ATOMIC STRUCTURE

SINGLE CORRECT CHOICE TYPE QUESTIONS

1. The electrons, identified by quantum number n and l:

(I) $n = 3; l = 0$ (II) $n = 5; l = 2$
(III) $n = 2; l = 1$ (IV) $n = 4; l = 3$

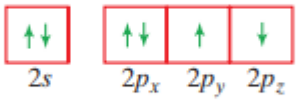
can be placed in order of increasing energy from the lowest to highest as:

(A) III < I < IV < II
(B) I < III < IV < II
(C) II < III < IV < I
(D) II < IV < I < III

2. 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) p-orbital
(D) s-orbital

3. Consider the following electronic configuration



If one electron is added into the given electronic arrangement, then upcoming electron will have:

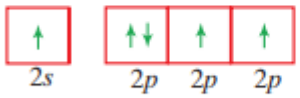
(A) Similar spin with that of electron of $2p_z$.
(B) Similar value of magnetic quantum number with that of $2p_x$.
(C) Similar value of $(n + l)$ with that of 2s orbital.
(D) Accommodation in either $2p_x$, $2p_y$ or $2p_z$ orbital.

4. Given that Z_{eff} value of an element N ($Z = 7$) is Y. Then which of the following statements is correct?

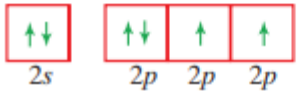
(A) σ value for N will be $7 + Y$.
(B) σ value for oxygen will be $7.35 - Y$.
(C) σ value for oxygen will be $7 - Y$.
(D) Given information is not sufficient.

5. The orbital diagram in which the Aufbau principle is violated

(A) 

(B) 

(C) 

(D) 

6. For which of the following orbitals, the electron finding probability is zero, if we move along the z-axis?

(I) p_x
(II) p_y
(III) d_{z^2}
(IV) $d_{x^2-y^2}$
(A) I and II
(B) III
(C) I, II and IV
(D) I, II and III

7. The degeneracy of H-atom in a shell is 9. The value of principal quantum number (n) for the shell is
(A) 3
(B) 9
(C) 1
(D) None of these

8. Process I $X(g) \xrightarrow{+3e^-} X^{3-}(g)$
Process II $X(g) \xrightarrow{-3e^-} X^{3+}(g)$
Which of the following is not changed during both the processes?
(A) Total number of protons
(B) Number of neutrons
(C) Both (A) and (B)
(D) Total number of electrons

9. Find the maximum number of electrons that can be filled in P shell.
(A) 6
(B) 2
(C) 72
(D) 50

10. In a hypothetical atom, the number of electrons in shell and subshell are x and y, respectively, where each electron has three possible spin states represented as $s = +1/2, -1/2$ and 0.
Then the value of $x + y$ is
(A) $2n^2 + 4l + 2$
(B) $3n^2 + 3l + 1$
(C) $3n^2 + 6l + 3$
(D) $6n^2 + 3l + 3$

11. The correct order of spin multiplicity of various ions of manganese including its neutral state is
(A) $Mn^{7+} > Mn^{6+} > Mn^{4+} > Mn^{2+} > Mn$
(B) $Mn > Mn^{2+} > Mn^{4+} > Mn^{6+} > Mn^{7+}$
(C) $Mn^{7+} < Mn^{6+} < Mn^{4+} < Mn^{2+} = Mn$
(D) All have equal spin multiplicity

12. Match the electronic configuration with the rule that it is violating.

Column-I	**Column-II**
(P) Only Aufbau's principle	(1) 
(Q) Only Pauli's exclusion principle	(2) 
(R) Only Hund's rule	(3) 

Column-I	**Column-II**
(S) Aufbau's and Hund's rule	(4) 

Code:

	P	Q	R	S
(A)	1	2	3	4
(B)	3	4	2	1
(C)	2	4	1	3
(D)	2	1	4	3

13. In which block will copper be placed if the Aufbau principle is not followed and the filling of electron takes place in the following sequence, $1s, 2s, 2p, 3s, 3p, 3d, 4s, 4p, 4d, 4f$ ...?

(A) s
(B) p
(C) d
(D) f

14. Which of the following is correct about Z_{eff} for an element?

(A) Z_{eff} is same for (ns, np) electron.
(B) Z_{eff} is same for (nd, nf) electron.
(C) σ is not same for (ns, np) electron.
(D) σ is same for (nd, nf) electron.

15. The number of possible orientations of d orbitals in space is

(A) 2
(B) 3
(C) 4
(D) 5

16. Spin only magnetic moment of dipositive ion of Mn is:

(A) 0
(B) $\sqrt{8}$ BM
(C) $\sqrt{24}$ BM
(D) $\sqrt{35}$ BM

17. The zero probability of finding the electron in $d_{x^2-y^2}$ orbital is
(A) on two opposite side of nucleus along x-axis.
(B) in the nucleus
(C) same on all the sides around the nucleus.
(D) None of these

18. If Z_{eff} of F($Z = 9$) is X and Z_{eff} of Li ($Z = 3$) is Y then find the value of $|X - Y|$
(A) 4.90
(B) 3.90
(C) 2.90
(D) 1.90

19. Which electronic configuration does not follow the Aufbau rule?
(A) $1s^2, 2s^2, 2p^6$
(B) $1s^2, 2s^2, 2p^4, 3s^2$
(C) $1s^2$
(D) $1s^2, 2s^2, 2p^6, 3s^3$

20. Which of the following may have same set of quantum numbers?
(A) Last electron of Sc and last electron of Fe.
(B) Unpaired electron of C and entered electron in C^-.
(C) Last electron of Sc and last electron of Y.
(D) Unpaired electron in $2p$ orbital of N and unpaired electron in $2p$ orbital of B.

21. Which out of Co (II) salts and Cd (II) salts, is attracted or repelled by the magnetic field?
(A) Co (II) salts are attracted and Cd (II) salts are repelled.
(B) Co (II) salts are repelled and Cd (II) salts are attracted.
(C) Co (II) salts are attracted, while Cd (II) salts are not affected by the magnetic field.
(D) Both Co (II) and Cd (II) salts are repelled.

22. An electron present in which of the following orbitals has the minimum value for $(n + l + m + s)$? Consider the minimum possible value for m and s (where ever applicable).
(A) $3p$
(B) $5p$
(C) $4d$
(D) $5s$

23. Choose the correct statement among the following:
(A) Number of orbitals in n^{th} shell is n^2.
(B) Number of orbitals in a subshell is $(2l - 1)$.
(C) Number of subshells in n^{th} shell is $(n - 1)$.
(D) Number of electrons in an orbital of a subshell is $2(2l + 1)$.

24. In boron atom shielding of the last electron is due to
(A) electrons of K shell only.
(B) all the electrons of K and L shells.
(C) two electrons of $1s$ and $2s$ each.
(D) all the electrons of L shell only.

25. Which of the following statements is correct?

(A) Total number of electrons in a subshell is $2l+1$.
(B) p_z, $d_{x^2-y^2}$ and d_{z^2} orbitals are non-axial.
(C) Only *s* orbital has directional orientation while p_z, *d* and *f* orbitals have non-directional properties.
(D) Spin multiplicity of nitrogen atom is 4.

26. Imagine a Universe in which the four quantum numbers can have the same possible value as in our Universe except that the magnetic quantum number (m) can have integral values from 0 to $\pm(l+1)$. Find the electronic configuration of atomic number 20.

(A) $1s^6\,2s^6\,2p^8$
(B) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2$
(C) $1s^4\,2s^4\,2p^6\,3s^4\,3p^2$
(D) $1s^2\,1p^6\,2s^2\,1d^{10}$

27. The subshells which are filled just before and just after the filling of 5*p* subshell are respectively:

(A) 5*s*, 5*d*
(B) 4*d*, 6*s*
(C) 4*d*, 4*f*
(D) 6*s*, 4*f*

28. Which of following species has the magnetic moment value of 3.87 BM?

(A) Fe^{3+}
(B) Cr^{2+}
(C) Co^{2+}
(D) Au^{3+}

29. Give the correct order of initials **True (T)** or **False (F)** for following statements.

(I) Number of electrons having $l=0$ is 10 in Pd.
(II) The value of Z_{eff} for 3*d* electron of Cr and 3*d* electron of Mn is same as number of electron in *d* sub shell of Cr and Mn are the same.
(III) Multiplicity of Fe is equal to that of Ni^{2+}.
(IV) Value of l/n for last electron of element having atomic number 57 is 0.4,

(A) T T T T
(B) F T T T
(C) T F T F
(D) F F F T

30. According to Slater rule, the set of elements that show incorrect order of Z_{eff} are:

(A) Al > Mg
(B) Na > Li
(C) K > Na
(D) None of these

31. The magnetic moment and nature for isolated gaseous ion Au^{3+} is

(A) zero and diamagnetic.
(B) 2.82 BM and diamagnetic.
(C) 2.82 BM and paramagnetic.
(D) None of these.

32. The correct set of quantum numbers for the last electron of Na^+ is

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

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

(C) 3, 1, 1, $+\frac{1}{2}$

(D) 2, 1, 0, $-\frac{1}{2}$

33. Select the correct statement for Ne.

(A) It is not isoelectronic wih H_2O

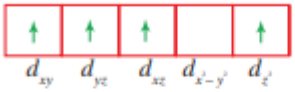
(B) Its last electron enters in *S* orbital

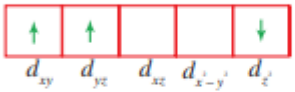
(C) The value of *m* must be zero for the last electron.

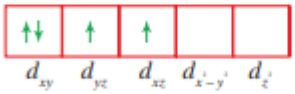
(D) The value of *l* must be 1 for the last electron.

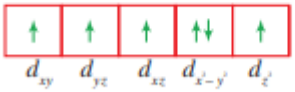
MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Hund's rule is violated in which of the following electronic configurations?

(A) 

(B) 

(C) 

(D) 

2. Which of the following set(s) consist of only isoelectronic species?

(A) N^{3-}, O^{3-}, Ne, Na^+

(B) NO_3^-, SiO_4^{4-}, CO_3^{2-}

(C) Hg^{2+}, Pb^{4+}

(D) H, He^+, Li^{2+}, Be^{3+}

3. If two subshells have equal value of $(n + l)$ and one of them has $n = 4, l = 3$, while second subshell has dumbbell shape. Then which of the following statement is/are correct?

(A) Second subshell has value of $n = 6$.

(B) Second subshell has one nodal plane.

(C) Second subshell is *d*-subshell.

(D) First subshell is *f*-subshell.

4. Select the correct statement(s) among the following.

(A) The maximum value of principal quantum number is 7.

(B) For $n = 2$, there may be four subshells and these may contain a maximum of 8 electrons.

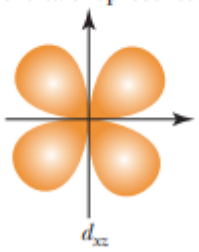
(C) M shell can accommodate a maximum of 18 electrons.

(D) The energy of 5*p*-orbitals is more than that of 4*d*-orbitals.

5. Which of the following statements are not true for d_{xy} orbital?

(A) It is double dumbbell shaped.
(B) The lobes lie in between x-and z-axes.
(C) p_z orbital is perpendicular to d_{xy} orbital.
(D) The lobes of p_x orbital are collinear with those of d_{xy} orbital.

6. Which are the orbitals represented in Figure 1.7?



(A) d_{xy}
(B) $d_{x^2-y^2}$
(C) d_{xz}
(D) d_{yz}

7. Which of the following orbitals are represented by $n = 4$ and $l = 1$?

(A) $4p_y$
(B) $4p_x$
(C) $4d_{xy}$
(D) $4d_{x^2-y^2}$

8. Which of the following electronic configurations are incorrect for a d^6 system for an isolated gaseous ion?

(A) 
(B) 
(C) 
(D) 

9. Using the Slater's rule, choose the correct statements among the following.

(A) Value of σ (shielding constant) for d-electrons of penultimate shell of Sc, Y, La are equal.
(B) Z_{eff} for d-electrons of penultimate shell of Sc, Y, La are equal.
(C) Value of σ increases by a factor of 0.3 in the first period from left to right.
(D) Value of Z_{eff} increases by a factor of 0.35 in the second period from left to right.

10. Which of the following quantum numbers may be the same for an electron present in $3p$ and $5p$ orbitals?

(A) Principal quantum number
(B) Azimuthal quantum number
(C) Magnetic quantum number
(D) Spin quantum number

11. Choose the correct options from the following:

(A) Cr and S have the same number of valence shell electrons.
(B) Cr and S have different number of unpaired electrons in their ground state.
(C) Cr and S are the elements of the same period.
(D) In the long form of the periodic table, the Group number of Cr and S is 6 and 16, respectively.

12. Which of the following set of quantum numbers are valid for electrons of ground state electronic configuration of elements having atomic number upto 25.

	n	*l*	*m*	*s*
(A)	3	2	0	$+\frac{1}{2}$
(B)	4	0	0	$+\frac{1}{2}$
(C)	4	1	0	$-\frac{1}{2}$
(D)	2	2	+1	$+\frac{1}{2}$

13. Select the incorrect statements among the following.

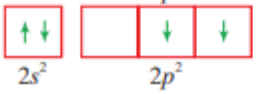
(A) In $d_{x^2-y^2}$ orbital, two nodal planes are present in *xz*- and *yz*-plane.
(B) d_{xy} and $d_{x^2-y^2}$ have one common nodal plane.
(C) One 4*d* orbital contains only two electrons of the same spin.
(D) One 3*d* orbital contains a total of 10 electrons.

14. Which of the following can be a stable ground state electronic configuration (only valence shell) of carbon atom?

(A) 

(B) 

(C) 

(D) 

15. Which of the following species is isoelectronic with Ne?

(A) H_2O
(B) C^{4-}
(C) Na^-
(D) NH_2^-

16. Choose the correct option regarding energy of empty orbitals.

	n	*l*	*m*	*s*
(I)	4	0	0	$+\frac{1}{2}$
(II)	3	2	0	$-\frac{1}{2}$
(III)	3	1	1	$+\frac{1}{2}$
(IV)	3	0	0	$-\frac{1}{2}$

(A) I > IV
(B) II > I
(C) II > III
(D) I = III

17. Which of the following may represent the possible quantum numbers for the last electron of Ga?

(A) 3, 1, +1, $+\frac{1}{2}$

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

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

(D) 4, 1, +1, $+\frac{1}{2}$

COMPREHENSION TYPE QUESTIONS

Passage 1: For Questions 1–2

Nodal plane of an orbital is the region around the nucleus where probability of finding electrons of that orbital is zero. Number of nodal planes of an orbital = *l*.

1. Nodal plane of *s*-orbital is
(A) *xy*-plane (B) *yz*-plane
(C) *xz*-plane (D) None of these

2. Which of the following contains at least one common nodal plane?
(A) p_x and d_{xz} (B) d_{xy} and $d_{x^2-y^2}$
(C) $d_{x^2-y^2}$ and d_{z^2} (D) p_z and d_{z^2}

Passage 2: For Questions 3–4

In a hypothetical system, all the known concepts of shell, subshell, orbitals, etc., exist in the same way as in our system except that the $(n + l)$ rule is modified to $(n - l)$ rule for deciding the subshell energy. In case of equal value of $(n - l)$, the higher value of n gives the higher energy.

3. In this hypothetical system S ($Z = 16$) will be a
(A) p-block element
(B) s-block element
(C) d-block element
(D) f-block element

4. For $n \leq 3$, the subshell having maximum energy for the above hypothetical system will be
(A) $2s$ (B) $3d$
(C) $3p$ (D) $3s$

Passage 3: For Questions 5–6

The effective nuclear charge (Z_{eff}) takes into account the interelectronic repulsion in multielectron atoms. Slater's rule helps us in evaluating Z_{eff} for various species. Apply Slater's rules to answer the following questions.

5. Z_{eff} for $3d$ electron of Zn $= x$
Z_{eff} for $3d$ electron of $Zn^{2+} = y$
Z_{eff} for $4s$ electron Zn $= z$
Choose the **correct** option(s)
(A) $x > z$ (B) $y > z$
(C) $x = y$ (D) All of these

6. Z_{eff} for valence electron of Ga $= a$
Z_{eff} for valence electron of Al $= b$
Z_{eff} for valence electron of Ca $= c$
Choose the **correct** option(s)
(A) $a > c$ (B) $a > b$
(C) $b > c$ (D) Both (A) and (B)

Passage 4: For Questions 7–9

Consider a hypothetical atom where, p_x, p_y, p_z and d_{xy}, d_{xz}, d_{yz}, $d_{x^2-y^2}$ orbitals are present for principal quantum number $n = 3$.

7. In the nodal plane of p_x orbital, the number of other orbital lobes that are fully present is

(A) 2
(B) 3
(C) 4
(D) 5

8. In the nodal plane of p_z orbital, the number of other orbital lobes that are fully present is

(A) 2
(B) 3
(C) 4
(D) 5

Passage 5: For Questions 10–12

The general electronic configuration of outer most and penultimate shell is given as $(n-1)s^2(n-1)p^6(n-1)d^x\ ns^2$. Then for an element with $n = 4$ and $x = 7$.

10. The number of protons present in the divalent cation of the element of above configuration is

(A) 25
(B) 26
(C) 27
(D) 28

11. The element is isoelectronic with which of the following species?

(A) Fe^-
(B) Ni^+
(C) Cu^{2+}
(D) All of these.

12. The number of unpaired electrons in the divalent cation of the element in isolated gaseous state is

(A) 0
(B) 3
(C) 4
(D) 1

Passage 6: For Questions 13–15

Three quantum numbers are required to define an orbital while four quantum numbers are required to describe an electron.

13. Which of the following statement is correct?

(A) The quantum numbers of the electron in H atom are exactly identical with that of one electron of He atom.
(B) The maxima of the radial distribution of *s* orbital decreases as the principal quantum number increases.
(C) According to Pauli's exclusion principle, the lower energetic orbital will be filled first.
(D) The N atom has the electronic configuration of $1s^2\ 2s^2\ 2p^3$ which is represented as

14. $(n + l)$ is maximum and minimum for which of the following orbitals: $6s, 5p, 6d, 4d, 2p, 3s, 2s$?

(A) $6f$ and $1s$
(B) $6d$ and $2s$
(C) $5p$ and $3s$
(D) $6s$ and $2p$

15. Which of the following statements is correct for H atom?

(A) H atom can be placed both in Group 1 and Group 18.
(B) H atom can be placed both in Group 1 and Group 17.
(C) H atom produces smallest anion in reality.
(D) $2s, 2p, 3s$ orbitals are not available in H atom.

Passage 7: For Questions 16–18

The electronic configuration of an element is written as follows: $1s^2 2s^2 2p^6\ 3s^2 3p^6\ 3d^8\ 4s^2$

16. On removal of one electron, the electronic configuration will become

(A) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 3d^7\ 4s^2$

(B) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 3d^8\ 4s^1$

(C) $1s^2\ 2s^2 2p^6\ 3s^2 3p^6\ 3d^9\ 4s$

(D) None of these.

17. The screening constant value for an electron in 3*s* is identical with that of an electron present in

(A) 3*p* orbital.
(B) 3*d* orbital.
(C) 4*s* orbital.
(D) 4*p* orbital.

18. Which of the following statements is incorrect?

(A) In calculation of σ value (shielding constant) for an electron in 4*s* orbital, the contribution of 1*s* electron is 0.3.
(B) In calculation of σ value for of an electron in 3*d* orbital, the contribution of 4*s* electron is zero.
(C) In calculation of σ value for an electron in 3*d* orbital, the contribution of electron present in 3*p* orbital is 1.0.
(D) In calculation of σ value for an electron in 4*s* orbital, the contribution of electron present in 3*p* orbital is 0.85.

ASSERTION-REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

(A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
(B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
(C) If Statement I is true but Statement II is false.
(D) If Statement I is false but Statement II is true.

1. **Statement I:** Each *f*-block series contains 14 elements.

Statement II: The *f* orbitals can have seven possible orientations in space and can accommodate maximum of 14 electrons in the *f*-subshell.

2. **Statement I:** The 3*p* orbitals are higher in energy as compared to 3*s* orbital.

Statement II: $(n + l)$ for 3*p* orbitals is lower than that of 3*d* orbitals.

3. **Statement I:** Cu^+ is repelled by magnetic field.

Statement II: All electrons are paired up in Cu^+ ion.

4. **Statement I:** The fully filled configuration is more stable as compared to half-filled configuration.

Statement II: More exchange energy causes greater stability.

5. **Statement I:** Mn can show maximum oxidation state of +7.

   Statement II: Total number of valence shell electrons present in Mn is 5.

6. **Statement I:** The p_x, p_y, p_z orbitals are called degenerate orbitals.

   Statement II: p_x, p_y, and p_z orbitals have almost the same energy.

7. **Statement I:** Pairing of electrons in degenerate orbitals decreases the energy of the system.

   Statement II: Spinning directions of the two paired electrons are different.

8. **Statement I:** The electronic configuration for d^5 system is wrongly represented as

   Statement II: Hund's rule is violated in the above representation.

9. **Statement I:** In writing the electronic configuration of an atom, the 5*s* orbital will be filled before 4*p* orbital.

   Statement II: The $(n + l)$ values for 5*s* orbital and 4*p* orbital are identical.

INTEGER ANSWER TYPE QUESTIONS

1. Among the given elements, number of species which are isodiaphers of each other are_____.
   ${}_{92}U^{238}, {}_{88}Ra^{230}, {}_{89}Ac^{232}, {}_{90}Th^{234}$

2. Total number of orbitals that are to be filled completely before entering into the 6*s* subshell for filling of electrons is_____.
   (Add the digits till you get single digit answer.)

3. Find the maximum value of $n + l + m$ for the last electron present in an element which belongs to fifth period and group number 15.

4. Find the total number of elements out of the given elements which will need two more electrons to achieve 8 electrons in the outermost shell.
   Na, C, N, P, F, O

5. If unknown element X has Z_{eff} value of 3.5 and only two electrons of valence shell contribute towards sigma (σ) calculation, then what is the atomic number of element? (Consider elements up to atomic number 20.)
   (Add the digits till you get single digit answer.)

6. Find the total number of possible exchanges for d^4 configuration in an element.

7. If Z_{eff} of Mg is 2.85, then what will be the value of y for magnesium, where $y = \frac{(\sigma + 0.85)}{2}$?

8. How many elements amongst the following have at least 4 electrons in *p*-subshells?
   B, N, Al, Si, P, Cl

9. If Aufbau's rule is not followed and electron filling is done shell after shell, then number of unpaired electrons present in copper will be _____.

10. The first excited state of Cl^- ion will have degeneracy of _____.

11. Maximum number of degenerate orbitals in M shell of Li^{2+} is _____.

12. Number of groups incorrectly mentioned according to their relationship given in brackets is_____.
(A) ${}^{16}_{8}O$, ${}^{17}_{8}O$, (isotopes)
(B) CaO, KF (isosteres)
(C) ${}^{15}_{7}N$, ${}^{19}_{9}F$, (isobars)
(D) Na^+, Mg^{2+} Al^{3+} (isoelectronic)
(E) ${}^{3}_{1}H$, ${}^{4}_{2}He$, (isodiaphers)
(F) H_2O, NH_3 (isosteres)
(G) ${}^{40}_{19}K$, ${}^{40}_{20}Ca$ (isobars)
(H) ${}^{39}_{19}K$, ${}^{40}_{20}Ca$ (isotones)

13. The number of chemical species among the following which can produce spin magnetic moment greater than zero is_____.
Sc^{3+}, V^{3+}, Cr^{6+}, Mn^{2+}, Zn, Pd, Ag^+, Cu^{2+}, Hg, Cu^+, Cu

14. The ratio of unpaired electrons present in *d* orbitals of Co^{2+} and Cr^{3+} is _____.

15. In Mn, the maximum number of electrons having $m_s = +\frac{1}{2}$ is _____.

16. In Mn, the minimum number of electrons having $m_s = -\frac{1}{2}$ is _____.

17. In the following species, the number of them having same magnetic moment value is _____.
Fe^{3+}, Co^{3+}, Ni^{2+}, Mn^{3+}, Cu^+, Zn^{2+}, Cd^{2+}, Cu^{2+}, Ag^+.

18. The total value of *m* for all electrons in N atom is _____.

19. Find maximum number of electrons in Al for which $\frac{l \times m}{n} = 0$. (Atomic number of Al =13).

20. Find total number of orbitals in S atom, for which $|m| \le 1$ and which contains at least one electron. (Atomic number of S = 16).

21. Find total number of orbitals in which electron density is observed along any of the axis (*x*, *y* or *z*).

$$s, p_x, p_y, p_z, d_{xy}, d_{xz}, d_{yz}, d_{z^2}, d_{x^2-y^2}$$

22. Calculate maximum number of electrons in ${}_{25}Mn$ which have $n = 3, m = 0$ and $s = +1/2$.

23. Find the maximum number of electrons in Cr atom which have $m = -1$ and $s = +1/2$ but $n \neq 2$.

24. Find the number of electrons having $(n \times l + m) = 3$ for Kr atom (Atomic number = 36)

25. The shielding constant for the last electron in Sc is _____.

26. The Z_{eff} on the last electron in Sc is _____.

27. The number of species among the following, having magnetic moment value of 2.84 BM is _____.

$$Fe^{2+},\ Cr,\ Cr^{3-},\ Ti^{2+},\ Mn^{2+},\ V^{3+}$$

28. The number of electrons for Cd^{2+} that have the value of azimuthal quantum number $l = 1$ is _____.

29. The number of electrons present in the Br^- ion that have the value of magnetic quantum number $m = +1$ is _____.

30. The Z_{eff} on the last electron of Zr^{3+} ion is _____.

31. The Z_{eff} on the electron present in $5d$ orbital of Gd (atomic number = 64) is _____.

MATRIX-MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as **(A), (B), (C) and (D), while those in Column II are labelled as (P), (Q), (R), (S) and (T)**. Any given statement in Column I can have correct matching with one or more statements in Column II.

1. Match the orbitals with their spatial arrangement.

Column-I	Column-II
(A) p_z	(P) xy plane is the nodal plane.
(B) d_{xz}	(Q) yz plane is the nodal plane.
(C) d_{yz}	(R) xz plane is the nodal plane.
(D) d_{xy}	(S) Has a common nodal plane with p_x
	(T) Has a common nodal plane with d_{xy}

2. Match the shell with the property.

Column-I	Column-II
(A) K	(P) Maximum number of electrons present is 18.
(B) L	(Q) If the shell is fully occupied, some electrons must have value of $m = 0$.
(C) M	(R) There are no electrons with l value of 2, if the shell is fully occupied.
(D) N	(S) p subshell is present.

3. Match the electronic configuration with the nature/ property of the element.

Column-I	Column-II
(A) [Ar] $3d^{10}\ 4s^2\ 4p^6\ 5s^1$	(P) *p*-block element.
(B) [Ne] $3s^2\ 3p^6\ 4s^2\ 3d^6$	(Q) Zero group element.
(C) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$	(R) *d*-block element.
(D) [Xe] $4f^{14}\ 5d^{10}\ 6s^2\ 6p^3$	(S) 4th period element.
	(T) Paramagnetic element.

4. Match the ion with the property.

Column-I	Column-II
(A) Fe^{2+}	(P) Set of quantum number for the last electron $n=2, l=1, m=1, s=+\frac{1}{2}$
(B) Mn^{4+}	(Q) Magnetic moment (μ) = Zero.
(C) Zn^{2+}	(R) Spin multiplicity(SM) = 4
(D) Na^{+}	(S) Paramagnetic

ANSWERS

Single Correct Choice Type Questions

1. (A)	**8.** (C)	**15.** (D)	**22.** (A)	**29.** (D)
2. (D)	**9.** (C)	**16.** (D)	**23.** (A)	**30.** (C)
3. (D)	**10.** (C)	**17.** (B)	**24.** (C)	**31.** (C)
4. (B)	**11.** (C)	**18.** (B)	**25.** (D)	**32.** (D)
5. (B)	**12.** (C)	**19.** (B)	**26.** (A)	**33.** (D)
6. (C)	**13.** (A)	**20.** (D)	**27.** (B)	
7. (A)	**14.** (A)	**21.** (A)	**28.** (C)	

Multiple Correct Choice Type Questions

1. (B), (C)	**5.** (B), (D)	**9.** (B), (C)	**13.** (A), (B), (C), (D)	**17.** (C), (D)
2. (A), (C), (D)	**6.** (A), (C), (D)	**10.** (B), (C), (D)	**14.** (A), (C), (D)	
3. (A), (B), (D)	**7.** (A), (B)	**11.** (A), (B), (D)	**15.** (A), (B), (D)	
4. (C), (D)	**8.** (C), (D)	**12.** (A), (B)	**16.** (A), (B), (C)	

Comprehension Type Questions

1. (D)	**5.** (D)	**9.** (A)	**13.** (A)	**17.** (A)
2. (A)	**6.** (D)	**10.** (C)	**14.** (B)	**18.** (A)
3. (C)	**7.** (B)	**11.** (D)	**15.** (B)	
4. (D)	**8.** (C)	**12.** (B)	**16.** (B)	

Assertion-Reasoning Type Questions

1. (A)	**3.** (A)	**5.** (C)	**7.** (D)	**9.** (D)
2. (B)	**4.** (A)	**6.** (C)	**8.** (A)	

Integer Answer Type Questions

1. 4	**3.** 7	**5.** 4	**7.** 5	**9.** 1
2. 9	**4.** 1	**6.** 6	**8.** 4	**10.** 5
11. 9	**16.** 10	**21.** 6	**26.** 3	**31.** 3
12. 3	**17.** 4	**22.** 3	**27.** 2	
13. 4	**18.** 0	**23.** 2	**28.** 18	
14. 1	**19.** 9	**24.** 6	**29.** 8	
15. 15	**20.** 9	**25.** 18	**30.** 4	

Matrix-Match Type Questions

1. (A) → (P)
(B) → (P), (Q), (S), (T)
(C) → (P), (R), (T)
(D) → (Q), (R), (S)

2. (A) → (Q), (R)
(B) → (Q), (R), (S)
(C) → (P), (Q), (S)
(D) → (Q), (S)

3. (A) → (T)
(B) → (R), (S), (T)
(C) → (P), (Q)
(D) → (P), (T)

4. (A) → (S)
(B) → (R), (S)
(C) → (Q)
(D) → (P), (Q)