QUESTION BANK

ATOMIC STRUCTURE

Q1. Deduce the possible sets of four quantum number when n = 2.

Q2. What is the maximum number of electron that may be present in all the atomic orbitals with principal quantum number 3 and azimuthal quantum number 2 ?

Q3. How many electron in an atom can have the following sets of quantum number ?

(i) n = 3 (ii) n = 2, l = 0 (iii) n = 2, l = 2 (iv) n = 2, l = 0, m = 0, s = $+\frac{1}{2}$

Q4. Although no currently known element contains electrons in g orbitals in the ground state, it is possible that such element will be found or that electrons in excited states of known elements could be in g orbitals. For g orbitals, l = 4. What is the lowest value of n for which g orbitals could exist? What are the possible values of m? How many electrons could a set of g orbitals hold?

Q5. Arrange the electrons represented by the following sets of quantum numbers in the decreasing order of energy. (R.E.E. 1987)

(i) $n = 4, l = 0, m_l = 0, m_s = +\frac{1}{2}$ (ii) $n = 3, l = 1, m_l = 1, m_s = -\frac{1}{2}$

(iii) $n = 3, l = 2, m_l = 0, m_s = +\frac{1}{2}$ (iv) n = 3, l = 0, m_l = 0, m_s = $-\frac{1}{2}$

Note : Magnetic and spin quantum numbers are denoted by m_l and m_s respectively in this question

Q6. Maximum number of unpaired electrons which can be accommodated in the sub-shell: s, p, d, f, g is____

Q7. Which of the following orbitals has a dumbbell shape
(A) s (B) p (C) d (D) f

Q8. Which of the following orbitals is non-directional
(A) s (B) p (C) d (D) f

Q9. Which of the following quantum number is not obtained by the solution of Schrodinger wave equation
(A) magnetic quantum number (B) principal quantum number
(C) spin quantum number (D) azimuthal quantum number

Q10. Principal, azimuthal and magnetic quantum numbers are respectively related to
(A) size, shape and orientation (B) shape, size and orientation
(C) size, orientation and shape (D) none of these

Q11. Degenerate atomic orbital have
(A) equal energy (B) nearly equal energy
(C) different energy (D) none of above

Q12. The orbital occupied by an electron with quantum numbers $n = 4, l = 3, m = 0 and s = -\frac{1}{2}$ is called
(A) 1s subshell (B) 4d orbital
(C) 4f subshell (D) 3s subshell

Q13. Which of the following sets of quantum number is not possible
(A) $n = 2, l = 1, m = -1, s = -1/2$ (B) $n = 3, l = 2, m = -3, s = +1/2$
(C) $n = 2, l = 0, m = 0, s = +1/2$ (D) $n = 3, l = 2, m = -2, s = +1/2$

Q14. Which of the following sets of quantum number is not correct

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

(C) $n=2, l=2, m=0, s=-\frac{1}{2}$ (D) all of these

Q15. Which is correctly matched

(A) $n=5, l=2, m=+2, s=-1/2$ (B) $n=5, l=5, m=-2, s=+1/2$

(C) $n=3, l=2, m=+2, s=0$ (D) $n=3, l=2, m=+3, s=+1/2$

Q16. Which of the following sets of quantum numbers is correct for an electron in 4f orbital

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

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

Q17. In the n th quantum level, the number of electronic subshell is

(A) n (B) $2n^2$ (C) $2n$ (D) $2\times(2l+1)$

Q18. For the energy level with the principal quantum number 3, the number of possible orbitals is

(A) 1 (B) 4 (C) 3 (D) 9

Q19. For electrons having principal quantum number are 3, the number of (i) subshells and (ii) orbitals would be respectively

(A) 3 and 5 (B) 3 and 7 (C) 3 and 9 (D) 2 and 5

Q20. The magnetic quantum number m_l is fixed by the azimuthal quantum number, l. If $l=2,$ the type and number of the orbitals indicated by

(A) f, 7 (B) d, 5 (C) p, 3 (D) s, 1

Q21. The electrons, identified by quantum by numbers n and l, (i) $n=4, l=1$ (ii) $n=4, l=0$ (iii) $n=3, l=2$ (iv) $n=3, l=1$ 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) (I.I.T. 1999)

Q22. Which electron level would allow the hydrogen atom to absorb a photon but not emit a photon

(A) 3s (B) 2p (C) 2s (D) 1s (I.I.T. 1984)

Q23. The maximum probability of finding an electron in the d_{xy} orbital is

(A) along the x-axis (B) along the y-axis

(C) at an angle of 45^0 from the x and y axes (D) at an angle of 90^0

Q24. The quantum numbers +1/2 and -1/2 for the electron spin represent

(A) rotation of the electron in clockwise and anticlockwise direction respectively

(B) rotation of the electron in anticlockwise and clockwise direction respectively

(C) magnetic moment of the electron pointing up and down respectively

(D) two quantum mechanical spin states which have no classical analogue (I.I.T. 2001)

Q25. An electron has magnetic quantum number as -3. Its principal quantum number can be
(A) 1 (B) 2 (C) 3 (D) 4

Q26. Magnetic and spin quantum number of an electron are -1 and +1/2 respectively. This electron cannot be in
(A) s orbital (B) p orbital (C) d orbital (D) f orbital

Q27. Which of the following statement is not correct for an electron that has the quantum numbers 4 = and m =2
(A) then electron may have the quantum number s = +1/2
(B) the electron may have the quantum number l = 2
(C) the electron may have the quantum number l = 3
(D) the electron may have the quantum number l = 0,1,2,or 3

Q28. Which one the following sets of quantum number is incorrect

	principal quantum number (n)	azimuthal quantum number (l)	magnetic quantum number (m)
(A)	1	0	0
(B)	2	0 and 1	0 and 0, $\pm$ 1
(C)	3	0 and 1 and 2	0 and 0, $\pm$ 1 and 0, $\pm$ 1, $\pm$ 2

(D) none of the above

Q29. Which of the following is not possible
(A) two electrons of an atom may have identical values of n,l and m
(B) a 4d electrons of may have n = 4 and l = 3
(C) two electrons of equal energy occupying p-orbitals of an atom may have parallel spin
(D) two electron of equals energy occupying p-orbitals of an atom may have opposite spin

Q30. The orbital angular momentum of an electron in 2s orbitals is
(A) $+\frac{1}{2}.\frac{h}{2\prod}$ (B) 0 (C) $\frac{h}{2\prod}$ (D) $\sqrt{2}.\frac{h}{2\prod}$

Q31. The orbital angular momentum of an electron in an s orbital is
(A) 1 (B) zero (C) $\frac{\sqrt{2h}}{2\prod}$ (D) all of these

Q32. For a d electron, the orbital angular momentum is
(A) $\sqrt{6\eta}$ (B) $\sqrt{2\eta}$ (C) η (D) 2η

Q33. The quantum number/s needed to describe an electron fully in an atom is/are:
(A) 1 (B) 2 (C) 3 (D) 4

Q34. The principal quantum number of an atom is related to the:
(A) size of the orbital (B) orbital angular momentum
(C) spin angular momentum (D) orientation of the orbital in space

Q35. The magnetic quantum is a number related to:
(A) size (B) shape (C) orientation (D) spin

Q36. The principal quantum number represents:
(A) shape of an orbital (B) number of electrons in an orbit
(C) distance of electron from nucleus (D) number of orbitals in an orbit

Q37. The atomic orbital is:
(A) the circular path of the electron
(B) elliptical shaped orbit
(C) three-dimensional field around nucleus
(D) the region in which there is maximum probability of finding an electron

Q38. Principal, azimuthal and magnetic quantum numbers are respectively related to:
(A) size, shape and orientation
(B) shape, size & orientation
(C) size, orientation and shape
(D) none of the above

Q39. Any p-orbital can accommodate up to:
(A) 4 electrons
(B) 2 electrons with parallel spins
(C) 6 electrons
(D) 2 electrons with opposite spins

Q40. Which orbital is dumb-bell shaped?
(A) s-orbital (B) p-orbital (C) d-orbital (D) f-orbital

Q41. The maximum number of electrons that can be accommodated in f-shell is:
(A) 2 (B) 8 (C) 18 (D) 14

Q42. Which one of the following represents an impossible arrangement?

	n	l	m	s		n	l	m	s
(A)	3	2	-2	1/2	(B)	4	0	0	1/2
(C)	3	2	-3	1/2	(D)	5	3	0	1/2

Q43. Which of the following is correct for 2p-orbitals?
(A) n = 1, l = 2 (B) n = 1, l = 0 (C) n = 2, l = 0 (D) n = 2, l = 1

Q44. Which of the following represents the correct set of four quantum numbers of a 4d electron?
(A) 4, 3, 2, +1/2 (B) 4, 2, 1, 0 (C) 4, 3, -2, +1/2 (D) 4, 2, 1, -1/2

Q45. A subshell with l = 2 is called?
(A) s (B) p (C) d (D) f

Q46. The angular momentum of an electron depends on:
(A) principal quantum number
(B) azimuthal quantum number
(C) magnetic quantum number
(D) all of these

Q47. The energy of an electron of $2p_y$ orbital is:
(A) greater than $2p_x$ orbital
(B) less than $2p_z$ orbital
(C) equal to 2s orbital
(D) same as that of $2p_x$ and $2p_z$ orbitals

Q48. The two electrons occupying the same orbital are distinguished by:
(A) principal quantum number
(B) azimuthal quantum number
(C) magnetic quantum number
(D) spin quantum numbers

Q49. The maximum number of electrons in subshell is given by the expression:
(A) $4l + 2$ (B) $4l - 2$ (C) $2l + 1$ (D) $2n^2$

Q50. An electron has a spin quantum number +1/2 and magnetic quantum number -1. It cannot be present in:
(A) d-orbital (B) f-orbital (C) s-orbital (D) p-orbital

Q51. The value of azimuthal quantum number of electrons present in 4p-orbital is:
(A) 1
(B) 2
(C) any value between 0 and 3 except 1
(D) zero

Q52. For the energy levels in an atom which one of the following statements is correct?
(A) the 4s sub-energy level is at a higher energy that the 3d sub-energy level
(B) The M-energy level can have maximum of 32 electrons
(C) The second principal energy level can have four orbitals and contain a maximum of 8 electrons
(D) The 5th main energy level can have maximum of 50 electrons

Q53. The set of quantum numbers not applicable for an electron in an atom is

	n	*l*	m	s		n	*l*	m	s
(A)	1	1	1	1/2	(B)	1	0	0	+1/2
(C)	1	0	0	+1/2	(D)	2	0	0	+1/2

Q54. Quantum No. $l = 2$ and m = 0 represent which orbital:
(A) d_{xy} (B) $d_{x^2 - y^2}$ (C) d_{z^2} (D) d_{zx}

Q55. d_{z^2} orbital has:
(A) A lobe along Z-axis and a ring along X-Y plane
(B) A lobe along Z-axis and a lobe along X-Y plane
(C) A lobe along Z-axis and a ring along Y-Z plane
(D) A lobe and ring along Z-axis

Q56. For the energy levels in an atom which one of the following statements is(are) correct?
(A) There are seven principal electron energy levels
(B) The second principal energy level can have 4 subenergy levels and contain a max. of 8 electrons
(C) The M energy level can have a maximum of 32 electrons
(D) The 4s sub-energy level is at a lower energy that the 3d sub-energy level

Q57. Which of the following statements are correct for an electron that has n = 4 and m = -2?
(A) The electron may be in a d-orbital
(B) The electron is in the fourth principal electronic shell
(C) The electron may be in a p-orbital
(D) The electron must have the spin quantum number = +1/2.

Q58. Which of the following statement is/are wrong?
(A) If the value of $l = 0$, the electron distribution is spherical
(B) The shape of the orbital is given by magnetic quantum no.
(C) Angular moment of 1s, 2s, 3s electrons are equal
(D) In an atom, all electrons travel with the same velocity

Q59. The wave mechanical model of atom is based upon
(A) de Broglie concept of dual character of matter (B) Heisenberg's uncertainty principle
(C) Schrodinger wave equation (D) all the above three

Q60. Which of the following statements is incorrect?
(A) Probabilities are found by solving Schrodinger wave equation
(B) Energy of the electron at infinite distance is zero and yet it is maximum
(C) Some spectral lines of an element may have the same wave number
(D) The position and momentum of a rolling ball can be measured accurately

Q61. Choose the correct statement
(A) Electronic energy is positive
(B) ψ^2 represents the probability of finding an electron per unit volume
(C) ψ represents the probability of finding an electron
(D) none of the above is correct

Q62. For s-orbitals, since ψ (orbital) is independent of angles, the probability (ψ^2) is
(A) also independent of angles (B) spherically symmetric
(C) both (A) and (B) are correct (D) both (A) and (B) are incorrect

Q63. Splitting of spectral lines when atoms are subjected to strong electric field is called:
(A) zeeman effect (B) stark effect (C) decay (D) disintegration

Q64. Which of the following statements is not correct?
(A) The shape of an atomic orbital depends on the azimuthal quantum number
(B) The orientation of an atomic orbital depends on the magnetic quantum number
(C) The energy of an electron in an atomic orbital of multi election atom depends on the principal quantum number
(D) The number of degenerate atomic orbitals of one type depends on the values of azimuthal and magnetic quantum numbers.

Q65. Which of the following statement concerning the four quantum numbers is false
(A) n gives idea of the size of an orbital
(B) *l* gives the shape of an orbital
(C) m gives the energy of the electron in the orbital
(D) s gives the direction of spin of the electron in an orbital.

Q66. Which one of the statement of quantum numbers is false?
(A) Quantum number were proposed out of necessity in Bohr model of the atom.
(B) Knowing n and *l* it is possible to designate a subshell.
(C) The principal quantum number alone can give the complete energy of an electron in any atom.
(D) Azimutal quantum number refers to the subshell to which an electron belongs and describes the motion of the electron.

Q67. Which of the following transitions are allowed in the normal electronic emission spectrum of an atom?
(A) $2s \rightarrow 1s$ (B) $2p \rightarrow 1s$ (C) $3d \rightarrow 2p$ (D) $5d \rightarrow 2s$

Q68. The probability of finding an electron in the p_x orbital is
(A) zero at nucleus (B) the same on all the sides around nucleus
(C) zero on the z-axis (D) maximum on the two opposite sides of the nucleus along the x-axis

Q69. The spin of the electron
(A) increases the angular momentum
(B) decreases the angular momentum
(C) can be forward (clockwise) relative to the direction of the path of the electron.
(D) can be backward (anti-clockwise) relative to the direction of the path of the electron

Q70. When an atom is placed in the magnetic field, then due to the presence of electrons in it
(A) the orbitals do not orient themselves relative to the magnetic field.
(B) the orbitals orient themselves relative to the magnetic field.
(C) there are (2l + 1) different values of m for each value of l
(D) there are (2) different values of m for each value of 1.

Q71. The quantum numbers +1/2 and -1/2 for the electron spin represent
(A) rotation of the electron in clockwise and anticlockwise derection respectively
(B) rotation of the electron in anticlockwise and clockwise direction respectively
(C) magnetic moment of the electron pointing up and down respectively
(D) two quantum mechanical spin states which have no classical analogue

Q72. The set of quantum number for the 19th electrons in chromium is
(A) n = 4, l = 0, s = +1/2 or -1/2 (B) n = 3, l = 2, m = 1, s = +1/2 or -1/2
(C) n = 3, l = 2, m = -1, s = +1/2 or -1/2 (D) n = 4, l = 1, m = 0, s = +1/2 or -1/2

Q73. Which of the following subshell can accommodate as many as 10 electrons?
(A) 2d (B) 3d (C) 3dxy (D) $3dz^2$

The questions given below consist of an 'Assertion' (A) and the 'Reason' (R). Use the following key for the appropriate answer.
(A) If both (A) and (R) are correct and (R) is the correct reason for (A).
(B) If both (A) and (R) are correct but (R) is not the correct explanation for (A)
(C) If (A) is correct but (R) is not.
(D) If (A) is incorrect but (R) is correct
(E) If assertion (A) & reason (R) both are incorrect.

Q74. *Assertion :* For n = 3, l = 0, 1 & 2, and m = 0, 0, ± 1, & 0, ±1, ±2
Reason : For a given value of n, the values of l are all integers from 0 to n-1 and for a given value of l, the values of m are all integers from $-l$ to $+l$ including 0.

Q75. *Assertion :* The energy of an electron is largely determined by its principal quantum number.
Reason : The principal quantum number (n) is a measure of the most probable distance of finding the electrons around the nucleus.

Q76. *Assertion :* The p-orbital is dumb bell shaped.
Reason : The magnetic quantum number (m) can have three values in the case of a p-orbitals.

Q77. *Assertion :* For n =3, l may be 0, 1, and 2 and m may be 0, ± 1 and 0, ± 1 and ± 2.
Reason : For each value of n, there are 0 to (n -1) possible values of l: for each value of l, there are 0 to $\pm\, l$ values of m.

Q78. *Assertion :* p-orbital is dumb-bell shaped.
Reason : Electron present in p-orbital can have any one of the three values of magnetic quantum number, i.e. 0, +1 or -1.

Q79. *Assertion :* A special line will be seen for $2p_x$ - $2p_y$ transition.
Reason : Energy is released in the form of wave of light when the electron drops from $2p_x$ to $2p_y$ orbital.

Q80. *Assertion :* Limiting line in the Balmer series has a wavelength of 364.4 mm.
Reason : Limiting line is obtained for a jump of electron from n = ∞.

Q81. *Assertion :* Each electron in an atom has two spin quantum number.
Reason : Spin quantum numbers are obtained by solving schrodinger wave equation.

Q82. *Assertion :* The main shell with principal quantum number n = 2 has four orbitals present in it.
Reason : Number of orbitals present in a shell is given by n^2.

Q83. *Assertion :* Ten distinct set of four quantum numbers are possible for d-subshell.
Reason : d-subshell splits into five orbitals.

Q84. *Assertion :* $3d_{z^2}$ orbital is spherically symmetrical
Reason : $3d_{z^2}$ orbital is the only d-orbital which is spherical in shape.

Q85. *Assertion :* Orbitals form the basis of the electronic structure of atoms.
Reason : An atomic orbital is the wave function · for an electron in an atom.

Q86. *Assertion :* Fine lines are observed in spectra if an atom is placed in a magnetic field.
Reason : Degenerate orbitals split in the presence of magnetic field

Q87. *Assertion :* Spin quantum number can have the value +½ or –½.
Reason : (+) sign here signifies the wave function.

Q88. *Assertion :* Magnetic quantum number can have the value $l = 0, ..., (n–1)$
Reason : Magnetic quantum number specifies the number of orbitals.

Q89. *Assertion :* 5s orbital has greater energy than 4s.
Reason : Energy of the orbital depends on the azimuthal quantum number.

Q90. *Assertion :* Total number of orbitals associated with principal quantum number n = 3 is 6
Reason : Number of orbitals in a shell equals to 2n.

Q91. *Assertion :* Energy of the orbitals increases as
$1s < 2s = 2p < 3s = 3p < 3d < 4s = 4p + 4d = 4f < .....$
Reason : Energy of the electron depends completely on principal quantum number.

Q92. *Assertion :* Splitting of the spectral lines in the presence of magnetic field is known as stark effect.
Reason : Line spectrum is simplest for hydrogen atom.

Q93. *Assertion :* Orbit and orbital are synonymous.
Reason : Both represent a circular path around which electron moves.

Q94. *Assertion :* Atomic orbital in an atom is designated by n, l, m_l and m_s.
Reason : These are helpful in designated electron present in an orbital.

Q95. *Assertion :* Total numberof electrons in a subshell designated by azimuthal quantum number l is $2l + 1$.
Reason : l can have value 1, 2, 3.....n–1, where n is principal quantum number.

Q96. *Assertion :* Shape associated with the orbital designated by n=2, l=1 is double dumb-cell.
Reason : It belongs to d-orbital.

Q97. *Assertion :* A spectral line will be observed for a $2p_x - 2p_y$ transition..
Reason : The energy is released in the form of wavelight when electron drops from $2p_x$ to $2p_y$ orbital.

Q98. *Assertion :* An orbital cannot have more than two electrons, moreover, if an orbital has two electrons they must have opposite spins.
Reason : No two electrons in an atom can have same set of all the four quantum numbers.

ANSWERS

Q1. n = 2, l = 0, m = –1, 0, +1, s = ±½ Q2. $10es^{-}\{3d^{10}\}$ Q3. (i) - (18), (ii)-(2), (iii)-(10), (iv)-(1)

Q4. n = 5, m = –4 to +4, no. of electrons = 18 Q5. (iii) > (i) > (ii) > (iv) Q6. g subshell

Q7. B	Q8. A	Q9. C	Q10. A	Q11. A	Q12. C	Q13. B
Q14. C	Q15. A	Q16. A	Q17. A	Q18. D	Q19. C	Q20. B
Q21. A	Q22. D	Q23. C	Q24. D	Q25. D	Q26. A	Q27. D
Q28. D	Q29. B	Q30. B	Q31. B	Q32. A	Q33. D	Q34. A
Q35. C	Q36. C	Q37. D	Q38. A	Q39. D	Q40. B	Q41. D
Q42. C	Q43. D	Q44. D	Q45. C	Q46. B	Q47. D	Q48. D
Q49. A	Q50. C	Q51. A	Q52. CD	Q53. A	Q54. C	Q55. A
Q56. A	Q57. AB	Q58. BD	Q59. D	Q60. C	Q61. B	Q62. C
Q63. B	Q64. D	Q65. C	Q66. ACD	Q67. ABCD	Q68. ACD	Q69. CD
Q70. BC	Q71. D	Q72. A	Q73. B	Q74. A	Q75. A	Q76. B
Q77. A	Q78. B	Q79. D	Q80. A	Q81. D	Q82. A	Q83. A
Q84. E	Q85. A	Q86. A	Q87. C	Q88. D	Q89. C	Q90. E
Q91. C	Q92. D	Q93. E	Q94. D	Q95. C	Q96. E	Q97. E
Q98. A						