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IIT JAM – INORGANIC PRACTICE BOOK		
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ATOMIC STRUCTURE & PERIODICITY

MULTIPLE CHOICE QUESTIONS (MCQ)

- Which of the following species are isoelectronic pairs:
 (a) NH_2^- and H_3O^+ (b) NH_3 and H_3O^+
 (c) BH_2 and N (d) CN^- and N_2^+
- For an electronic configuration $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$ the block and group number are:
 (a) d block, 5th group (b) s block, 6th group
 (c) d block, 6th group (d) s block, 1st group
- The IUPAC name and symbol for the element having Atomic number= 105
 (a) Ununpentium (uup)
 (b) unnilpentium (unp)
 (c) nilunpentium (nup)
 (d) ennilpentium (unp)
- Select the correct electronic configuration of Chromium (Cr) and Cr^{+2} respectively : (Given Atomic No of Cr = 24)
 (a) $\text{Cr} = [\text{Ar}] 4s^2 3d^4$ and $\text{Cr}^{+2} = [\text{Ar}] 3d^4$
 (b) $\text{Cr} = [\text{Ar}] 4s^1 3d^5$ and $\text{Cr}^{+2} = [\text{Ar}] 4s^1 3d^3$
 (c) $\text{Cr} = [\text{Ar}] 4s^1 3d^5$ and $\text{Cr}^{+2} = [\text{Ar}] 3d^4$
 (d) $\text{Cr} = [\text{Ar}] 4s^2 3d^4$ and $\text{Cr}^{+2} = [\text{Ar}] 4s^2 3d^2$
- For $n = 1$, what are the allowed values of l and m_l :
 (a) $l = 1, m_l = -1$ (b) $l = 1, m_l = 0$
 (c) $l = 0, m_l = 1$ (d) $l = 0, m_l = 0$
- Which of the following set of quantum numbers are not possible for 5g orbital?
 (a) $n=5, l=4, m=4, s=+1/2$ (b) $n=5, l=0, m=0, s=-1/2$
 (c) $n=5, l=2, m=3, s=+1/2$ (d) $n=5, l=4, m=-4, s=-1/2$
- Which of the following set of quantum n, l, m, s respectively are not possible?
 (a) 3, 2, 2, $1/2$ (b) 4, 3, 3, $1/2$
 (c) 3, 2, -1, $-1/2$ (d) 3, 3, 2, $1/2$
- Which of the following atomic orbital electron is filled first among the others?
 (a) 5d (b) 4f
 (c) 7s (d) 6p
- The maximum number of electrons in any principal shell 'n' is given by:
 (a) n^2 (b) $(2n+1)^2$
 (c) $2n^2$ (d) $2n$
- The principal quantum number (n) tells about the radius of an orbit (R_n). How is the n related with R_n ?
 (a) $R_n \propto n^2$ (b) $R_n \propto n$
 (c) $R_n \propto 1/n^2$ (d) $R_n \propto 1/n$
- Which of the following are pairs of amphoteric oxides:
 (a) ZnO and SnO (b) N_2O and SiO_2
 (c) B_2O_3 and CO_2 (d) NO and CaO
- Which of the following anion is less stable?
 (a) Be^- (b) Li^-
 (c) O^- (d) C^-
- How many electrons can be filled in 4th shell and 4p subshell respectively:
 (a) 10 and 6 (b) 14 and 2
 (c) 16 and 6 (d) 18 and 6
- What is the the Z^* for the s and d electron of Zinc respectively?
 (a) 4.35 and 8.85 (b) 3.65 and 6.15
 (c) 5.35 and 8.15 (d) 3.85 and 6.85
- Select the correct ionic radius of any element A?
 (a) $A^- > A > A^+ > A^{2+}$ (b) $A > A^+ > A^{2+} > A^-$
 (c) $A^{2+} > A^+ > A > A^-$ (d) $A^+ > A^{2+} > A > A^-$
- Among the following pair which have nearly the same ionic radii?
 (a) N and P (b) B and Al
 (c) Be and Mg (d) Zr and Hf
- Among the following ions which has highest ionic mobility in aqueous solution?
 (a) Li^+ (b) Mg^{+2}
 (c) Na^+ (d) K^+
- The correct order of increasing atomic size or ionic size
 (a) $\text{K}^+ < \text{Ca}^{+2} < \text{Se}^{+2}$ (b) $\text{Cl} < \text{Mg} < \text{Ca}$
 (c) $\text{Na}^+ < \text{Mg}^{+2} < \text{Cl}^-$ (d) $\text{S}^{2-} > \text{O}^{2-} > \text{As}^{3-}$
- Which of the following ionic size order of these species is correct?
 (a) $\text{S}^{2-} > \text{S}^{4-}$ (b) $\text{Mn}^{+7} > \text{Mn}$
 (c) $\text{Mn}^{+2} < \text{Mn}$ (d) $\text{S} > \text{S}^{2-}$
- Total no of nodes in 5d orbital?
 (a) 4 (b) 2
 (c) 1 (d) 3

21. Which of the following ions, has the highest polarizing power?
 (a) Na^+ (b) Ca^{2+}
 (c) Mn^{3+} (d) Mn^{2+}
22. The electronegativity formula $\chi = (0.359 \cdot Z_{\text{eff}}/r^2) + 0.744$ where r is in angstrom is given by which scale:
 (a) Pauling Scale (b) Mulliken Scale
 (c) Allred -Rochow Scale (d) Hanney and Smith
23. Which of the following species is more electronegative?
 (a) O^- (b) O
 (c) O^{2-} (d) O^+
24. Which of the following is the correct order of basic strength of hydroxides ?
 (a) $\text{LiOH} < \text{NaOH} < \text{KOH} < \text{CsOH}$
 (b) $\text{CsOH} < \text{KOH} < \text{NaOH} < \text{LiOH}$
 (c) $\text{LiOH} < \text{KOH} < \text{CsOH} < \text{NaOH}$
 (d) $\text{LiOH} < \text{NaOH} < \text{CsOH} < \text{KOH}$
25. The correct order of ionisation energy to remove the electron from s,p,d,f orbitals
 (a) $s > p > d > f$ (b) $s < p < d < f$
 (c) $p < d < f < s$ (d) $f < p < s < d$
26. Which of the following has the highest first ionisation energy?
 (a) F (b) N
 (c) O (d) Ne
27. Which electronic configuration of an atom represents the lowest second ionization energy?
 (a) $1s^2 2s^1$ (b) $1s^2 2s^2 2p^6 3s^1$
 (c) $1s^2 2s^2 2p^6 3s^2$ (d) $1s^2 2s^2 2p^6$
28. Among the following, the correct increasing order of ionization energy is?
 (a) $\text{Li} < \text{Na} < \text{K} < \text{Rb} < \text{Cs}$ (b) $\text{Na} < \text{K} < \text{Li} < \text{Rb} < \text{Cs}$
 (c) $\text{Cs} < \text{Rb} < \text{K} < \text{Na} < \text{Li}$ (d) $\text{Rb} < \text{Cs} < \text{K} < \text{Na} < \text{Li}$
29. Among, the following, the correct increasing order of ionization energy is?
 (a) $\text{N} < \text{O} < \text{F} < \text{Ne}$ (b) $\text{F} < \text{O} < \text{N} < \text{Ne}$
 (c) $\text{O} < \text{N} < \text{F} < \text{Ne}$ (d) $\text{Ne} < \text{O} < \text{F}$
30. Which of the following ion has the highest ionization energy?
 (a) Li^+ (b) Ne^+
 (c) O^+ (d) F^+
31. Which of the following relations about ionization energy is correct?
 (a) $\text{N}_2 > \text{O}_2$ and $\text{N} > \text{O}$ (b) $\text{N}_2 > \text{O}_2$ and $\text{N} < \text{O}$
 (c) $\text{N}_2 < \text{O}_2$ and $\text{N} > \text{O}$ (d) $\text{N}_2 < \text{O}_2$ and $\text{N} < \text{O}$
32. The second ionization energy of an element is the first ionization energy.
 (a) Greater than (b) equal
 (c) Lesser than (d) not fixed.
33. The electron gain enthalpy is lower i.e less negative or positive for:
 (a) Alkali metals (b) Alkaline earth metals
 (c) Halogens (d) Nitrogen family
34. Correct order of electron affinities
 (a) $\text{Cl} > \text{Na} > \text{Si} > \text{Ar}$ (b) $\text{Cl} > \text{Si} > \text{Na} > \text{Ar}$
 (c) $\text{Si} > \text{Cl} > \text{Ar} > \text{Na}$ (d) $\text{Ar} > \text{Si} > \text{Cl} > \text{Na}$
35. Electron gain enthalpy of fluorine is.....
 (a) Less negative (b) less positive
 (c) more positive (d) more negative
36. In which of the following reaction ΔH is positive?
 (a) $\text{F(g)} + \text{e}^- \longrightarrow \text{F}^-$
 (b) $\text{O(g)} + \text{e}^- \longrightarrow \text{O}^-$
 (c) $\text{Cl(g)} + \text{e}^- \longrightarrow \text{Cl}^-$
 (d) $\text{O}^-(\text{g}) + \text{e}^- \longrightarrow \text{O}^{2-}$
37. Which of the following scale relate I.E and E.A to give the electronegativity?
 (a) Mulliken scale (b) Allred rochow scale
 (c) Hanney and Smith (d) Pauling scale
38. The correct order of covalent character in KCl , CaCl_2 , AlCl_3 , SiCl_4 ?
 (a) $\text{SiCl}_4 > \text{AlCl}_3 > \text{CaCl}_2 > \text{KCl}$ (b) $\text{SiCl}_4 < \text{AlCl}_3 < \text{CaCl}_2 < \text{KCl}$
 (c) $\text{AlCl}_3 > \text{SiCl}_4 > \text{CaCl}_2 > \text{KCl}$ (d) $\text{SiCl}_4 > \text{CaCl}_2 > \text{AlCl}_3 > \text{KCl}$
39. Among the following which has lowest electronegativity?
 (a) Mn^{+2} (b) Mn^{+5}
 (c) Mn (d) Mn^{+7}
40. Which of the following anion of oxygen has more electron gain enthalpy?
 (a) O (b) O^-
 (c) O^{2-} (d) O^{3-}

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
c	c	b	c	d	c	d	b	c	a
11	12	13	14	15	16	17	18	19	20
a	a	c	a	a	d	d	b	c	a
21	22	23	24	25	26	27	28	29	30
c	c	d	a	a	d	c	c	c	a
31	32	33	34	35	36	37	38	39	40
a	a	b	b	d	d	a	a	c	a

PART 2

- Which of the following elements has the largest atomic radius?
(a) Be (b) C
(c) N (d) F
- The valence electronic configuration of Cr atom (At. no. 24) in its ground state is:
(a) $4s^1 3d^5$ (b) $3d^5 4s^1$
(c) $4s^1 3d^4$ (d) $3d^4 4s^2$
- The largest ionization energy is found with:
(a) alkali metals (b) alkaline earth metals
(c) halogens (d) inert gases
- In Planck's hypothesis $E = h\nu$, E is the energy of:
(a) a photon (b) a hydrogen atom
(c) one electron (d) one H_2 molecule
- Which one of the following species is not isoelectronic with N_2 ?
(a) CN^- (b) NO
(c) CO (d) CS
- The ground state electronic configuration of iron is $[Ar]3d^6 4s^2$. The electronic configuration of ferric ion is:
(a) $[Ar]3d^6 4s^0$ (b) $[Ar]3d^5 4s^0$
(c) $[Ar]3d^4 4s^2$ (d) $[Ar]3d^3 4s^2$
- Among the following the one that is not an amphoteric oxide is:
(a) Al_2O (b) MgO
(c) ZnO (d) SnO
- The minimum uncertainty in the speed of an electron in a one-dimensional box of length 10^{-10} m is:
(a) 510 ms^{-1} (b) 580 kms^{-1}
(c) 1160 kms^{-1} (d) 5800 kms^{-1}
- The longest wavelength transition in the Balmer series of atomic hydrogen is:
(a) 656.5 nm (b) 6564.7 nm
(c) 15233 nm (d) 65647 nm
- The wavelength possessed by cricket ball of mass, 1 kg, travelling with velocity of 40 ms^{-1} is:
(a) $1.66 \times 10^{-38} \text{ m}$ (b) $1.66 \times 10^{-35} \text{ m}$
(c) $2.65 \times 10^{-32} \text{ m}$ (d) $1.66 \times 10^{-33} \text{ m}$
- The function $\cos(ax)$ is an eigen function of d^2/dx^2 with an eigen value of:
(a) -a (b) $-a^2$
(c) a (d) $-a^{-2}$
- The heteronuclear diatomic molecule that is isoelectronic to HCN is:
(a) NO (b) CO
(c) BO (d) SO
- Heisenberg's uncertainty principle expressed as:
(a) $\Delta p \Delta x > h / 2\pi$ (b) $\Delta p \Delta x < h / 4\pi$
(c) $\Delta p \Delta x < h / 2\pi$ (d) $\Delta p \Delta x > h / 4\pi$
- Specify which among the following statements describe uncertainty principle.
(a) No two electrons in an atom can have the same set of four quantum numbers.
(b) It is impossible to determine simultaneously the velocity and momentum of an object with certainty.
(c) Matter like radiation exhibit a dual behavior
(d) It is impossible to simultaneously determine position and momentum of an object with
- The ionization energy of hydrogen atom in ground state is 13.6 eV. The ionization energy of Li^{2+} in ground state would be:
(a) 1.51 eV (b) 4.53 eV
(c) 40.8 eV (d) 122.4 eV
- The region in which the following spectral lines are observed is
P. Lyman series Q. Balmer series R. Paschen series
(a) P - UV, Q - UV/Vis, R - IR
(b) P - UV/Vis, Q - UV, R - IR
(c) P-IR, Q - UV, R - Vis/IR
(d) P - UV, Q - IR, R - UN/Vis
- Which of the following substances will produce acidic oxides when burnt in excess air?
Sodium (P), Sulfur (Q) and Methane (R)
(a) All three (b) Both Q and R
(c) Only Q (d) Both P and R
- If the ground state ionization energy of the hydrogen atom is denoted by δ , then the energy required to ionize an electron from the 3d energy level of the hydrogen atom is:
(a) $\frac{2\delta}{3}$ (b) $\frac{\delta}{9}$
(c) $\frac{\delta}{3}$ (d) $\frac{8\delta}{9}$
- The ionization energy follows the order:
(a) $O_2^+ > O_2 > O_2^- > O_2^{2-}$ (b) $O_2 > O_2^+ > O_2^{2-} > O_2^-$
(c) $O_2^- > O_2^{2-} > O_2^+ > O_2$ (d) $O_2^{2-} > O_2 > O_2^- > O_2^+$
- A molecular electronic excited state has a life time of 10^{-9} s, the uncertainty in measuring the frequency (Hz) of the electronic transition is approximately:
(a) $\frac{h}{4\pi} \times 10^9$ (b) $\frac{h}{4\pi} \times 10^{-9}$
(c) $\frac{1}{4\pi} \times 10^9$ (d) $\frac{1}{4\pi} \times 10^{-9}$

21. The ions with lowest and highest radii among O^{2-} , F^- , Na^+ and Mg^{2+} are respectively,
 - (a) Mg^{2+} and O^{2-} (b) O^{2-} and F^-
 - (c) O^{2-} and Mg^{2+} (d) Na^+ and Mg^{2+}
22. The ionic size of Na^+ , F^- , Mg^{2+} and Al^{3+} varies as:
 - (a) $Al^{3+} > Mg^{2+} > Na^+ > F^-$ (b) $Al^{3+} < Mg^{2+} < Na^+ < F^-$
 - (c) $Al^{3+} > Mg^{2+} > F^- > Na^+$ (d) $Na^+ > F^- > Al^{3+} > Mg^{2+}$
23. A ball of mass 330 g is moving with a constant speed, and its associated de Brogue wavelength is $1 \times 10^{-33}m$. The speed of the ball is _____ m/s.
24. Molecules that are not isoelectronic to NO_2^+ are:
 - (a) CO_2 and N_3^- (b) NCO^- and H_3BCN^-
 - (c) BO_2^- and propyne (d) OF_2 and O_3^-
25. For a 4-orbital of hydrogen atom, the magnetic quantum number (m_l) is:
 - (a) 4 (b) 3
 - (c) 1 (d) 0
26. The azimuthal. Quantum number (l) of an electron in the d_{z^2} orbital of a copper atom. (atomic number: 29) is:
27. The correct order of the, first ionization energies of He, B, N and O in their corresponding ground state is:
 - (a) $He > N > O > B$ (b) $O > N > B > He$
 - (c) $He > B > N > O$ (d) $N > O > B > He$
3. Which of the following properties increase down the group
 - (a) Atomic Radii
 - (b) Polarising Power of anion
 - (c) Basic nature of oxides.
 - (d) Ionisation Potential
4. Which ion is isoelectronic with F^- ?
 - (a) Li^+ (b) N^{3-}
 - (c) Ca^{2+} (d) O^{2-}
5. What is the possible value of m_l for given set of quantum number $n=3$, $l=1$, $m_l=?$
 - (a) 0 (b) +1
 - (c) -1 (d) 2
6. For an electron have magnetic quantum number value = -1, this electron can be present in
 - (a) s orbital (b) p orbital
 - (c) d orbital (d) f orbital
7. What will be the two possible sets of quantum number to describe an electron in a 3p atomic orbital
 - (a) $n=3, l=2, m=0, s=+1/2$
 - (b) $n=3, l=1, m=2, s=+1/2$
 - (c) $n=3, l=1, m=-1, s=-1/2$
 - (d) $n=3, l=1, m=+1, s=+1/2$
8. Which of the following sets of quantum numbers (n, l, m, s) are possible arrangement?
 - (a) 4,1,0,+1/2 (b) 3,2,-2,-1/2
 - (c) 3,2,-3,+1/2 (d) 4,4,2,+1/2
9. What are the possible value of magnetic quantum number for $n=3$?
 - (a) 3 (b) +2
 - (c) -2 (d) +1
10. Which of the following properties are correct regarding the modern periodic table?
 - (a) Actinoids belongs to the main group of periodic table.
 - (b) In periodic table 18 groups are present.
 - (c) 17th group belongs to halogens
 - (d) There are separate position of isotopes in periodic table.
11. The elements which belong to the f block in periodic table?
 - (a) Sb (b) Ce
 - (c) Gd (d) Os
12. Among the following statements, which one of the following is incorrect?
 - (a) Electronegativity of fluorine is greater than oxygen.
 - (b) On going right in a period atomic size decreases, due to increase in effective nuclear charge.

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
a	b	d	a	b, d	b	b	b	a	b
11	12	13	14	15	16	17	18	19	20
b	b	d	d	d	a	a	b	a	d
21	22	23	24	25	26	27			
a	b	2 m/s	d	d	2	a			

MULTIPLE SELECT QUESTIONS (MSQ)

1. What are the demerits of Mendeleev's Periodic Table?
 - (a) Position of hydrogen is uncertain
 - (b) No regular trend in increasing of atomic mass down the group.
 - (c) Anomalous positions of lanthanides and actinides in periodic table.
 - (d) More elements was yet to be known.
2. Choose the incorrect statement:
 - (a) Vander waal radius are greater than covalent radius.
 - (b) Polarising power of the cation increase down the group.
 - (c) Polarising power of the anion decrease down the group.
 - (d) Hydration tendency of ions increase down the group.

- (c) Mn^{+2} has smaller size than Mn^{+7}
 (d) The Al^{+3} and Mg^{+2} are isoelectronic species but first one is larger than the second.
13. The chemistry of Be relates with chemistry of Al because; Which of the reason are not correct?
 (a) They belong to the same period.
 (b) They have same ionization potential.
 (c) They belong to same group.
 (d) The ratio of their charge to size is nearly same.
14. The correct statement about d-block elements are?
 (a) They all are metals.
 (b) They show variable valency.
 (c) They have strong tendency to gain electrons.
 (d) All these elements have fully filled $(n-1)d$ orbitals
15. Which of the following physical quantities are related with principal quantum number?
 (a) Energy (b) Radius of orbit
 (c) Angular momentum (d) magnetic moment.
16. Choose the correct ionic radii relation
 (a) $\text{Na}^+ > \text{Mg}^{+2} > \text{Al}^{+3}$ (b) $\text{Fe}^{+3} > \text{Fe}^{+2} > \text{Fe}^+$
 (c) $\text{H}^- > \text{O}^{2-} > \text{F}^-$ (d) $\text{O}^{2-} > \text{F}^- > \text{N}^{3-}$
17. Which of the following order is correct?
 (a) Electronegativity Order : $\text{Mo(II)} > \text{Mo(III)} > \text{Mo(IV)}$
 (b) Electronegativity Order : $\text{Fe(I)} < \text{Fe(II)} < \text{Fe(III)}$
 (c) Ionic radius : $\text{Mo(II)} < \text{Mo(III)} < \text{Mo(IV)}$
 (d) Ionic Radius: $\text{Fe(III)} < \text{Fe(II)} < \text{Fe(I)}$
18. The series with correct order of decreasing ionization energy
 (a) $\text{Li} > \text{Na} > \text{K} > \text{Rb}$ (b) $\text{Ne} > \text{F} > \text{N} > \text{O}$
 (c) $\text{Ne} > \text{N} > \text{O} > \text{F}$ (d) $\text{Rb} > \text{K} > \text{Na} > \text{Li}$
19. Which of the following statement is correct?
 (a) Ionisation energy is independent of ionic radii
 (b) Energy is released when electron is added to an isolated gaseous atom.
 (c) Ionisation energy decreases with increase in atomic radii.
 (d) Electron gain enthalpy is always positive.
20. Which of the following statement is correct?
 (a) s orbitals have more penetration power than p,d,f orbitals.
 (b) s orbitals are directional
 (c) p orbitals are directional.
 (d) Centre of symmetry is not present in s orbitals
21. Which of the following statement is incorrect about the d orbitals?
 (a) All d orbitals are similar.
 (b) Planer node is present in all d orbital.
 (c) d_{z^2} have more shielding power than other orbitals.
 (d) d orbitals have less shielding power than s and p orbitals.
22. According to mulliken scale electronegativity depends upon?
 (a) Ionisation Potential (b) Electron affinity
 (c) Atomic Radii (d) Size of Hydrated ion
23. According to Allred Rochow scale, Electronegativity depends upon?
 (a) Covalent radius (b) Ionization potential
 (c) Effective nuclear charge (d) Electron affinity.
24. Which of the following statement is correct?
 (a) The second ionization energy of O is greater than that of second ionization than second ionization potential of N.
 (b) Halogens have highest ionisation potential in respective period.
 (c) Successive ionization energy decreases
 (d) The second ionization energy is maximum for Li in respective period.
25. Zr and Hf have nearly same size because
 (a) They belong to same period.
 (b) Due to lanthanide contraction.
 (c) Due to poor shielding of f orbitals.
 (d) Due to poor shielding of d orbitals.
26. Which of the following pair of elements are metalloids?
 (a) B, Si (b) Ge, As
 (c) Sn, I (d) In, Tl
27. Electron gain enthalpy will be positive in
 (a) O^{3-} is formed from O^{2-} (b) S^{-1} is formed from S.
 (c) Na^+ is formed from Na. (d) O^{2-} is formed from O^- .
28. Which of the following are correct regarding size?
 (a) $\text{Zn} > \text{Cu}$ (b) $\text{N} > \text{O}$
 (c) $\text{B} > \text{C}$ (d) $\text{Ga} > \text{Al}$
29. The reason for higher ionization energies of 5d transition series are?
 (a) High shielding power of d orbitals
 (b) High effective nuclear charge
 (c) Smaller size of atoms
 (d) Low effective nuclear charge.
30. Which of the following statement is correct?
 (a) Cl has highest negative electron gain enthalpy.
 (b) Fluorine is the 2nd most electronegative element.
 (c) Helium has the highest ionization energy.
 (d) Helium is the smallest element in periodic table.

ANSWER KEY

1	2	3	4	5
a, b, c, d	b, c, d	a, b, c	b, d	a, b, c
6	7	8	9	10
b, c, d	c, d	a, b	b, c, d	b, c
11	12	13	14	15
b, c	c, d	a, b, c	a, b	a, b
16	17	18	19	20
a, c	b, d	a, b	b, c	a, c
21	22	23	24	25
a, b	a, b	a, c	a, d	b, c
26	27	28	29	30
a, b	a, d	a, b, c	b, c	a, c, d

ANSWER KEY

1	2	3	4	5	6	7	8	9	10
3.45	4.55	3	3	18	32	8	7	75	3
11	12	13	14	15					
0	3	16	16	3.72					

NUMERICAL ANSWER TYPE QUESTIONS (NAT)

- For a electron configuration $(1s^2)(2s^2, 2p^4)$. By using Slater's rule, what will be the shielding constant for 2p electron..... ?
- What will be the effective nuclear charge in 1st question
- Among the 2s, 3s, 4s, 3p, 5d, 1s, 4p, 3d orbitals, how many of these orbitals have 2 radial node?
- Among the 2s, 3s, 4s, 3p, 5p, 1s, 4p, 3d orbitals, how many of these have 1 angular node?
- How many electrons can be attributed in 5g subshell?
- How many electrons can present in all subshells (fully filled) having condition $n+l = 7$?
- Number of protons in ${}^{15}_7\text{N}$
- If the value of l varies from 0 to $n+1$, then how many subshells are present in 5th shell?
- If there are three spin quantum number $+\frac{1}{2}$, 0, $-\frac{1}{2}$ possible, then how many electrons can be present in 5th shell?
- Among the following , number of species which are isoelectronic with N_2 , CO , O_2^- , NO^+ , CN^- , NO , C_2^-
- How many unpaired electrons are present in Cu^{+1} ?
- What is the group number of an element which have atomic number =23?
- Find out the group of the element having the electronic configuration $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^4$
- How many electrons can be present having $n = 4$, $s = +1/2$ in all atomic orbitals?
- Ionisation energy and electron affinity of fluorine are respectively 17.42 and 3.45 eV. Calculate electronegativity of fluorine atom.

PART 1

ANSWERS WITH SOLUTION

MULTIPLE CHOICE QUESTION (MCQ)

1. **Solution:** The isoelectronic species are those which have same number of valence electron. BH_2 and N both have 7 valence electron. So, they are isoelectronic pairs.

Option (c) is correct answer.

2. **Solution:** The electronic configuration $ns^x(n-1)d^y$ is of d block elements. Group number can be given as $x+y$. So $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5, 4s^1$ is a d block element. Group number = $5+1=6$

Option (c) is correct answer.

3. **Solution:** IUPAC naming of elements having atomic number greater than 100 can be done using this table For 105 the IUPAC name will be unnilpentium (unp), ium is used as suffix.

Option (b) is the correct answer.

0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quad	q
5	pent	p
6	hex	h
7	sept	s
8	oct	o
9	enn	e

4. **Solution:** The electronic configuration for Cr = $[\text{Ar}] 4s^1 3d^5$ as it is stable half-filled d orbital configuration. The removal of electron will be first from 4s orbital so electron configuration will be $[\text{Ar}] 3d^4$

Option (c) is correct answer

5. **Solution:** The value of l can be 0 to $n-1$ so value of l for $n=1$ is 0 m_l can be from $-l$ to $+l$. For $l=0$, $m_l=0$

Option (d) is correct answer.

6. **Solution:** Value of l varies from 0 to $n-1$, value of m varies from $-l$ to $+l$ Option (c) is not possible, because for $l=2$, m cannot be 3

7. **Solution:** option d is not possible, as value of l can never be equal to n. l value varies from 0 to $n-1$ so for $n=3$, l can be 0, 1, 2

Option (d) is the correct answer.

8. **Solution:** The electrons in atomic orbitals are filled according to Aufbau principle which state that less value of $n+l$, will fill first. But if value of $n+l$ became same then, the orbital having low value of n will fill first.

4f orbital option (b) will fill first.

9. **Solution:** Number of orbitals in a shell n is given by n^2 . One orbital occupy 2 electrons. n^2 orbitals can contain $2n^2$ electrons.

Option (c) is the correct answer.

10. **Solution:** The relation between principal quantum number and R_n is $R_n = 0.529 n^2/z$

Option (a) is the correct answer.

11. **Solution:** ZnO and PbO are amphoteric oxides.

Option (a) is correct answer.

12. **Solution:** Beryllium (Be) has stable electronic configuration $1s^2 2s^2$. When it becomes the anion the electronic configuration becomes $1s^2 2s^2 2p^1$. The stable electronic configuration no more exist. So the Be^- is less stable.

Option (a) is correct answer.

13. **Solutions:** Number of electron in n shell is given by n^2 , so number of electron in 4th shell = $4^2 = 16$

Number of orbital in 4p subshell = $2(l)+1 = 2*1+1=3$

Number of electron can filled in 4p subshell is $2*3=6$

Option (c) is the correct answer.

14. **Solutions:** $\text{Zn}_{30} = 1s^2/2s^2 2p^6/3s^2 3p^6 3d^{10}/4s^2$

(i) For electron present in 4s orbital

(1) The remaining electron present in same shell will shield by the factor of 0.35 each $\sigma = 0.35*1 = 0.35$

(2) Each electron in (n-1) shell or penultimate shell shield by factor of 0.85

$$\sigma = 0.85*18 + 10*1 = 25.3$$

$$\text{Total } \sigma = 25.3 + 0.350 = 25.65$$

$$Z_{\text{eff}} = Z - \sigma = 30 - 25.65 = 4.35$$

(ii) For electron present in 3d

$$\sigma_{3d} = 9*0.35 + 18*1 = 21.15$$

$$Z_{\text{eff}} = Z - \sigma$$

$$= 30 - 21.15$$

$$= 8.85,$$

Option (a) is the correct answer.

15. **Solution:** More the negative charge on a species more will be the radius. More the positive charge on a species smaller will be the radius The positive charge shows that

electrons is less than protons, so effective nuclear charge by nucleus on electrons is more, which decreases the size.

Option (a) is correct answer.

16. **Solutions:** Zr and Hf are of comparable size because of the lanthanide contraction. Due to the poor shielding of f subshell, the attraction on outermost shell electrons by nucleus increases and thus the size of Hf decreases and become comparable of Zr.

Option (d) is correct answer.

17. **Solutions:** The ions which have high charge and smaller radii have tendency to hydrate more. The hydrated ions have less ionic mobility because of high hydrated radius. Mg^{+2} will hydrate more so have less ionic mobility. K^+ will be least hydrated and have high value of ionic mobility.

Option (d) is the correct answer.

18. **Solution:** Ca is of 4th period element, so bigger in size than Mg and Cl. Among Cl and Mg, the both are from 3rd period. Ongoing left to the period the atomic size decreases because increase in effective nuclear charge.

So, size of Cl < Mg. So, option b is correct.

19. **Solution:** More the negative charge on a species more will be the radius. More the positive charge on a species smaller will be the radius.

Option (c) is the correct answer.

20. **Solutions:** Total no of nodes = radial nodes + angular nodes
Radial node = $n - l - 1 = 5 - 2 - 1 = 2$
Angular node = $l = 2$
Total nodes = $2 + 2 = 4$

Option (a) is the correct answer.

21. **Solutions:** According to the Fajan's rule more the charge on cation more will be the polarising power of that cation. So, Mn^{+3} has more polarising power.

Option (c) is the correct answer.

22. **Solutions:** The electronegativity formula $\chi = (0.359 \cdot Z_{eff}/r^2) + 0.744$ where r is in angstrom is given by which scale: (a) Allred-Rochow Scale

23. **Solution:** Oxygen is electronegative species and if one electron further remove from an electronegative species it becomes more electronegative. Electronegativity is directly proportional to the positive oxidation state.

Option d is correct answer.

24. **Solution:** The ionisation enthalpy decreases down the group, the M-OH bonds become weak when we go down the group. Due to this release of OH becomes easy down the group.

Option (a) is correct answer.

25. **Solutions:** An s orbital's electron penetrates closer to nucleus, and is therefore more tightly bound to the nucleus than a p electron. Similarly p orbital's electrons are more tightly held to nucleus than d orbital. Thus, the ionisation energies are in the order $s > p > d > f$.

Option (a) is the correct answer.

26. **Solutions:** The ionisation is the removal of an electron from gaseous atom or ion. Ne has stable noble gas configuration $1s^2, 2s^2, 2p^6$. Removal of electron from these configuration requires very high energy.

Option (d) is correct answer.

27. **Solution:** The ionization energy is lowest for that atom in which the electronic configuration becomes noble gas electronic configuration after the removal of two electrons. In option (c) after removal of 2nd electron it attains noble gas electronic configuration.

Option (c) is the correct answer.

28. **Solution:** As we go down the group the atomic size increases. The outermost electrons go far from the effect of nuclear charge as the size increases. So, the removal of electrons becomes easy down the group and requires low ionization energy. Hence, we can say ionisation energy decreases down the group.

Option (c) is the correct answer.

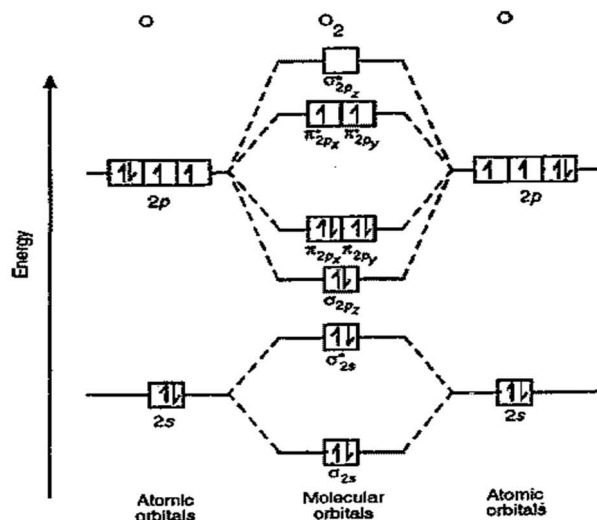
29. **Solution:** Ne has stable noble electronic configuration and has very high ionization energy. F is most electronegative element and has tendency to gain the electrons. Among N and O, N has high ionization energy because of its stable half-filled electronic configuration $1s^2, 2s^2, 2p^3$. Removal of an electron from this configuration requires high ionization energy than oxygen.

Option (c) is the correct answer.

30. **Solution:** Li^+ has stable inert gas configuration $1s^2$. Removal of an electron from these $1s^2$ requires very high energy.

Option (a) is the correct answer.

31. **Solution:** Removal of electrons from a diatomic orbital can be understood by MOT diagram. The ionization energy of O_2 is less than N_2 , because in O_2 the HOMO is antibonding.



Removal of an electron from antibonding is easy as compared to bonding orbitals. Among N and O, N has high ionization energy because of its stable half-filled electronic configuration $1s^2, 2s^2, 2p^3$.

Option (a) is the correct answer.

32. **Solution:** Successive ionization energy may be defined as the energy required for the removal of the second electron from the ion.

Successive ionization energy increases in the order $IE_1 < IE_2 < IE_3$

Option (a) is the correct answer.

33. **Solution:** Alkaline earth metals have stable electronic configuration ns^2 . Their electron gain tendency is very poor. Thus, have low electron gain enthalpy.

Option (b) is the correct answer.

34. **Solution:** E.A increases along the period because the effective nuclear charge increases. Due to increase in effective nuclear charge electron gaining tendency increases. Ar has least E.A value because it has stable noble gas electronic configuration.

Option (b) is the correct answer.

35. **Solution:** Fluorine have electronic configuration $1s^2 2s^2 2p^5$. It has high tendency to gain electron to attain the stable noble gas electronic configuration. Thus, have high value of electron gain enthalpy i.e more negative.

Option (d) is the correct answer.

36. **Solution:** Option (d) has the positive electron gain enthalpy i.e ΔH . O^- does not want take one more electron due to electrostatic repulsions. So, energy has to provide to attain this reaction.

Option (d) is the correct answer.

37. **Solution:** Mulliken simply considers the electronegativity as the average of Ionisation potential and electron affinity of that element.

$$\chi = [E.A + I.E]/2$$

Option (a) is the correct answer.

38. **Solutions:** The covalent character in an ionic compound is tell by Fajan's Rule. More the charge on cation more will be the polarizibilty and more will be the covalent character.

Option (a) is the correct answer.

39. **Solution:** Smaller the size of element, more is the tendency to gain electronegativity. Among the following Mn has larger size, has low ability to attract the electrons, thus it is least electronegative.

Option (c) is the correct answer.

40. **Solutions:** The negative charge on oxygen atom disfavours the electron gain ability of oxygen due to electrostatic repulsions. O^{3-} have least electron gain enthalpy.

The option (a) O has more electron gain enthalpy.

PART 2

ANSWERS WITH SOLUTION

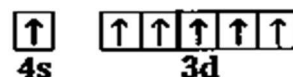
1. **Solutions:** Chemical periodicity - atomic size of the elements

Atomic size gradually decreases from left to right across a period of elements. This is because, within a period or family of elements, all electrons are added to the same shell. This leads to the increase in the effective nuclear charge and hence, Be has the highest atomic radius. The trend is given as: $Be > C > N > F$

Hence, option (a) is the correct answer.

2. **Solutions:** Chemical periodicity – Electronic configuration of atoms and ions

Electronic configuration of Cr is $[Ar]3d^5 4s^1$, instead of the expected $[Ar]3d^4 4s^2$. This is so because the orbitals of electron are most stable when they are full-filled or half-filled. In the case of chromium, an electron from the 4s orbital jumps to 3d subshell because $3d^5$ is a much more stable configuration than $3d^4$. Chromium (Cr) attain extra stability of half-filled electronic configuration by changing the expected pattern of electronic configuration. This can be shown as follows-



Hence, option (b) is the correct answer.