with the atomic number of an element forming the cathode
301. The energy of a photon is 3×10^{-12}ergs. What is its wavelength in nm? ($h = 6.62 \times 10^{-27}$ergs, $c = 3 \times 10^{10}$cm/s)
    a) 662 b) 1324 c) 66.2 d) 6.62
302. In a multi-electron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic and electric fields?
    (A) $n = 1, l = 0, m = 0$
    (B) $n = 2, l = 0, m = 0$
    (C) $n = 2, l = 1, m = 1$
    (D) $n = 3, l = 2, m = 1$
    (E) $n = 3, l = 2, m = 0$
    a) (D) and (E)
    b) (C) and (D)
    c) (B) and (C)
    d) (A) and (B)
303. Zeeman effect refers to the
    a) Splitting up of the lines in an emission spectrum in the presence of an external electrostatic field
    b) Random scattering of light by colloidal particles
    c) Splitting up of the lines in an emission spectrum in a magnetic field
    d) Emission of electrons from metals when light falls upon them
304. Bohr's radius of 2nd orbit of Be^{3+} is equal to that of
    a) 4th orbit of hydrogen b) 2nd orbit of He^+
    c) 3rd orbit of Li^{2+} d) First orbit of hydrogen
305. The velocity of an electron must possess to acquire a momentum equal to the photon of wavelength 5200 Å, will be
    a) 1398 ms^{-1} b) 1298 ms^{-1} c) 1400 ms^{-1} d) 1300 ms^{-1}
306. In potassium the order of energy level for 19th electron is:
    a) $3s > 3d$ b) $4s < 3d$ c) $4s > 4p$ d) $4s = 3d$
307. $[Ar]3d^{10}, 4s^1$ electronic configuration belongs to
    a) Ti b) Tl c) Cu d) V
308. The charge on an electron is 4.8×10^{-10}esu. What is the value of charge in Li^+ ion?
    a) 4.8×10^{-10}esu b) 9.6×10^{-10}esu c) 1.44×10^{-9}esu d) 2.4×10^{-10}esu
309. What is the ration of mass of an electron to the mass of a proton?
    a) 1:2 b) 1:1 c) 1:1837 d) 1:3
310. As the number of orbit increase from the nucleus, the difference between the adjacent energy levels:
    a) Increases b) Remains constant c) Decreases d) None of these
311. The potential energy of an electron present in the ground state of Li^{2+} ion is
    a) $+\frac{3e^2}{4\pi\varepsilon_0 r}$ b) $-\frac{3e}{4\pi\varepsilon_0 r}$ c) $-\frac{3e^2}{4\pi\varepsilon_0 r}$ d) $-\frac{3e^2}{4\pi\varepsilon_0 r^2}$
312. The orbital angular momentum of a p-electron is given as:
    a) $\frac{h}{\sqrt{2}\pi}$ b) $\sqrt{3}\frac{h}{2\pi}$ c) $\sqrt{\frac{3}{2}\frac{h}{\pi}}$ d) $\sqrt{6} \cdot \frac{h}{2\pi}$
313. Transition from $n = 2,3,4,5 \ldots$ to $n = 1$ is called
    a) Lyman series b) Paschen series c) Balmer series d) Bracket series

314. If the total energy of an electron in a hydrogen like atom in an excited state is -3.4 eV, then the de Broglie wavelength of the electron is:

a) 6.6×10^{-10} b) 3×10^{-10} c) 5×10^{-9} d) 9.3×10^{-12}

315. Which d-orbital does not have four lobes?

a) $d_{x^2-y^2}$ b) d_{xy} c) d_{z^2} d) d_{xz}

316. The nucleus of an atom contains

a) Proton and electron b) Neutron and electron
c) Proton and neutron d) Proton, neutron and electron

317. Total number of electrons present in acetylene molecule is:

a) 14 b) 26 c) 18 d) 16

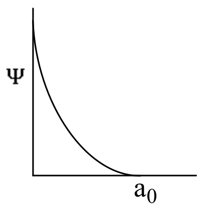
318. An ion which has 18 electrons in the outermost shell is:

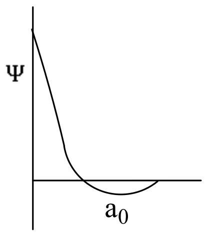
a) Cu^+ b) Th^{4+} c) Cs^+ d) K^+

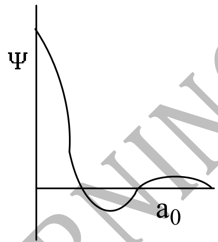
319. The maximum number of electrons in a p-orbital with $n = 6$ and $m = 0$ can be:

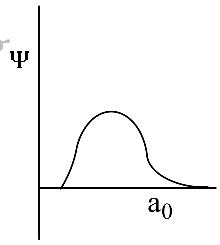
a) 2 b) 6 c) 10 d) 14

320. The graph representing node is

a) 

b) 

c) 

d) 

321. Energy of photon of visible light is

a) 1 eV b) 1 MeV c) 1 eV d) 1 keV

322. Which of the following statements is incorrect?

a) Extra stability of half filled and completely filled orbitals among s and p block elements is reflected in trends of IE across a period
b) Extra stability of half-filled and completely filled orbitals among s and p block elements is reflected in EA trends across a period
c) Aufbau principle is incorrect for cases where energy difference between ns and $(n-1)d$ sub-shell us larger
d) Extra stability to half filled sub-shell is due to higher exchange energies

323. The photoelectric effect occurs only when the incident light has more frequency than a certain minimum:

a) Frequency b) Wavelength c) Speed d) Charge

324. If the energy difference between the ground state of an atom and its excited state is 4.4×10^{-4}J, the wavelength of photon required to produce the transition

a) 2.26×10^{-12}m b) 1.13×10^{-12}m c) 4.52×10^{-16}m d) 4.52×10^{-12}m

325. For which of the following, the radius will be same as for hydrogen atom having $n = 1$?

a) $He^+, n = 2$ b) $Li^{2+}, n = 2$ c) $Be^{3+}, n = 2$ d) $Li^{2+}, n = 3$

326. The volume of a proton is approximately;

a) $1.5 \times 10^{-30}cm^3$ b) $1.5 \times 10^{-38}cm^3$ c) $1.5 \times 10^{-34}cm^3$ d) None of these

327. Normally, the time taken in the transition is :

a) Zero b) 1 sec c) 10^{-5}sec d) 10^{-8}sec

328. When the value of azimuthal quantum number is 3, magnetic quantum number can have values:

a) $+1, -1$ b) $+3, +2, +1, 0, -1, -2, -$ c) $+2, +1, 0, -1, -2$ d) $+1, 0, -1$

329. Positive rays or canal rays are:

a) Electromagnetic waves
b) A steam of positively charged gaseous ions
c) A steam of electrons
d) Neutrons

330. X-rays do not show the phenomenon of :

a) Diffraction
b) Polarisation
c) Deflection by electric field
d) Interference

331. For an electron, if the uncertainty in velocity is Δv, the uncertainty in its position (Δx) is given by:
a) $\frac{h}{2}\pi m\Delta v$ b) $\frac{2\pi}{hm\Delta v}$ c) $\frac{h}{4\pi m\Delta v}$ d) $\frac{2\pi m}{h\Delta v}$

332. If the shortest wavelength of H-atom in Lyman series is x, the longest wavelength in Balmer series of He^+ is
a) $\frac{36x}{5}$ b) $\frac{5x}{9}$ c) $\frac{x}{4}$ d) $\frac{9x}{5}$

333. Rydberg is :
a) Also called Rydberg constant and is a universal constant
b) Unit of wavelength and one Rydberg equal to $1.097 \times 10^{-7}m^{-1}$
c) Unit of wave number and one Rydberg equal to $1.097 \times 10^{7}m^{-1}$
d) Unit of energy and one Rydberg equal to 13.6 eV

334. Which is not deflected by magnetic field:
a) Neutron b) Positron c) Proton d) Electron

335. The quantum numbers $+\frac{1}{2}$ and $-\frac{1}{2}$ for an electron represent
a) Rotation of electron in clockwise and anticlockwise direction respectively
b) Rotation of electron in anticlockwise and clockwise direction respectively
c) Magnetic moment of electron pointing up and down respectively
d) Two quantum mechanical spin states which have no classical analogue

336. Increase in the frequency of the incident radiations increases the:
a) Rate of emission of photo-electrons
b) Work function
c) Kinetic energy of photo-electrons
d) Threshold frequency

337. What is the frequency of photon whose momentum is 1.1×10^{-23}kg ms^{-2}?
a) 5×10^{16}Hz b) 5×10^{17}Hz c) 0.5×10^{18}Hz d) 5×10^{18}Hz

338. A quanta will have more energy, if :
a) The wavelength is larger
b) The frequency is higher
c) The amplitude is higher
d) The velocity is lower

339. I_2 molecule dissociates into atoms after absorbing light of 4500 A°. If one quantum of energy is absorbed by each molecule, the KE of iodine atoms will be
(BE of I_2 = 240 kJ/mol)
a) 240×10^{-19} J b) 0.216×10^{-19} J c) 2.16×10^{-19} J d) 2.40×10^{-19} J

340. The rest mass of a photon of wavelength λ is:
a) Zero b) hc/λ c) $h/c\lambda$ d) h/λ

341. An atom emits energy equal to 4×10^{-12}erg. To which part of electromagnetic spectrum it belongs?
a) UV region b) Visible region c) IR region d) Microwave region

342. The valence shell electronic configuration of Cr^{2+} ion is
a) $4s^0 3d^4$ b) $4s^2 3d^2$ c) $4s^2 3d^0$ d) $3p^6 4s^2$

343. The total number of electrons present in all the 's' orbitals, all the 'p' orbitals and all the 'd' orbitals of cesium ion are respectively
a) 8, 26, 10 b) 10, 24, 20 c) 8, 22, 24 d) 12, 20, 22

344. In the above question, the velocity acquired by the electron will be;
a) $\sqrt{V/m}$ b) $\sqrt{(eV/m)}$ c) $\sqrt{(2eV/m)}$ d) None of these

345. The ionization energy of the ground state hydrogen atom is 2.18×10^{-18} J. The energy of an electron in its second orbit would be
a) -2.67×10^{-18} J b) -5.45×10^{-19} J c) -3.58×10^{-18} J d) -4.68×10^{-19} J
346. The velocity of electron in first orbit of H-atoms as compared to the velocity of light is
a) $\frac{1}{10}$th b) $\frac{1}{100}$th c) $\frac{1}{1000}$th d) Same
347. A gas absorbs photon of 355 nm and emits at two wavelengths. If one of the emission is at 680 nm, the other is at
a) 1035 nm b) 325 nm c) 743 nm d) 518 bm
348. Bohr's model violates the rules of classical physics because it assumes that:
a) All electrons have same charge
b) The nucleus have same charge
c) Electrons can revolve around the nucleus
d) A charged particle can accelerate without emitting radiant energy
349. The stability of ferric ion is due to
a) Half filled f-orbitals b) Half filled d-orbitals
c) Completely filled f-orbitals d) Completely filled d-orbitals
350. The electron possesses wave properties was shown experimentally by:
a) Bohr b) de Broglie c) Davission and germer d) Schrödinger
351. The nature of canal rays depends on:
a) Nature of electrode
b) Nature of discharging tube
c) Nature of residual gas
d) All of the above
352. Total number of valency electrons in phosphonium ion PH_4^+ is:
a) 16 b) 32 c) 8 d) 18
353. Neutron possesses:
a) Positive charge b) No net charge
c) Negative charge d) All are correct
354. Cathode-ray tube is used in:
a) Compound microscope
b) A radio receiver
c) A television set
d) A van de Graff generator
355. Non-directional orbital is
a) $4p$ b) $4d$ c) $4f$ d) $3s$
356. How many unpaired electrons are present in Ni^{2+} cation? (At. No. = 28)
a) 0 b) 2 c) 4 d) 6
357. The maximum sum of the number of neutrons and proton is an isotope of hydrogen is :
a) 6 b) 5 c) 4 d) 3
358. The magnitude of the spin angular momentum of an electron is given by
a) $S = \sqrt{s(s+1)}\frac{h}{2\pi}$ b) $S = s\frac{h}{2\pi}$ c) $S = \frac{3}{2} \times \frac{h}{2\pi}$ d) None of these
359. A $3d$-electron having $s = +1/2$ can have a magnetic quantum no:
a) +2 b) +3 c) −3 d) +4
360. The emission spectrum of hydrogen is found to satisfy the expression for the energy change, ΔE (in joules), such that $\Delta E = 2.18 \times 10^{-18}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$ J, where, $n_1 = 1,2,3, \ldots$ and $n_2 = 2,3,4, \ldots$ The spectral lines correspond to Paschen series are
a) $n_1 = 1$ and $n_2 = 2,3,4$ b) $n_1 = 1$ and $n_2 = 3,4,5$
c) $n_1 = 3$ and $n_2 = 4,5,6$ d) $n_1 = 2$ and $n_2 = 3,4,5$

361. The maximum number of $3d$-electrons having spin quantum number $s = +1/2$ are:
a) 10 b) 14 c) 5 d) None of these

362. The ratio of nucleons in O^{16} and O^{18} is:
a) 8/9 b) 4/5 c) 9/8 d) 1

363. A particle moving with a velocity 10^6 m/s will have de-Broglie wavelength nearly [Given, $m = 6.62 \times 10^{-27}$kg, $h = 6.62 \times 10^{-34}$J − s]
a) 10^{-9}m b) 10^{-13}m c) 10^{-19}m d) 1 Å

364. Which is not permissible subshell?
a) $2d$ b) $4f$ c) $6p$ d) $3s$

365. In Bohr's series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inner-orbit jumps of the electron for Bohr orbit in an atom of hydrogen?
a) 3→2 b) 5→2 c) 4→1 d) 2→5

366. If the electron in the hydrogen atom is excited to $n = 5$, the number of different frequencies of radiations which may be emitted is:
a) 4 b) 5 c) 8 d) 10

367. The uncertainty principle and the concept of wave nature of matter was proposed by … and … respectively
a) Heisenberg, de Broglie
b) de Brogli, Heisenberg
c) Heisenberg, Planck
d) Planck, Heisenberg

368. Quantum theory was postulated by:
a) Rutherford b) Maxwell c) Max Planck d) Becquerel

369. If the nitrogen atom had electronic configuration $1s^7$, it would have energy lower than that of the normal ground state configuration $1s^2 2s^2 2p^3$, because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed because is violates :
a) Heisenberg's uncertainty principle
b) Hund's rule
c) Pauli′s exclusion principle
d) Bohr′s postulate of stationary orbits

370. The number of p-electrons in bromine atom is
a) 12 b) 15 c) 7 d) 17

371. Potassium ion is isoelectronic with the atom of:
a) Ar b) He c) Fe d) Mg

372. An electron that has quantum number $n = 3$ and $m = 2$:
a) Must have spin value +1/2
b) Must have $l = 1$
c) Must have $l = 0$,1 or 2
d) Must have $l = 2$

373. Cr has electronic configuration as
a) $3s^2 3p^6 3d^4 4s^1$ b) $3s^2 3p^6 3d^5 4s^1$ c) $3s^2 3p^6 3d^6$ d) None of these

374. The number of vacant orbitals of element with atomic number 14 is:
a) 2 b) 4 c) 8 d) 6

375. Energy of H-atom in the ground state is -13.6 eV, hence energy in the second excited state is
a) −6.8 eV b) −3.4 eV c) −1.51eV d) −4.53 eV

376. As electron moves away from the nucleus, its KE:
a) Decreases b) Increases c) Remains constant d) None of these

377. A hydrogen atom in its ground state absorbs a photon. The maximum energy of such a photon is:
a) 1.5 eV b) 3.4 eV c) 10.2 eV d) 13.6 eV

378. Wave nature of electrons was demonstrated by
a) Schrodinger b) De-Broglie c) Davisson and Garmer d) Heisenberg

379. The principal quantum number of H-atom orbital, if the electron energy is -3.4 eV, will be

a) 1 b) 2 c) 3 d) Zero

380. No two electrons can have the same values of …. quantum numbers.

a) One b) Two c) Three d) Four

381. If $n = 3, l = 0$ and $m = 0$, then atomic number is

a) 12 or 13 b) 13 or 14 c) 10 or 11 d) 11 or 12

382. The threshold wavelength for photoelectric effect on sodium is 5000 Å. Its work function is:

a) 4×10^{-19} J b) 1 J c) 2×10^{-19} J d) 3×10^{-10} J

383. The first atom with incomplete d-shell is:

a) Sc b) Cu c) Fe d) Zn

384. The wave number of the spectral line in the emission spectrum of hydrogen will be equal to $\frac{8}{9}$ times the Rydberg's constant if the electron jumps from

a) $n = 3$ to $n = 1$ b) $n = 10$ to $n = 1$ c) $n = 9$ to $n = 1$ d) $n = 2$ to $n = 1$

385. Particle nature of electron was experimentally demonstrated by

a) Max Bon b) J.J. Thomson c) De-Broglie d) Schrondinger

386. The difference in angular momentum associated with the electron in two successive orbits of hydrogen atom is:

a) h/π b) $h/2\pi$ c) $h/2$ d) $(n-1)h/2\pi$

387. The volume of nucleus is about:

a) 10^{-4} times that of an atom

b) 10^{-12} times that of an atom

c) 10^{-6} times that of an atom

d) 10^{-10} times that of an atom

388. The species having more electrons than neutrons is:

a) F b) Na^+ c) O^{2-} d) Mg^{2+}

389. The characteristic not associated with Planck's theory is

a) Radiations are associated with energy

b) The magnitude of energy associated with a quantum is proportional to frequency

c) Radiation energy is neither emitted nor absorbed continuously

d) Radiation energy is neither emitted nor absorbed discontinuously

390. H has two natural isotopes of ${}_1H^1$ and ${}_1H^2$ and O has two isotopes O^{16} and O^{18}. Which of the following mol. wt. of H_2O will not be possible?

a) 19 b) 20 c) 24 d) 22

391. Which ion has the maximum magnetic moment?

a) Mn^{3+} b) Cu^{2+} c) Fe^{3+} d) V^{3+}

392. Photoelectric effect was discovered by :

a) Hallwach b) Lenard c) Einstein d) Hertz

393. The electronic configuration of Cr^{3+} is

a) $[Ar]3d^4 4s^2$ b) $[Ar]3d^3 4s^0$ c) $[Ar]3d^2 4s^1$ d) $[Ar]3d^5 4s^1$

394. When light is directed at the metal surface, the emitted electrons:

a) Are called photons

b) Have random energies

c) Have energies that depend upon intensity of light

d) Have energies that depend upon the frequency of light

395. Increasing order (lowest first) for the values of e/m for electron (e), proton (p), neutron (n) and α-particles is

a) e, p, n, α b) n, α, p, e c) n, p, e, α d) n, p, α, e

396. A photon having a wavelength of 845 Å, causes the ionisation of N atom. What is the ionisation energy of N?

a) 1.4 kJ b) 1.4×10^4 kJ c) 1.4×10^2 kJ d) 1.4×10^3 kJ

397. The minimum real charge on of any particle, which can exist is:
a) 1.6×10^{-19} coulomb b) 1.6×10^{-10} coulomb c) 4.8×10^{-10} coulomb d) Zero
398. Minimum number of photons of light of wavelength 4000 Å, which provide 1 J energy:
a) 2×10^{18} b) 2×10^{9} c) 2×10^{20} d) 2×10^{10}
399. An electron jumps from an outer orbit to an inner orbit with an energy difference of 3.0eV. What will be the wavelength of the line emitted?
a) 3660 Å b) 3620 Å c) 4140 Å d) 4560 Å
400. When a gold sheet is bombarded by a beam of α −particles, only a few of them get deflected, whereas most go straight, undeflected. This is because
a) The force of attraction exerted on α- particle by electrons is insufficient
b) The volume of nucleus is smaller than atom
c) The force of repulsion acting on fast moving α-particle is very small
d) The neutrons have no effect on α-particle
401. Which of the following elements has least number of electrons in its M-shell?
a) K b) Mn c) Ni d) Sc
402. The mass of an electron is m, its charge e and it is accelerated from rest through a potential difference V. The kinetic energy of the electron in joules will be :
a) V b) eV c) MeV d) None of these
403. In an atom wave mechanics suggests that electrons:
a) Move around the nucleus in circular orbits
b) Move around the nucleus in elliptical orbits
c) Form diffused cloud around the nucleus
d) None of the above
404. Which of the following is non-permissible?
a) $n = 4, l = 3, m = 0$ b) $n = 4, l = 2, m = 1$ c) $n = 4, l = 4, m = 1$ d) $n = 4, l = 0, m = 0$
405. Which electronic configuration does not follow the Pauli's exclusion principle?
a) $1s^2, 2s^2 2p^4$ b) $1s^2, 2s^2 2p^4, 3s^2$ c) $1s^2, 2p^4$ d) $1s^2, 2s^2 2p^6, 3s^3$
406. Given that in the H-atom the transition energy for $n = 1$ to $n = 2$, 10.2eV, the energy for the same transition in Be^{3+} is:
a) 20.4 eV b) 30.6 eV c) 163.2 eV d) 40.8 eV
407. How many electrons can be accommodated in a subshell for which $n = 3, l = 1$?
a) 8 b) 6 c) 18 d) 32
408. Which of the following is correctly matched?
a) Momentum of H atom when electrons return from $n = 2$ to $n = 1$: $\frac{3Rh}{4}$
b) Momentum of photon : Independent of wavelength of light
c) e/m ratio of anode rays : Independent of gas in the discharge tube
d) Radius of nucleus : $(\text{Mass no.})^{1/2}$
409. One require energy E_n to remove nucleon and an energy E_e to remove an electron from the orbit of an atom, then:
a) $E_n = E_e$ b) $E_n < E_e$ c) $E_n > E_e$ d) $E_n \geq E_e$
410. Light, a well known form of energy, is treated as a form of matter, by saying that it consist of :
a) Photons or bundles of energy
b) Electrons or a wave like matter
c) Neutrons, since electrically neutral
d) None of the above
411. Number of orbits and orbitals having electrons in $_{14}Si$ are respectively :
a) 3, 6 b) 6, 3 c) 7, 3 d) 3, 8
412. In a hydrogen atom, if energy of an electron in ground state is −13.6 eV, then that in the 2nd excited state is:
a) −1.51 eV b) −3.4 eV c) −6.0 eV d) −13.6 eV

413. The number of electrons with the azimuthal quantum number $l = 1$ and 2 for $_{24}Cr$ in ground state are:
a) 16 and 5 b) 12 and 5 c) 16 and 4 d) 12 and 4

414. The number of valence electrons in completely excited sulphur atom is:
a) Zero b) 4 c) 6 d) 2

415. An improbable configuration is:
a) $[Ar]3d^4, 4s^2$ b) $[Ar]3d^5, 4s^1$ c) $[Ar]3d^6, 4s^2$ d) $[Ar]3d^{10}, 4s^1$

416. The wave number of radiation of wavelength 500 nm is:
a) $5 \times 10^{-7} m^{-1}$ b) $2 \times 10^{-7} m^{-1}$ c) $2 \times 10^6 m^{-1}$ d) $500 \times 10^{-9} m^{-1}$

417. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths *i.e.* λ_1 and λ_2 will be:
a) $\lambda_1 = \frac{1}{2}\lambda_2$ b) $\lambda_1 = \lambda_2$ c) $\lambda_1 = 2\lambda_2$ d) $\lambda_1 = 4\lambda_2$

418. The nitrogen atom has 7 electrons, the nitride ion (N^{3-}) will have
a) 7 protons and 10 electrons
b) 4 protons and 7 electrons
c) 4 protons and 10 electrons
d) 10 protons and 7 electrons

419. Which among the following is correct for $_5B$ in normal state?

1s 2p

a) [↑↓] [ ][↑][ ]
: Against Hund's rule

b) [↑] [↑][↑][ ]
: Against Aufbau principle as well as Hund's rule

c) [↑↑] [↑][ ][ ]
: Violation of Pauli's exclusion principle and not Hund's rule

d) [↑↓] [↑][ ][ ]
:Against Aufbau principle

420. Cathode rays are produced when the pressure in the discharge tube is of the order of :
a) 76 cm of Hg
b) 10^{-6} cm of Hg
c) 1 cm of Hg
d) 10^{-2} to 10^{-3} mm of Hg

421. The energy ration of a photon of wavelength 3000 Å and 6000Å is
a) 1:1 b) 2:1 c) 1:2 d) 1:4

422. The study of photoelectric effect is useful in understanding :
a) Conservation of energy
b) Quantization of charge
c) Conservation of charge
d) Conservation of kinetic energy

423. What is the correct orbital designation for the electron with the quantum numbers, $n = 4, l = 3, m = -2, s = 1/2$?
a) $3s$ b) $4f$ c) $5p$ d) $6s$

424. E_1 for He^+ is -54.4 eV. The E_2 for He^+ would be :
a) -6.8eV b) -13.6eV c) -27.2eV d) -108.8eV

425. The total number of fundamental particles in one atom of $^{14}_{6}C$ is:
a) 6 b) 8 c) 14 d) 20

426. In ground state of chromium atom ($Z = 24$) the total number of orbitals populated by one or more electrons is:
a) 15 b) 16 c) 20 d) 14

427. Heisenberg's uncertainty principle has no significance for a moving
a) Proton b) Neutron c) Electron d) Cricket ball

428. Which set is not correct?
a) $3, 1, 0, -1/2$ b) $3, 2, 1, +1/2$ c) $3, 1, 2, -1/2$ d) $3, 2, 0, +1/2$

429. If E_e, E_a and E_p represent the kinetic energies of an electron, alpha particle and a proton respectively, each moving with same de-Broglie wavelength then
a) $E_e = E_\alpha = E_p$ b) $E_e > E_\alpha > E_p$ c) $E_\alpha > E_p > E_e$ d) $E_e > E_p > E_\alpha$

430. Which among the following species have the same number of electrons in its outermost as well as penultimate shell?
a) Mg^{2+} b) O^{2-} c) F^- d) Ca^{2+}

431. Photons of energy 6 eV are incidented on a potassium surface of work function 2.1 eV. What is the stopping potential?
a) -6 V b) -2.1 V c) -3.9 V d) -8.1 V

432. If uncertainty in position and momentum are equal, then uncertainty in velocity is:
a) $\sqrt{\frac{h}{2\pi}}$ b) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ c) $\sqrt{\frac{h}{\pi}}$ d) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$

433. Which one of the following ions is not isoelectronic with O^{2-}?
a) Ti^+ b) Na^+ c) F^- d) N^{3-}

434. How many electrons with $l = 2$ are there in an atom having atomic number 23?
a) 2 b) 3 c) 4 d) 5

435. The statements are valid for :
(i) In filling a group of orbitals of equal energy, it is energetically preferable to assign electrons to empty orbitals rather than pair them into a particular orbital
(ii) When two electrons are placed in two different orbitals, energy is lower if the spins are parallel
a) Aufbau principle
b) Hund's rule
c) Pauli's exclusion principle
d) Uncertainty principle

436. The radius of electron in the first excited state of hydrogen atom is
(Where, a_0 is the Bohr's radius)
a) a_0 b) $4a_0$ c) $2a_0$ d) $8a_0$

437. The momentum of a photon of frequency $5 \times 10^{17} s^{-1}$ is nearly:
a) 1.1×10^{-24} kg m s^{-1}
b) 3.33×10^{-43} kg m s^{-1}
c) 2.27×10^{-40} kg m s^{-1}
d) 2.27×10^{-38} kg m s^{-1}

438. In hydrogen atom, which energy level order is not correct:
a) $1s < 2p$ b) $2p = 2s$ c) $2p > 2s$ d) $2p < 3s$

439. The frequency v of certain line of the Lyman series of the atomic spectrum of hydrogen satisfies the following conditions:
(i) It is the sum of the frequencies of another Lyman line and a Balmer line.
(ii) It is the sum of the frequencies of a certain line, a Lyman line, and a Paschen line.
(iii) It is the sum of the frequencies of a Lyman and a Paschen line but no Bracket line.
To what transition does v correspond?
a) $n_2 = 3$ to $n_1 = 1$ b) $n_2 = 3$ to $n_1 = 2$ c) $n_2 = 2$ to $n_1 = 1$ d) $n_2 = 4$ to $n_1 = 1$

440. An isobar of $_{20}Ca^{40}$ is
a) $_{18}Ar^{40}$ b) $_{20}Ca^{38}$ c) $_{20}Ca^{42}$ d) $_{18}Ar^{38}$

441. If the speed of electron in the Bohr's first orbit of hydrogen atom is x, the speed of the electron in the third Bohr's orbit is:
a) $x/9$ b) $x/3$ c) $3x$ d) $9x$

442. The electronic velocity in the fourth Bohr's orbit of hydrogen is v. The velocity of the electron in the first

orbit would ne:

a) $4v$ b) $16v$ c) $v/4$ d) $v/16$

443. Which type of radiation is not emitted by the electronic structure of atoms?

a) Ultraviolet light b) X-rays c) Visible light d) γ-rays

444. If E_1, E_2 and E_3 represent respectively the kinetic energies of an electron, an alpha particle and a proton each having same de Broglie wavelength then:

a) $E_1 > E_3 > E_2$ b) $E_2 > E_3 > E_1$ c) $E_1 > E_2 > E_3$ d) $E_1 = E_2 = E_3$

445. The frequency of first line of Balmer series in hydrogen atom is v_0. The frequency of corresponding line emitted by singly ionised helium atom is :

a) $2v_0$ b) $4v_0$ c) $v_0/2$ d) $v_0/4$

446. In a set of degenerate orbitals, the electrons distribute themselves to retain like spins as far as possible. This statement belongs to

a) Pauli's exclusion principle b) Aufbau principle

c) Hund's rule of maximum multiplicity d) Slater's rule

447. Electrons occupy the available sub-level which has lower $n + l$ value. This is called:

a) Hund's rule

b) Aufbau principle

c) Heisenberg's uncertainty principle

d) Pauli's principle

448. Choose the correct statement among the following

a) Ψ^2 represents the atomic orbital

b) The number of peaks in radial distribution is $n - l$

c) A node is a point in space around nucleus where the wave function Ψ has zero value

d) All of the above

449. Which possesses an inert gas configuration?

a) Fe^{3+} b) Cl^- c) Mg^+ d) Cr^{3+}

450. Angular momentum of an electron in the n th orbit of hydrogen atom is given by

a) $\frac{nh}{2\pi}$ b) nh c) $\frac{2\pi}{nh}$ d) $\frac{\pi}{2nh}$

451. The discovered of neutron became very late because:

a) Neutrons are present in nucleus

b) Neutrons are fundamental particles

c) Neutrons are chargeless

d) All of the above

452. The frequency of a spectral line for electron transition in an atom is directly proportional to

a) Number of electrons undergoing transition

b) Velocity of electron

c) The difference of energy between energy levels involved in the transition

d) None of the above

453. Photoelectric emission is observed from a surface for frequency v_1 and v_2 of the incident radiation ($v_1 > v_2$). If the maximum kinetic energies of the photoelectrons in the two cases are in the ratio $1 : k$, then the threshold frequency v_0 is given by:

a) $\frac{v_2 - v_1}{k - 1}$ b) $\frac{kv_1 - v_2}{k - 1}$ c) $\frac{kv_2 - v_1}{k - 1}$ d) $\frac{v_2 - v_1}{k}$

454. The number of $2p$-electrons having spin quantum numbers $s = -1/2$ are

a) 6 b) 0 c) 2 d) 3

455. Which statement relating to the spectrum of H atom is false?

a) The lines can be defined by quantum number

b) The lines of longest wavelength in the Balmer series corresponds to the transition between $n = 3$ and $n = 2$ levels

c) The spectral lines are closer together at longer wavelengths

d) A continuum occurs at $n = \infty$

456. The atomic number of the element having maximum number of unpaired $3p$-electrons is:

a) 15 b) 10 c) 12 d) 8

457. The maximum wavelength of light that can excite an electron from first to third orbit of hydrogen atom is:

a) 487 nm b) 170 nm c) 103 nm d) 17 nm

458. The incorrect statement about Bohr's orbit of hydrogen atom is

a) $r = n^2 \frac{h^2}{4\pi^2 m \left(\frac{e^2}{4\pi\varepsilon_0}\right)}$

b) KE of electron = PE of electron

c) $E = -\frac{1}{n^2} \frac{2\pi^2 m \left(\frac{e^2}{4\pi\varepsilon_0}\right)^2}{h^2}$

d) None of the above is incorrect

459. Four different sets of quantum numbers for 4 electrons are given below

$e_1 = 4, 0, 0, -\frac{1}{2} : e_2 = 3, 1, 1, -\frac{1}{2}$

$e_3 = 3, 2, 2, +\frac{1}{2} : e_4 = 3, 0, 0, +\frac{1}{2}$

The order of energy of e_1, e_2, e_3 and e_4 is

a) $e_1 > e_2 > e_3 > e_4$ b) $e_4 > e_3 > e_2 > e_1$ c) $e_3 > e_1 > e_2 > e_4$ d) $e_2 > e_3 > e_4 > e_1$

460. When electrons in N-shell of excited hydrogen atom return to ground state, the number of possible lines spectrum is:

a) 6 b) 4 c) 2 d) 3

461. The electrons occupying the same orbital have always spin:

a) Paired b) Unpaired c) Both (a) and (b) d) None of these

462. The energy of hydrogen atom in its ground state is -13.6 eV. The energy of the level corresponding to the quantum number n=5 is

a) -5.4 eV b) -0.54 eV c) -2.72 eV d) -0.85 eV

463. According to Bohr's theory, the angular momentum for an electron of 5th orbit is:

a) $\frac{2.5h}{\pi}$ b) $\frac{5h}{\pi}$ c) $\frac{25h}{\pi}$ d) $\frac{6h}{2\pi}$

464. In which of the orbit of He^+, the angular momentum of the electron in $h/2\pi$?

a) First orbit b) Second orbit c) Third orbit d) Fourth orbit

465. Correct set of four quantum numbers for valence electron of rubidium ($Z = 37$) is

a) $5,0,0, +\frac{1}{2}$ b) $5,1,0, +\frac{1}{2}$ c) $5,1,1, +\frac{1}{2}$ d) $6,0,0, +\frac{1}{2}$

466. Electron density in the YZ plane of $3d_{x^2-y^2}$ orbital is

a) Zero b) 0.50 c) 0.75 d) 0.90

467. The total number of orbitals possible for principle quantum number n is

a) n b) n^2 c) $2n$ d) $2n^2$

468. Which does not characterise X-rays?

a) The radiation can ionise gas

b) It causes Zns to fluorescence

c) Deflected by electric and magnetic fields

d) Have wavelength shorter than ultraviolet rays

469. The velocity of an electron placed in 3rd orbit of H atom, will be

a) 2.79×10^7 cm/s b) 9.27×10^{27} cm/s c) 7.29×10^7 cm/s d) 92.7×10^7 cm/s

470. The electronic configuration of an atom is $1s^2, 2s^2 2p^3$. The number of unpaired electrons in this atom is:

a) 1 b) Zero c) 3 d) 5

471. The orbital angular momentum of an electron in $2s$ orbital is

a) $+\frac{1}{2} \cdot \frac{h}{2\pi}$ b) Zero c) $\frac{h}{2\pi}$ d) $\sqrt{2}\frac{h}{2\pi}$

472. In the atomic spectrum of hydrogen the series of lines observed in the visible region is:

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

473. According to Bohr's model of hydrogen atom :
a) The linear velocity of the electron is quantised
b) The angular velocity of the electron is quantised
c) The linear momentum of the electron is quantised
d) The angular momentum of the electron is quantised

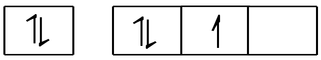
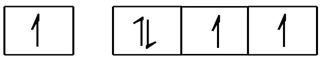
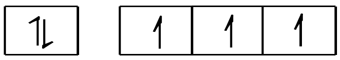
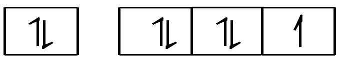
474. Which transition of electron in the hydrogen atom emits maximum energy?
a) $2 \rightarrow 1$ b) $1 \rightarrow 4$ c) $4 \rightarrow 3$ d) $3 \rightarrow 2$

475. The quantum number that does not describe the distance and the angular disposition of the electron:
a) n b) l c) m d) s

476. Li^{2+} and Be^{3+} are:
a) Isotopes b) Isomers c) Isobars d) Isoelectronic

477. In H atom, the electron is de-excited from 5th shell to 1st shell. How many different lines may appear in line spectrum?
a) 4 b) 8 c) 10 d) 12

478. The electronic configuration with maximum exchange energy will be
a) $3d_{xy}^1 3d_{yz}^1 3d_{zx}^1 4s^1$
b) $3d_{xy}^1 3d_{yz}^1 3d_{zx}^1 3d_{x^2-y^2}^1 3d_{z^2}^1 4s^1$
c) $3d_{xy}^2 3d_{yz}^2 3d_{zx}^2 3d_{x^2-y^2}^2 3d_{z^2}^1 4s^1$
d) $3d_{xy}^2 3d_{yz}^2 3d_{zx}^2 3d_{x^2-y^2}^2 3d_{z^2}^2 4s^1$

479. The orbital diagram in which aufbau principle is violated is:
a) 
b) 
c) 
d) 

480. In the ground state of Cu^+, the number of shell occupied, sub-shells occupied, fillied orbitals and unpaired electrons respectively are
a) 4,8,15,0 b) 3,6,15,1 c) 3,6,14,0 d) 4,7,14,2

481. If h is Planck's constant, the momentum of a photon of wavelength 0.01 Å is:
a) $10^{-2}h$ b) h c) $10^2 h$ d) $10^{12}h$

482. What does the electronic configuration $1s^2, 2s^2, 2p^5, 3s^1$ indicate?
a) Ground state of fluorine
b) Excited state of fluorine
c) Excited state of neon
d) Excited state of the O_2^- ion

483. Each p-orbital and each d-orbital except one has lobes respectively as:
a) 2,4 b) 1,4 c) 2,3 d) 1,1

484. Which of the following statements regarding an orbital is correct?
a) An orbital is a definite trajectory around the nucleus in which electron can move
b) An orbital always has spherical trajectory
c) An orbital is the region around the nucleus where there is a $90-95\%$ probability of finding all the electrons of an atom
d) An orbital is characterized by 3 quantum numbers n, l and m

485. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series, the energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are
a) $-313.6, -34.84$ b) $-313.6, -78.4$ c) $-78.4, -34.84$ d) $-78.4, -19.6$

486. The wavelengths of the radiations emitted when in a H atom, electron falls from infinity to stationary state 1, is:
a) 9.1×10^{-8}nm b) 192 nm c) 406 nm d) 91 nm

487. The values of quantum numbers for the outermost electron in scandium (Sc = 21) are:
a) $n = 3, l = 2$ b) $n = 3, l = 3$ c) $n = 4, l = 0$ d) $n = 2, l = 3$

488. Ultraviolet light of 6.2 eV falls on aluminium surface (work function = 4.2eV). The kinetic energy (in joule) of the fastest electron emitted is approximately:
a) 3×10^{-21} b) 3×10^{-19} c) 3×10^{-17} d) 3×10^{-15}
489. The number of spherical nodes in $3p$ orbitals is
a) 0 b) 1 c) 2 d) 3
490. The maximum number of electron in p-orbital with $n = 5, m = 1$ is
a) 6 b) 2 c) 14 d) 10
491. The species that has same number of electrons as $_{16}S^{32}$ is:
a) $_{16}S^{+}$ b) $_{17}Cl^{-}$ c) $_{16}S^{-}$ d) $_{17}Cl^{+}$
492. Select the odd man:
a) Deuteron b) Proton c) Electron d) Cyclotron
493. Assuming the velocity be same, which sub-atomic particle possesses smallest de Broglie wavelength;
a) An electron b) A proton c) An α-particle d) All have same λ
494. The chromium has different electronic configuration then what is expected according to aufbau principle because:
a) Cr is a metal
b) It belongs to d-block elments
c) Half-filled d-orbitals give extra stability
d) None of the above
495. If the ionisation potential for hydrogen atom is 13.6eV, then the wavelength of light required for the ionisation of hydrogen atom would be:
a) 1911 nm b) 912 nm c) 68 nm d) 91.2 nm
496. Bohr′s atomic theory gave the idea of:
a) Quantum numbers b) Shape of sub-levels c) Nucleus d) Stationary states
497. Which species has more electrons than protons?
a) Cl^{-} b) Ca^{2+} c) K^{+} d) Sc^{3+}
498. Electronic configuration of niobium (Nb = 41) is:
a) $[Kr]4d^4, 5s^1$ b) $[Kr]4d^6$ c) $[Kr]4d^3, 5s^2$ d) $[Kr]5s^2 5p^3$
499. The momentum of radiation of wavelength 0.33 nm is …kg m sec^{-1} .
a) 2×10^{-24} b) 2×10^{-12} c) 2×10^{-6} d) 2×10^{-48}
500. Predict the total spin in Ni^{2+} ion:
a) $\pm 5/2$ b) $\pm 3/2$ c) $\pm 1/2$ d) ± 1
501. An increasing order (lowest first) for the values of e/m for electron (e), proton (p), neutron (n) and alpha (α) particle is:
a) e, p, n, α b) n, α, p, e c) n, p, e, α d) n, p, α, e
502. Choose the arrangement which shows the increasing value of e/m for e, p, n and α-particles
a) $n < \alpha < p < e$ b) $e < p < \alpha < n$ c) $n < p < e < \alpha$ d) $p < n < \alpha < e$
503. The $'m'$ value for an electron in an atom is equal to the number of m value for $l = 1$. The electron may be present in
a) $3d_{x^2-y^2}$ b) $5f_{x(x^2-y^2)}$ c) $4f_{x^3/z}$ d) None of these
504. The kinetic energy of an electron in the second Bohr′s orbit of a hydrogen atom is: (a_0 is Bohr′s radius)
a) $\frac{h^2}{4\pi^2 m a_0^2}$ b) $\frac{h^2}{16\pi^2 m a_0^2}$ c) $\frac{h^2}{32\pi^2 m a_0^2}$ d) $\frac{h^2}{64\pi^2 m a_0^2}$
505. Number of electrons in nucleus of an element of atomic number 14 is:
a) Zero b) 14 c) 7 d) 20
506. When an electron of charge e and mass m moves with velocity u about the nuclear charge Ze in the circular orbit of radius r, the potential energy of the electron is given by:
a) Ze^2/r b) $-Ze^2/r$ c) Ze^2/r^2 d) mu^2/r
507. The orbital angular momentum of an electron revolving in a p-otbital is

a) Zero b) $\frac{h}{\sqrt{2\pi}}$ c) $\frac{h}{2\pi}$ d) $\frac{1}{2}\frac{h}{2\pi}$

508. The ratio of specific charge e/m of a proton to that of an α-particle is:
a) 1 : 4 b) 1 : 2 c) 1 : 1/4 d) 1 : 1/2

509. Possible values of $'m'$ for a given value of n are:
a) n^2 b) $2l+1$ c) n d) $2l$

510. Common name for proton and neutron is
a) Deutron b) Positron c) Meson d) Nucleon

511. Two electrons A and B in an atom have the following set of quantum numbers:
A: 3, 2, −2, +1/2,
B: 3, 0, 0, +1/2,
Which statement is correct for A and B?
a) A and B have same energy
b) A has more energy than B
c) B has more energy than A
d) A and B represents same electron

512. Radius of nucleus is proportional to …where A is mass number
a) A b) $A^{1/3}$ c) A^2 d) $A^{2/3}$

513. The energy levels for ${}_zA^{(+z-1)}$ can be given by:
a) E_n for $A^{(+z-1)} = Z^2 \times E_n$ for H
b) E_n for $A^{(+z-1)} = Z \times E_n$ for H
c) E_n for $A^{(+z-1)} = \frac{1}{Z^2} \times E_n$ for H
d) E_n for $A^{(+z-1)} = \frac{1}{Z} \times E_n$ for H

514. The observation that the ground state of nitrogen atom has 3 unpaired electrons in its electronic configuration and not otherwise is associated with
a) Pauli's exclusion principle b) Hund's rule of maximum multiplicity
c) Heisenberg's uncertainty relation d) Ritz combination principle

515. The energy of the electron in second Bohr's orbit in the hydrogen atom is −3.41eV. The energy of the electron in second Bohr's orbit of He^+ ion would be:
a) −85 eV b) −13.62 eV c) −1.70eV d) −6.82 eV

516. As an electron is brought from an infinite distance close to the nucleus of the atom, the energy of the electron-nucleus system:
a) Increases to a greater positive value
b) Decreases to a smaller positive value
c) Decreases to a greater negative value
d) Decreases to a smaller negative value

517. Beryllium's fourth electron will have the four quantum numbers:
n l m s
a) 1 0 0 + 1/2 b) 1 1 1 + 1/2 c) 2 0 0 + 1/2 d) 2 1 0 + 1/2

518. The electrons would go to lower energy levels first and then to higher energy levels according to which of the following?
a) Aufbau principle
b) Pauli's exclusion principle
c) Hund's rule of maximum multiplicity
d) Heisenberg's uncertainty principle

519. When the speed of electron increase, the specific charge:
a) Decreases b) Increases c) Remains same d) None of these

520. In the absence of magnetic field p-orbitals are known as… fold degenerate
a) Three b) Two c) One d) Four

521. In hydrogen spectrum least energetic transition of electrons are found in:

a) Lyman series b) Balmer series c) Bracket series d) Pfund series

522. The electronic configuration of an element is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^2$. This represents its
a) Cationic form b) Anionic form c) Ground state d) Excited state

523. A body of mass x kg is moving with a velocity of $100 ms^{-1}$. Its de-Broglie wavelength is 6.62×10^{-35}m. Hence, x is ($h = 6.62 \times 10^{-34}$Js)
a) 0.1 kg b) 0.25 kg c) 0.15 kg d) 0.2 kg

524. Maximum number of electrons in a subshell with $l = 3$ and $n = 4$ is:
a) 10 b) 12 c) 14 d) 16

525. One energy difference between the states $n = 2$ and $n = 3$ is E eV, in hydrogen atom. The ionisation potential of H atom is:
a) 3.2 E b) 5.6 E c) 7.2 E d) 13.2 E

526. The first emission line in the electronic spectrum of hydrogen in the Balmer series appears at cm^{-1}
a) $\frac{9R}{400} cm^{-1}$ b) $\frac{7R}{144} cm^{-1}$ c) $\frac{3R}{4} cm^{-1}$ d) $\frac{5R}{36} cm^{-1}$

527. The probability of finding an electron residing in a p_x orbital is not zero:
a) In the yz plane b) In the xy plane c) In the y direction d) In the z direction

528. What is the electronic configuration of Mn^{2+}?
a) $[Ne]3d^5, 4s^0$ b) $[Ar]3d^5, 4s^2$ c) $[Ar]3d^5, 4s^0$ d) $[Ne]3s^5, 4s^2$

529. Number of neutron in C^{12} is
a) 6 b) 7 c) 8 d) 9

530. Which of the following reaction led to the discovery of neutrons?
a) ${}_6C^{16} + {}_1p^1 \rightarrow {}_7N^{14} + {}_0n^1$ b) ${}_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + {}_0n^1$
c) ${}_5B^{11} + {}_1D^2 \rightarrow {}_6C^{11} + {}_0n^1$ d) ${}_4Be^8 + {}_2He^4 \rightarrow {}_6C^{11} + {}_0n^1$

531. Combination of an α-particle with a nuclide results in the formation of a new nuclide which has:
a) Less number of neutrons
b) Equal number of electrons
c) Lower mass number
d) Higher atomic number

532. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?
a) $Li^{2+}(n = 2)$ b) $Li^{2+}(n = 3)$ c) $Be^{3+}(n = 2)$ d) $He^+(n = 2)$

533. Which statement is not correct in case of isotopes of chlorine ${}_{17}Cl^{35}$ and ${}_{17}Cl^{37}$?
a) Both have same atomic number
b) Both have the same number of electrons
c) Both have same number of neutrons
d) Both have same number of protons

534. Which has minimum number of unpaired d-electrons?
a) Fe^{3+} b) Co^{3+} c) Co^{2+} d) Mn^{2+}

535. The total spin for atoms with atomic number 7,24,34 and 36 will be
a) $0, \pm1, \pm3, \pm3/2$ b) $\pm1, 0, \pm3/2, \pm3$ c) $\pm3/2, \pm3, \pm1, 0$ d) $\pm3, \pm1, 0, \pm3/2$

536. A photo-sensitive metal is not emitting photo-electrons when irradiated. It will do so when threshold is crossed. To cross the threshold we need to increase :
a) Intensity b) Frequency c) Wavelength d) None of these

537. The KE of electron in He^+ will be maximum in:
a) 3rd orbit
b) 2nd orbit
c) 1st orbit
d) In orbit with $n = \infty$

538. Which neutral atom has 18 electrons in its outer shell?
a) Cu^+ b) Pd c) Mn^{4+} d) Zn

539. Rutherford scattering formula fails for very small scattering angles because

a) The kinetic energy of α- particles is larger
b) The gold foil is very thin
c) The full nuclear charge of the target atom is partially screened by its electron
d) All of the above

540. 3 p-orbital has :
a) Two non-spherical nodes
b) Two spherical nodes
c) One spherical and one non-spherical node
d) One spherical and two non-spherical nodes

541. Rutherford's alpha particle scattering experiment eventually led to the conclusion that:
a) Mass and energy are related
b) Electrons occupy space around the nucleus
c) Neutrons are buried deep into the nucleus
d) The point of impact with matter can be precisely determined

542. The d-orbital with the orientation along X and Y axes is called:
a) d_{z^2} b) d_{zx} c) d_{yz} d) $d_{x^2-y^2}$

543. Which of the following transitions are not allowed in the normal electronic emission spectrum of an atom?
a) $2s \longrightarrow 1s$ b) $2p \longrightarrow 1s$ c) $3d \longrightarrow 4p$ d) $5p \longrightarrow 3s$

544. In an atom two electrons move around the nucleus in circular orbits of radii R and $4R$. The ratio of the time taken by them to complete one revolution is:
a) $1:4$ b) $4:1$ c) $1:8$ d) $8:7$

545. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^8 m s^{-1}. Which value is closest to the wavelength in nanometre of a quantum of light with frequency of 8×10^{15} s^{-1}?
a) 2×10^{-25} b) 5×10^{-18} c) 4×10^{-8} d) 3×10^7

546. The number of electrons and protons in an atoms of third alkaline earth metal is
a) e 20, p 20 b) e 18, p 20 c) e 18, p 18 d) e 19, p 20

547. In photoelectric effect the number of photo-electron emitted is proportional to :
a) Intensity of incident beam
b) Frequency of incident beam
c) Velocity of incident beam
d) Work function of photo cathode

548. Which of the following statements is wrong about cathode rays?
a) They produce heating effect
b) They carry negative charge
c) They produce X −rays when strike with material having high atomic masses
d) None of the above

549. In an atom no two electrons can have the same value for all the quantum numbers. This was proposed by:
a) Hund b) Pauli c) Dalton d) Avogadro

550. The minimum energy required to eject an electron from an atom is called :
a) Kinetic energy b) Electrical energy c) Chemical energy d) Work function

551. The orbital angular momentum for an electron revolving in an orbit is $\frac{h}{2\pi}\sqrt{l(l+1)}$. Thus momentum for a s-electron is:
a) $\frac{h}{2\pi}$ b) $\sqrt{2} \cdot \frac{h}{2\pi}$ c) $\frac{1}{2} \cdot \frac{h}{2\pi}$ d) Zero

552. The binding energy of the electron in the lowest orbit of the hydrogen atom is 13.6 eV. The energies required in eV to remove an electron from three lowest orbits of the hydrogen atom are:
a) 13.6, 6.8, 8.4 eV b) 13.6, 10.2, 3.4 eV c) 13.6, 27.2, 40.8 eV d) 13.6, 3.4, 1.5 eV

553. The probability of finding the electron in the orbital is
a) 100% b) 90-95% c) 70-80% d) 50-60%

554. The correct de Broglie relationship is:

a) $\frac{\lambda}{mu} = p$ b) $\lambda = \frac{h}{mu}$ c) $\lambda = \frac{h}{mp}$ d) $\lambda m = \frac{u}{p}$

555. The one electron species having ionisation energy of 54.4 eV is
a) H b) He^+ c) B^{4+} d) Li^{2+}

556. The correct set of quantum numbers (n, l and m respectively) for the unpaired electron of chlorine atom is
a) 2, 1, 0 b) 2, 1, 1 c) 3, 1, 1 d) 3, 2, 1

557. If $'R_H'$ is the Rydberg constant, then the energy of an electron in the ground state of hydrogen atom is:
a) $\frac{R_H c}{h}$ b) $\frac{I}{R_H ch}$ c) $\frac{hc}{R_H}$ d) $-R_H hc$

558. The radius of hydrogen atom is 0.53Å. The radius of $_3Li^{2+}$ is of
a) 1.27 Å b) 0.17 Å c) 0.57 Å d) 0.99 Å

559. Among the following series of transition metal ions, the one in which all metal ions have $3d^2$ electronic configuration is (At. no. Ti=22, V=23, Cr=24, Mn=25)
a) $Ti^{3+}, V^{2+}, Cr^{3+}, Mn^{4+}$ b) $Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+}$ c) $Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}$ d) $Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+}$

560. Total number of unpaired electrons, in an unexcited atom of atomic number 29 is:
a) 1 b) 2 c) 3 d) 4

561. The work function for a metal is 4 eV. To emit a photoelectron of zero velocity from the surface of the metal, the wavelength of incident light should be:
a) 2700 Å b) 1700 Å c) 5900 Å d) 3100 Å

562. The wave number of the first line in the Lyman series in hydrogen spectrum is
a) 72755.5cm^{-1} b) 109678 cm^{-1} c) 82258.5 cm^{-1} d) 65473.6 cm^{-1}

563. The nodes present in $3p$-orbitals are
a) One spherical, one planar
b) Two spherical
c) Two planar
d) One planar

564. Electronic configuration of deuterium atom is
a) $1s^1$ b) $2s^2$ c) $2s^1$ d) $1s^2$

565. The number of d-electrons retained in Fe^{2+}(At. No. Fe=26) ions is
a) 3 b) 4 c) 5 d) 6

566. For azimuthal quantum number $l = 3$, the maximum number of electrons will be:
a) 2 b) 6 c) Zero d) 14

567. Which of the following sets of quantum numbers is correct?
a) $n = 5, l = 4, m = 0, s = +\frac{1}{2}$
b) $n = 3, l = 3, m = +3, s = +\frac{1}{2}$
c) $n = 6, l = 0, m + 1, s = -\frac{1}{2}$
d) $n = 4, l = 2, m = +2, s = 0$

568. Correct energy value order is
a) $ns, np, nd, (n-1)f$
b) $ns, np, (n-1)d, (n-2)f$
c) $ns, np, (n-1)d, (n-1)f$
d) $ns, (n-1)d, np, (n-1)f$

569. Which hydrogen like species will have same radius as that of Bohr orbit hydrogen atom?
a) $n = 2, Li^{2+}$ b) $n = 2, Be^{3+}$ c) $n = 2, He^+$ d) $n = 3, Li^{2+}$

570. The nucleus and an atom can be assumed to be spherical. The radius of the nucleus of mass no. A is given by $1.25 \times 10^{-13} \times A^{1/3}$cm. The atomic radius of atom is 1 Å. If the mass no. is 64, the fraction of the atomic volume that is occupied by nucleus is:
a) 1.0×10^{-3} b) 5.0×10^{-5} c) 2.5×10^{-2} d) 1.25×10^{-13}

571. The expression Ze gives :
a) The charge of α-particle
b) The charge on an atom
c) The charge on the nucleus of atomic number Z
d) The kinetic energy of an α-particle

572. Which has the highest number of unpaired electrons?
a) Mn b) Mn^{5+} c) Mn^{3+} d) Mn^{4+}

573. The ratio between the neutrons present in carbon and silicon with respect to atomic masses of 12 and 28 is:
a) 3 : 7 b) 7 : 3 c) 3 : 4 d) 6 : 28
574. The last electron placed in the third ($n = 3$) quantum shell for:
a) Kr b) Zn c) Cu d) Ca
575. Which have the same number of s-electrons as the d-electrons in Fe^{2+}?
a) Li b) Na c) N d) P
576. The number of spectral lines that can be possible when electrons in 7th shell in different hydrogen atoms return to the 2nd shell, is
a) 12 b) 15 c) 14 d) 10
577. The value of Rydberg constant is
a) 10,9678 cm^{-1} b) 10,9876 cm^{-1} c) 10,8769 cm^{-1} d) 10,8976 cm^{-1}
578. In absence of Pauli exclusion principle, the electronic configuration of Li in ground state may be:
a) $1s^2, 2s^2$ b) $1s^3$ c) $1s^1, 2s^2$ d) $1s^2, 2s^1 2p^1$
579. Which relates to light only as stream of particles?
a) Diffraction b) Photoelectronic effect c) Interference d) Planck's theory
580. Who introduced the concept of electron spin?
a) Schrödinger
b) Planck
c) Bohr
d) Uhlenbeck and Gaudsmit
581. The unit of wavelength (nm) is equal to:
a) 10Å b) 100Å c) 1000Å d) 55Å
582. Mass of neutron is … times the mass of electron
a) 1840 b) 1480 c) 2000 d) None of these
583. The highest excited state that unexcited hydrogen atom can reach when they are bombarded with 12.2 eV electron is :
a) $n = 1$ b) $n = 2$ c) $n = 3$ d) $n = 4$
584. The total number of atomic orbitals in fourth energy level of an atom is:
a) 4 b) 8 c) 16 d) 32
585. The radius of the first Bohr orbit of hydrogen atom is 0.529Å. The radius of the third orbit of H^+ will be
a) 8.46 Å b) 0.705 Å c) 1.59 Å d) 4.79 Å
586. Particles, which can be added to the nucleus of an atom without changing the chemical properties, are called:
a) Electrons b) Protons c) Neutrons d) α-particles
587. An electron with values 4, 3, −2 and $+\frac{1}{2}$ for the set of four quantum numbers n, l, m_1 and m_s, respectively, belongs to
a) $4s$ orbital b) $4p$ orbital c) $4d$ orbital d) $4f$ orbital
588. The total number of electrons that can be accommodated in all the orbitals having principal quantum number 2 and azimuthal quantum number 1 is:
a) 2 b) 4 c) 6 d) 8
589. When atoms are bombarded with α-particles suffer deflections while others pass through undeflected. This is because :
a) The force of attraction on the α-particle by the oppositely charged electrons is not sufficient
b) The nucleus occupies much smaller volume compared to the volume of the atom
c) The force of repulsion on the fast moving α-particle small
d) The effect in the nucleus do not have any effect on the α-particles
590. How many electrons with $l = 3$ are there in an atom having atomic number 54?
a) 3 b) 10 c) 14 d) None of these
591. Suppose a completely filled or half filled set of p or d-orbitals is spherically symmetrical. Point out the

species, which is spherical symmetrical?

a) O b) C c) Cl^- d) Fe

592. The number of electrons and neutrons of an element is 18 and 20 respectively. Its mass number is

a) 2 b) 17 c) 37 d) 38

593. Which d-orbital has different shape from rest of all d-orbital?

a) $d_{x^2-y^2}$ b) d_{z^2} c) d_{x^2y} d) d_{xz}

594. Photoelectric effect is the phenomenon in which:

a) Photons come out of a metal when it is hit by a beam of electrons

b) Photons come out of the nucleus of an atom under the action of an electric field

c) Electrons come out of a metal with a constant velocity which depends on the frequency and intensity of incident light wave

d) Electrons come out of a metal with different velocities not greater than a certain value which depends only on the frequency of the incident light wave and not on its intensity

595. Total number of orientations of sublevel in n^{th} orbit is:

a) $2n$ b) $2l+1$ c) n^2 d) $2n^2$

596. What is the minimum energy that photons must posses in order to produce photoelectric effect with platinum metal? The threshold frequency for platinum is $1.3\times 10^{15} s^{-1}$

a) 3.6×10^{-13}erg b) 8.2×10^{-13}erg c) 8.2×10^{-14}erg d) 8.6×10^{-12}erg

597. For an electron in a hydrogen atom, the wave function Ψ is proportional to $\exp^{-t/a_0}$, where a_0 is the Bohr's radius. What is the ratio of the probability of finding the electron at the nucleus to the probability of finding it at a_0?

a) e b) e^2 c) $\frac{1}{e^2}$ d) Zero

598. Millikan's oil drop experiment is used to find:

a) e/m ratio of electron b) Electronic charge

c) Mass of an electron d) Velocity of an electron

599. The maximum number of unpaired electrons present in $4f$-energy level is:

a) 5 b) 7 c) 10 d) 6

600. According to Bohr's model of the hydrogen atom, the radius of a stationary orbit characterised by the principle quantum number n is proportional to :

a) n^{-1} b) n c) n^{-2} d) n^2

601. Which one of the following has unit positive charge and 1 u mass?

a) Electron b) Neutron c) Proton d) None of these

602. The frequency of a green light is 6×10^{14}Hz. Its wavelength is:

a) 500 nm b) 5 nm c) 50,000 nm d) None of these

603. Among the following sets of quantum numbers, which one is incorrect for $4d$ −electron?

a) $4, 3, 2, +\frac{1}{2}$ b) $4, 2, 1, +\frac{1}{2}$ c) $4, 2, -2, +\frac{1}{2}$ d) $4, 2, 1, -\frac{1}{2}$

604. Nitrogen has the electronic configuration $1s^2, 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ and not $1s^2, 2s^2\ 2p_x^2\ 2p_x^1\ 2p_z^0$. It was proposed by:

a) Aufbau principle

b) Pauli's exclusion principle

c) Hund's rule

d) Uncertainty principle

605. Which one of the following sets of ions represents a collection of isoelectronic species?

a) $K^+, Cl^-, Ca^{2+}, Sc^{3+}$ b) $Ba^{2+}, Sr^{2+}, K^+, S^{2-}$ c) $N^{3-}, O^{2-}, F^-, S^{2-}$ d) $Li^+, Na^+, Mg^{2+}, Ca^{2+}$

606. The e/m ratio is maximum for:

a) D^+ b) He^+ c) H^+ d) He^{2+}

607. The principle, which gives a way to fill the electrons in the available energy level is:

a) Hund's rule

b) Pauli's exclusion principle
c) Aufbau principle
d) None of the above

608. The ground state electronic configuration of nitrogen atom can be represented as

a)

↑↓	↑↓	↑	↓	↑

b)

↑↓	↑↓	↑	↓	↓

c)

↑↓	↑↓	↓	↓	↓

d) All of the above

609. The uncertainty in position of a minute particle of mass 25 g in space is 10^{-5}m. The uncertainty in its velocity (in m s^{-1}) is:
a) 2.1×10^{-34} b) 0.5×10^{-34} c) 2.1×10^{-28} d) 0.5×10^{-23}

610. Out of first 100 elements, number of elements having electrons in $3d$-orbitals are:
a) 80 b) 10 c) 100 d) 60

611. Number of electrons in 1.8 mL of H_2O are:
a) 6.02×10^{23} b) 6.02×10^{24} c) 6.02×10^{22} d) 6.02×10^{25}

612. The number of orbitals present in the shell with $n = 4$ is
a) 8 b) 16 c) 18 d) 32

613. Number of electrons in the outermost orbit of the element of atomic number 15 is:
a) 7 b) 5 c) 3 d) 2

614. The angular momentum of electron of H-atom is proportional to:
a) r^2 b) $\frac{1}{r}$ c) $\sqrt{r}$ d) $\frac{1}{\sqrt{r}}$

615. The total number of electrons present in 1 mL Mg:
(Given density of ${}_{12}Mg^{24} = 1.2$ g/mL)
a) 0.6 N b) 6 N c) 2 N d) 3 N

616. Which set of quantum number represents the electron of the lowest energy?
a) $n = 2, l = 0, m = 0, s = -1/2$
b) $n = 2, l = 1, m = 0, s = +1/2$
c) $n = 4, l = 0, m = 0, s = +1/2$
d) $n = 4, l = 0, m = 0, s = -1/2$

617. Electron behaves both as a particle and a wave. This was proposed by
a) Heisenberg b) Gilbert N. Lewis c) de-Broglie d) L. Rutherford

618. Which of the following is isoelectronic with carbon atom?
a) N^+ b) O^{2-} c) Na^+ d) Al^{3+}

619. The uncertainity in position for a dust particle ($m = 10^{-11}$ g ; diameter $= 10^{-4}$ cm and velocity $= 10^{-4}$ cm/s) will be (The error in measurement of velocity is 1%)
a) 5.27×10^{-4} cm b) 5.27×10^{-5} cm c) 5.27×10^{-6} cm d) 5.27×10^{-7} cm

620. Which is not basic postulate of Dalton's atomic theory?
a) Atoms are neither created nor destroyed in a chemical reaction
b) In a given compound, the relative number and kinds of atoms are constant
c) Atoms of all elements are alike, including their masses
d) Each element is composed of extremely small particles called atoms

621. Among the various quantum numbers (n, l, m, s) describing an electron, which can have the largest value:
a) n b) l c) m d) s

622. The valency orbital configuration of an element with $Z = 23$ is:
a) $3d^5$ b) $3d^3, 4s^2$ c) $3d^2, 4s^1 4p^1$ d) $3d^3, 4s^1 4p^1$

623. A particle of mass, $'m'$ when annihilated completely given an energy E equal to:
a) mc^2 b) m/c^2 c) mc d) c^2/m

624. The correct set of four quantum number for the valence electron of rubidium (Z=37) is
a) $n = 5, l = 0, m = 0, s = +1/2$ b) $n = 5, l = 1, m = 1, s = +1/2$
c) $n = 5, l = 1, m = 1, s = +1/2$ d) $n = 6, l = 0, m = 0, s = +1/2$

625. A photon is :

a) A quanta of light (or electromagnetic) energy
b) A quanta of matter
c) A positively charged particle
d) An instrument for measuring light intensity

626. Which orbital is dumb-bell shaped?
a) s b) $2p_y$ c) $3s$ d) $3d_z^2$

627. Aufbau principle does not give the correct arrangement of filling up of atomic orbital's in
a) Cu and Zn b) Co and Zn c) Mn and Cr d) Cu and Cr

628. Ordinary oxygen contains:
a) Only O-16 isotope
b) Only O-17 isotope
c) A mixture of O-16 and O-18 isotopes
d) A mixture of O-16,O-17 and O-18 isotopes

629. The approximate quantum number of a circular orbit of diameter, 20.6 nm of the hydrogen atom according to Bohr's theory is:
a) 10 b) 14 c) 12 d) 16

630. A p-orbital in a given shell can accommodate upto
a) Four electrons b) Two electrons with parallel spin
c) Six electrons d) Two electrons with opposite spin

631. An electron beam is accelerated through a potential difference of 10,000 volt. The de-Broglie wavelength of the electron beam is
a) 0.123 A° b) 0.356 A° c) 0.186 A° d) 0.258 A°

632. Transition of electron from $n = 3$ to $n = 1$ level results in:
a) X-ray spectrum b) Emission spectrum c) Band spectrum d) Infrared spectrum

633. Atomic radius is of the order of 10^{-8}cm and nuclear radius of the order of 10^{-13}cm. The fraction of atom occupied by nucleus is:
a) 10^{-5} b) 10^{5} c) 10^{-15} d) None of these

634. The ratio of the masses of proton and neutron are:
a) > 1 b) < 1 c) $= 1$ d) $> \sqrt{1}$

635. If the mass number of an element is W and its atomic number is N, then:
a) Number of ${}_{-1}e^0 = W - N$
b) Number of protons $({}_{1}H^1) = W - N$
c) Number of ${}_{0}n^1 = W - N$
d) Number of ${}_{0}n^1 = N$

636. For a particular value of azimuthal quantum number, the total number of magnetic quantum number values are given by
a) $l = \frac{m+1}{2}$ b) $l = \frac{m-1}{2}$ c) $l = \frac{2m+1}{2}$ d) $m = \frac{2l+1}{2}$

637. The relation between energy of a radiation and its frequency was given by:
a) De Broglie b) Einstein c) Planck d) Bohr

638. The filling of $4p$-sublevel starts in the element of atomic number:
a) 29 b) 31 c) 35 d) 19

639. The angular speed of the electron in the nth orbit of Bohr hydrogen atom is :
a) Directly proportional to n
b) Inversely proportional to $\sqrt{n}$
c) Inversely proportional to n^2
d) Inversely proportional to n^3

640. The chlorine atom differs from chloride ion in the number of:
a) Protons b) Neutrons c) Electrons d) None of these

641. If the ionisation potential for hydrogen atom is 13.6 eV, then the ionisation potential for He^+ ion should be

a) 13.6 eV b) 6.8 eV c) 54.4 eV d) 72.2 eV

642. The λ for H_α line of Balmer series is 6500 Å. Thus, λ for H_β line of Balmer series is :
a) 4814 Å b) 4914 Å c) 5014 Å d) 4714 Å

643. According to Bohr's theory, the angular momentum for an electron of 3rd orbit is
a) $3\ h$ b) $1.5\ h$ c) $9\ h$ d) $2\frac{h}{\pi}$

644. The de-Broglie equation applies
a) To protons only b) To electrons only
c) All the material objects in motion d) To neutrons only

645. Which of the following electronic configuration is not possible?
a) $1s^2, 2s^2$ b) $1s^2, 2s^2 2p^6$ c) $[Ar]3d^{10}, 4s^2 4p^2$ d) $1s^2, 2s^2 2p^2, 3s^1$

646. Maximum number of electrons which can be accommodated in a g-subshell is:
a) 14 b) 18 c) 12 d) 20

647. The correct ground state electronic configuration of chromium is
a) $[Ar]3d^5 4s^1$ b) $[Ar]3d^4 4s^2$ c) $[Ar]3d^6 4s^0$ d) $[Ar]4d^5 4s^1$

648. The ionisation energy of hydrogen atom is 13.6 eV. What will be the ionisation energy of He^+?
a) 13.6 eV b) 54.4 eV c) 122.4 eV d) Zero

649. If each hydrogen atom is excited by giving 8.4 eV of energy, then the number of spectral lines emitted is equal to:
a) None b) Two c) Three d) Four

650. ψ^2(psi) the wave function represents the probability of finding electron. Its value depends:
a) Inside the nucleus
b) Far from the nucleus
c) Near the nucleus
d) Upon the type of orbital

651. The orbital angular momentum of an electron in a d-orbital is
a) $\sqrt{6}\frac{h}{2\pi}$ b) $\sqrt{2}\frac{h}{2\pi}$ c) $\frac{h}{2\pi}$ d) $\frac{2h}{2\pi}$

652. The space between the proton and electron in hydrogen atom is:
a) Filled with air
b) Empty
c) Filled with magnetic radiation
d) None of the above

653. When $4f$-level of an atom is completely filled with electrons, the next electron will enter:
a) $5s$ b) $6s$ c) $5d$ d) $5p$

654. The number of unpaired electrons in Fe^{3+}ion is
a) 3 b) 1 c) 5 d) 2

655. The number of d-electrons in Fe^{2+} (at. No. of Fe $= 26$) is not equal to that of the:
a) p-electrons in Ne (at. no. $= 10$)
b) s-electrons in Mg (at. no. $= 12$)
c) d-electrons in Fe
d) p-electrons in Cl^-(at. no. Cl $= 17$)

656. When the value of azimuthal quantum number is 1, magnetic quantum number can have values :
a) -1 only b) $+1$ only c) $+1, 0, -1$ d) $+1$ and -1

657. The H atom electron dropped from $n = 3$ to $n = 2$, then energy emitted is
a) 1.9 eV b) 12 eV c) 10.2 eV d) 0.65 eV

658. The $n + l$ value for the 3 p-energy level is:
a) 4 b) 7 c) 3 d) 1

659. The maximum number of sublevels, orbitals and electrons in N-shell of an atom are respectively
a) 4, 12, 32 b) 4, 16, 30 c) 4, 16, 32 d) 4, 32, 64

660. A particle having a mass of 1.0 mg has a velocity of 3600 km/h. Calculate the wavelength of the particle

($h = 6.626 \times 10^{-27}\text{erg} - \text{s}$)

a) 6.626×10^{-28}cm b) 6.626×10^{-29}cm c) 6.626×10^{-30}cm d) 6.626×10^{-31}cm

661. The target used for production of X-ray beam must have:

a) High melting point and high atomic number

b) High melting point and low atomic number

c) Low melting point and low atomic number

d) Low melting point and high atomic number

662. When photons of energy 4.25eV strike the surface of a metal A, the ejected photoelectrons have maximum kinetic energy, T_A (expressed in eV) and de Broglie wavelength λ_A. The maximum kinetic energy of photoelectrons liberated from another metal B by photons of energy 4.70V is $T_B = T_A - 1.50$ eV. If the de Broglie wavelength of these photoelectrons is $\lambda_B = 2\lambda_A$, then which is not correct?

a) The work function of A is 2.25 eV

b) The work function of B is 3.70 eV

c) $T_A = 2.00$eV

d) $T_B = 0.5$eV

663. An electrons is in one of the $3d$-orbitals, which of the quantum number is not possible?

a) $l = 1$ b) $n = 3$ c) $m = 1$ d) $m = 2$

664. The momentum of a photon is p. The corresponding wavelength is:

a) h/p b) hp c) p/h d) $h/\sqrt{p}$

665. An electron, a proton and an alpha particle have KE of $16E$, $4E$ and E respectively. What is the qualitative order of their de-Broglie wavelengths?

a) $\lambda_e > \lambda_p > \lambda_\alpha$ b) $\lambda_p = \lambda_\alpha > \lambda_e$ c) $\lambda_p < \lambda_e < \lambda_\alpha$ d) $\lambda_\alpha < \lambda_e \approx \lambda_p$

666. How many sets of four quantum number are possible for the electrons present in He^{2-}?

a) 4 b) 3 c) 2 d) None of these

667. Which of the following has the maximum number of unpaired 'd' electrons?

a) Zn^{2+} b) Fe^{2+} c) Ni^{3+} d) Cu^{+}

668. The electrons, identified by quantum number n and l,

V. $n = 3; l = 2$

VI. $n = 5; l = 0$

VII. $n = 4; l = 1$

VIII. $n = 4; l = 2$

IX. $n = 4; l = 0$

can be placed in order of increasing energy, as

a) $I<V<III<IV<II$ b) $I<V<III<II<IV$ c) $V<I<III<II<IV$ d) $V<I<II<III<IV$

669. Identify the least stable ion amongst the following

a) Li^- b) Be^- c) B^- d) C^-

670. Mass number of atom represents the number of its:

a) Protons only

b) Protons and neutrons

c) Protons and electrons

d) Neutrons and electrons

671. The equation, $\lambda = \frac{h}{mv}$ was deduced by

a) Newton b) de-Broglie c) Planck d) Heisenberg

672. Ionisation potential of hydrogen atom is 13.6 eV. Hydrogen atom in the ground state are excited by monochromatic light of energy 12.1 eV. The spectral lines emitted by hydrogen according to Bohr's theory will be:

a) One b) Two c) Three d) Four

673. The line spectrum observed when electron falls from the higher level into L-level is known as:

a) Balmer series b) Paschen series c) Bracket series d) None of these

674. Atomic weight of Ne is 20.2. Ne is a mixture of Ne^{20} and Ne^{22}. Relative abundance of heavier isotope is:

a) 90 b) 20 c) 40 d) 10

675. The number of waves in an orbit are
a) n^2 b) n c) $n-1$ d) $n-2$

676. An ion Mn^{a+} has the magnetic moment equal to 4.9 B. M. The value of a is:
a) 3 b) 4 c) 2 d) 5

677. The number of electrons in $[_{19}K^{40}]^-$ is:
a) 19 b) 20 c) 18 d) 40

678. p-orbitals of an atom in presence of magnetic field are;
a) Three fold degenerate
b) Two fold degenerate
c) Non-degenerate
d) None of these

679. In 'aufbau principle', the term aufbau represents:
a) The name of scientist
b) German term meaning for building up
c) The energy of electron
d) The angular momentum of electron

680. The velocity of electron in the hydrogen atom is 2.2×10^6 m/s. The de Broglie wavelength for this electron is:
a) 33 nm b) 45.6 nm c) 23.3 nm d) 0.33 nm

681. An atom has net charge of −1. It has 18 electrons and 20 neutrons. Its mass number is:
a) 37 b) 35 c) 38 d) 20

682. Which of the following is related with both wave nature and particle nature?
a) Interference b) $E = mc^2$ c) Diffraction d) $E = hv$

683. An electron is moving in Bohr's fourth orbit. Its de-Broglie wavelength is λ. What is the circumference of the fourth orbit?
a) $\frac{2}{\lambda}$ b) 2λ c) 4λ d) $\frac{4}{\lambda}$

684. Which of the following sets of quantum numbers represents an impossible arrangement?

	n	l	m	s
a)	3	2	−2	$+\frac{1}{2}$
b)	3	2	−3	$+\frac{1}{2}$
c)	4	0	0	$-\frac{1}{2}$
d)	5	3	0	$-\frac{1}{2}$

685. A cricket ball of 0.5 kg is moving with a velocity of 100m/s. The wavelength associated with its motion is
a) 0.01 cm b) 6.6×10^{-34}m c) 1.32×10^{-35}m d) 6.6×10^{-28}m

686. The ratio between kinetic energy and the total energy of the electrons of hydrogen atom according to Bohr's model is:
a) 1 : −1 b) 1 : 1 c) 1 : 2 d) 2 : 1

687. Binding energy of hydrogen atom is 13.6 eV. The binding energy of a singly ionised helium atom is:
a) 13.6 eV b) 27.2 eV c) 54.4 eV d) 3.4 eV

688. Calculate the velocity of an electron having wavelength of 0.15 nm Mass of an electron is 9.109×10^{-28}g. ($h = 6.626 \times 10^{-27}$erg-s).
a) 0.262×10^{-8}cm. s^{-1} b) 2.062×10^{-15}cm. s^{-1} c) 4.84×10^{8}cm. s^{-1} d) 2.062×10^{-9}cm. s^{-1}

689. Einstein's theory of photoelectric effect is based on
a) Maxwell's electromagnetic theory of light
b) Planck's quantum theory of light
c) Both of the above
d) None of the above

690. Which orbital does not possess angular node?
a) s b) p c) d d) f

691. The azimuthal quantum number for an electron in a 5d-orbital is:
a) May be zero
b) Two

c) Can have any value less than 5 but greater than zero
d) May be +5 to −5 including zero

692. What is the wavelength of an α-particle having mass 6.6×10^{-27} kg moving with a speed of 10^5 cm s^{-1}? ($h = 6.6 \times 10^{-34}$kg $m^2 - s$)
a) 2×10^{-12} m
b) 3×10^{-10} m
c) 1×10^{-10} m
d) 2×10^{-10} m

693. A transition element X has configuration [Ar]$3d^5$ in its +3 oxidation state. Its atomic number is:
a) 22
b) 25
c) 26
d) 19

694. The maximum energy is possessed by an electron, when it is present
a) In nucleus
b) In ground state
c) In first excited state
d) At infinite distance from the nucleus

695. The radii of two of the first four Bohr′s orbits of the hydrogen atom are in the ratio 1 : 4. The energy difference between them may be:
a) either 12.09 eV or 3.4 eV
b) either 2.55 eV or 10.2 eV
c) either 13.6 eV or 3.4 eV
d) either 3.4 eV or 0.85 eV

696. The frequency of light emitted for the transition n=40 to n=2 of He^+ is equal to the transition in H atom corresponding to which of the following?
a) $n = 3$ to $n = 1$
b) $n = 2$ to $n = 1$
c) $n = 3$ to $n = 2$
d) $n = 4$ to $n = 3$

697. What is the atomic number of the element with M^{2+} ion having electronic configuration $[Ar]3d^8$?
a) 25
b) 28
c) 27
d) 26

698. The first emission line of Balmer series for H-spectrum has the wave no. equal to:
a) $\frac{9R_H}{400}$ cm^{-1}
b) $\frac{7R_H}{144}$ cm^{-1}
c) $\frac{3R_H}{4}$ cm^{-1}
d) $\frac{5R_H}{36}$ cm^{-1}

699. Which statement does not form part of Bohr's model of the hydrogen atom?
a) Energy of the electrons in the orbit is quantized
b) The electron in the orbit nearest the nucleus is in the lowest energy
c) Electrons revolve in different orbits around the nucleus
d) The position and velocity of the electrons in the orbit cannot be determined simultaneously

700. If r is the radius of first orbit, the radius of n^{th} orbit of the H atom will be
a) rn^2
b) rn
c) $\frac{r}{n}$
d) r^2n^2

701. Neutron was discovered by:
a) Thomson
b) Chadwick
c) Bohr
d) Rutherford

702. The frequency of radiations emitted when electron falls from $n = 4$to $n = 1$ in H atom would be: (Given E_1 for H = 2.18×10^{-18} J atom^{-1} and $h = 6.625 \times 10^{-34}$ Js.)
a) 1.54×10^{15} s^{-1}
b) 1.03×10^{15} s^{-1}
c) 3.08×10^{15} s^{-1}
d) 2.0×10^{15} s^{-1}

703. Nuclides:
a) Have same number of protons
b) Have specific atomic numbers
c) Have specific atomic number and mass numbers
d) Are isotopes

704. The compound in which cation is isoelectronic with anion is
a) NaCl
b) CsF
c) NaI
d) K_2S

705. The electronic configuration of silver atom in ground state is:
a) $[Ar]3d^{10}, 4s^1$
b) $[Xr]4f^{14}, 5d^{10}, 6s^1$
c) $[Kr]4d^{10}, 5s^1$
d) $[Kr]4d^9, 5s^2$

706. n and l values of an orbital "A" are 3 and 2 and of another orbital "B" are 5 and 0. The energy of:
a) B is more than A
b) A is more than B
c) A and B are of same energy
d) None of the above

707. Which is correct in case of p-orbitals?
a) They are spherical
b) They have a strong directional character
c) They are five fold degenerate
d) They have no directional character

708. X-rays and γ-rays of same energies may be distinguished by:
a) Velocity b) Ionizing power c) Intensity d) Method of production

709. A neutral atom always consist of :
a) Protons
b) Neutrons + protons
c) Neutrons + electrons
d) Neutrons + protons + electrons

710. A photon of 300 nm is absorbed by a gas then re-emits two photons. One re-emitted photon has wavelength 496 nm, the wavelength of second re-emitted photon is:
a) 757 b) 857 c) 957 d) 657

711. If uncertainties in the measurement of position and momentum of an electron are equal, the uncertainty in the measurement of velocity is
a) 8.0×10^{12} ms^{-1} b) 4.2×10^{10} ms^{-1} c) 8.5×10^{10} ms^{-1} d) 6.2×10^{10} ms^{-1}

712. If the quantum number for the 5th electron in carbon atoms are 2,1,1,+1/2, then for the 6th electron, these values would be
a) $2, 1, 0, -\frac{1}{2}$ b) $2, 0, 1, +\frac{1}{2}$ c) $2, 1, 1, -\frac{1}{2}$ d) $2, 1, -1, + -\frac{1}{2}$

713. A patient is asked to drink $BaSO_4$ solution for examining the stomach by X-rays, because X-rays are:
a) Less absorbed by heavy atoms
b) More absorbed by heavy atoms
c) Diffracted by heavy atoms
d) Refracted by heavy atoms

714. Which of the following is correct for number of electrons, number of orbitals respectively in n-orbit?
a) 4, 4 and 8 b) 4, 8 and 16 c) 32, 16 and 4 d) 4, 16 and 32

715. Which has highest e/m ratio?
a) He^{2+} b) H^+ c) He^+ d) H

716. The quantum number sufficient to describe the electron in H atom is:
a) n b) l c) m d) s

717. If an isotope of hydrogen has two neutrons in its atom, its atomic number and mass number will be:
a) 2 and 1 b) 3 and 1 c) 1 and 1 d) 1 and 3

718. The radius of hydrogen atom in the ground state is 0.53Å. The radius of Li^{2+} ion (atomic number =3) in a similar state is
a) 0.176 Å b) 0.30 Å c) 0.53 Å d) 1.23 Å

719. The speed of the cathode rays is:
a) Equal to light
b) Less than light
c) Greater than light
d) May be less than, greater than or equal to light

720. Bohr model can explain
a) The solar spectrum
b) The spectrum of hydrogen molecule
c) Spectrum of any atom or ion containing one electron only
d) The spectrum of hydrogen atom only

721. Which represents the correct set up of the four quantum numbers of 4s-electron?
a) 4, 3, 2, +1/2 b) 4, 2, 1, 0 c) 4, 3, −2, +1/2 d) 4, 0, 0, 1/2

722. Electron in the atom are held by:

a) Coulombic forces b) Nuclear forces c) Gravitational forces d) Van der Waals' forces

723. According to Bohr's theory, the angular momentum of an electron in 5th orbit is
a) $25\frac{h}{\pi}$ b) $1.0\frac{h}{\pi}$ c) $10\frac{h}{\pi}$ d) $2.5\frac{h}{\pi}$

724. Positron is:
a) Electron with +ve charge
b) A helium nucleus
c) A nucleus with two protons
d) A nuclear with one neutron and one proton

725. The line spectra of two elements are not identical because
a) The elements do not have the same number of neutrons
b) They have different mass numbers
c) Their outermost electrons are at different energy levels
d) All of the above

726. Which of the following expressions gives the de-Broglie relationship?
a) $p = \frac{h}{mv}$ b) $\lambda = \frac{h}{mv}$ c) $\lambda = \frac{h}{mp}$ d) $\lambda m = \frac{v}{p}$

727. Three electrons in p-sublevel must have the quantum number:
a) $n = 2$ b) $m = 0$ c) $l = 0$ d) $s = -1/2$ or $+1/2$

728. The number of vacant d-orbitals in completely excited Cl atom is:
a) 2 b) 3 c) 1 d) 4

729. The planck's constant has a unit of :
a) Work b) Energy c) Angular momentum d) Linear momentum

730. The quantum numbers of most energetic electron in Ne atom when it is in first excited state is:
a) $2, 1, 0, +1/2$ b) $3, 1, 1, +1/2$ c) $3, 0, 0, +1/2$ d) $3, 1, 0, +1/2$

731. The charge to mass ratio of α-particle is approximately . . . the charge to mass ratio of protons
a) Six times b) Four times c) Half d) Two times

732. The number of photons emitted per second by a 60 W source of monochromatic light of wavelength 663 nm is ($h = 6.63 \times 10^{-34}$ Js)
a) 4×10^{-20} b) 1.54×10^{20} c) 3×10^{-20} d) 2×10^{20}

733. Density of the electron is:
a) 2.77×10^{12} g/mL b) 4.38×10^{17}g/mL c) 2.17×10^{14}g/mL d) None of these

734. The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state 1, would be (Rydberg constant $=1.097 \times 10^{7}\text{m}^{-1}$)
a) 91 nm b) 192 nm c) 406 nm d) 9.1×10^{-8}nm

735. The number of electrons accommodated in an orbit with principle quantum number 2, is
a) 2 b) 6 c) 10 d) 8

736. Suppose 10^{-17} J of light energy is needed by the interior of a human eye to see an object. Calculate the number of photons of green light ($\lambda = 550$ nm) needed to generate this minimum amount of energy
a) 26 b) 27 c) 28 d) 29

737. A 0.66 kg ball is moving with a speed of 100 m/s. The associated wavelength will be:
a) 6.6×10^{-32}m b) 6.6×10^{-34}m c) 1.0×10^{-35}m d) 1.0×10^{-32}m

738. Which of the following is correct?
a) $_1H^1$ and $_2He^3$ are isotopes
b) $_6C^{14}$ and $_7N^{14}$ are isotopes
c) $_{19}K^{39}$ and $_{20}Ca^{40}$ are isotones
d) $_9F^{19}$ and $_{11}Na^{24}$ are isodiaphers

739. Nuclear theory of the atom was put forward by
a) Rutherford b) Aston c) Neils Bohr d) J.J. Thomson

740. Which of the following is not permissible arrangement of electrons in an atom?
a) $n = 3, l = 2, m = -2, s = -1/2$
b) $n = 4, l = 0, m = 0, s = -1/2$
c) $n = 5, l = 3, m = 0, s = +1/2$

d) $n = 3, l = 2, m = -3, s = -1/2$

741. The measurement of the electron position is associated with an uncertainty in momentum, which is equal to 1×10^{-18} g cm s^{-1}. The uncertainty in electron velocity is:
(mass of an electron is 9×10^{-28} g)
a) 1×10^{6}cm s^{-1} b) 1×10^{5}cm s^{-1} c) 1×10^{11}cm s^{-1} d) 1.1×10^{9}cm s^{-1}

742. The two electrons ins K-sub shell will differ in
a) Principal quantum number b) Azimuthal quantum number
c) Magnetic quantum number d) Spin quantum number

743. An atom having even number of electrons may be:
a) Diamagnetic
b) Paramagnetic
c) Diamagnetic or paramagnetic
d) None of the above

744. Dual nature of particles was proposed by
a) Heisenberg b) Lowry c) de-Broglie d) Schrodinger

745. In photoelectric effect, the number of photoelectrons emitted is proportions to
a) Intensity of incident beam b) Frequency of incident beam
c) Wavelength of incident beam d) All of the above

746. A ball of mass 200 g is moving with a velocity of 10 m sec^{-1}. If the error in measurement of velocity is 0.1%, the uncertainty in its position is:
a) 3.3×10^{-31}m b) 3.3×10^{-27}m c) 5.3×10^{-25}m d) 2.64×10^{-32}m

747. The number of radial nodes of $3s$ and $2p$-orbitals are respectively
a) 2, 0 b) 0, 2 c) 1, 2 d) 2, 11

748. The mass of a photon with wavelength 3.6 Å is
a) 6.135×10^{-29}kg b) 3.60×10^{-29}kg c) 6.135×10^{-33}kg d) 3.60×10^{-27}kg

749. Correct set of four quantum numbers of a $4d$-electron is:
a) $4, 3, -2, 1/2$ b) $4, 2, -1, 0$ c) $4, 3, -2, +1/2$ d) $4, 2, -1, -1/2$

750. The orbital angular momentum of an electron in $3s$-orbital is
a) $\frac{1}{2}.\frac{h}{2\pi}$ b) $\frac{h}{2\pi}$ c) $\frac{1}{3}.\frac{h}{2\pi}$ d) Zero

751. The uncertainties in the velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respecively. The mass of B is five times to that of mass A. What is the ratio of uncertainties $\left(\frac{\Delta x_A}{\Delta x_B}\right)$ in their positions?
a) 2 b) 0.25 c) 4 d) 1

752. Which of the following statement is relation to the hydrogen atom is correct?
a) $3s$, $3p$ and $3d$-orbitals all have the same energy
b) $3s$ and $3p$-orbitals is lower energy than $3d$-orbital
c) $3p$-orbital is lower in energy than $3d$-orbital
d) $3s$-orbital is lower in energy than $3p$-orbital

753. Atoms in hydrogen gas have preponderance of:
a) $_1H^1$ atoms
b) Deuterium atoms
c) Tritium atoms
d) All the three (a),(b) and (c) are in equal ratio

754. The energy of the electron at infinite distance from the nucleus in Bohr's model is taken a:
a) Zero b) Positive c) Negative d) Any value

755. The quantum numbers for the last electron in an atom are $n = 3, l = 1$ and $m = -1$. The atom is:
a) Al b) Si c) Mg d) C

756. The maximum number of electrons possible in a sublevel is equal to:
a) $2l + 1$ b) $2n^2$ c) $2l^2$ d) $4l + 2$

757. The quantum number for the last electrons of an atom are $n = 2, l = 0, m = 0, s = +1/2$. The atom is:

a) Lithium b) Boron c) Carbon d) Hydrogen

758. The radius of second stationary orbit in Bohr′s atoms is R. The radius of third orbit will be:

a) $3R$ b) $9R$ c) $2.25\ R$ d) $R/3$

759. Number of f-orbitals associated with $n = 5$ is:

a) 7 b) 5 c) 9 d) 10

760. The number of d-electrons retained in Fe^{2+} ion is :

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

761. The triad of nuclei which is isotonic is

a) ${}^{14}_{6}C, {}^{14}_{7}N, {}^{17}_{9}F$ b) ${}^{14}_{6}C, {}^{14}_{7}N, {}^{19}_{9}F$ c) ${}^{14}_{6}C, {}^{15}_{7}N, {}^{17}_{9}F$ d) ${}^{12}_{6}C, {}^{14}_{7}N, {}^{19}_{9}F$

762. The wavelength of a spectral line in Lyman series, when electron jumps back from 2nd orbit, is

a) 1162 Å b) 1216 Å c) 1362 Å d) 1176 Å

763. Ionisation energy of He^{+} is 19.6×10^{-18}J atom^{-1}. The energy of the first stationary state ($n = 1$) of Li^{2+} is

a) 4.41×10^{-16}J atom^{-1} b) -4.41×10^{-17}J atom^{-1}

c) -2.2×10^{-15}J atom^{-1} d) 8.82×10^{-17}J atom^{-1}

764. The energy of second Bohr orbit of the hydrogen atom is -328 kJ mol^{-1} ; hence the energy of fourth Bohr orbit would be

a) -41 kJ mol^{-1} b) -1312 kJ mol^{-1} c) -164 kJ mol^{-1} d) -82 kJ mol^{-1}

765. In hydrogen spectrum most energetic transitions of electrons are found in:

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

766. The ratio of specific charge (e/m) of an electron to that of a hydrogen ion is:

a) 1 : 1 b) 1840 : 1 c) 1 : 1840 d) 2 : 1

767. Which property of elements is not a whole number?

a) Mass number

b) Atomic number

c) Average atomic weight

d) None of these

768. The maximum kinetic energy of the photoelectrons is found to be 6.63×10^{-19} J. When the metal is irradiated with a radiation of frequency 2×10^{15} Hz, the threshold frequency of the metal is about

a) 2×10^{15} s^{-1} b) 1×10^{15} s^{-1} c) 2.5×10^{15} s^{-1} d) 4×10^{15} s^{-1}

769. Which of the following is Heisenberg uncertainty principle?

a) $\Delta x.\Delta p \geq \frac{h}{4\pi}$ b) $\Delta x.\Delta p = \frac{h}{4\pi}$ c) $\Delta x.\Delta p \leq \frac{h}{4\pi}$ d) $\Delta x.\Delta p < \frac{h}{4\pi}$

770. Which of the following make up an isotonic triad?

a) ${}^{78}_{32}Ge, {}^{77}_{33}As, {}^{74}_{31}Ga$ b) ${}^{40}_{18}Ar, {}^{40}_{19}K, {}^{40}_{20}Ca$ c) ${}^{233}_{92}U, {}^{232}_{90}Th, {}^{239}_{94}Pu$ d) ${}^{14}_{6}C, {}^{16}_{8}O, {}^{15}_{7}N$

771. The magnetic quantum number for valency electron of sodium is:

a) 3 b) 2 c) 1 d) Zero

772. Which pair has elements containing same number of electrons in the outermost orbit?

a) Cl and Br b) Ca and Cl c) Na and Cl d) N and O

773. The electromagnetic radiation with maximum wavelength is:

a) Ultraviolet b) Radiowaves c) X-ray d) Infrared

774. An element contains:

a) Only one type of nuclide

b) Two types of nuclides

c) Different types of nuclides

d) None of the above

775. Which of the following statements is incorrect?

a) The charge on electron and proton are equal and opposite

b) Neutrons have no charge

c) The mass of proton and electron are nearly the same

d) None of the above

776. Heaviest particle is:
a) Meson b) Neutron c) Proton d) Electron

777. The set of quantum numbers for the outermost electron for copper in its ground state is
a) $4, 1, 1, +\frac{1}{2}$ b) $3, 2, 2, +\frac{1}{2}$ c) $4, 0, 0, +\frac{1}{2}$ d) $4, 2, 2, +\frac{1}{2}$

778. 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?
a) 36 b) 35.46 c) 32 d) 39

779. Atom containing an odd number of electron is:
a) Ferromagnetic b) Ferrimagnetic c) Paramagnetic d) Diamagnetic

780. Amplification of electromagnetic waves by simulated emission of radiation produces:
a) Polarised light b) Neutrons c) Laser d) γ-rays

781. In the discharge tube emission of cathode rays requires:
a) Low potential and low pressure
b) Low potential and high pressure
c) High potential and high pressure
d) High potential and low pressure

782. Which electron transition in a hydrogen atom requires the largest amount of energy?
a) From $n = 1$ to $n = 2$ b) From $n = 2$ to $n = 3$ c) From $n = \infty$ to $n = 1$ d) From $n = 3$ to $n = 5$

783. The number of electrons in the valence shell of calcium is
a) 2 b) 4 c) 6 d) 8

784. A cricket ball of 0.5 kg is moving with a velocity of 100 m/s. The wavelength associated with its motion is
a) 1/100 cm b) 6.6×10^{-34}m c) 1.32×10^{-35}m d) 6.6×10^{-28}m

785. A body of mass 10 mg is moving with a velocity of 100 ms^{-1}. The wavelength of de-Broglie wave associated with it would be
($h = 6.63 \times 10^{-34}$Js)
a) 6.63×10^{-35}m b) 6.63×10^{-34}m c) 6.63×10^{-31}m d) 6.63×10^{-37}m

786. The absolute value of the charge on electron was determined by
a) J.J. Thomson b) R.A. Millikan c) Rutherford d) Chadwick

787. Which of the following will violates aufbau principle as well as Pauli's exclusion principle?
a) 1s [↑↓] 2s [↑↓] 2p [↑↓][↑][ ]
b) 1s [↑↓] 2s [↑↓] 2p [↑↓][↑↓][↑]
c) 1s [↑↓] 2s [↑] 2p [↑↑][↑][↑]
d) None of the above

788. The angular momentum of an electron in an atomic orbital is governed by the:
a) Principal quantum number
b) Azimuthal quantum number
c) Magnetic quantum number
d) Spin quantum number

789. In Bohr's model of the hydrogen atom the ratio between the period of revolution of an electron in the orbit $n = 1$ to the period of revolution of the electron in the orbit $n = 2$ is:
a) 1 : 2 b) 2 : 1 c) 1 : 4 d) 1 : 8

790. The "spin-only" magnetic moment [in unit of Bohr magneton, (μ_B)] of Ni^{2+} in aqueous solution would be: (At. no. Ni = 28)
a) 2.84 b) 4.90 c) 0 d) 1.73

791. The atoms in a molecule vibrate around their mean position by stretching or bending out of place. These vibration and the energy they carry are studied by:
a) X-ray spectra b) Visible spectra c) IR spectra d) UV spectra

792. The maximum number of electrons that can have principle quantum number, $n = 3$ and spin quantum number, $m_s = -\frac{1}{2}$, is

a) 3 b) 5 c) 7 d) 9

793. Maximum number of electrons present in "N" shell is:

a) 18 b) 32 c) 2 d) 8

794. Which electronic level will allow the hydrogen atom to absorb photon but not to emit?

a) $1s$ b) $2s$ c) $2p$ d) $2d$

795. The mass of electron moving with velocity of light is:

a) $2m_e$ b) $3m_e$ c) Infinite d) Zero

796. The electron configuration of the oxide ion is much most similar to the electron configuration of the

a) Sulphide ion b) Nitride ion c) Oxygen atom d) Nitrogen atom

797. If S_1 be the specific charge (e/m) of cathode ray and S_2 be that of positive rays, then which is true?

a) $S_1 = S_2$ b) $S_1 < S_2$ c) $S_1 > S_2$ d) Either of these

STRUCTURE OF ATOM

CHEMISTRY

: ANSWER KEY :

1)	c	2)	b	3)	d	4)	c
5)	b	6)	c	7)	c	8)	c
9)	a	10)	a	11)	c	12)	d
13)	a	14)	a	15)	c	16)	c
17)	a	18)	c	19)	b	20)	a
21)	c	22)	a	23)	d	24)	b
25)	c	26)	b	27)	d	28)	d
29)	c	30)	b	31)	b	32)	c
33)	d	34)	a	35)	d	36)	b
37)	d	38)	d	39)	a	40)	c
41)	a	42)	b	43)	b	44)	d
45)	c	46)	b	47)	d	48)	d
49)	b	50)	a	51)	a	52)	d
53)	b	54)	c	55)	a	56)	b
57)	b	58)	d	59)	b	60)	a
61)	a	62)	b	63)	b	64)	c
65)	b	66)	b	67)	a	68)	a
69)	d	70)	a	71)	d	72)	a
73)	b	74)	c	75)	b	76)	a
77)	b	78)	c	79)	c	80)	c
81)	b	82)	a	83)	c	84)	c
85)	b	86)	d	87)	b	88)	b
89)	d	90)	b	91)	a	92)	c
93)	a	94)	c	95)	b	96)	c
97)	a	98)	a	99)	b	100)	c
101)	b	102)	b	103)	d	104)	a
105)	c	106)	a	107)	b	108)	c
109)	c	110)	c	111)	b	112)	d
113)	b	114)	a	115)	d	116)	c
117)	b	118)	c	119)	a	120)	d
121)	d	122)	d	123)	c	124)	a
125)	b	126)	a	127)	b	128)	b
129)	c	130)	a	131)	c	132)	a
133)	b	134)	a	135)	d	136)	d
137)	c	138)	b	139)	d	140)	b
141)	b	142)	a	143)	a	144)	b
145)	c	146)	d	147)	c	148)	b
149)	b	150)	a	151)	b	152)	d
153)	c	154)	a	155)	d	156)	a
157)	b	158)	c	159)	d	160)	c
161)	c	162)	c	163)	a	164)	c
165)	b	166)	b	167)	c	168)	c

169)	d	170)	c	171)	d	172)	d
173)	b	174)	c	175)	b	176)	b
177)	a	178)	b	179)	b	180)	a
181)	d	182)	c	183)	d	184)	c
185)	c	186)	a	187)	c	188)	a
189)	d	190)	a	191)	c	192)	a
193)	c	194)	c	195)	a	196)	a
197)	c	198)	b	199)	a	200)	d
201)	c	202)	c	203)	b	204)	a
205)	b	206)	b	207)	c	208)	b
209)	b	210)	a	211)	b	212)	c
213)	b	214)	c	215)	c	216)	c
217)	c	218)	d	219)	c	220)	c
221)	c	222)	d	223)	b	224)	c
225)	c	226)	b	227)	b	228)	c
229)	b	230)	c	231)	d	232)	b
233)	b	234)	d	235)	a	236)	c
237)	b	238)	b	239)	c	240)	a
241)	c	242)	b	243)	b	244)	d
245)	c	246)	d	247)	d	248)	b
249)	b	250)	b	251)	a	252)	d
253)	c	254)	b	255)	c	256)	d
257)	c	258)	d	259)	b	260)	d
261)	d	262)	c	263)	b	264)	a
265)	c	266)	b	267)	b	268)	d
269)	d	270)	a	271)	b	272)	c
273)	d	274)	a	275)	b	276)	b
277)	c	278)	b	279)	c	280)	d
281)	c	282)	b	283)	a	284)	d
285)	a	286)	a	287)	c	288)	b
289)	d	290)	d	291)	d	292)	c
293)	c	294)	d	295)	b	296)	c
297)	c	298)	c	299)	a	300)	b
301)	a	302)	a	303)	c	304)	d
305)	c	306)	b	307)	c	308)	a
309)	c	310)	c	311)	c	312)	a
313)	a	314)	a	315)	c	316)	c
317)	a	318)	a	319)	a	320)	c
321)	a	322)	c	323)	a	324)	d
325)	c	326)	b	327)	d	328)	b
329)	b	330)	c	331)	c	332)	d
333)	d	334)	a	335)	d	336)	c

337)	d	338)	b	339)	b	340)	a
341)	b	342)	a	343)	b	344)	c
345)	b	346)	b	347)	c	348)	d
349)	b	350)	c	351)	c	352)	c
353)	b	354)	c	355)	d	356)	b
357)	d	358)	a	359)	a	360)	c
361)	c	362)	a	363)	b	364)	a
365)	b	366)	d	367)	a	368)	c
369)	c	370)	d	371)	a	372)	d
373)	b	374)	d	375)	c	376)	a
377)	d	378)	b	379)	b	380)	d
381)	d	382)	a	383)	a	384)	a
385)	b	386)	b	387)	b	388)	c
389)	d	390)	c	391)	c	392)	d
393)	b	394)	d	395)	b	396)	d
397)	a	398)	a	399)	c	400)	b
401)	a	402)	b	403)	c	404)	c
405)	d	406)	c	407)	b	408)	a
409)	c	410)	a	411)	d	412)	a
413)	b	414)	c	415)	a	416)	c
417)	c	418)	a	419)	c	420)	d
421)	b	422)	a	423)	b	424)	b
425)	d	426)	a	427)	d	428)	c
429)	d	430)	d	431)	c	432)	d
433)	a	434)	b	435)	c	436)	b
437)	a	438)	c	439)	d	440)	a
441)	b	442)	a	443)	d	444)	a
445)	b	446)	c	447)	b	448)	d
449)	b	450)	a	451)	c	452)	c
453)	b	454)	d	455)	c	456)	a
457)	c	458)	b	459)	c	460)	a
461)	a	462)	b	463)	a	464)	a
465)	a	466)	a	467)	b	468)	c
469)	c	470)	c	471)	b	472)	a
473)	d	474)	a	475)	d	476)	d
477)	c	478)	d	479)	b	480)	c
481)	d	482)	c	483)	a	484)	c
485)	b	486)	d	487)	c	488)	b
489)	b	490)	b	491)	d	492)	d
493)	c	494)	c	495)	d	496)	d
497)	a	498)	a	499)	a	500)	d
501)	b	502)	a	503)	b	504)	c
505)	a	506)	b	507)	b	508)	d
509)	c	510)	d	511)	b	512)	b
513)	a	514)	b	515)	b	516)	c
517)	c	518)	a	519)	a	520)	a
521)	d	522)	c	523)	a	524)	c
525)	c	526)	d	527)	b	528)	c
529)	a	530)	b	531)	d	532)	c
533)	c	534)	c	535)	c	536)	b
537)	c	538)	b	539)	c	540)	c

541)	b	542)	d	543)	a	544)	c
545)	c	546)	a	547)	a	548)	d
549)	b	550)	d	551)	d	552)	d
553)	b	554)	b	555)	b	556)	c
557)	d	558)	b	559)	d	560)	a
561)	d	562)	c	563)	a	564)	a
565)	d	566)	d	567)	a	568)	d
569)	c	570)	d	571)	c	572)	a
573)	a	574)	c	575)	d	576)	b
577)	a	578)	b	579)	b	580)	d
581)	a	582)	a	583)	c	584)	c
585)	d	586)	c	587)	d	588)	c
589)	b	590)	d	591)	c	592)	d
593)	b	594)	d	595)	c	596)	d
597)	d	598)	b	599)	b	600)	d
601)	c	602)	a	603)	a	604)	c
605)	a	606)	c	607)	c	608)	c
609)	c	610)	a	611)	a	612)	b
613)	b	614)	c	615)	a	616)	a
617)	c	618)	a	619)	c	620)	c
621)	a	622)	b	623)	a	624)	a
625)	a	626)	b	627)	d	628)	d
629)	b	630)	c	631)	a	632)	b
633)	c	634)	b	635)	c	636)	b
637)	c	638)	b	639)	d	640)	c
641)	c	642)	a	643)	a	644)	c
645)	d	646)	b	647)	a	648)	b
649)	a	650)	d	651)	a	652)	b
653)	c	654)	c	655)	d	656)	c
657)	a	658)	a	659)	c	660)	b
661)	a	662)	b	663)	a	664)	a
665)	a	666)	a	667)	b	668)	c
669)	b	670)	b	671)	b	672)	c
673)	a	674)	d	675)	b	676)	a
677)	b	678)	c	679)	b	680)	d
681)	a	682)	d	683)	c	684)	b
685)	c	686)	a	687)	c	688)	c
689)	b	690)	a	691)	b	692)	c
693)	c	694)	d	695)	b	696)	b
697)	b	698)	d	699)	d	700)	a
701)	b	702)	c	703)	b	704)	d
705)	c	706)	a	707)	b	708)	d
709)	a	710)	a	711)	a	712)	d
713)	c	714)	c	715)	b	716)	a
717)	d	718)	a	719)	b	720)	c
721)	d	722)	a	723)	d	724)	a
725)	c	726)	b	727)	d	728)	a
729)	c	730)	c	731)	c	732)	d
733)	a	734)	a	735)	d	736)	c
737)	c	738)	c	739)	a	740)	d
741)	d	742)	d	743)	c	744)	c

745)	**a**	**746)**	**d**	**747)**	**a**	**748)**	**c**
749)	**d**	**750)**	**d**	**751)**	**a**	**752)**	**a**
753)	**a**	**754)**	**a**	**755)**	**a**	**756)**	**d**
757)	**a**	**758)**	**c**	**759)**	**a**	**760)**	**b**
761)	**c**	**762)**	**b**	**763)**	**b**	**764)**	**d**
765)	**d**	**766)**	**b**	**767)**	**c**	**768)**	**b**
769)	**a**	**770)**	**d**	**771)**	**d**	**772)**	**a**
773)	**b**	**774)**	**c**	**775)**	**c**	**776)**	**b**
777)	**c**	**778)**	**c**	**779)**	**c**	**780)**	**c**
781)	**d**	**782)**	**a**	**783)**	**a**	**784)**	**c**
785)	**c**	**786)**	**b**	**787)**	**c**	**788)**	**b**
789)	**d**	**790)**	**a**	**791)**	**c**	**792)**	**d**
793)	**b**	**794)**	**a**	**795)**	**c**	**796)**	**b**
797)	**c**						

STRUCTURE OF ATOM

CHEMISTRY

: HINTS AND SOLUTIONS :

2 **(b)**
Roentgen discovered X-rays.

3 **(d)**
Spins of an electron are $\pm 1/2$ in an orbital

4 **(c)**
No. of subshell $= n$; no. of orbitals $= n^2$.

5 **(b)**
No. of electrons in an orbital $= 2$
No. of orbitals in a subshell $= 2l + 1$
$\therefore$ No. of electrons in an orbital $= 2(2l + 1)$

6 **(c)**
Mesons are electrically neutral (π^0) or charged (π^-, π^+) particles having their mass 236 times of electron.

7 **(c)**
$Mg^{2+} = [Ne]$ [Zero unpaired electrons]
$Ti^{3+} = [Ar]3d^1$ [One unpaired electrons]
$Fe^{2+} = [Ar]3d^5$ [Five unpaired electrons]
$V^{3+} = [Ar]3d^2$ [Two unpaired electrons]

8 **(c)**
According to Bohr's atomic model, if energy is supplied to an electron it may jump from a lower energy level to higher energy level. Energy is absorbed in the form of quanta (or photon).
$\Delta E = hv$
Where, v is the frequency.
According to above postulate an electron from one Bohr stationary orbit can go to next higher orbit by the absorption of electromagnetic radiation of particular frequency.

9 **(a)**
Tritium is the isotope of hydrogen. Its composition is as follows :
1 electron, 1 proton and 2 neutrons

10 **(a)**
If $m = +3$ (maximum), then $l = 3$ (maximum).
Thus, maximum value of $n = 4$. Also no. of waves in an orbit = no. of orbit

11 **(c)**
For Lyman series,

$$\frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{15R}{16} = R\left[\frac{1}{1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{15R}{16R} = \left[\frac{n_2^2 - 1}{n_2^2}\right]$$

$$\frac{15}{16} = \frac{n_2^2 - 1}{n_2^2}$$

$$15n_2^2 = 16n_2^2 - 16$$

$$n_2^2 = 16, n_2 = 4$$

12 **(d)**
The desired formulae to calculate nodes.

13 **(a)**

$$v = \frac{c}{\lambda} = \frac{3 \times 10^{10}}{2000 \times 10^{-8}} = 1.5 \times 10^{15} s^{-1}$$

$h = 6.6 \times 10^{-27}$ erg s.
$E = hv = 6.6 \times 10^{-27} \times 1.5 \times 10^{15}$
$= 9.94 \times 10^{-12}$ erg

14 **(a)**
In p-orbitals electrons are present as

↑↓	↑	↑

15 **(c)**
Rest all are evidence for wave nature.

16 **(c)**
Ground state of $_{12}Mg$ is $1s^2, 2s^2 2p^6, 3s^2$.

17 **(a)**

$$\lambda = \frac{h}{\sqrt{2m(\text{KE})}}$$

$$\text{KE} = \frac{h^2}{2\lambda^2 m}$$

$$= \frac{(6.626 \times 10^{-34})^2}{2 \times (0.090 \times 20^{-10})^2 \times 9.1 \times 10^{-31}}$$

$= 2.98 \times 10^{-15}$ J
Accelerating potential

$$= \frac{2.98 \times 10^{-15}}{1.6 \times 10^{-19}} \text{ eV}$$

$= 1.86 \times 10^4$ eV

18 **(c)**

$$\frac{\frac{e}{m_d}}{\frac{2e}{m_{a-p}}} = \frac{4m_{a-p}}{4m_d} = 1$$

So, deuterium and an α-particles have identical value of e/m

19 **(b)**
All the protons carrying +ve charge are present in nucleus.
20 **(a)**
$Cr^{3+}: 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3$. The $3d^1_{xy}, 3d^1_{xz}, 3d^1_{yz}$ has lower energy.
21 **(c)**
We know that kinetic energy $= eV$
or $= \frac{1}{2}mv^2$
So, $\frac{1}{2}mv^2 = eV$
$$v^2 = \frac{2eV}{m}$$
$$\therefore v = \sqrt{\frac{2eV}{m}}$$
22 **(a)**
At. wt. scale now-a-days is based on C^{12}.
23 **(d)**
$K(Z = 19): 1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$
In the ground state the value of l can be either zero or one.
Hence, the set (d) of quantum numbers $i.e.$, $(n = 3, l = 2, m = +2)$cannot possible in the ground state.
24 **(b)**
Six with C^{12} as $C^{12}O^{16}O^{16}, C^{12}O^{16}O^{17}, C^{12}O^{17}O^{17}$ $C^{12}O^{18}O^{18}, C^{12}O^{16}O^{18}, C^{12}O^{17}O^{18}$ and six with C^{13}
25 **(c)**
To designate an orbital, n, l, m are required.
26 **(b)**
Total values of m for a given subshell $(2l + 1)$.
27 **(d)**
Na has $3s^1$ configuration for last electron.
28 **(d)**
The principle is valid only for sub-atomic particles.
29 **(c)**
Isotopes are atoms of same elements having different mass number
Isobars are atoms of different elements having same mass number.
Isotones are atoms of different elements having same number of neutrons.
Nuclear isomers are atoms with the same atomic number and same mass number but different radioactive properties.
30 **(b)**
B has $1s^2, 2s^2 2p^1$ configuration; p is non-spherically shell.
31 **(b)**
Follow Stark effect.
32 **(c)**
$n = 4$, means electron is in 4th shell and $l = 2$, means subshell is d. Therefore, the orbital is in $4d$-subshell.
33 **(d)**
$$E = hv = \frac{hc}{\lambda} = hc\overline{v}$$
34 **(a)**
$m_e = 9.108 \times 10^{-28} g = 9.108 \times 10^{-31}$kg
35 **(d)**
Cr has $3d^5, 4s^1$ configuration.
36 **(b)**
$_{22}Ti^{3+}: \ldots\ldots\ldots 3d^1$, $i.e.$, one unpaired electron.
37 **(d)**
The electronic configuration of element with atomic number 24 is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
($\because$Exactly half-filled orbitals are more stable than nearly half-filled orbitals.)
38 **(d)**
$n = 4, m_l = +1$
$m_1 = +1$ shows the p-subshell, the maximum number of electron will be six.
39 **(a)**
Principal quantum number specifies size and energy level of orbit.
40 **(c)**
Specific charge $= e/m$; Higher is m, lesser will be e/m.
41 **(a)**
The formula for magnetic moment of an atom.
42 **(b)**
$\lambda = h/mu$.
43 **(b)**
The cosmic rays are highest energy rays having smallest λ, of the order of less than 10^{-15}m .
44 **(d)**
Planck's constant $h = \frac{E}{v}$. Put dimensions of energy and frequency, $i.e.$, energy/time^{-1} = energy × time.
45 **(c)**
$$\Delta u \cdot \Delta x = \frac{h}{4\pi m}$$
$$\Delta u = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.11 \times 10^{-31} \times 0.1 \times 10^{-10}}$$
$= 5.8 \times 10^6$m/sec
46 **(b)**
According to de-Broglie,
$$\lambda = \frac{h}{mv}$$

or $\frac{\lambda_{He}}{\lambda_{H_2}} = \frac{m_{H_2}}{m_{He}} \times \frac{v_{H_2}}{v_{He}}$

Given, $v_{H_2} = v_{He}$

$$\therefore \quad \frac{\lambda_{He}}{\lambda_{H_2}} = \frac{2}{4} \times \frac{v_{He}}{v_{He}} = \frac{1}{2}$$

47 **(d)**

Energy required for 1 Cl_2 molecule $= \frac{242 \times 10^3}{N_A}$ J

$E = \frac{hc}{\lambda}$

or $\lambda = \frac{hc}{E}$

$= \frac{6.626 \times 10^{-34} \times 3 \times 10^8 \times 6.02 \times 10^{23}}{242 \times 10^3}$

$= 494 \times 10^{-9}\text{m} = 494$ nm

48 **(d)**

$\Delta x \cdot \Delta P = \frac{h}{4\pi}$

$\Delta x = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 10^{-5}}$

$= \frac{5.27 \times 10^{-35}}{1 \times 10^{-5}}$

$= 5.27 \times 10^{-30}$ m

49 **(b)**

Velocity of light is same for all types of radiations.

50 **(a)**

Four quantum numbers are

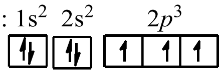
$n = 4, l = 0, m = 0, s = +\frac{1}{2}$

$n = 4$ indicates that the valence electron is present in 4th shell (4th period), $l = 0$ indicates that the valence electron is present in s-subshell. $m = 0$ indicates that the valence electron is present in orbital of s-subshell. $s = +\frac{1}{2}$ indicates that the spining of electron in orbital is clockwise. So, from the above discussion it is clear that valence electron is present in $4s$ subshell as $4s^1$. s^1 indicates that the element is present in IA group. So, the element present in 4th period and IA group is potassium (K).

51 **(a)**

The atomic number of nitrogen is 7 and its electronic configuration in ground state is as :

${}_7N^{14}$: $1s^2$ $2s^2$ $2p^3$



52 **(d)**

Free charge can exist only as integer multiple of electronic charge.

53 **(b)**

For Paschen series electron must fall in 3rd shell.

54 **(c)**

Symbols		K	L	M	N
${}_{19}X$	=	2	8	8	1
${}_{21}Y$	=	2	8	9	2
${}_{25}Z$	=	2	8	13	2

Hence, the order of number of electrons in M shell is

$Z > Y > X$

55 **(a)**

Mass no. ≈ At. wt;

Mass no. = No. of protons + No. of neutrons;

At. no. = No of protons

56 **(b)**

A part of energy of photon is used up to do work against coulombic forces of attractions.

57 **(b)**

It is expression to represent angular momentum of an electron in an orbital.

58 **(d)**

$\lambda = \frac{h}{mc}$ or $m = \frac{h}{\lambda c}$

$= \frac{6.63 \times 10^{-27}}{5890 \times 10^{-8} \times 3 \times 10^{10}}$

$= 3.752 \times 10^{-33}$ g

59 **(b)**

$Z = (24) = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$

$l = 1$, means p-orbitals and p-orbitals have total 12 electrons

$l = 2$ means d-orbitals and $d -$ orbitals have total 5 electrons

60 **(a)**

1.	J.J. Thomson	Determined charge on electron
2.	Neil Bohr	Gave structure of atom
3.	James Chadwick	Discovered neutron
4.	Mullikan	Carried out oil drop experiment

61 **(a)**

$m = -1$ is not possible for s-orbital ($l = 0$)

62 **(b)**

For s-electron, $l = 0$

63 **(b)**

A heavy element has atomic number X and mass number Y.

The atomic number of heavy element is smaller than its mass number.

$i.e.,\quad X < Y$

64 **(c)**

Proton is referred as H^+.

65 **(b)**
The isotones are a species which have equal number of neutrons.
No. of neutrons is $^{77}_{32}Ge = 77 - 32 = 45$
No. of neutrons in $^{77}_{33}As = 77 - 33 = 44$
No. of neutrons $^{77}_{34}Se = 77 - 34 = 43$
No. of neutron $^{77}_{36}Sc = 76 - 36 = 40$
No. of neutrons in $^{76}_{32}Ge = 76 - 32 = 44$
$\therefore$ $^{77}_{33}As$ is isotone of $^{76}_{32}Ge$.

66 **(b)**
Follow Pauli's exclusion principle.

67 **(a)**
Kinetic energy in an orbit$= \frac{Ze^2}{8\pi E^\circ r}$ ...(i)
Potential energy in an orbit $= \frac{Ze^2}{4\pi E^\circ r}$ ...(ii)
Comparing Eqs. (i) and (ii)
$\text{KE} = \frac{1}{2}\text{PE}$

68 **(a)**
For shortest λ of Lyman series,
$n_1 = 1$ and $n_2 = \infty; \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$
Because $\Delta E = \frac{hc}{\lambda}$ is maximum when λ is small
Thus, $\Delta E = E_\infty - E_1$

69 **(d)**
No. of orbitals for a given value of $n = n^2$.

70 **(a)**
The number of orbitals in an orbit (or shell) $= n^2$
where, n =no. of orbit or shell
Given, $n = 4$
$\therefore$ No. of orbitals in the 4th shell $=(4)^2$
$= 16$

71 **(d)**
For $3d$-orbital,
$n = 3$
For d-orbital, $l = 2$
and $m = -2, -1, 0, +1, +2$
$s = \pm\frac{1}{2}$
$\therefore$ The correct set for $3d$-orbital is
$n = 3, l = 2, m = 1, s = +\frac{1}{2}$

72 **(a)**
Lyman series falls in UV region.

73 **(b)**
The 3rd shell as well as all higher shells have d-subshells.

74 **(c)**
$\Delta x \times \Delta p \geq \frac{h}{4\pi}$
where, Δx =uncertainty in position.
Δp=uncertainty in momentum.
$= 1.0 \times 10^{-5}\text{kg ms}^{-1}$
$\therefore\ \Delta x \times 1.0 \times 10^{-5} \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14}$
$\Delta x \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 1.0 \times 10^{-5}}$
$\geq 5.27 \times 10^{-30}\text{m}$

75 **(b)**
De-Broglie wavelength,
$\lambda = \frac{h}{mv}$
or $\lambda = \frac{1}{m}$

76 **(a)**
Splitting of spectral lines under the influence of an external electrostatic field is called Stark effect.

77 **(b)**
Bohr's model is applicable to one electron system only.

78 **(c)**
$E_{1\,He^+} = E_{1\,H} \times Z^2$
$\therefore -871.6 \times 10^{-20} = E_{1\,H} \times 4$
$\therefore E_{1\,H} = -217.9 \times 10^{-20}$ J

79 **(c)**
For $n = 3, l$ may have values $0_{(s)}, 1_{(p)}$ and $2_{(d)}$.

80 **(c)**
s-orbitals are spherical; p-orbitals are dumb-bell; d-orbitals are double dumb-bell; f-orbitals are complicated.

81 **(b)**
Positron is as heavy as an electron.

82 **(a)**
Both are waves of radiant energy.

83 **(c)**
Give that,
Bohr's orbit of hydrogen atom (n)=2
Atomic number of hydrogen (Z)=1
By using

$$r = \frac{0.529\,n^2}{Z}$$
$$= \frac{0.529 \times (2)^2}{1}$$
$$= \frac{0.529 \times 4}{1}$$
$$= 2.116\ \text{Å}$$
$$= 0.2116\ \text{nm}$$

84 **(c)**
Interference shows the wave nature and photoelectric effect represents particle nature.

85 **(b)**
Elements show characteristics line spectrum

which is finger print of atom.

86 **(d)**
d^7 configuration has three unpaired electrons. Thus, total spin $= \pm 1/2 \times$ no. of unpaired electrons.

87 **(b)**
Radius of deflected path $= \frac{mu}{e \cdot H}$; where H is magnetic field.

88 **(b)**
$N^{3-} 7 + 3 = 10$ electrons
$F^{-} 9 + 1 = 10$ electrons
$Na^{+} 11 - 1 = 10$ electrons

89 **(d)**
Rest all involves nuclear forces of higher degree.

90 **(b)**
H_2 has two nuclear isomers knows as *ortho* (same spin of nuclei) and *para* (anti-spin).

91 **(a)**
Spectral lines of different λ suggest for different energy levels.

92 **(c)**
Rutherford's scattering experiment for the first time showed the presence of positively charged nucleus at the centre of atom.

93 **(a)**
For longest λ of Lyman series $n_1 = 1$ and $n_2 = 2$,
$$\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$
Because $\Delta E = \frac{hc}{\lambda}$ is minimum when λ is longest
Thus, $\Delta E = E_2 - E_1$

94 **(c)**
Angular momentum of electron in an orbit $= n\frac{h}{2\pi}$

95 **(b)**
Angular momentum $= n \cdot \frac{h}{2\pi}$; where n is integer and thus discrete value.

96 **(c)**
$hv_1 =$ work function $+ K \cdot E_1$
$2 \times hv_1 =$ work function $+ K \cdot E_2$

97 **(a)**
Mass on one mole electron
$= N \times m_e = 6.023 \times 10^{23} \times 9.108 \times 10^{-31}$kg

98 **(a)**
Given, velocity of particle A=0.05 ms^{-1}
Velocity of particle B=0.02 ms^{-1}
Let the mass of particle $A = x$
$\therefore$ The mass of particle $B = 5x$
de-Broglie's equation is
$$\lambda = \frac{h}{mv}$$
For particle A
$$\lambda_A = \frac{h}{x \times 0.05} \qquad \ldots \text{(i)}$$
For particle B
$$\lambda_B = \frac{h}{5x \times 0.02} \qquad \ldots \text{(ii)}$$
Eq. (i)/(ii)
$$\frac{\lambda_A}{\lambda_B} = \frac{5x \times 0.02}{x \times 0.05}$$
$$\frac{\lambda_A}{\lambda_B} = \frac{2}{1}$$
or 2: 1

99 **(b)**
λ increase in the order $\underset{(U.V)}{\text{Lyman}} < \underset{(\text{Visible})}{\text{Balmer}} < \underset{(IR)}{\text{Paschen}}$

100 **(c)**
According to Pauli Exclusion Principle, In any orbital, maximum two electrons can exist, having opposite spin.

101 **(b)**
Element just above element having at no. 43 is one which has at.no. 25.

102 **(b)**
Follow $(n + l)$ rule

103 **(d)**
The smallest value that an electron in H atom in ground state can absorb.
$= E_2 - E_1$
$$= \frac{-13.58}{4} - \left(\frac{-13.58}{12}\right) d = 10.19$$

104 **(a)**
$E_{Li^{2+}} = E_H \times Z^2$
$$\therefore \frac{E_{1Li^{2+}}}{E_{1\,H}} = Z^2 = 3^2 = 9$$

105 **(c)**
$m_e = 9.108 \times 10^{-31}$kg
$m_H = 1.672 \times 10^{-27}$kg

106 **(a)**
Bragg's equation is $n\lambda = 2d \sin\theta$, $\sin\theta = \frac{n\lambda}{2d}$;
if $\lambda > 2d$; $\sin\theta > 1$ which is not possible.

107 **(b)**
An experimental fact.

108 **(c)**
$$r_n \text{ for He}^+ = \frac{r_n \text{ for H}}{Z}$$
$$\therefore r_2 \text{ for He}^+ = \frac{r_2 \text{ for H}}{2}$$
$$= \frac{r_1 \text{ for H} \times 2^2}{2} \quad (\because r_n = r_1 \times n^2)$$
$\therefore r_2$ for $He^+ = 0.053 \times 2 = 0.106$nm

109 **(c)**
Stark Effect The splitting of spectral lines under

the influence of electric field is called Stark effect.

Raman Effect When light of frequency v_0 is scattered by molecules of a substance which have a vibrational frequency of v_1, the scattered light when analysed spectroscopically has lines of frequency v where

$v = v_0 \pm v_0$

Zeeman Effect The splitting of spectral lines under the influence of magnetic field is called Zeeman Effect.

Rutherford Effect According to Rutherford on the bombardment of the atoms by high speed α particles, the center of the atom scatters the α-particles.

110 **(c)**

$r_n = r_1 \times n^2$.

111 **(b)**

Deuterium is $_1H^2$ (*ie*, have 1 proton and 1 neutron.)

($\therefore$ C may be $_6C^{12}$ or $_6C^{14}$. Similar is true for N.)

112 **(d)**

$$E_1 - E_2 = 1312 \times Z^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$E_1 - E_2 = 1312 \times Z^2 \left[\frac{3}{4}\right] \quad \text{... (i)}$$

$$E_2 - E_3 = 1312 \times Z^2 \left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$E_2 - E_3 = 1312 \times Z^2 \left[\frac{5}{36}\right] \quad \text{... (ii)}$$

From Eqs. (i) and (ii)

$$\frac{E_1 - E_2}{E_2 - E_3} = \frac{3 \times 36}{4 \times 5} = \frac{27}{5}$$

113 **(b)**

$$\frac{1}{\lambda} = R_H \times \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = 4.86 \times 10^{-7} m = 486 \text{ nm}$$

114 **(a)**

No. of electrons = no. of protons.

115 **(d)**

$E = Nhv$

$= 6.023 \times 10^{23} \times 6.626 \times 10^{-34} \times 10^4 \times 10^6$

$= 3.99$ J

116 **(c)**

$$\Delta x . \Delta v \geq \frac{h}{4\pi m}$$

$$\Delta x = \frac{6.63 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 300 \times 0.001 \times 10^{-2}}$$

$= 0.01933$

$= 1.93 \times 10^{-2}$

117 **(b)**

5. $n = 2, l = 1, m = 0$ it is possible

6. $n = 2, l = 0, m = -1$ it is not possible because if $l - 0, m$ must be 0. The value of m totally depends upon the value of $l (m = -l \text{ to } +l)$.

7. $n = 3, l = 0, m = -0$ it is possible.

8. $n = 3, l = 1, m = -1$ it is possible.

118 **(c)**

$$\lambda = \frac{h}{mc}$$

119 **(a)**

An experimental value.

120 **(d)**

$\Delta E(eV) = \frac{12375}{\lambda}$; where λ in Å.

121 **(d)**

A subshell having nearly half-filled or nearly completely filled configurations tends to acquire exactly half-filled or exactly completely filled nature to have lower energy level in order to attain extra stability

122 **(d)**

Ionisation enthalpy of hydrogen atom is $1.312 \times 10^6 \text{J mol}^{-1}$.

It suggests that the energy of electron in the ground state (first orbit) is $-1.312 \times 10^6 \text{ J mol}^{-1}$.

$\Delta E = E_2 - E_1$

$$= \left(\frac{-1.312 \times 10^6}{2^2}\right) - \left(\frac{-1.312 \times 10^6}{1}\right)$$

$= 9.84 \times 10^5 \text{ J mol}^{-1}$

123 **(c)**

Any sub-orbit is represented as nl such that n is the principal quantum number (in the form of values) and l is the azimuthal quantum number (its name).

Value of $l < n, l$: 0 1 2 3 4

$s\ p\ d\ f\ g$

Value of m: $-l, \dots\dots\dots .0, \dots\dots + l$

Value of s: $+\frac{1}{2}$ or $-\frac{1}{2}$

Thus, for $4f$: $n = 4, l = 3, m =$ any value between -3 to +3.

124 **(a)**

No. of electrons in $-CONH_2$ = No. of electrons in (C + O + N + H) + 1 (for covalent bond).

125 **(b)**

$r_{nucleus} \propto (\text{mass no.})^{1/3}$

126 **(a)**

Electronic configuration of

$_{28}Ni = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^2$

$Ni^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^0$

$_{29}\text{Cu} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$
$\text{Cu}^+ = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^0$
So, the given configuration is of Cu^+.

127 **(b)**
The three quantum no. n, l, m were obtained as a result of solution of Schrödinger wave equation.

128 **(b)**
e/m ratio for $\text{He}^{2+} = \frac{2}{4}$
e/m ratio for $\text{H}^+ = \frac{1}{1}$
e/m ratio for $\text{He}^+ = \frac{1}{4}$
e/m ratio for $\text{D}^+ = \frac{1}{2}$
∴ The e/m is highest for hydrogen.

129 **(c)**
When $n = 4$ and $x = 5$ then electronic configuration can be written as
$(4-1)s^2(4-1)p^6(4-1)d^5 4s^2$
This electronic configuration represents Mn and its atomic number is 25. Hence, number of protons are 25 in its nucleus.

130 **(a)**
$$\lambda = \frac{h}{mv}$$
$$= \frac{6.63 \times 10^{-34}}{60 \times 10^{-3} \times 10}$$
$$= 1.105 \times 10^{-33}\text{m}$$

131 **(c)**
Each metal has different effective nuclear charge.

132 **(a)**
A characteristic of each element is its line spectrum.

133 **(b)**
Schrodinger wave equation is
$$\frac{\partial^2\Psi}{\partial x^2} + \frac{\partial^2\Psi}{\partial y^2} + \frac{\partial^2\Psi}{\partial z^2} + \frac{8\pi^2 m}{h^2}(E - V)\Psi = 0$$

134 **(a)**
np is filled after ns in each shell

135 **(d)**
Cathode rays are fastly moving electrons.

136 **(d)**
$_{27}\text{Co}^{3+}: \ldots\ldots .3d^6$.

137 **(c)**
By Heisenberg's uncertainty principle
$$\Delta x . m\Delta V = \frac{h}{4\pi}$$
$\Delta V = 0.005\%$ or $600\text{m/s} = \frac{600 \times 0.005}{100} = 0.03$
$$\Delta x \times 9.1 \times 10^{-31} \times 0.03 = \frac{6.6 \times 10^{-34}}{4 \times 3.14}$$
Hence, $\Delta x = \frac{6.6 \times 10^{-34}}{4 \times 3.14 \times 0.03 \times 9.1 \times 10^{-31}}$
$= 1.92 \times 10^{-3}\text{m}$.

138 **(b)**
EC of Cr $(Z = 24)$ is

Outer configuration	n	l
$1s^2$	1	0
$2s^2$	2	0
$2p^6$	2	1
$3s^2$	3	0
$3p^6$	3	1
$3d^5$	3	2
$4s^1$	4	0

Thus, electrons with $l = 1$, are 12
With $l = 2$, are 5

139 **(d)**
Acc. to Mosley : $\sqrt{v} = a(Z - b)$.

140 **(b)**
Follow discovery of cathode rays.

141 **(b)**
$_{12}\text{Mg} : 1s^2, 2s^2 2p^6, 3s^2$, *i.e.*, six s- and six p-electrons.

142 **(a)**
Pd is $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^6 4d^{10}$ and thus, $\text{Pd}^{2+} = [\text{Kr}]4d^8$.

144 **(b)**
$l = 2$ means d-orbital and thus,
$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$ has 3 electrons in d-subshell.

145 **(c)**
Mosley proposed the new periodic law based on atomic number.

146 **(d)**
Angular momentum of electrons $= mvr = \frac{nh}{2\pi}$

147 **(c)**
$4\,p$ has $(n + l)$ value, $(i.e., 5)$ lesser than $4d, (i.e., 6)$ and $4f\,(i.e., 7)$ $4s$ has already filled before $3d$.

148 **(b)**
$n + l = 5$ maximum.

149 **(b)**
Jump of electron from lower energy level $L, (i.e.,$ 2nd shell) to higher energy level $M, (i.e.,$ 3rd shell) absorbs energy.

150 **(a)**
$$\lambda = \frac{h}{\sqrt{2Em}}$$
When kinetic energy of electron becomes four times, the de-Broglie wavelength will become half

151 **(b)**

Energy of photon= $\frac{hc}{\lambda}$J $= \frac{hc}{e\lambda}$eV

$= \frac{6.625 \times 10^{-34} \times 3 \times 10^8}{300 \times 10^{-9} \times 1.602 \times 10^{-19}} = 4.14$ eV

For photoelectric effect to occur, energy of incident photons, must be greater than work functions of metal. Hence, only Li, Na, K and Mg have work functions less than 4.14 V.

152 **(d)**

Positron + Electron → Positroniu.

153 **(c)**

Nucleus of He is $_2He^4$.

154 **(a)**

It is an experimental evidence for particle nature of electron.

155 **(d)**

An experimental fact supported by argument.

156 **(a)**

$\lambda = \frac{h}{mu} = \frac{6.63 \times 10^{-34}}{1 \times 10^{-3} \times 100}$

$= 6.63 \times 10^{-33}$m

159 **(d)**

For photoelectric effect, energy of the incident radiations must be greater than work function of the metal.

160 **(c)**

No. of neutrons = Mass no. −Atomic no.

161 **(c)**

Deflection back shows that the nucleus is heavy but of only a few particles shows that nucleus is small.

162 **(c)**

Configuration of atom $1s^2, 2s^2 2p^6, 3s^2 3p^4$.

163 **(a)**

$n = 4, l = 2, m = 0, i.e., 4d$

164 **(c)**

Number of electrons in $M^{2+} = 24$

∴ Number of electrons in M=26

$i.e.$, atomic number (Z)=26

Mass number (A)=56

∴ Number of neutrons $=A - Z$=56-26=30

165 **(b)**

Angular momentum in an orbital $= \frac{h}{2\pi}\sqrt{l(l+1)}$.

166 **(b)**

Each has sic s-electrons.

167 **(c)**

In H_3PO_4, P is present as P^{5+}

$_{15}P = 1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

$P^{5+} = 1s^2, 2s^2, 2p^6$

168 **(c)**

Radius of nth orbit of hydrogen atom $=0.529n^2$

where, n =no. of orbit = 2

∴ $r_2 = 0.529 \times (2)^2 = 2.116$Å $= 2.12$Å

169 **(d)**

$E_{\text{Mini}} = hv_0$

170 **(c)**

An experimental fact.

172 **(d)**

$\Delta E = 13.6\, Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$= 13.6 \times (1)^2 \left(\frac{1}{1} - \frac{1}{2^2}\right)$

$= 13.6\left(1 - \frac{1}{4}\right)$

$= 13.6 \times \frac{3}{4} = 10.2$eV

173 **(b)**

$E_8 - E_3$ is minimum. Also, transition from 3 to 8 result in absorption spectrum.

174 **(c)**

Aufbau principle states that in the ground state of an atom, the orbital with lower energy is filled up first before the filling of the orbitals with a higher energy commences.

Increasing order of energy of various orbitals is $1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, \ldots$ etc.

Therefore,

| 1 |

1l	1	1

Is not obeyed by aufbau principle. Without fully filling of s-subshell electrons cannot enter in p-subshell in ground state of atom.

175 **(b)**

The configuration are :

Zn^+: [Ar]$3d^{10}, 4s^1$; Fe^{2+}: [Ar]$3d^6$

Ni^+: [Ar]$3d^7$; Cu^+[Ar]$3d^{10}$

176 **(b)**

Niels Bohr utilised the concepts of quantisation of energy (proposed by Max planck) first time to give a new model of atom.

177 **(a)**

$E = \frac{N \cdot hc}{\lambda}$

178 **(b)**

$\lambda_A = \frac{h}{m_A v_A}$ and $\lambda_B = \frac{h}{m_B v_B}$

$\frac{\lambda_A}{\lambda_B} = \frac{m_B v_B}{m_A v_A}$

$\frac{1 \times 10^{-10}}{\lambda_B} = \frac{m_A \times 3v_A}{m_A \times 4 \times v_A \times 4}$

$\lambda_B = \frac{16 \times 10^{-10}}{3} = 5.33$ Å

179 **(b)**

$n = 4, l = 3$, means $4f$, since $l = 3$ for f-subshell.

180 **(a)**

For first excited state $n = 2$

$\therefore \quad E_n = \frac{E_1}{n^2}$

(Where, E_1= energy of first Bohr's orbit)

$\therefore \quad E_2 = \frac{-13.6}{(2)^2}$

$= -3.4eV$

182 **(c)**

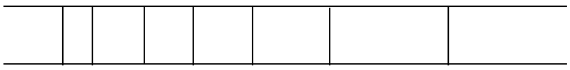
$r_n = r_1 \times n^2$

183 **(d)**

All are same terms having same meaning.

184 **(c)**

Line spectrum of atomic hydrogen in the visible region.



185 **(c)**

Kinetic energy $=\frac{1}{2}mv^2$,

Potential energy $= \frac{-e^2}{r}$

But, $mv^2 = \frac{e^2}{r}$

KE$=\frac{1}{2}\frac{e^2}{r}$

Total energy =KE+PE

$= \frac{1}{2}\frac{e^2}{r} - \frac{e^2}{r} = \frac{e^2}{r}\left(\frac{1}{2} - 1\right) = \frac{-e^2}{2r}$

188 **(a)**

Each shell possesses one circular and rest all elliptical orbits.

Total number of orbits $= n$.

189 **(d)**

Based on all these three principles.

190 **(a)**

Velocity of light is constant.

191 **(c)**

Ionisation energy of H

$= 2.18 \times 10^{-18}$J atom^{-1}

$\therefore E_1$(Energy of 1st orbit of H-atom)

$= -2.18 \times 10^{-18}$J atom^{-1}

$\therefore E_n = \frac{-2.18 \times 10^{-18}}{n^2}$J atom^{-1}

$Z = 1$ for H − atom

$\Delta E = E_4 - E_1$

$= \frac{-2.18 \times 10^{-18}}{4^2} - \frac{-2.18 \times 10^{-18}}{1^2}$

$= -2.18 \times 10^{-18} \times \left[\frac{1}{4^2} - \frac{1}{1^2}\right]$

$\Delta E = h\nu = -2.18 \times 10^{-18} \times -\frac{15}{16}$

$= +2.0437 \times 10^{-18}$J atom^{-1}

$\therefore \quad \nu = \frac{\Delta E}{h} = \frac{2.0437 \times 10^{-18}\text{J atom}^{-1}}{6.625 \times 10^{-34}\text{Js}}$

$= 3.084 \times 10^{15}$s^{-1}atom^{-1}

192 **(a)**

Node is the surface where electron density = 0.

193 **(c)**

Higher photo-current implies , higher no. of electrons emitted/sec.

194 **(c)**

No. of subshells in a subshell $= 2l + 1$

195 **(a)**

Magnetic quantum number signifies the possible number of orientations of an orbital.

196 **(a)**

It is due to isotopic effect.

197 **(c)**

For $n = 4, l \neq 4$, for $n = l = 3, m \neq 4$

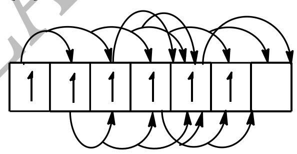
198 **(b)**

Bohr proposed the concept of stationary state known as orbits.

199 **(a)**

Follow photoelectric effect.

200 **(d)**



$5 + 4 + 3 + 2 + 1 = 15$

201 **(c)**

Isoelectronic species have same number of electron. Mg^{2+} and Na^{+}both have 10 electrons hence, they are isoelectronic species.

202 **(c)**

This is obtained by the solution of Schrodinger wave equation

Probability $= \Psi^2 dV$

Ist orbital is spherically symmetrical

$\therefore V = \frac{4}{3}\pi r^3, \therefore \frac{dV}{dr} = 4\pi r^2$

$\because$ Probability $= \Psi^2 4\pi r^2 dr$

204 **(a)**

$\Delta E_{(\text{eV})} = \frac{12375}{\lambda_{\text{in Å}}} = \frac{12375}{5890} = 2.10$ eV

205 **(b)**

1 eV $= 1.602 \times 10^{-12}$erg.

206 **(b)**

s can have only two values $+1/2$ and $-1/2$.

207 **(c)**

The de-Broglie wavelength associated with the charged particle as

For electron, $\lambda = \frac{12.27}{\sqrt{V}}$ Å

For proton, $\lambda = \frac{0.286}{\sqrt{V}}$ Å

For α-particles, $\lambda = \frac{0.101}{\sqrt{V}}$ Å

208 **(b)**

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{1.67 \times 10^{-27} \times 1 \times 10^3}$$
$$= 3.97 \times 10^{-10} \text{m} \sim 0.40 \text{ nm.}$$

209 **(b)**

The number of waves in an orbit$=n$.

210 **(a)**

$$E \propto \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

or $E \propto \frac{1}{n^2}$

211 **(b)**

n is an integer except zero.

212 **(c)**

According to aufbau principle, electrons enter into orbitals according to their energy. The electrons first enters into orbital having lesser value of $(n + l)$. If the value of $n + l$ is same for two orbitals then the electron will first enter into orbital having lesser value of n.

$n = 5, l = 0 \therefore n + l = 5 + 0 = 5$

For other,

$n = 3, l = 2 \quad \therefore n + l = 3 + 2 = 5$

$\because$ Both of the orbitals have same value for $n + l$.

$\therefore$ Electron will enter into orbital having lower value of n.

$\therefore$ Electron will enter into $n = 3, l = 2$ orbital.

213 **(b)**

$E = \frac{hc}{\lambda}$, h and c for both causes are same so,

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{16000}{8000}$$
$$E_1 = 2E_2$$

214 **(c)**

When $n = 3$, number of values of l are 0 to $(n - 1) i.e.$, 0, 1, 2

Hence,

when $n = 3$, then $l = 3$ does not exist.

215 **(c)**

We know that,

$$\Delta E = hc.R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

For lowest energy, of the spectral line in Lyman series, $n_1 = 1, n_2 = 2$

Hence,

$$\Delta E = hc.R\left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\Delta E = \frac{3hcR}{4}$$

216 **(c)**

Cathode rays are fastly moving electrons.

217 **(c)**

9. $n = 4, l = 0, m = 0, s = +\frac{1}{2}$

$\rightarrow 4s$ energy level.

10. $n = 3, l = 1, m = -1, s = +\frac{1}{2}$

$\rightarrow 3p$ energy level.

11. $n = 3, l = 2, m = -2, s = +\frac{1}{2}$

$\rightarrow 3d$ energy level.

12. $n = 3, l = 0, m = 0, s = +\frac{1}{2}$

$\rightarrow 3s$ energy level.

According to aufbau principle, the energy of orbitals (other than H-atom) depend upon $n + 1$ value.

$n + l$ for $3d = 3 + 2 = 5$

So, it is highest energy level (in the given options).

218 **(d)**

Each one possesses mass.

219 **(c)**

X-rays have larger wavelength than γ-rays.

220 **(c)**

$$\Delta E = \frac{hc}{\lambda}$$

221 **(c)**

H atom has $1s^1$ configuration.

222 **(d)**

No charge by doubling mass of electrons, however, by reducing mass of neutron to half total atomic mass becomes $6 + 3$ instead of $6 + 6$. Thus, reduced by 25%.

223 **(b)**

It is a characteristic fact.

224 **(c)**

Tritium contains 2 neutrons and 1 proton.

225 **(c)**

$\text{Fe}(26) = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

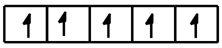
$3d^6$ means | ↑↓ | ↑ | ↑ | ↑ | ↑ |

Hence, it has 4 unpaired electrons.

$\text{Fe}^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^0$

$\therefore$ It also has 4 unpaired electrons.

$Fe^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^0$

$3d^5$ means 

Hence, it has 5 unpaired electrons.

226 **(b)**

Follow Pauli's exclusion principle.

228 **(c)**

The mass of electron $= \frac{1}{1837}$ (mass of lightest nuclei)

or approximately $\frac{1}{1800}$

229 **(b)**

Both have $1s^2, 2s^2 2p^6, 3s^2 3p^6$ configuration.

230 **(c)**

No. of orbitals in a shell $= n^2$.

231 **(d)**

According to Bohr's model of hydrogen atom, the energy of electrons in the orbit is quantised, the electron in the orbit nearest to nucleus has lowest energy and electrons revolve in different orbits around the nucleus.

Whereas according to Heisenberg's uncertainty principle position and velocity of the electrons in the orbit cannot be determined simultaneously.

232 **(b)**

A proton requires more energy for penetration due to its relatively higher mass and positive charge than electron.

234 **(d)**

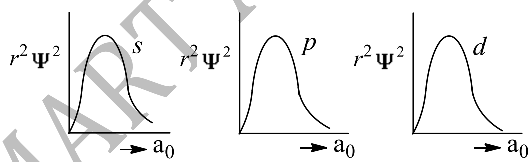
Last electron of Mg^+ is $3s^1$.

235 **(a)**

$_{26}Fe$ has 2,8,14,2 configuration.

236 **(c)**

The electron density is directly proportional to Ψ^2. The larger the electron density, the larger the value of Ψ^2 and more is the probability of finding the electrons



237 **(b)**

$4p$ is more closer to nucleus.

238 **(b)**

$Ca^{2+}(2, 8, 8)$ and Ar $(2, 8, 8)$ contains equal number (18) of electrons, hence they are isoelectronic.

239 **(c)**

Threshold frequency (v_0) means for zero kinetic energy of electrons; Thus,

$hv =$ work function $+(1/2)mu^2$

or $hv_0 =$ work function

240 **(a)**

1. For $n = 4, l = 1;\ 4p$
2. For $n = 4, l = 0;\ 4s$
3. For $n = 3, l = 2; 3d$
4. For $n = 2, l = 1; 2p$

The order of increasing energy is as

$$2p < 4s < 3d < 4p$$

$$i.e., (\text{IV}) < (II) < (III) < (I)$$

241 **(c)**

$E_n = \frac{E_1}{n^2} \times Z^2$

$= \frac{-13.6}{4} \times 9 = -30.6$ eV

(for the excited state, $n = 2$ and for Li^{2+}ion, $Z = 3$)

242 **(b)**

Given, azimuthal quantum number (l)=2

Number of orbital's =$(2l+1)$

$= (2 \times 2 + 1) = 4 + 1 = 5$

243 **(b)**

Heaviest atom has mass no. 238, $(i.e., {}_{92}U^{238})$ and lighter one is ${}_1H^1$.

244 **(d)**

$\lambda = \frac{h}{mu}$.

245 **(c)**

p_x orbital has two lobes on x-axis.

246 **(d)**

f-orbital has 7 orientations.

248 **(b)**

III shell is more closer to nucleus.

249 **(b)**

Ar and Ca^{2+} are isoelectronic species as they have same number of electrons, $i.e.$, 18.

250 **(b)**

$p = mu = \frac{h}{\lambda}$ and $E = \frac{hc}{\lambda}$

$\therefore E = \frac{c}{\lambda} \cdot p \cdot \lambda = c \cdot p$

251 **(a)**

$\Delta x . \Delta v \geq \frac{h}{4\pi m}$

$\Delta x \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 25 \times 10^{-3} \times 10^{-5}}$

$= 2.10 \times 10^{-28}$m

252 **(d)**

Mass of neutron $= 1.675 \times 10^{-27}$ kg .

253 **(c)**

$\lambda = \frac{h}{mu} = \frac{6.62 \times 10^{-34}}{66 \times 10^3 \times 1}$

255 **(c)**

$n = 4$(4th shell)

$l = 2$(d-subshell)

$m_1 = -2(d_{xy}$ orbital)

$s = +\frac{1}{2}(\uparrow)$

Hence, electron belongs to 4d-orbital.

256 **(d)**

The four lobes of $d_{x^2-y^2}$ orbital are lying along x and y axes, while the two lobes of d_{z^2} orbital are lying along z-axis, and contain a ring of negative charge surrounding the nucleus in xy plane

2s orbitals has one spherical node, where electron density is zero

p-orbital have direction character

Orbital $\longrightarrow p_z \quad p_x \quad p_y$

$m \longrightarrow 0 \quad \pm 1 \quad \pm 1$

Nodal plane $\longrightarrow xy \quad yz \quad zx$

257 **(c)**

d_{xy} orbital lies at 45° angle in between x-and y-axes.

258 **(d)**

According to Pauli exclusion principle.

259 **(b)**

$E = \frac{hc}{\lambda}$.

260 **(d)**

Cu has configuration [Ar]3d^{10}, 4s^1; the two electrons are lost, one from 4s^1 and one from 3d^{10}.

261 **(d)**

Ions have charge, different size and configuration than atom.

262 **(c)**

H^- has two electrons.

263 **(b)**

In the ground state of an atom the number of states is limited by Hund's rule. There are $\frac{\lfloor n}{\lfloor r \cdot \lfloor n-r}$ ways in which electron in an orbital may be arranged which do not violate Pauli's exclusion principle.

Where, n=number of maximum electrons that can be filled in an orbital and r=number of electrons present in orbital.

But the valid ground state term is calculated by Hund's rule of maximum multiplicity. As Hund's rule gives the most stable electronic configuration of electrons.

264 **(a)**

$\frac{1}{\lambda} = Z^2.R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\Rightarrow \frac{1}{\lambda} = (Z)^2.R_H\left\{\frac{1}{1} - \frac{1}{4}\right\} = \frac{3}{4}R_H Z^2$

$\therefore \lambda \propto \frac{1}{Z^2}$

Hence for shortest λ, Z must be maximum, which is for Li^{2+}.

265 **(c)**

Element with atomic no. 17 has $3s^2 3p^5$ valence shell.

266 **(b)**

The electronic configuration of element with at. no. 105 is:

$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^6 4d^{10} 4f^{14}$,

$5s^2 5p^6 5d^{10} 5f^{14}, 6s^2 6p^6 6d^3, 7s^2$

for $5f$ $(n + l) = 5 + 3 = 8$

for $6d$ $(n + l) = 6 + 2 = 8$

267 **(b)**

Average mass $=$ (m + 0.5) $=$

$\frac{m \times 4 + (m+1) \times 1 + (m+2) \times 1}{6} = \frac{6m+3}{6}$

268 **(d)**

$r_n = \frac{r_1 n^2}{Z}$; r_1 is radius of H-atom.

269 **(d)**

According to Bohr model,

Radius of hydrogen atom

$(r_n) = \frac{0.529 \times n^2}{Z}$ Å

Where, n= number of orbit

Z= atomic number

$r_3 = \frac{0.529 \times (3)^2}{1} = 4.761$Å

270 **(a)**

de Broglie equation is $\lambda = \frac{h}{mu}$

271 **(b)**

$E_3 = E_1 + E_2$ or $\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$

272 **(c)**

e.g., oxygen has O^{16}, O^{17} and O^{18} isotopes.

273 **(d)**

Energy order : $5s < 4d < 4f$.

274 **(a)**

1F $= 10^{-13}$ cm $= 10^{-15}$ m

275 **(b)**

The difference of energy is given out.

276 **(b)**

$E_X > E_{VR} \therefore \lambda_{VR} > \lambda_X$ or X is UV region.

277 **(c)**

According to aufbau principle, as electron enters the orbital of lowest energy first and subsequent electrons are fed in the order of increasing energies. The relative energies of various orbital in increasing order are

$1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p$

278 **(b)**

No. of (valence) electrons in $NH_4^+ = 8$,

No. of valence electron in N, $(i.e., 5)$ + No. of e in 4H, $(i.e., 4) - 1$(of +ve charge).

280 **(d)**

Hydrogen spectrum is an emission spectrum. It shows the presence of quantized energy levels in hydrogen atom.

281 **(c)**

Total no. of protons in all the elements from at. no. 1 to at no. $n = n \times (n+1)/2$.

282 **(b)**

$$\text{Frequency } (n) = \frac{1}{\text{time period } (T)}$$

Here, $T = 5 \times 10^{-3}$s

$$n = \frac{1}{5 \times 10^{-3}} = 0.2 \times 10^3$$
$$= 2 \times 10^2 \text{s}^{-1}$$

283 **(a)**

$\frac{e}{m}$ for : (i) neutron $= \frac{0}{1} = 0$

(ii)α-particle $= \frac{2}{4} = 0.5$

(iii)proton $= \frac{1}{1} = 1$

(iv)electron $= \frac{1}{1/1837} = 1837$

284 **(d)**

It is the definition of degenerate orbitals.

285 **(a)**

N and P have 3 unpaired electrons in $2p$ and $3p$ respectively; V has 3 unpaired electrons in $3d$.

286 **(a)**

$$\text{Momentum of photon} = mu = \frac{h}{\lambda} \left(\because \lambda = \frac{h}{mu}\right)$$
$$= \frac{6.6 \times 10^{-34}}{2 \times 10^{-11}} = 3.3 \times 10^{-23} \text{kg m s}^{-1}$$

287 **(c)**

$35 = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^5$

Thus, it contains 7 electrons in 4th or outermost shell

288 **(b)**

Follow Dalton's assumptions.

289 **(d)**

Schrödinger proposed the concept of orbitals –a three-dimensional region in which probability for finding electron is maximum.

290 **(d)**

All are facts

291 **(d)**

Pb sheets cut X-rays.

292 **(c)**

Maximum no. of electron in an orbit $= 2n^2$.

293 **(c)**

Total values of $'m'$ in a given shell $= n^2$.

294 **(d)**

$$\frac{1}{\lambda} = Z^2, R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

For He^+, $\frac{1}{\lambda} = 2^2 . R_H \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = 4 \times \frac{3}{16} = \frac{3}{4}$

For H, $\frac{1}{\lambda} = 1^2 . R_H \left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3}{4}$

Hence, for hydrogen $n = 2$ to $n = 1$.

295 **(b)**

After filling up of electron in np, the next electron occupies $(n+1)s$ level.

296 **(c)**

$$\frac{1}{\lambda_{\text{Lyman}}} = R_{\text{H}} \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right];$$
$$\frac{1}{\lambda_{\text{Balmer}}} = R_{\text{H}} \left[\frac{1}{2^2} - \frac{1}{\infty^2}\right]$$

297 **(c)**

Work function for Cs is minimum.

298 **(c)**

It is famous Schrödinger wave equation.

299 **(a)**

Tritium has only one electron.

300 **(b)**

A characteristic of cathode rays particles (electrons).

301 **(a)**

$E = 3 \times 10^{-12}$ergs

$\lambda = ?$

$h = 6.62 \times 10^{-27}$ergs

$c = 3 \times 10^{10}$cms^{-1}

$$E = \frac{hc}{\lambda}$$
$$3 \times 10^{-2} = \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{\lambda}$$
$$\lambda = \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{3 \times 10^{-12}}$$
$$= 6.62 \times 10^{-5} \text{cm}$$
$$= 662 \times 10^{-7} \text{cm}$$
$$= 662 \times 10^{-9} \text{m}$$
$$= 662 \text{ nm.}$$

302 **(a)**

5. $1s$

6. $2s$

7. $2p$

8. $3d$

9. $3d$

In the absence of any field, $3d$ in (D) and (E) will be of equal energy.

303 **(c)**
Zeeman effect is splitting up of the lines of an emission spectrum in a magnetic field.

304 **(d)**
Bohr radius for nth orbit $= 0.53 \times \frac{n^2}{Z}$
Where, Z =atomic number
$\therefore$ Bohr radius of 2nd orbit of $Be^{3+} = \frac{0.53\times(2)^3}{4}$
$= 0.53$ Å
(d) Bohr radius of 1st orbit of H= $\frac{0.53\times(1)^2}{1}$

Hence, Bohr's radius of 2nd orbit of $Be^{3+}$is equal to that of first orbit of hydrogen.

305 **(c)**
$$\lambda = \frac{h}{mv}$$
$$\therefore mv = \frac{6.626\times10^{-34}}{5200\times10^{-10}} = 1.274\times10^{-27}$$
For electron, $m = 9.1\times10^{-31}$kg
$9.1\times10^{-31}\times v = 1.274\times10^{-27}$
$v = 1400$ m/s

306 **(b)**
$(n+l)$ is more for a subshell, more will be its energy.

307 **(c)**
$[Ar]3d^{10}, 4s^1$ (atomic no. 29) electronic configuration belongs to copper.

308 **(a)**
Li^+ has charge of 1 proton due to loss of electron.

309 **(c)**
Mass or proton $= 1.672614\times10^{27}$kg
Mass of electron $= 1.60211\times10^{-31}$kg
$\therefore$ Mass of proton/Mass of electron $= \frac{1}{1837}$

310 **(c)**
Follow : $E_n = E_1/n^2$

312 **(a)**
Orbital angular momentum $= \sqrt{l(l+1)}\times\frac{h}{2\pi}$
For p-electron $(l=1) = \sqrt{1(1+1)}\times\frac{h}{2\pi}$
$$= \sqrt{2}\times\frac{h}{2\pi} = \frac{h}{\sqrt{2}\pi}$$

313 **(a)**
Transition from any higher level to $n = 1$ gives Lyman series.

314 **(a)**
$$\text{Total energy} = \frac{-e^2}{2r_n} = -3.4\text{ eV} = \frac{E_1}{n^2}$$
$$\therefore n^2 = \frac{-13.6}{-3.4} = 4 \;\therefore n = 2$$
The velocity in II orbit
$$= \frac{u_1}{2} = \frac{2.18\times10^8}{2}\text{ cm sec}^{-1}$$
$$\therefore \lambda = \frac{h}{mu} = \frac{6.6\times10^{-27}\times2}{9.108\times10^{-28}\times2.18\times10^8}$$
$$= 6.6\times10^{-10}$$

315 **(c)**
The orbital d_{z^2} has 2 lobes.

316 **(c)**
Nucleus of an atom is small in size but carries the entire mass *i.e.*, contains all the neutrons and protons.

317 **(a)**
In C_2H_2 total electrons $= 6+6+1+1 = 14$.

318 **(a)**
Cu^+ has $3d^{10}$ configuration.

319 **(a)**
Only 2 electrons in p-orbitals can have $m = 0$.

321 **(a)**
λ for visible light is in the range of 400 to 780 nm.
$$E = \frac{hc}{\lambda}.$$
This, it is in the range of electron volt (eV).

323 **(a)**
To cross over threshold energy level.

324 **(d)**
$$\Delta E = h\nu = \frac{hc}{\lambda}$$
$$\lambda = \frac{hc}{\Delta E} = \frac{6.62\times10^{-34}\times3\times10^8}{4.4\times10^{-14}}$$
$= 4.52\times10^{-12}$m

325 **(c)**
$$_{r_2}Be^{3+} = \frac{r_1H}{4}\times2^2$$
$$\left(\because r_2H = r_{1\,H}\times2^2 \text{ and } {}_{r_n}Be^{3+} = \frac{r_nH}{n}\right)$$

326 **(b)**
An experimental fact.

327 **(d)**
The transition is almost instantaneous process

328 **(b)**

The values of m are $-l$ to $+l$ through zero.

329 **(b)**

A fact.

330 **(c)**

X-rays are light waves or a form of light energy.

331 **(c)**

$$\Delta x \cdot \Delta v \geq \frac{h}{4\pi m}$$

332 **(d)**

$$\overline{v} = \frac{1}{\lambda} = R'Z^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

For shortest wavelength (maximum energy) in Lyman series of hydrogen $Z = 1, n_1 = 1, n_2 \longrightarrow \infty$ and

$\lambda = x$

$\frac{1}{x} = R'$

For longest wavelength (minimum energy) in Balmer series of He^+, $Z = 2$ and $n_1 = 2, n_2 = 3$

$$\frac{1}{\lambda} = R'2^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = \frac{4}{x}\left[\frac{1}{4} - \frac{1}{9}\right]$$

$$\frac{1}{\lambda} = \frac{4}{x}\frac{5}{36}$$

$$\lambda = \frac{9x}{5}$$

333 **(d)**

Rydberg is an unit of energy.

334 **(a)**

Neutrons are neutral particles.

335 **(d)**

$+\frac{1}{2}$ and $-\frac{1}{2}$ spinning produces angular momentum equal to Z − component of angular momentum which is given as $m_s(h/2\pi)$

336 **(c)**

Since, hv = work function $+(1/2)mu^2$.

337 **(d)**

$$\lambda = \frac{h}{p}$$

$$v = \frac{c}{\lambda}$$

$$v = \frac{3 \times 10^8 \times 1.1 \times 10^{-23}}{6.6 \times 10^{-34}}$$

$$= 5.0 \times 10^{18}\text{Hz}$$

338 **(b)**

$$E = \frac{hc}{\lambda} = hv$$

339 **(b)**

Step 1 Calculate energy given to I_2 molecule by $\frac{hc}{\lambda}$

Step 2 Calculate energy used to break I_2 molecule. The difference in above two energies will be the KE of two I atoms

340 **(a)**

It is a fact.

341 **(b)**

Find λ from $E = \frac{hc}{\lambda}$; It comes out to be 4965 Å, which represents visible region (*i.e.*, in between 3800 − 7600 Å).

342 **(a)**

The ground state configuration of chromium is

$_{24}Cr = [Ar]3d^5 4s^1$

$\therefore \; _{24}cr^{2+} = [Ar]3d^4 4s^0$

343 **(b)**

The atomic number of cesium is 55. The electronic configuration of cesium atom is

$_{55}Cs$

$= 1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^2, 3d^{10} 4p^6, 5s^2, 4d^{10}, 5p^6$

The electronic configuration of cesium atom is

Cs^+

$= 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^6 4d^{10}, 5s^2 5p^6, 6$

So, the total number of s-electrons =10,

The total number of p-electrons=24,

The total number of d-electrons=20

344 **(c)**

$KE = (1/2)mu^2 = \text{eV}$

$$\therefore u = \sqrt{\frac{2eV}{m}}$$

345 **(b)**

Sine, $E \propto -\frac{1}{n^2}$

The energy of an electron in the second orbit will be

$$E_2 = \frac{E_1}{4} = \frac{(-2.18 \times 10^{-18}\text{J})}{4}$$

$$= -5.45 \times 10^{-19}\text{J}$$

346 **(b)**

Velocity of an electron in first orbit of H atom is

$$u = \frac{2.1847 \times 10^8}{1}\text{cms}^{-1}$$

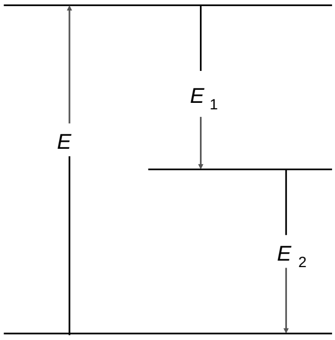
Hence, it is $\frac{1}{100}$th as compared to the velocity of light.

347 **(c)**

Energy values are always additive.

$E_{\text{total}} = E_1 + E_2$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$



$$\frac{1}{\lambda}=\frac{1}{\lambda_1}+\frac{1}{\lambda_2}$$

$$\frac{1}{355}=\frac{1}{680}+\frac{1}{\lambda_2}$$

$\lambda_2 = 742.77\text{ nm} \approx 743\text{ nm}$

348 **(d)**

Bohr's model is against the law of electrodynamics.

349 **(b)**

Fe^{3+} ion has the following configuration

$Fe^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5$

Hence, ferric ion is quite stable due to half-filled d-orbitals.

350 **(c)**

During the experimental verification of de Broglie equation, Davission and Germer confirmed wave nature of electron.

For a given shell, say $n = 2, l = 0 \therefore m = 0$

$l = 1 \therefore m = -1, 0, +1$

351 **(c)**

Anode rays particles are ionised gaseous atoms left after removal of electron.

352 **(c)**

P has 5 valence electron; each H has 1;

Thus, total electrons = 5 + 4 − 1 = 8.

353 **(b)**

Neutron is composed of $_{+1}p^1 + {}_{-1}e^0$ and thus, net charge is zero.

354 **(c)**

Picture tube of TV set is cathode rays tube.

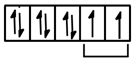
355 **(d)**

s-subshell has only one orbital and that is spherical, hence, s-orbitals are non-directional.

356 **(b)**

$_{28}Ni = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^8$

$Ni^{2+} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^8$



two unpaired electrons

357 **(d)**

In $_1H^3$, nucleons are 3.

359 **(a)**

m can be $\underline{+}2, \underline{+}1$ and 0 for $3d$-subshell.

360 **(c)**

For Paschen series, $n_1 = 3$ and $n_2 = 4, 5, 6$

361 **(c)**

$3d$-subshell has five orbitals. Each orbital can have one electron with spin $+1/2$.

362 **(a)**

The no. of nucleons in O^{16} and O^{18} are 16 and 18 respectively.

363 **(b)**

de-Broglie wavelength, $\lambda = \frac{h}{p} = \frac{h}{mv}$

($\because$momentum $p = mv$)

$$\Rightarrow \lambda = \frac{6.62 \times 10^{-34}\text{J} - \text{s}}{6.62 \times 10^{-27} \times 10^6 \text{kg m/s}}$$

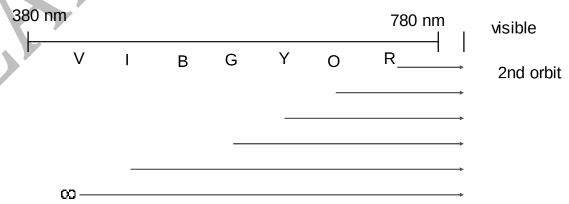
$= 10^{-13}\text{m}$

364 **(a)**

For $n = 2$; l can have value only 0 and 1, $i.e.$, s and p-subshells.

365 **(b)**

Hydrogen spectrum coloured radiation means visible radiation corresponds to Balmer series ($n_1 = 2, n_2 = 3, 4 \ldots$)



3rd line from the red end it means 5→ 2

366 **(d)**

Frequencies emitted

$= \sum(n-1) = \sum(5-1) = \sum 4$

$= 1 + 2 + 3 + 4 = 10$

367 **(a)**

Heisenberg's uncertainty principle; de Broglie's dual concept.

368 **(c)**

Follow planck's quantum theory.

369 **(c)**

As per Pauli's exclusion principle "no two electrons in the same atom can have all the four quantum numbers equal or an orbital cannot contain more than two electrons and it can accommodate two electrons only when their directions of spins are opposite."

370 **(d)**

Br (At. no.=35)

E. C. $= 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^5$

$\therefore$ Br atom has 17 p-electrons.

371 **(a)**

K^+ and Ar both have 18 electrons.

372 **(d)**

Since $m = 2$ and thus, l must be not lesser than m.

373 **(b)**

Cr $(24) = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$

374 **(d)**

Configuration of atomic number 14 is

$1s^2, 2s^2 2p^6, 3s^2 3p^2$;

One p-orbital and five d-orbitals are vacant.

375 **(c)**

$E_n = -\frac{13.6}{n^2}$eV

For second excited state $n = 3$,

$E_3 = -\frac{13.6}{9} = -1.51$eV

376 **(a)**

Kinetic energy $= \frac{Ze^2}{2r}$

377 **(d)**

$E_1 = -13.6$ eV; Thus, it can absorb 13.6 eV to get itself knocked out.

378 **(b)**

Wave-nature of electrons was first demonstrated by de-Broglie's who gave following equation for the wavelength of electrons

$$\lambda = \frac{h}{mv}$$

379 **(b)**

$E_n = \frac{-13.6 \times Z^2}{n^2}$eV

For H atom, $Z = 1$,

$-3.4 = \frac{-13.6 \times (1)^2}{n^2}$

$\Rightarrow\ n^2 = 4$

$\therefore n = 2$

380 **(d)**

This is according to Pauli's exclusion principle. The principle states that no two electrons of the same atom can have all the four quantum number values identical.

381 **(d)**

The values of quantum number will give idea about the last subshell of element. From that value we can find the atomic number of element,

$n = 3$ means 3rd-shell

$\left.\begin{matrix} l = 0 \\ m = 0 \end{matrix}\right\}$means subshell

It means it is $3s$-subshell which can have 1 or 2 electrons.

$\therefore$ Configuration of element is

$1s^2, 2s^2, 2p^6, 3s^{1-2}$

$\therefore$ Atomic $i.e.$, number is 11 or 12.

382 **(a)**

$hv =$ work function $+KE$;

or $hv = hv_0 + KE$;

$hv_0 =$ work function $= \frac{hc}{\lambda_0}$;

where λ_0 is threshold wavelength.

383 **(a)**

The Sc atom has $3d^1, 4s^2$ configuration.

384 **(a)**

Wave number of spectral line in emission spectrum of hydrogen,

$\bar{v} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ ... (i)

Given, $\bar{v} = \frac{8}{9} R_H$

On putting the value of $\bar{v}$ in Eq. (i), we get

$\frac{8}{9} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$\frac{8}{9} = \frac{1}{(1)^2} - \frac{1}{n_2^2}$

$\frac{8}{9} - 1 = -\frac{1}{n_2^2}$

$\frac{1}{3} = \frac{1}{n_2}$

$\therefore\ \ n_2 = 3$

Hence, electron jumps from $n_2 = 3$ to $n_1 = 1$

385 **(b)**

J.J. Thomson (1987) was first experimentally demonstrated particle nature of electron. It was first of all proposed by Millikan's oil drop experiment.

386 **(b)**

Angular momentum for n and $(n + 1)$ shells are $\frac{nh}{2\pi}$ and $(n + 1)\frac{h}{2\pi}$.

387 **(b)**

The volume of nucleus : volume of atom,

$\frac{4}{3}\pi r_n^3 : \frac{4}{3}\pi r^3$ atom.

388 **(c)**

O^{2-} has 10 electrons but 8 neutrons ($_8O^{16}$).

390 **(c)**

Possible mol. wt. may be 18,20,19,20,22,21 respectively for

$H^1H^1O^{16}, H^2H^2O^{16}, H^1H^2O^{16}, H^1H^1O^{18}, H^2H^2O^{18}$, H

.

391 **(c)**

Magnetic moment $= \sqrt{[n(n + 2)]}$ where n is number of unpaired electrons .

392 **(d)**

Hertz for the first time noticed the effect.

393 **(b)**

Cr (24): $[Ar]3d^5 4s^1$
Cr^{3+}: $[Ar]3d^3 4s^0$

394 **(d)**
A part of energy of photon ($h\nu$-work function) is used for kinetic energy of electrons.

395 **(b)**
$$\frac{e}{m} \text{ for electron } (e) = \frac{1.6 \times 10^{-19}}{9.1 \times 10^{-28}} = 1.758 \times 10^8$$
$$\frac{e}{m} \text{ for proton } (p) = \frac{1.6 \times 10^{-19}}{1.672 \times 10^{-24}} = 9.56 \times 10^4$$
$$\frac{e}{m} \text{ for neutron } (n) = \frac{0}{1.675 \times 10^{-24}} = 0$$
$$\frac{e}{m} \text{ for } \alpha - \text{particle} = \frac{2}{4} = 0.5$$
Hence, the increasing order of $\frac{e}{m}$ is as
$n < \alpha < p < e$

396 **(d)**
Ionisation energy of nitrogen =energy of photon
$= Nh\frac{c}{\lambda}$
where, $N = 6.02 \times 10^{23}$
$c = 3 \times 10^8 \text{ms}^{-1}$
$\lambda = 854 \text{ Å} = 854 \times 10^{-10}\text{m}$
$$= \frac{6.02 \times 10^{23} \times 6.6 \times 10^{-34} \times 3 \times 10^8}{854 \times 10^{-10}}$$
$= 1.4 \times 10^6 \text{ J mol}^{-1}$
$= 1.4 \times 10^3 \text{ kJ mol}^{-1}$

397 **(a)**
e/m for proton $= \frac{1}{1}$; e/m for $\alpha = \frac{2}{4}$

398 **(a)**
$$E = n\frac{hc}{\lambda}$$
$h = 6.6 \times 10^{-34}$ Js or 1J
$$= \frac{n \times 6.6 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10}}$$

399 **(c)**
We know that the energy is emitted in the form of quanta and is given by,
$$\Delta E = h\nu = \frac{hc}{\lambda}$$
or $\lambda = \frac{hc}{\Delta E}$
$$= \frac{6.62 \times 10^{-27} \times 3 \times 10^{10}}{3 \times 1.6 \times 10^{-12}}$$
$= 4.14 \times 10^{-5}$ cm
$= 4140$ Å

401 **(a)**
${}_{19}K = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$
${}_{25}Mn = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$
${}_{28}Ni = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$
${}_{21}Sc = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$
Therefore, K has least number of electrons in its M-shell ($n = 3$) = 8.

402 **(b)**
KE of charged particle = change × pot. Difference.

403 **(c)**
According to wave mechanics, the latest approach for electron in orbital.

404 **(c)**
According to rules of quantum number the possible values of n, l, m and s are
$n = 1$ to ∞ any whole number
$l = 0$ to $(n - 1)$ for every value of n
$m = -l$ to zero to $+l$ for every value of l
$s = \frac{1}{2}$ or $-\frac{1}{2}$

0. $n = 4, l = 3, m = 0$

   All the values are according to rules.

1. $n = 4, l = 2, m = 1$

   All the values are according to rules.

2. $n = 4, l = 4, m = 1$

   ∵The value of l can have maximum $(n - 1)$value *i.e.*, 3 in this case.

   ∴ This set of quantum numbers is non-permissible.

3. $n = 4, l = 0, m = 0$

   All the values are according to rules.

∴ Choice (a), (b) and (d) are permissible.

405 **(d)**
s-orbital can have only two electrons.

406 **(c)**
ΔE for H = 10.2 eV for $n = 1$ to $n = 2$
∴ ΔE for $Be^{3+} = 10.2 \times Z^2$ for $n = 1$ to $n = 2$
∵ $Z = 4$ ∴ $\Delta E = 10.2 \times 16 = 163.2$

407 **(b)**
In $3p$-subshell max. no of electrons = 6.

408 **(a)**
$$\frac{1}{\lambda} = R\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3R}{4}$$
$$\lambda = \frac{h}{p}$$
$$P = \frac{h}{\lambda} = h \times \frac{3R}{4} = \frac{3Rh}{4}$$

409 **(c)**

$E_n > E_e$

410 **(a)**

Follow Planck's quantum theory.

411 **(d)**

${}_{14}$Si: $1s^2, 2s^2 2p^6, 3s^2 3p^2$, *i.e.*, 3 orbits of s and 8 orbitals of p.

412 **(a)**

2nd excited state means 3rd energy level.

$$E_3 = \frac{E_1}{n^2} = \frac{-13.6}{9} = -1.51 \text{ eV}$$

413 **(b)**

${}_{24}\text{Cr} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

Thus, $l = 1$ is s-orbital and $l = 2$ is p-orbital

414 **(c)**

In excited state S has six unpaired electrons.

415 **(a)**

Nearly half-filled orbitals tend to acquire exactly half-filled nature to attain lower energy level.

416 **(c)**

$$\overline{v} = \frac{1}{\lambda} = \frac{1}{500 \times 10^{-9}} = 2 \times 10^6 \text{m}^{-1}$$

417 **(c)**

$$E_1 = \frac{hc}{\lambda_1} \text{ and } E_2 = \frac{hc}{\lambda_2}$$

$$\therefore \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{25}{50} = \frac{\lambda_2}{\lambda_1}$$

$$\therefore \lambda_1 = 2\lambda_2$$

418 **(a)**

N^{3-} has three more electrons than N atom.

419 **(c)**

Option (c) is correct as in it Pauli's exclusion principle is violated but Hund's rule does not

420 **(d)**

An experimental fact.

421 **(b)**

$\lambda_1 = 3000\text{Å}, \lambda_2 = 6000\text{Å}$

$$E_1 = \frac{hc}{\lambda_1} = \frac{hc}{3000}$$

$$E_2 = \frac{hc}{\lambda_2} = \frac{hc}{6000}$$

$$\frac{E_1}{E_2} = \frac{\frac{hc}{3000}}{\frac{hc}{6000}} = \frac{hc}{3000} \times \frac{6000}{hc} = \frac{2}{1}$$

$E_1 : E_2 = 2 : 1$

422 **(a)**

The radiation energy absorbed is used to overpower effective nuclear charge and imparting velocity to electron $hv = W + KE$.

423 **(b)**

$l = 3$ represent for f − subshell.

424 **(b)**

$$E_n = \frac{E_1}{n^2} \quad \therefore E_2 = \frac{-54.4}{4} = -13.6 \text{ eV}$$

425 **(d)**

No. of fundamental particles = 6 protons + 6 electrons + 8 neutrons = 20.

426 **(a)**

The configuration of ${}_{24}$Cr is

$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$

∴ Total s-orbitals = 4

Total p-orbitals = 6

Total d-orbitals = 5 and thus

Total orbitals = 4 + 6 + 5 = 15

428 **(c)**

$m \ngtr l$ for $l = 1$.

429 **(d)**

$$\lambda = \frac{h}{mv} \quad [mv = \sqrt{2m \cdot KE}]$$

$$\lambda = \frac{h}{\sqrt{2m \cdot KE}}$$

$$KE \propto \frac{1}{\lambda^2 \sqrt{2m}}$$

Since, λ is same,

KE $\propto \frac{1}{m}$

The order of mass of electron, alpha particle and proton is $m_a > m_p > m_e$

Thus, the order of KE is $E_e > E_p > E_a$

430 **(d)**

${}_{20}\text{Ca} = 2, 8, 8, 2$

$\text{Ca}^{2+} = 2, 8, 8$

Hence, Ca^{2+} has 8 electrons each in outermost and penultimate shell.

431 **(c)**

$$\frac{1}{2}mu^2 = E_k^{\max} = hv - w = (6 - 2.1)\text{eV}$$

$= 3.9$ eV or $eV_0 = 3.9$ eV

Thus, stopping potential = −3.9 eV

432 **(d)**

$$\Delta x = \Delta p \quad \therefore \Delta x \cdot \Delta p = \frac{h}{4\pi}$$

$$\text{or} \quad \Delta x = \sqrt{\frac{h}{4\pi}}$$

$$\text{Now}, \Delta x \cdot \Delta u = \frac{h}{4\pi m}$$

$$\therefore \Delta u = \frac{h}{4\pi m} \times \sqrt{\frac{4\pi}{h}} = \frac{1}{2m} \times \sqrt{\frac{h}{\pi}}$$

433 **(a)**

${}_8O^{2-}$ has 10 electrons. ${}_{18}Ti^{+}$ has 80 electrons.

434 **(b)**

$l = 2$ means d-subshell; $_{23}V = 1s^2, 2s^2 2p^6, 3s^2 39^6 3d^3, 4s^2$.

435 **(c)**

Follow Hund's multiplicity rules

436 **(b)**

For first excited state ($i.e.$, second energy level)

$$n = 2$$

$$r_n = \frac{a_0 . n^2}{Z}$$

(where, a_0 = Bohr radius = 0.53 Å)

$$r_2 = \frac{a_0(2)^2}{1} \quad \text{(for H, } Z = 1\text{)}$$

$$= 4a_0$$

437 **(a)**

$$\lambda = \frac{h}{\text{momentum}} \therefore \text{momentum} = \frac{h}{\lambda} = \frac{h \times v}{c}$$

$$\therefore \text{momentum} = \frac{6.6 \times 10^{-34} \times 5 \times 10^{17}}{3.0 \times 10^8}$$

$$= 1.1 \times 10^{-24} \text{ kg m sec}^{-1}$$

438 **(c)**

In H-atom subshell of a shell possess same energy lavel.

439 **(d)**

For $n = 4$ to $n = 1$ transition

$= v_{\text{Lyman}(2\to1)} + v_{\text{Balmer }(4\to2)}$

also $= v_{\text{Paschen }(4\to3)} + v_{\text{Balmer }(3\to2)} + v_{\text{L}(2\to1)}$

also $= v_{\text{Paschen }(4\to3)} + v_{\text{Lyman }(3\to1)}$

440 **(a)**

Isobars have same atomic mass but different atomic number.

Thus, the isobar of $_{20}Ca^{40}$ is $_{18}Ar^{40}$.

441 **(b)**

$u_n = \frac{u}{n}$.

442 **(a)**

$$u_n = \frac{u_1}{n}$$

443 **(d)**

γ-rays emission occurs due to radioactive change, a nuclear phenomenon.

444 **(a)**

$KE = (1/2)mu^2$

and $\lambda = \frac{h}{mu}$

$$\therefore KE = \frac{1}{2} m \frac{h^2}{m^2\lambda^2} = \frac{h^2}{2m\lambda^2}$$

445 **(b)**

for H $\frac{1}{\lambda_{B_1}} = R_H \left[\frac{1}{2^2} - \frac{1}{3^2}\right]$;

for He$^+$ $\lambda_{B_1} = 2^2 R_H \left[\frac{1}{2^2} - \frac{1}{3^2}\right]$

447 **(b)**

This is one of the principles laid down in aufbau principles.

448 **(d)**

Ψ^2 is a probability factor. For hydrogen wave function, number of nodes (the space where probability of finding electron is zero) can be calculated as

Radial nodes = $(n - l - 1)$

Angular nodes = l

Total number of nodes = $(n - 1)$

449 **(b)**

Cl^- has $3s^2 3p^6$ configuration, $i.e.$, of Ar.

450 **(a)**

According to Bohr, an electron can move only in those orbits in which its angular momentum is a simple multiple of $\frac{h}{2\pi}$.

$i.e.$, equal to $\frac{nh}{2\pi}$ (where, n is an integer)

451 **(c)**

A fact for late discovery of neutron.

453 **(b)**

$$hv_1 = hv_0 + \frac{1}{2}mu_1^2 \quad \text{... (i)}$$

$$hv_2 = hv_0 + \frac{1}{2}mu_2^2 \quad \text{... (ii)}$$

$$\because \frac{1}{2}mu_1^2 = \frac{1}{k}\left\{\frac{1}{2}mu_2^2\right\}$$

$$\therefore \text{From (i)} hv_1 = hv_0 + \frac{1}{2k}mu_2^2 \quad \text{... (iii)}$$

$$\text{or } \frac{1}{2}mu_2^2 = khv_1 - khv_0 \quad \text{... (iv)}$$

By Eqs. (ii) and (iv),

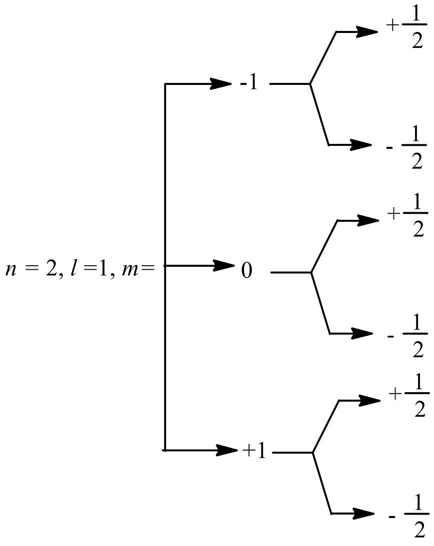
$hv_2 = hv_0 - khv_0 + khv_1$

or $v_0(1 - k) = v_2 - kv_1$

or $v_0 = \frac{kv_1 - v_2}{(k - 1)}$

454 **(d)**

For $2p$-subshell,



Hence, number of e^- with $s = -\frac{1}{2}$ is 3.

455 **(c)**

The spectral lines are closed only when ΔE is large, $i.e.$, λ is small

456 **(a)**

Element with atomic no. 15 has $3s^2 3p^3$ valence shell.

457 **(c)**

$E_3 - E_1 = \frac{12375}{\lambda}$

$\therefore \frac{-13.6}{9} - (-13.6) = \frac{12375}{\lambda}$

$\lambda = 1030$ Å

458 **(b)**

In Bohr orbit,

KE of $e^- = \frac{1}{2}\frac{Zke^2}{r_n}$

PE of $e^- = \frac{Zke^2}{r_n}$

Thus, KE$= -\frac{1}{2}$ PE

459 **(c)**

Higher the $(n+l)$, higher will be the energy. If $(n+l)$ is same for two electrons, the electron for which n is larger, energy is higher

460 **(a)**

No. of spectral line during transition,

$= \sum \Delta n = \sum (4-1) = \sum 3 = 1+2+3 = 6$

461 **(a)**

The spins of electron in an orbital may be $\pm 1/2$ only.

462 **(b)**

Energy of e^- in the nth orbit of atom= $\frac{-13.6}{n^2}$ eV/atom

Given, $n = 5$

$\therefore \; E_5 = -\frac{13.6}{(5)^2} = -\frac{13.6}{25} = -0.54$ eV/atom

463 **(a)**

Angular momentum $= \frac{n \cdot h}{2\pi} = \frac{5 \cdot h}{2\pi} = \frac{2.5\,h}{\pi}$.

464 **(a)**

Angular momentum in an orbit $= \frac{nh}{2\pi}$ if $n = 1$, it will be $\frac{h}{2\pi}$.

465 **(a)**

Electronic configuration of $Rb_{(37)}$ is

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 5s^1$

So, for the valence shell electron $5s^1$

$n = 5, l = 0, m = 0, s = +\frac{1}{2}$

466 **(a)**

Electron density of $3d_{x^2-y^2}$ orbital in yz plane is zero.

467 **(b)**

Total number of orbitals for principal quantum number n is equal to n^2 .

468 **(c)**

X-rays represents radiant energy.

469 **(c)**

$v = \frac{2.18 \times 10^8 \times Z}{n}$ cm s^{-1}

For H atom, $Z = 1$ and third orbit, $n = 3$,

$v_3 = \frac{2.18 \times 10^8 \times 1}{3}$

$= 7.26 \times 10^7$ cm s^{-1}

470 **(c)**

All the three electrons in p are unpaired.

471 **(b)**

Orbital angular momentum

$= \sqrt{l(l+1)}.\frac{h}{2\pi}$

For $2s$-orbital, $\quad l = o$

$\therefore$ Orbital angular momentum

$= \sqrt{0(0+1)}\frac{h}{2\pi} =$ zero

472 **(a)**

Balmer series wavelengths lies in between 6564Å to 3647Å $i.e.$, visible region.

473 **(d)**

Follow assumptions of Bohr's model.

474 **(a)**

$E_2 - E_1$ is maximum for H-atom and $E_2 - E_1 = \frac{hc}{\lambda}$.

475 **(d)**

s describes only spin of electron.

476 **(d)**

Each has one electron.

477 **(c)**

No. of line given during a jump $= \sum \Delta n$;

where $\Delta n = n_2 - n_1$

$\therefore \sum \Delta n = \sum(5-1) = \sum 4 = 10$

478 **(d)**

The energy of electrons in the same orbital is the same. For $3d$ orbitals,

$3d_{xy}, 3d_{yz}, 3d_{zx}, 3d_{z_2^2}, 3d_{x^2-y^2,}$ are at the same level of energy, irrespective of their orientation.

The electronic configuration

$3d_{xy}^2, 3d_{yz}^2, 3d_{zx}^2, 3d_{x^2-y^2}^2, 3d_{z^2}^2, 4s^1$ has maximum exchange energy

479 **(b)**

s-subshell should be filled first as it possesses lower energy level than p-subshell.

480 **(c)**

$_{29}Cu = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

$Cu^+ = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^0$

Total number of shells occupied = 3

Number of sub-shell occupied = 6

Number of orbitals filled = 14

Number of unpaired electrons = 0

481 **(d)**

$\lambda = \frac{h}{mu}$; where mu is momentum .

482 **(c)**

The atomic number of neon is 10.

G. S. Ne[10]: $1s^2, 2s^2, 2p^6$

E. S. Ne [10]: $1s^2, 2s^2, 2p^5, 3s^1$

Hence, $1s^2, 2s^2, 2p^5, 3s^1$ electronic configuration indicates the excited state of neon.

483 **(a)**

p-orbitals have two lobes; except d_{z^2} all the four d-orbitals have four lobes.

485 **(b)**

Energy of an electron in nth orbit,

$$E_n = \frac{2\pi^2 k^2 m Z^2 e^4}{n^2 h^2}$$

On submitting the values of k, m, e and h, we get

$$E_n = -\frac{2.172 \times 10^{-18} Z^2}{n^2} \text{ J atom}^{-1}$$

$$\text{or } = -\frac{1311.8 Z^2}{n^2} \text{ kJ mol}^{-1}$$

$$\text{or } = -\frac{313.52 Z^2}{n^2} \text{ kcal mol}^{-1} [\because 1 \text{ kcal} = 4.184 \text{ kJ}]$$

For H-atom, $Z = 1$

For Lyman series, $n_1 = 1, n_2 = 2$

Energy of electron in n_1 orbit

$$= -\frac{313.52 \times (1)^2}{(1)^2} \text{ kcal mol}^{-1}$$

$= -313.52$ kcal mol^{-1}

≈ -313.6 kcal mol^{-1}

Energy of electron in n_2 orbit

$$= -\frac{313.52 \times (1)^2}{(2)^2} \text{ kcal mol}^{-1}$$

$$= -\frac{313.52}{4} \text{ kcal mol}^{-1}$$

$= -78.38$ kcal mol^{-1}

486 **(d)**

$$\frac{1}{\lambda} = R_H \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$

487 **(c)**

The outermost electron in $_{21}Sc$ is $4s^2$.

488 **(b)**

hv = work function $+KE$;

$\therefore KE = 6.2 - 4.2 = 2.0$ eV

Find $\frac{1}{2}mu^2$ in J

489 **(b)**

Number of spherical nodes in $3p$ orbital

$= n - l - 1 = 3 - 1 - 1 = 1$

490 **(b)**

The maximum number of electron in any orbital is 2.

491 **(d)**

Each has 16 electrons.

492 **(d)**

Rest all are particles.

493 **(c)**

de Broglie wavelength $\lambda = \frac{h}{mu}$,

m is maximum for α-particle.

494 **(c)**

$3d^5, 4s^1$ is more stable configuration than $3d^4, 4s^2$.

495 **(d)**

$E = \frac{12375}{\lambda}$; where E in eV and λ in Å.

496 **(d)**

Follow text.

497 **(a)**

Cl^- has 18 electrons and 17 protons.

498 **(a)**

No doubt in Cr it is $3d^5, 4s^1$; but in Nb it is $4d^4, 5s^1$.

499 **(a)**

$$mu = \frac{h}{\lambda}$$

500 **(d)**

No. of unpaired electrons in Ni^{2+} is two.

501 **(b)**

Charge on neutrons is zero and mass of electron is minimum.

502 **(a)**

Mass of electron $= 9.1 \times 10^{-31}$ kg,

Mass of proton $= 1.67 \times 10^{-27}$ kg
Mass of neutron $= 1.675 \times 10^{-27}$ kg
Mass of α-particle $= 6.67 \times 10^{-27}$ kg
So, increasing order of e/m for e, p, n and α-particle is $e > p > \alpha > n$($\because$ neutron has no charge)

503 **(b)**
Total value of $m = (2l + 1) = 3$ for $l = 1$ $m = 3$ is for f-subshell orbitals

504 **(c)**
As per Bohr′s postulate, kinetic energy in II orbit
$= +\frac{e^2}{2r_2} = \frac{e^2}{2a_0 \times 2^2} \quad (\because r_2 = r_1 \times n^2)$
$= \frac{e^2}{8a_0}$
Since, $a_0 = \frac{h^2}{4\pi^2 me^2}$
$\therefore$ Kinetic energy in II orbit $= \frac{h^2}{4\pi^2 ma_0} \times \frac{1}{8a_0} = \frac{h^2}{32\pi^2 ma_0^2}$

505 **(a)**
Nucleus does not contain electron in it.

506 **(b)**
Potential energy in an orbit $= -Ze^2/r_n$

507 **(b)**
Orbital angular momentum $=\sqrt{l(l+1)}\frac{h}{2\pi}$
For p-orbital, $l = 1$
$\therefore$ Orbital angular momentum
$= \sqrt{1(1+1)}\frac{h}{2\pi} = \frac{\sqrt{2}h}{2\pi}$
$= \frac{h}{\sqrt{2}\pi}$

508 **(d)**
e/m for proton $= \frac{1}{1}$;
e/m for α-particle $= \frac{2}{4}$;

509 **(c)**
The total values of m for $n = 2$ are four.

510 **(d)**
Common name for proton and neutron is nucleon.

511 **(b)**
For $A, (n + l) = 5$ Thus, larger is value of $(n + l)$.
For $B, (n + l) = 3$ more is energy level.

512 **(b)**
$r_{\substack{\text{nucleus} \\ \text{(cm)}}} = (1.3 \times 10^{-13})A^{\frac{1}{3}}$
Where A is mass no. of nucleus

513 **(a)**
$E_{He^+} = E_H \times 2^2; E_{Li^{2+}} = E_H \times 3^2$

514 **(b)**
This observation that the ground state of nitrogen atom has 3 unpaired electrons in its electronic configuration and not otherwise is associated with Hund's rule of maximum multiplicity.

515 **(b)**
$E_{2He^+} = \frac{E_{1H} \times Z^2}{2^2}$
$E_{1H} = -13.62$ eV

516 **(c)**
As a result of attraction, some energy is released.

517 **(c)**
4th electron of Be is in $2s$-subshell.

518 **(a)**
Filling up of electron is made according to aufbau principle.

519 **(a)**
$m_e = \frac{m_e(\text{in rest})}{\sqrt{1-(v/c)^2}}$;
The mass of moving electron increase with increase in velocity and thus e/m decreases

520 **(a)**
p-orbital are three, $i.e.$, p_x, p_y and p_z each having same energy level, $i.e.$, degenerate orbitals.

521 **(d)**
Pfund series spectral lines have longer wavelength and thus lesser energy

523 **(a)**
$\lambda = \frac{h}{mv}$
$= \frac{6.62 \times 10^{-34}}{6.62 \times 10^{-35} \times 100}$
$= 0.1$ kg

524 **(c)**
If $n = 4, l = 3, i.e., 4f$-orbital. Thus total number of electrons in $4f$ orbital is 14.

525 **(c)**
$E_3 - E_2 = E(\text{eV})$ or $-\frac{E_1}{9} + \frac{E_1}{4} = E$
$\therefore E_1 = \frac{36E}{5} = 7.2\,E$

526 **(d)**
$\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$
For Balmer series
$n_1 = 2, n_2 = 3, 4, 5, \dots \infty$
For first emission line $n_2 = 3$
$\therefore \bar{v} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$
$= R\left(\frac{1}{4} - \frac{1}{9}\right) = R\left(\frac{5}{36}\right)$
$\bar{v} = \frac{5R}{36}\,\text{cm}^{-1}$

527 **(b)**
p_x orbital has electron density along x-axis.
528 **(c)**
Electronic configuration of Mn(25) is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
$\therefore$ Electronic configuration of Mn^{2+} is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$
$\because Mn^{2+} = [Ar]3d^5, 4s^0$
$= [Ar]$ $3d^5$: ↿ ↿ ↿ ↿ ↿ $4s^0$: □
529 **(a)**
No. of neutron=atomic mass−atomic number.
For C^{12}No. of neutron $= 12 - 6 = 6$
531 **(d)**
Combination of α-particle with nuclide always increases mass no. by four units and at.no. by two units.
532 **(c)**
$r_H = 0.529$Å
$$r_n = r_H \times \frac{n^2}{Z}$$
For $Li^{2+}(n = 2)$,
$$r_{Li^{2+}} = r_H \times \frac{(2)^2}{3} = \frac{r_H \times 4}{9}$$
For $Li^{2+}(n = 3)$,
$$r_{Li^{2+}} = r_H \times \frac{(3)^3}{3} = 3r_H$$
For $Be^{3+}(n = 2)$
$$r_{Be^{3+}} = r_H \times \frac{(2)^2}{4} = r_H$$
For $He^{+}(n = 2)$
$$r_{He^{+}} = r_H \times \frac{(2)^2}{2} = 2r_H$$
Thus, $Be^{3+}(n = 2)$ has same radius as that of the first Bohr's orbit of H-atom
533 **(c)**
Isotopes of an element have different number of neutrons.
534 **(c)**
Co^{2+} has $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^7$ configuration having 3 unpaired electron only,
535 **(c)**
Total spin $= \pm\frac{1}{2} \times$ number of unpaired electrons in atom
536 **(b)**
More is frequency of photon, more is energy.
537 **(c)**
$$\text{Kinetic energy} = \frac{Ze^2}{r_n}$$
538 **(b)**
Pd has $[Kr]4d^{10}$ configuration and is diamagnetic.
539 **(c)**
According to Rutherford
Scattering angle $\propto \frac{1}{\sin^4(\theta/2)}$
It fails for very small scattering angles because the full nuclear charge of the target atom is partially screened by its electron
540 **(c)**
Radial node $= n - l - 1$; Angular node $= l$.
541 **(b)**
This led Rutherford to propose nucleus.
542 **(d)**
It is d_{xy} or $d_{x^2-y^2}$ orbital.
543 **(a)**
Atoms corresponds to different transitions from higher energy levels to lower energy levels
544 **(c)**
$$T = \frac{2\pi r_n}{u_n} = \frac{2\pi r_1 \times n^2}{u_1/n}$$
or $T \propto n^3$; $n = 2$ here
545 **(c)**
$v = \frac{c}{\lambda}, \therefore \lambda = \frac{3\times10^8}{8\times10^{15}} = 4 \times 10^{-8}$.
546 **(a)**
The third alkaline metal is ${}^{40}_{20}Ca$. It contains 20 protons and 20 electrons.
547 **(a)**
More intense beam will give out more electrons.
549 **(b)**
Follow Pauli's exclusion principle.
550 **(d)**
$hv =$ work function $+KE$;
if $KE = 0$;
$hv =$ work function.
551 **(d)**
For s-orbital $l = 0$.
552 **(d)**
$E_1 = -13.6$ eV;
$\therefore E_2 = \frac{E_1}{2^2}$ and $E_3 = \frac{E_1}{3^2}$
553 **(b)**
The probability of finding the electrons in the orbital is 90-95%.
554 **(b)**
de Broglie equation is $\lambda = \frac{h}{mu}$.
555 **(b)**
Out of other alternates, He^+has ionisation energy of 54.4 eV because in He^+effective nuclear charge is fairly high and ionic size is small.
556 **(c)**

For chlorine atom,
electronic configuration
$= 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
For $3p^5$,
$n = 3, l = 1, m = -1, 0, +1$

557 **(d)**
The relative for E_1; $E_1 = -R_H \cdot h \cdot c$.

558 **(b)**
The radius of hydrogen atom=0.53Å
$_3Li^{2+}$ion also has only one electron but it has 3 proton in nucleus, hence its electron feels three times more attraction from nucleus in comparison of hydrogen atom. Thus, the radius of $_3Li^{2+}$will be
$$= \frac{0.53}{3} = 0.17 \text{ Å}$$

559 **(d)**
$Ti^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$
$V^{3+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6, 3d^2, 4s^0$
$Cr^{4+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$
$Mn^{5+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^0$

560 **(a)**
The configuration of $_{29}Cu$ is
$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$.

561 **(d)**
$hv =$ work function $+KE$;
Given $KE = 0$;
Thus, $hv = 4$ eV or $4 = \frac{12375}{\lambda}$, where λ is in Å.

562 **(c)**
Applying Rydberg formula,
$$\bar{v} - \frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \text{cm}^{-1}$$
For the first line in Lyman series,
$n_1 = 1$ and $n_2 = 2$
$$So, \bar{v} = 109678 \left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{109678 \times 3}{4}$$
$$= 82258.5 \text{cm}^{-1}$$

563 **(a)**
Number of spherical nodes in 3 p-orbital's $= 3 - 1 - 1 = 1$
There is one planner node in all p-orbitals.

564 **(a)**
Deuterium is an isotope of hydrogen. Its atomic number is one. Hence, its electronic configuration is
$_1D^2: 1s^1$

565 **(d)**
$_{26}Fe = [Ar]3d^6 4s^2$
Fe^{2+}(24 electrons)=$[Ar]3d^6 4s^0$

566 **(d)**
No. of electrons in a subshell is $(4l + 2)$.

567 **(a)**
When, $n = 5, l = 0, 1, 2, 3$ or 4 and $m = -4$ to $+4$
$\therefore n = 5, l = 4, m = 0, s = +\frac{1}{2}$ is a correct set of quantum numbers.

568 **(d)**
Subshell having lower value of $(n + l)$ will be of lower energy, where n is the principle and l is the azimuthal quantum number. Thus,
Correct energy value order is
$ns, (n-1)d, np, (n-1)f$.

569 **(c)**
Radius of orbit (r)=$\frac{n^2h^2}{4\pi^2me^2} \times \frac{1}{Z}$
In it h, π, m and e are constants, so after substituting these values, we get
$r = \frac{0.529n^2}{Z}$Å
$Z = 1$ for H
$$\therefore \quad r_H = \frac{0.529n^2}{1} \text{Å} \qquad \text{... (i)}$$
The transition from $n = 2$ to $n = 1$ in H-atom will have the same wavelength as the transition from $n = 4$ to $n = 2$ in He^+ ion.

570 **(d)**
$$\frac{V_n}{V_a} = \frac{(43)\pi r_n^3}{(43)\pi r_a^3} = \frac{r_n^3}{r_a^3} = \frac{\left[1.25 \times 10^{-13} \times (64)^{1/3}\right]^3}{(10^{-8})^3}$$

571 **(c)**
Z is atomic no. and e is charge on proton.

572 **(a)**
Mn has five unpaired electrons.

573 **(a)**
Carbon is $_6C^{12}$ and silicon is $_{14}Si^{28}$.

574 **(c)**
The 29th electron enters into $3d^9$ to have $3d^{10}$ configuration in Cu.

575 **(d)**
P has 6 electrons in s-subshells as in s-shell of Fe^{2+}.

576 **(b)**
Number of spectral lines $= \frac{(n_2-n_1)(n_2-n_1+1)}{2}$
$$= \frac{(7-2)(7-2+1)}{2} = 15$$

577 **(a)**
The value of Rydberg constant is 10,9678 cm^{-1}.

578 **(b)**
All the three electrons are to be kept in $1s$.

579 **(b)**
Particle nature of electron was experimentally evidenced by photoelectric effect.

580 **(d)**

They proposed the concept of electron spin.

581 **(a)**

$1 \text{ nm} = 1 \times 10^9 \text{m} = 10 \times 10^{-10} \text{m} = 10 \text{ Å}$

582 **(a)**

Mass of neutron $= 1.675 \times 10^{-27}$kg

Mass of electron $= 9.108 \times 10^{-31}$kg

583 **(c)**

$E_1 = -13.6$ eV

After absorption of 12.2 eV energy

$E_\text{H} = -13.6 + 12.2$

$= -1.4$ eV

Now $E_n = \frac{E_1}{n^2} \therefore n^2 = \frac{-13.6}{-1.4} = 9.71$

$\therefore n = 3$

584 **(c)**

Number of atomic orbitals in 4th energy shell $= 4^2 = 16$

585 **(d)**

According to Bohr model,

Radius of hydrogen atom

$(r_n) = \dfrac{0.529 \times n^2}{Z}$ Å

(where, n=number of orbit, Z=atomic number)

$r_3 = \dfrac{0.529 \times (3)^2}{1} = 4.761$Å

586 **(c)**

Isotopes have same chemical nature.

587 **(d)**

The value of 'n' and 'l' equal to 4 and 3 respectively corresponds to $4f$-orbital, hence the electron will belong to $4f$-orbital.

588 **(c)**

p-orbitals ($l = 1$) can have six electrons.

589 **(b)**

It is a fact derived by Rutherford from his α-scattering experiment.

590 **(d)**

At. no. 54 does not contain electron in f-orbital. Filling of f-orbital takes place from at. no. 58.

591 **(c)**

Cl^- has ns^2np^6 configuration.

592 **(d)**

The mass number =atomic number + number of neutron

Atomic number=no. of proton

=no. of electron (for an atom)

So, mass number =18+20=38

593 **(b)**

All d-orbitals except d_{z^2} have four lobes.

594 **(d)**

$\frac{1}{2} mu_\text{max}^2 = hv - W$

595 **(c)**

No. of subshells in a shell $= n^2$.

596 **(d)**

The threshold frequency (v_0) is the lowest frequency that photons may possess to produce the photoelectric effect. The energy corresponding to this frequency is the minimum energy (E)

$E = hv_0$

$= (6.625 \times 10^{-27}\text{erg s})\ (1.3 \times 10^{15} \times \text{s}^{-1})$

$= 8.6 \times 10^{-12}$ erg

597 **(d)**

Higher values of Ψ^2 means greater probability for finding electron and a zero value of Ψ^2 means the probability for finding the electron is zero (at nucleus)

598 **(b)**

It provides experimental determination of charge on electron.

599 **(b)**

f-orbital possesses 7 subshells and thus, maximum number of unpaired electrons = 7.

600 **(d)**

$r_n = r_1 \cdot n^2$

601 **(c)**

The proton has unit positive charge ($+1.602 \times 10^{-19}$C) and its mass is 1.007 u (1.677×10^{-27}kg).

602 **(a)**

$v = \frac{c}{\lambda}$ where v is frequency; c is velocity and λ is wavelength for light used.

603 **(a)**

For $4d$ electron,

$n = 4, l = 2, m = -2, -1, 0, +1, +2$

$s = +\dfrac{1}{2}$ or $-\dfrac{1}{2}$

604 **(c)**

Follow Hund's multiplicity rule.

605 **(a)**

Isoeletronic means having same number of electrons. $K^+, Cl^-, Ca^{2+}, Sc^{3+}$ (all are having 18 electrons).

606 **(c)**

e/m for D^+, H^+, He^+ and He^{2+} are $\frac{1}{2}, \frac{1}{1}, \frac{1}{4}$ and $\frac{2}{4}$.

607 **(c)**

Filling up of electrons in an atom obey aufbau principle.

609 **(c)**

$$\Delta u = \frac{h}{4\pi m \cdot \Delta x} = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 25 \times 10^{-3} \times 10^{-5}}$$
$= 2.1 \times 10^{-28}$ m/s

610 **(a)**
Elements from atomic no.21 to 100, each has $3d$-electron in its configuration.

611 **(a)**
1.8 mL H_2O = 1.8 g H_2O. also 18 g H_2O has $10N$ electrons;
Find electrons in 1.8 g H_2O

613 **(b)**
The configuration of at. no. 15 is
$1s^2, 2s^2 2p^6, 3s^2 3p^3$.

614 **(c)**
From Bohr's model : $\frac{mu^2}{r} = \frac{e^2}{r^2}$
or $\frac{mr^2 mu^2}{r} = \frac{e^2}{r^2} \cdot mr^2$ or $(mur)^2 = e^2 m \cdot r$
$\therefore$ Angular momentum $\propto \sqrt{r}$

615 **(a)**
1 mL ≡ 1.2 g Mg; Also 24 g Mg has $12N$ electrons.

616 **(a)**
$2s$ has minimum energy level.

617 **(c)**
de-Broglie, first of all suggested that electron, like light photons, possess wave nature. He proposed that all micro-particles have dual nature *i.e.*, both wave nature and particle nature. The wavelength of electron is given by
$$\lambda = \frac{h}{mv}$$
where, h =Planck's constant

619 **(c)**
Use, $\Delta v \times \Delta x = \frac{h}{4\pi m}$ or $\Delta x = \frac{h}{4\pi m \cdot \Delta v}$

620 **(c)**
Atoms of an element are alike.

621 **(a)**
n lies from 1 to ∞; $l = 0$ to $(n-1)$; $m = -1$ to $+l$ through zero.

622 **(b)**
Electronic configuration of $_{23}V$ is
$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3, 4s^2$

623 **(a)**
Einstein mass-energy relation is $E = mc^2$

624 **(a)**
Rb —Atomic number is 37,
So configuration is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^1$
$\therefore$ Last electron (valence electron) is $5s^1$
$\therefore n = 5$ ($\because$ Electron enters 5 energy level)
$l = 0$ ($\because$It is s-subshell)
$m = 0$
$s = \pm 1/2$

625 **(a)**
Follow Plank's quantum theory.

626 **(b)**
p-orbitals are dumb-bell type.

627 **(d)**
Aufbau principle does not give the correct arrangement of filling up of atomic orbitals in copper and chromium because half-filled and completely filled electronic configuration of Cr and Cu have lower energy and therefore, more stable.
Cr($Z = 24$): $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5, 4s^1$
Cu($Z = 29$): $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$

628 **(d)**
O has O − 16, O − 17, O − 18 isotopes.

629 **(b)**
$r_n = r_1 \times n^2 \quad \therefore n^2 = \frac{r_n}{r_1} = \frac{10.3 \times 10^9}{0.529 \times 10^{-10}} \therefore n = 14$

630 **(c)**
A p-orbital has 3 dumbles (*i.e.* p_x, p_y and p_z) and each dumble can accommodate maximum of 2 electrons. So, maximum number of electrons in p-orbital is 6.

631 **(a)**
$$\lambda = \frac{h}{\sqrt{2eVm_e}}$$
$e = 1.6 \times 10^{-19}$C, $V = 10{,}000$ V, $m_e = 9.1 \times 10^{-31}$ kg
$$\lambda = \frac{6.63 \times 10^{-34}}{\sqrt{2 \times 1.6 \times 10^{-19} \times 10{,}000 \times 9.1 \times 10^{-31}}}$$
$= 0.123$ Å

632 **(b)**
The jump of electron from higher level to lower one shows a decrease in energy and thus, equivalent amount of energy is given out as emission spectra.

633 **(c)**
$$\frac{V_n}{V_a} = \frac{4/3\pi(r_n)^3}{4/3\pi(r_a)^3}$$
$$= \frac{r_n^3}{r_a^3} = \frac{(10^{-13})^3}{(10^{-8})^3} = 10^{-15}$$

634 **(b)**
$m_p < m_n$

635 **(c)**
No. of neutron = Mass no. – At. no.

636 **(b)**

For a particular value of azimuthal quantum number, the total number of magnetic quantum number,

$m = 2l + 1$

or $2l = m - 1$

$l = \frac{m-1}{2}$

637 **(c)**

According to Planck, E/photon$= h\nu$.

638 **(b)**

At. no. 30 has configuration ... $3d^{10}, 4s^2$ and thus, 31 has ...$3d^{10}, 4s^2 4p^1$

639 **(d)**

Angular speed is $\frac{u}{r}$;

Also $u_n \propto \frac{1}{n}$ and $r_n \propto n^2$

640 **(c)**

Cl has 17 electrons, Cl^- has 18 electrons.

641 **(c)**

IP for Fe^+ ion =IP for H×$(Z)^2$

where, Z =atomic number

$\therefore$ IP $= 13.6 \times (2)^2$

$= 13.6 \times 4 = 54.4$ eV

642 **(a)**

$\frac{1}{\lambda_a} = R_H \left[\frac{1}{2^2} - \frac{1}{3^2}\right]$

and $\frac{1}{\lambda_\beta} = R_H \left[\frac{1}{2^2} - \frac{1}{4^2}\right]$

643 **(a)**

Angular momentum, $mvr = \frac{nh}{2\pi} = \frac{3\times h}{2\pi} = \frac{1.5h}{\pi}$

$= 3\hbar \quad \left[\because \hbar = \frac{h}{2\pi}\right]$

644 **(c)**

First of all, de-Broglie told that like light, all the microscopic moving particles also have dual nature, *i.e.*, both wave and particle nature. Hence, for any microscopic particle (like $e^-, p^+ n$ etc) the wavelength is given by

$\lambda = \frac{h}{mv} = \frac{h}{p}$

where, h=Planck's constant

mv=p=momentum

645 **(d)**

According to aufbau principle, 2p-orbital will be filled before 3s-orbital. Therefore, the electronic configuration $(1s^2, 2s^2 2p^2, 3s^1)$ is not possible.

646 **(b)**

No. of electrons in a subshell $= 2(2l + 1) = 4l + 2$

Also, $l = 4$ for g-subshell.

648 **(b)**

Ionisation energy of $He^+ = 13.6 \times Z^2$ eV

$= 13.6 \times (2)^2$eV

$= 13.6 \times 4$ eV $= 54.4$ eV

649 **(a)**

For excitation of electron from ground state the minimum energy needed is 10.2 eV; $E_2 - E_1 = -3.4 - (-13.6)$.

650 **(d)**

For s-orbitals, Ψ^2 is maximum for closer to nucleus. For p-orbital, Ψ^2 maximum for far away distance from nucleus.

651 **(a)**

Orbital angular momentum

(L) $= \sqrt{l(l+1)}\frac{h}{2\pi}$

For d-orbital, $l = 2$

(L) $= \sqrt{2(2+1)}\frac{h}{2\pi}$

$= \frac{\sqrt{6}h}{2\pi}$

652 **(b)**

A fact.

653 **(c)**

$(n + l)$ for $4f$ and $5d$ is same but n being lesser in $4f$ and thus, energy order, $4f < 5d$.

654 **(c)**

The electronic configuration of Fe atom is

Fe (26) $=$ [Ar]$3d^6 4s^2$

$Fe^{3+} =$ [Ar]$3d^5 4s^0$

1	1	1	1	1

five unpaired electrons

655 **(d)**

Fe^{2+} has 6 electrons in $3d$-shell; Cl^- has 12p-electrons.

656 **(c)**

m can have values $-l$ to $=+l$ through zero.

657 **(a)**

$E_n = \frac{13.6}{n^2}$eV

$E_3 - E_2 = 13.6\left(\frac{1}{(2)^2} - \frac{1}{(3)^2}\right)$ eV

$E_3 - E_2 = 13.6 \left(\frac{1}{4} - \frac{1}{9}\right)$ eV

$E_3 - E_2 = 13.6 \times \left(\frac{5}{36}\right)$ eV

$= 1.9$ eV

658 **(a)**

$n = 3; l = 1 \;\therefore (n + l) = 4$

659 **(c)**

For 'N' shell

∵ The number of shell $(n)=4$
∴The number of sub-levels or sub-shell $(l)=4$
The number of orbitals $= n^2 = 4^2 = 16$
and the number of electrons$= 2n^2 = 2 \times 4^2 = 32$

660 **(b)**

$$\lambda = \frac{h}{mv}$$

Here, $v = 3600$ km/h
$= 10^5$cm/s
$m = 1.0\text{mg} = 10^{-3}$

$$\lambda = \frac{6.626 \times 10^{-27}}{10^{-3} \times 10^5}$$
$$= 6.626 \times 10^{-29}\text{cm}$$

661 **(a)**
A fact to produce X-rays.

662 **(b)**
Let work function of A and B be w_A and w_B and T_A, T_B are kinetic energy
$\therefore 4.25 = w_A + T_A$
or $T_A = 4.25 - w_A$ ...(i)
Similarly $T_B = 4.70 - w_B$ ...(ii)
$\therefore T_B - T_A = 0.45 + w_A - w_B$
$-1.5 = 0.45 + w_A - w_B$ $(\because T_B - T_A = -1.5)$
or $w_B - w_A = 1.95$

$$\because \lambda = \frac{h}{mv} = \frac{h}{\sqrt{2K \times m}}$$

$$\therefore \lambda \propto \frac{1}{K} \quad (K \text{ is kinetic energy})$$

$$\therefore \frac{\lambda_B}{\lambda_A} = \sqrt{\frac{K_A}{K_B}} = 2$$

$$\text{Also } \frac{T_A}{T_B} = 4 = \frac{K_A}{K_B}$$

$$\therefore \frac{T_A}{T_A - 1.5} = 4$$

$\therefore T_A = 2$ eV
$T_B = 0.5$ eV
$w_A = 2.25$ eV
$w_B = 4.2$ eV

663 **(a)**
For $3d$-orbital l cannot be 1.

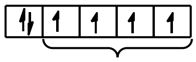
664 **(a)**

$$\lambda = \frac{h}{mu} = \frac{h}{p}$$

665 **(a)**
$\lambda = \frac{h}{mv}, ie, \lambda \propto \frac{1}{\sqrt{mE}}$ and $m >>> E$
Thus, correct order is $\lambda_e > \lambda_p > \lambda_\alpha$

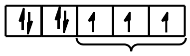
666 **(a)**
He^{2-} has four electrons and thus, four sets are possible (Pauli's exclusion principle.

667 **(b)**
$Zn(30) = [Ar]3d^{10}, 4s^2$
$Zn^{2+} = [Ar]3d^{10}$ (no unpaired electron)
$Fe(26) = [Ar]3d^6, 4s^2$
$Fe^{2+} = [Ar]3d^6$

$3d^6$ 

(four unpaired electrons)

$Ni(28) = [Ar]3d^8, 4s^2$
$Ni^{3+}[Ar]3d^7$

$3d^7$ 

(three unpaired electrons)

$(Cu(29) = [Ar]3d^{10}, 4s^1$
$Cu^+ = [Ar]3d^{10}$ (no unpaired electron)

668 **(c)**
Higher the value of $(n + l)$, higher will be the energy of electrons. If value of $(n + l)$ is same for any two or more electrons, the electron with higher value of n, has higher energy. Hence, the correct order of energy is

$$V < I < III < II < IV$$

$\because$ $(n + 1)$ 4 5 5 5 6

669 **(b)**
$Li^- = 1s^2, 2s^2$(In it all subshells are saturated so, it is stable)
$Be^- = 1s^2, 2s^2, 2p^1$ (very much less stable)
$B^- = 1s^2, 2s^2, 2p^2$ (less stable)
$C^- = 1s^2, 2s^2, 2p^3$ (stable due to presence of half-filled $2p$-subshell)

670 **(b)**
Mass no. of an element represents no. of nucleons in it.

671 **(b)**
According to de-Broglie, all the microscopic particles have dual nature. The wavelength of these is given by

$$\lambda = \frac{h}{mv}$$

672 **(c)**
The electron in H atom is excited to III shells after absorbing 12.1 eV; because,

$$E_3 - E_1 = \frac{-13.6}{9} + 13.6 = 12.1$$

Thus, possible transitions are $\sum(3 - 1) = 3$

673 **(a)**
Fall of electron from higher level to L-level, ($i.e.$, 2nd shell) gives Balmer series.

674 **(d)**
Average isotopic wt.

$$= \frac{\text{per cent} \times \text{wt. of isotope} + \text{per cent} \times \text{wt. of othe}}{100}$$

$\therefore 20.2 = \dfrac{a \times 20 + (100 - a) \times 22}{100}$

$\therefore a = 90$; per cent of lighter isotope

$= 100 - 90 = 10$

675 **(b)**

The total number of waves in an orbit

$= \dfrac{\text{circumference of orbit}}{\text{wavelenght}} = \dfrac{2\pi r}{\lambda}$

$= \dfrac{2\pi r \cdot mu}{h}$

$= n \ \left(\because mur = \dfrac{nh}{2\pi}\right)$

676 **(a)**

Magnetic moment $= \sqrt{n(n+2)}$; where n is no. of unpaired electron

$\therefore 4.9 = \sqrt{n(n+2)}$ or $n = 4$

Thus, electronic configuration of Mn^{a+} having 4 unpaired electron is

$_{25}Mn^{3+}: 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^4$.

677 **(b)**

K^- has $19 + 1 = 20$ electrons.

678 **(c)**

Under the influence of magnetic field orbitals (p, d) are non degenerate, *i.e.*, have different energy levels.

679 **(b)**

Aufbau is a German term meaning for building up.

680 **(d)**

$\lambda = \dfrac{h}{mu}$;

Given $u = 2.2 \times 10^{-6}$m/s

$m_e = 9.10 \times 10^{-31}$kg

681 **(a)**

A^- has 18 electrons, thus, neutral atom A has 17 electrons or 17 protons. Also neutron $= 20$ thus, mass no. $= 17 + 20 = 37$

682 **(d)**

14. Interference and diffraction support the wave nature of electron.

15. $E = mc^2$ support the particle nature of electron.

16. $E = hv = \frac{hc}{\lambda}$ is de-Broglie equation and it supports both wave nature and particles nature of electron.

683 **(c)**

According to Bohr's concept, an electron always move in the orbit with angular momentum (mvr) equal to $nh/2\pi$.

$\therefore mvr = \dfrac{nh}{2\pi}$

or $\quad r = \dfrac{n}{2\pi} \cdot \left(\dfrac{h}{mv}\right)$

or $\quad r = \dfrac{n\lambda}{2\pi}$

(From de-Broglie equation, $\lambda = \frac{h}{mv}$)

for fourth orbit $(n = 4)$

$r = \dfrac{2\lambda}{\pi}$

$\therefore$ Circumference $= 2\pi r = 2\pi \times \frac{2\lambda}{\pi} = 4\lambda$

685 **(c)**

From de-Broglie equation,

$\lambda = \dfrac{h}{mv} = \dfrac{6.6 \times 10^{-34}}{0.5 \times 100}$

$= 1.32 \times 10^{-35} m$

686 **(a)**

$KE = -\dfrac{e^2}{2r_n}; TE = -\dfrac{e^2}{2r_n}$

$\therefore \dfrac{KE}{TE} = \dfrac{1}{-1} = -1$

687 **(c)**

$E_{1\,He^+} = E_{1\,H} \times Z^2$

688 **(c)**

$\lambda = \dfrac{h}{mv}$

$v = \dfrac{h}{m\lambda} = \dfrac{6.626 \times 10^{-27}}{9.109 \times 10^{-28} \times 0.15 \times 10^{-7}}$

$= 4.84 \times 10^8 \text{cms}^{-1}$

690 **(a)**

Angular node $= l$; Also $l = 0$ for s-orbitals.

691 **(b)**

$5d$-orbital has $l = 2$.

692 **(c)**

$\lambda = \dfrac{h}{mv} = \dfrac{6.6 \times 10^{-34} \text{ kg m}^2\text{s}^{-1}}{6.6 \times 10^{-27}\text{kg} \times 10^3 \text{ms}^{-1}}$

$= 1 \times 10^{-10}$ m

693 **(c)**

$_{26}Fe^{3+}$ has $3d^5$ configuration.

694 **(d)**

We know that $E_n \propto \left[-\frac{1}{n^2}\right]$, where n is the number of orbit.

Hence, as the value of n increases, energy of the electron also increases. Hence, when n becomes infinite, energy also becomes infinite. Hence, due to this reason maximum energy is possessed by an electron, when it is present at infinite distance from the nucleus.

695 **(b)**

The two orbits are either I and II or II and IV

$\because \frac{r_{n_2}}{r_{n_1}} = \frac{4}{1}$ and $r_n \propto n^2$

Thus, $E_2 - E_1 = \frac{-13.6}{4} + 13.6 = 10.2$ eV

and $E_4 - E_2 = \frac{-13.6}{16} + \frac{13.6}{4} = 2.55$ eV

696 **(b)**

$$\Delta E = h\nu = \frac{2\pi^2 m Z^2 e^4 k^2}{h^2}\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

If electron falls from n_2 −level to n_1 −level.

$\therefore$ In He^+ for the $n_2 = 4$ to $n_1 = 2$ transition

$\upsilon(He^+) = \text{constant } (4)\left[\frac{1}{2^2} - \frac{1}{4^2}\right] \quad [\because Z_{He^+} = 2]$

$= \text{constant } \times 4 \left[\frac{3}{16}\right] = \frac{3}{4}\text{constant}$

$\upsilon(H) = \text{constant } (1)^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$= \text{constant } \times \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

(a)For $n_2 = 3$ and $n_1 = 1$,

$\upsilon(H) = \text{constant}\left[\frac{1}{1} - \frac{1}{9}\right]$

$= \frac{8}{9}\text{constant}$

$\neq \frac{3}{4} \times \text{constant}$

(b)For $n_2 = 2$ and $n_1 = 1$,

$\upsilon(H) = \text{ constant } \times \left[\frac{1}{1} - \frac{1}{4}\right]$

$= \frac{3}{4} \times \text{constant}$

$= \upsilon\ (He^+)$

697 **(b)**

E.C. of $M = [Ar]4s^2 3d^8$

E.C. of $M^{2+} = [Ar]4s^0 3d^8$

Total electrons =28=atomic number

698 **(d)**

$\overline{\upsilon} = \frac{1}{\lambda} = R_H\left[\frac{1}{2^2} - \frac{1}{3^2}\right]; n_1 = 2$ for Balmer series and $n_2 = 3$ for first line or H_α line of Balmer series.

699 **(d)**

It represent Heisenberg's uncertainty principle.

701 **(b)**

Follow Chadwick experiment for discovery of neutrons.

702 **(c)**

$$\Delta E = E_4 - E_1 = \frac{hc}{\lambda} = h\nu$$

$$\therefore \nu = \frac{E_4 - E_1}{h} = \frac{-21.76 \times 10^{-19}\left[\frac{1}{4^2} - \frac{1}{1^2}\right]}{6.625 \times 10^{-34}}$$

$= 3.079 \times 10^{15} s^{-1}$

703 **(b)**

A nuclide has a definite number of proton.

704 **(d)**

The isoelectronic species have same number of electrons.

17. NaCl has Na^+ and Cl^- ions

Electrons in $Na^+ = 11 - 1 = 10$

Electrons in $Cl^- = 17 + 1 = 18$

$\therefore$ They are not isoelectronic.

18. CsF has Cs^+ and F^- ions

Electrons in $Cs^+ = 55 - 1 = 54$

Electrons in F^- =9+1=10

$\therefore$ They are not isoelectronic.

19. NaI has Na^+ and I^- ions

Electrons in $Na^+ = 11 - 1 = 10$

Electrons in $I^- = 53 + 1 = 54$

$\therefore$ These are not isoelectronic.

20. K_2S has K^+ and S^{2-} ions

Electrons in $K^+ = 19 - 1 = 18$

Electrons in $S^{2-} = 16 + 2 = 18$

$\therefore$ In K_2S, the ions K^+ and S^{2-} are isoelectronic.

705 **(c)**

Completely filled orbitals are extra stable.

706 **(a)**

A is $3d$ and B is $5s$; $(n + l)$ for both is 5 and thus, lower value of $'n'$ decides lower energy level.

707 **(b)**

p-orbitals are dumb-bell in shape and thus, have directional nature.

708 **(d)**

Both have different modes of preparation.

709 **(a)**

${}_1H^1$ does not have neutrons.

710 **(a)**

$E_{\text{Photon absorbed}} = \underset{\text{Energy released}}{E_1 + E_2}$

or $\frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$ or $\frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$

711 **(a)**

Given, $\Delta x = \Delta P$ or $\Delta x = m \cdot \Delta v$

Heisenberg's uncertainty principle,

$$\Delta x \cdot m \cdot \Delta v = \frac{h}{4\pi}$$
$$m \cdot \Delta v \cdot m\Delta v = \frac{h}{4\pi}$$
$$(\Delta v)^2 = \frac{h}{4\pi m^2}$$
$$\Delta v = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$
$$= \frac{1}{2 \times 9.1 \times 10^{-31}}\sqrt{\frac{6.63 \times 10^{-34}}{3.14}}$$
$$= 7.98 \times 10^{12} \text{ms}^{-1} \approx 8 \times 10^{12} \text{ms}^{-1}$$

712 **(d)**

$_6C = 1s^2, 2s^2, 2p^2$

For 6th electron; $n = 2, l = 1, m = -1$ and $s = +\frac{1}{2}$

713 **(c)**

Ba^{2+} ions scatter X-rays.

714 **(c)**

For N-shell, $n = 4$

$l=$	0,	1,	2,	3
(subshell)	s	p	d	f
orbitals	1	3	5	7

Hence, total sub shells =4, orbitals =16 and number of electrons =32

715 **(b)**

Mass of H^+ is minimum.

716 **(a)**

$_1H^1$ has only 1s electron, $i.e.$, $n = 1$ is sufficient to describe H atom.

717 **(d)**

It is tritium atom, $i.e.$, $_1H^3$.

718 **(a)**

$$r_n = \frac{r_0 \times n^2}{Z}$$

Given, r_0= radius of H atom in ground state =0.5Å

n = number of orbit = 1

Z = atomic number of Li = 3

$$\therefore \quad r_n = \frac{0.53 \times 1^2}{3} = 0.176 \text{ Å}$$

719 **(b)**

The velocity of light is maximum.

720 **(c)**

Bohr's theory is applicable to unielectron atom or ion only.

721 **(d)**

For 4s level; $n = 4, l = 0$.

722 **(a)**

Nucleus and electrons are oppositely charged.

723 **(d)**

Angular momentum of an electron

$= mvr = \frac{nh}{2\pi}$ (n is orbit number)

in 5th orbit $= \frac{5h}{2\pi} = \frac{2.5h}{\pi}$

724 **(a)**

Positron is $_{+l}e^0$.

726 **(b)**

The de-Broglie relation is,

$$\lambda = \frac{h}{mv}$$

where, λ=de-Broglie wavelength

h =Planck's constant

m =mass of particle

V=velocity of particle

727 **(d)**

Three electrons in p-subshells have same spin.

728 **(a)**

Cl in completely excited state has,

$1s^2, 2s^2 2p^6, 3s^1 3p^3 3d^3$.

729 **(c)**

$mur = n\,h/2\pi$

730 **(c)**

Excited Ne atom is $1s^2, 2s^2 2p^5, 3s^1$.

731 **(c)**

The charge on α-particles is twice the charge on proton, and mass of α − particle is four times the mass of proton

732 **(d)**

Energy, $E = \frac{nhc}{\lambda}$

$\Longrightarrow 60 \times 1$Js

$= \frac{n \times 6.63 \times 10^{-34} \text{Js} \times 3 \times 10^8 \text{m}}{663 \times 10^{-9} \text{m}}$ $\left[\because \text{Power} = \frac{\text{energy}}{\text{time}}\right]$

$$\therefore \quad n = \frac{60 \times 1 \times 663 \times 10^{-9}}{6.63 \times 10^{-34} \times 3 \times 10^8}$$
$$= 2 \times 10^{20}$$

733 **(a)**

$$d = \frac{m}{V} = \frac{9.11 \times 10^{-28}}{\frac{4}{3} \times \frac{22}{7} \times (4.28 \times 10^{-14})^3}$$
$$= 2.77 \times 10^{12} \text{ g/mL}$$

734 **(a)**

$$\frac{1}{\lambda} = \bar{v}_H = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$
$$= 1.097 \times 10^7 \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right]$$
$$\lambda = \frac{1}{1.097 \times 10^7} \text{m}$$
$$= 9.11 \times 10^{-8} \text{m}$$
$$= 91.1 \times 10^{-9} \text{m}$$

$= 91.1 \text{nm}$

$(1 \text{ nm} = 10^{-9} \text{ m})$

735 **(d)**

The number of electrons $= 2n^2$

where, n = principal quantum number.

For $n = 2$

Number of electrons $= 2(2)^2 = 8$

736 **(c)**

Energy of one photon, $E = \frac{hc}{\lambda}$

$= \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{550 \times 10^{-9} \text{ m}}$

$\therefore$ Number of photons $= \frac{\text{energy required}}{\text{energy of one photon}}$

$= \frac{10^{-17}}{3.61 \times 10^{-19}} = 27.67 = 28$

737 **(c)**

$\lambda = \frac{h}{mu} = \frac{6.6 \times 10^{-34}}{0.66 \times 100} = 1 \times 10^{-35} \text{m}$

738 **(c)**

Isotones are species which have equal number of neutrons.

Neutrons in $_{19}K^{39} = 39 - 19 = 20$

Neutrons in $_{20}Ca^{40} = 40 - 20 = 20$

739 **(a)**

Rutherford showed the existence of nucleus in an atom by his α −particles scattering experiment. He postulated that every atom has a small central part which has positive charge and almost all the mass of atom (*i.e.*, nucleus consists of protons and neutrons).

740 **(d)**

For $l = 2, m$ can have values $-2, -1, 0, +1, +2$

741 **(d)**

$\Delta x \cdot \Delta u = \frac{h}{4 \pi m}$

$\Delta p = 1 \times 10^{-18} \text{g cm sec}^{-1}$

$m \times \Delta u = 1 \times 10^{-18}$

$\therefore \Delta u = \frac{1 \times 10^{-18}}{9 \times 10^{-28}} = 1.1 \times 10^9 \text{cm sec}^{-1}$

743 **(c)**

$_6C^{12}$ has six electrons, two of them are unpaired and thus, paramagnetic $_{12}Mg^{24}$ has twelve electrons, all are paired and thus, diamagnetic.

744 **(c)**

Dual nature of particles was proposed by de-Broglie.

745 **(a)**

Number of photoelectrons ejected per unit area, per unit time is directly proportional to the intensity of the incident radiation

746 **(d)**

$\Delta u = \frac{0.1}{100} \times 10 = 10^{-2} \text{m sec}^{-1}$; Now $\Delta u \cdot \Delta x$

$= \frac{h}{4\pi m}$

$\therefore \Delta x = \frac{6.625 \times 10^{-34}}{4 \times 10^{-2} \times 3.14 \times 200 \times 10^{-3}}$

$= 2.64 \times 10^{-32}$

747 **(a)**

Number of radial nodes $= (n - l - 1)$

For $3s, n = 3, l = 0$(number of radial node=2)

For $2p, n = 2, l = 1$(number of radial node=0)

748 **(c)**

We know that,

$E = mc^2 = \frac{hc}{\lambda}$

$\therefore \lambda = \frac{h}{mc}$ or $m = \frac{h}{\lambda . c}$

where, λ=wavelength of photon

h = Planck's constant

m = mass of photon

c = velocity of light

Given, $\lambda = 3.6 \text{ Å} = 3.6 \times 10^{-10} \text{m}$

$\therefore \quad m = \frac{6.62 \times 10^{-34}}{3.6 \times 10^{-10} \times 3 \times 10^8}$

$= 6.135 \times 10^{-33} \text{kg}$

749 **(d)**

$4d$-subshell has $n = 4, l = 2, m = \pm 2, \pm 1, 0, s = \mp 1/2$

750 **(d)**

The orbital angular momentum

$= \frac{h}{2\pi} \sqrt{l(l+1)}$

For $3s$-electron, $l = 0$

$\therefore$ Orbital angular momentum

$= \frac{h}{2\pi} \sqrt{0(0+1)}$

$= 0$(zero)

751 **(a)**

According to Heisenberg

$\Delta x \times m \times \Delta v = \frac{h}{4\pi}$

where, Δx=uncertainty in position.

m=mass of particle

Δv=uncertainty in velocity.

According to question

$\Delta x_A \times m \times 0.05 = \frac{h}{4\pi}$ ... (i)

$\Delta x_B \times 5m \times 0.02 = \frac{h}{4\pi}$ ... (ii)

Eq. (i) divided by Eq. (ii), then

$\frac{\Delta x_A \times m \times 0.05}{\Delta x_B \times 5m \times 0.02} = 1$

or $\frac{\Delta x_A}{\Delta x_B} = 2$

752 **(a)**
Hydrogen atom is in $1s^1$ and these $3s$, $3p$ and $3d$-orbitals will have same energy w.r.t. $1s$-orbital.

753 **(a)**
${}_1H^1$ has more % in H_2.

754 **(a)**
The energy level increase with increase in distance from the nucleus and the negative values of electrons energy near to nucleus decrease to zero at infinite distance.

755 **(a)**
It is $3p_x$ or $3p_y$ orbital, *i.e.*, Al having $3s^2 3p^1$ configuration .

756 **(d)**
The max. no. of orbitals in a shell $= 2l + 1$,
$\therefore$ Max. no. of electron$= 2(2l + 1) = 4l + 2$,

757 **(a)**
Li has $2s^1$ configuration of valence shell.

758 **(c)**
$r_n = r_1 \times n^2$
$\therefore \frac{r_3}{r_2} = \frac{9}{4}$

759 **(a)**
No. of f-orbitals in any shell = 7.

760 **(b)**
${}_{26}Fe^{2+}: 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6$

761 **(c)**
Isotonic species are those species which have equal number of neutrons,
e.g., ${}^{14}_{6}C, {}^{15}_{7}N$ and ${}^{17}_{9}F$.

762 **(b)**
$$\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$
For Lyman series, $n_1 = 1, n_2 = 2$
$$\frac{1}{\lambda} = 10{,}9678 \left[\frac{1}{(1)^2} - \frac{1}{(2)^2}\right]$$
$$= \frac{10{,}9678 \times 3}{4}$$
$\lambda = 1216$ Å

763 **(b)**
IE$=-E_1$
E_1 for $He^+ = -19.6 \times 10^{-18}$J atom^{-1}
$$\frac{(E_1)_{He^+}}{(E_1)_{Li^{2+}}} = \frac{(Z_{He^+})^2}{(Z_{Li^{2+}})^2}$$
$$\frac{-19.6 \times 10^{-18}}{(E_1)_{Li^{2+}}} = \frac{4}{9}$$
or $E_1(Li^{2+}) = \frac{-19.6 \times 9 \times 10^{-18}}{4}$
$= -4.41 \times 10^{-17}$J atom^{-1}

764 **(d)**
The energy of second Bohr orbit of hydrogen atom (E_2) is -328 kJ mol^{-1} because
$$E_2 = -\frac{1312}{2^2} \text{kJ mol}^{-1}$$
$$\therefore \quad E_n = -\frac{1312}{n^2} \text{kJ mol}^{-1}$$
If $n = 4$
$$\therefore \quad E_4 = -\frac{1312}{4^2} \text{kJ mol}^{-1}$$
$$= -82 \text{ kJ mol}^{-1}$$

765 **(d)**
Lyman series spectral lines have smaller λ and thus, higher energy.

766 **(b)**
Charge on electron and H^+ is same; the ratio e/m is ratio of mass of proton to electron.

767 **(c)**
It is average isotopic weight.

768 **(b)**
Kinetic energy $= h(v - v_0)$
KE $= hv - hv_0$
$$v_0 = v - \frac{KE}{h} = 2 \times 10^{15} - \frac{6.63 \times 10^{-19}}{6.63 \times 10^{-34}}$$
$= 1 \times 10^{15}$s^{-1}

769 **(a)**
It is impossible to determine simultaneously the exact position and momentum of moving particle like electron, proton, neutron.
$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$
where, Δx=uncertainty in position.
Δp=uncertainty in momentum.

770 **(d)**
${}^{14}_{6}C, {}^{16}_{8}O, {}^{15}_{7}N$ =isotonic triad
Isotonic=same number of neutron.
All species contain 8 neutrons.

771 **(d)**
Valence electron for Na is $3s^1$;
Thus, $n = 3, l = 0, m = 0$.

772 **(a)**
Both Cl and Br have 7 electrons in their valence shell.

773 **(b)**
The λ order is : Radiowave > Infrared > UV > X-rays.

774 **(c)**
For example oxygen contains ${}_8O^{16}$, ${}_8O^{17}$ and ${}_8O^{18}$ nuclides, *i.e.*, of different types.

776 **(b)**
Neutron has more mass among all.

777 **(c)**
The electronic configuration of the Cu atom is
${}_{29}Cu = [Ar]3d^{10}4s^1$
Since, the outermost shell is $4s$, thus outermost electron is in it.
For $4s^1$,
$n = 4,\ l = 0,\ m = 0,\ s = +\frac{1}{2}$

778 **(c)**
The X-atom has 18 neutrons and 16 electrons and thus, 16 protons also. Thus, it is ${}_{16}S^{34}$. The most abundant isotope of sulphur is ${}_{16}S^{32}$.

779 **(c)**
Unpaired electron leads to paramagnetism.

780 **(c)**
Laser is abbreviated as light amplification by simulated emission of radiation.

781 **(d)**
These are required conditions to obtain cathode rays.

782 **(a)**
$E_2 - E_1$ is maximum .

784 **(c)**
From de-Broglie equation
$\lambda = \frac{h}{mv}$
$= \frac{6.62 \times 10^{-34}}{0.5 \times 100}$
$= 1.32 \times 10^{-35} m$

785 **(c)**
$m = 10\ mg = 10 \times 10^{-6} kg$
$v = 100\ ms^{-1}$
$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{10 \times 10^{-6} \times 100}$
$= 6.63 \times 10^{-31} m$

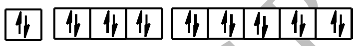
788 **(b)**
Angular momentum of electron in an orbit and orbital are $\frac{nh}{2\pi}$ and $\sqrt{l(l+1)}.\frac{h}{2\pi}$ respectively.

789 **(d)**
Period of one revolution $= \frac{2\pi r}{u}$
$\therefore \frac{T_2}{T_1} = \frac{2\pi r_2}{u_2} \times \frac{u_1}{2\pi r_1} = \frac{r_2 u_1}{r_1 u_2}$
Also $u_n = \frac{u_1}{n}; r_n = r_1 \times n^2$
$\frac{T_1}{T_2} = 1 : 8$

790 **(a)**
$Ni^{2+}: 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8$ (with two unpaired electrons)
Thus, magnetic moment $= \sqrt{n(n+2)} = \sqrt{8} =$ 2.83 BM .

791 **(c)**
A technique to study the given fact.

792 **(d)**
When $n = 3, l = 0, 1, 2$ $i.e.$, there are $3s$, $3p$ and $3d$-orbital's. If all these orbitals are completely occupied as



Total 18 electrons, 9 electrons with $s = +\frac{1}{2}$ and 9 with
$s = -\frac{1}{2}$.

793 **(b)**
No. of electron in a shell $= 2n^2$

794 **(a)**
$1s^1$ being lowest level of energy and thus, it can absorb photon but cannot release photon.

795 **(c)**
$m'_e = \frac{m_e}{\sqrt{1 - \left\{\frac{v}{c}\right\}^2}}$

796 **(b)**
Species having the same number of electrons as in oxide ion, has the same electronic configuration as oxide ion. O^{2-} or N^{3-} both species have same number of electrons (10 electrons).

797 **(c)**
Mass of positively charged ions in positive rays is more than mass of electrons.

STRUCTURE OF ATOM

CHEMISTRY

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: Energy of the orbitals increases as $1s<2s=2p>3p=3d=3d<4s=4p=4d=4f<$…….

Statement 2: Energy of the electron depends completely on the principal quantum numbers.

2

Statement 1: K and Cs are used in photoelectric cells.

Statement 2: K and Cr emit electrons on exposure to light.

3

Statement 1: An orbital cannot have more than the electrons

Statement 2: The two electrons in an orbital create opposite magnetic field.

4

Statement 1: The charge to mass ratio of the particles in anode rays depends on nature of the gas taken in the discharge tube

Statement 2: The particles in anode rays carry positive charge

5

Statement 1: Only principal quantum number determines the energy of an electron in an orbital in sodium atom

Statement 2: For one electron system, the expression of energy is the same as that obtained in Bohr's theory

6

Statement 1: Isobars are identical in chemical properties.

Statement 2: Isobars have same atomic numbers.

7

Statement 1: Kinetic energy of photoelectrons is directly proportional to the intensity of the incident radiation

Statement 2: Each photon of light causes the emission of only one photoelectrons

8

Statement 1: The radius of second orbit of He^{+} is equal to that of first orbit of hydrogen

Statement 2: The radius of an orbit in hydrogen like species is directly proportional to n^2 and inversely proportional to Z

9

Statement 1: The orbital with $l = 0$ is spherical in shape

Statement 2: Azimuthal quantum number describes the shape of an orbital which is according to the quantum theory, in the space around the nucleus

10

Statement 1: Radiant energy of quantum is given by E=hv.

Statement 2: Quantum in the energy equation signifies the principal quantum number.

11

Statement 1: $5s$ orbital has greater energy then $4s$.

Statement 2: Energy of the orbital depends on the azimuthal quantum number.

STRUCTURE OF ATOM

CHEMISTRY

: ANSWER KEY :

1)	d	2)	a	3)	b	4)	b	9)	a	10)	c	11)	c
5)	d	6)	d	7)	d	8)	d						

STRUCTURE OF ATOM

CHEMISTRY

: HINTS AND SOLUTIONS :

1 **(d)**
The energy of an electron is determined by principal quantam number for multi electron system. Energy also depends on azimuthal quantam number. Energies of different subshell present with in the same principal shell are found to be in order of *s>p>d>f.*

2 **(a)**
Both K and Cs are used in photoelectric cells. This is explained on the basic that energy from the flame excites the electrons to higher energy levels. When these electrons return to their original levels, the absorbed energy in now emitted as different.

3 **(b)**
According to Pauli's exclusion principle, 'An orbital cannot have more than two electrons, which cannot show the same value of all quantum numbers. *n, l* and *m,* have the same value of both the electrons but the spin quantum numbers have two different value
$+\frac{1}{2}$ and $-\frac{1}{2}$ and shows opposite magnetic field.

4 **(b)**
The particles in anode rays are positive ions formed by loss of one or more electrons by atoms of the gas in the discharge tube

5 **(d)**
In a multi-electron atom such as sodium atom energy of the electron is determined by both n and l

7 **(d)**
Kinetic energy of photoelectrons is proportional to the frequency of the incident radiation and not on the intensity

8 **(d)**
The radius of second orbit of He^+ is twice that of the first orbit of hydrogen. Bohr expression for radius of the electron in a particular orbit in hydrogen and hydrogen like species is

$$r_n = \frac{n^2h^2}{4\pi^2kmZe^2}$$

9 **(a)**
An orbital is the space around the nucleus where there is 90.95% probability of finding the electrons. The orbital with $l = 0$ is spherical, for $l = 1$ the shape is dumb-bell and for $l = 2$, the shape is double dumb-bell

10 **(c)**

1. If Assertion is True, Reason is True, Reason is correct explanation of 1
2. If Assertion is True, Reason is True, Reason is not correct explanation of 1
3. If Assertion is True, Reason is False
4. If Assertion is False, Reason is True

11 **(c)**
Size and energy of the orbital depend upon the principal quantam number for multi electron system Energy also depends on azimuthal quantam number specifies the shape of orbital.