Additional Problems for Self Practice (APSP)

✍ **Marked Questions may have for Revision Questions.**

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST-1 (IIT-JEE (MAIN Pattern))

Max. Marks: 100 **Max. Time : 1 Hour**

Important Instructions:

A. General :

1. The test paper is of **1** hour duration.
2. The Test Paper consists of **25** questions and each questions carries **4** Marks. Test Paper consists of **Two** Sections.

B. Test Paper Format and its Marking Scheme:

1. Section-1 contains **20** multiple choice questions. Each question has four choices (1), (2), (3) and (4) out of which **ONE** is correct. For each question in Section-1, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. In all other cases, minus one **(–1)** mark will be awarded.
2. Section-2 contains **5** questions. The answer to each of the question is a **Numerical Value**. For each question in Section-2, you will be awarded 4 marks if you give the corresponding to the correct answer and zero mark if no given answers. No negative marks will be answered for incorrect answer in this section. In this section answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto two digit. If the numerical value has more than two decimal places **truncate/round-off** the value to **TWO** decimal placed.

SECTION-1

This section contains **20** multiple choice questions. Each questions has four choices (1), (2), (3) and (4) out of which Only **ONE** option is correct.

1. The elements which exhibit both vertical and horizontal similarities are :
(1) inert gas elements (2) representative elements
(3) transition elements (4) none of these

2. Of the following pairs, the one containing examples of metalloid elements is :
(1) B and Al (2) Ga and Ge (3) Al and Si (4) As and Sb

3. Which of the following is the wrong statement ?
(1) All the actinide elements are radioactive.
(2) Alkali and alkaline earth metals are s-block elements.
(3) Pnicogens and halogens are p-block elements.
(4) The first member of the lanthanide series is lanthanum.

4. Atomic number of 15, 33, 51 represents the following family :
(1) carbon family (2) nitrogen family (3) oxygen family (4) None of these

5. Which of the following is correct order of Z_{eff} :
(1) $I^- > I > I^+$ (2) $Mg^{2+} > Na^+ > F^-$ (3) $P^{5+} < P^{3+}$ (4) Li > Be >B

6. In Sodium atom on 3s electron the screening is due to :
(1) $3s^2$, $3p^6$ (2) $4s^1$ (3) $1s^2$, $2s^2$, $2p^6$ (4) $3s^1$

7. Which of the following elements can have negative oxidation states.
(1) Al (2) Ca (3) Fe (4) B

8. ✍ What is correct order of reducing capacity :
(1) $Ge^{2+} > Sn^{2+} > Pb^{2+}$ (2) $Ge^{2+} < Sn^{2+} < Pb^{2+}$ (3) $Ge^{2+} \approx Sn^{2+} \approx Pb^{2+}$ (4) $Pb^{2+} > Ge^{2+} > Sn^{2+}$

9. The lanthanide contraction refers to :
(1) radius of the series. (2) valence electrons of the series.
(3) the density of the series. (4) electronegativity of the series.

10. Which group of atoms have nearly same atomic radius :
(1) Na, K, Rb, Cs (2) Li, Be, B, C (3) Fe, Co, Mn (4) F, Cl, Br, I

11. The incorrect order of radius is :
(1) $Cu^- > Cu > Cu^+$ (2) $Sc^{3+} > K^+ > S^{2-}$ (3) Ni < Cu < Zn (4) All of these

12. The second ionization enthalpies of elements are always higher than their first ionization enthalpies because:
(1) cation formed always have stable half filled or completely filled valence shell electron configuration.
(2) it is easier to remove electron from cation.
(3) ionization is an endothermic process.
(4) the cation is smaller than its parent atom.

13. With reference to 1st IP which are correct.
(a) Li < C (b) O < N (c) Be < N < Ne
(1) a, b (2) b, c (3) a, c (4) a, b & c

14. Values of 1st four ionisaiton energies (kJ/mol) of an element are respectively 496, 4563, 6913, 9541; the electronic configuration of that element can be.
(1) $1s^2, 2s^1$ (2) $1s^2\ 2s^2\ 2p^1$ (3) $1s^2, 2s^2, 2p^6\ 3s^1$ (4) (2) and (3) both

15. Which one of the following statement is correct ?
(1) The elements having large negative values of electron gain enthalpy generally act as strong oxidising agents.
(2) The elements having low values of ionisation enthalpies act as strong reducing agents.
(3) The formation of $S^{2-}(g)$ from S(g) is an endothermic process.
(4) All of these.

16. For magnitude of electron gain enthalpy of chalcogens and halogens, which of the following options is correct?
(1) Br > F (2) S > F (3) O < Cl (4) S < Se

17. The correct order of electron gain enthalpy (most endothermic first and most exothermic last) is :
(1) Be < B < C < N (2) Be < N < B < C (3) N < Be < C < B (4) N < C < B < Be

18. $\frac{N_0}{2}$ atoms of X (g) are converted into X^+ (g) by absorbing E_1 energy. $2N_0$ atoms of X (g) are converted into $X^-(g)$ by releasing E_2 energy. Calculate ionisation enthalpy and electron gain enthalpy of X(g) per atom.
(1) I.E. $= \frac{2E_1}{N_0}$, $\Delta_{eg}H = -\frac{E_2}{2N_0}$ (2) I.E. $= -\frac{E_2}{2N_0}$, $\Delta_{eg}H = \frac{2E_1}{N_0}$
(3) I.E. $= \frac{E_1}{2N_0}$, $\Delta_{eg}H = -\frac{E_2}{2N_0}$ (4) I.E. $= \frac{N_0}{2E_1}$, $\Delta_{eg}H = -\frac{2N_0}{E_2}$

19. The formation of the oxide ion, $O^{2-}(g)$, from oxygen atom requires first an exothermic and then an endothermic step as shown below :
$O(g) + e^- \longrightarrow O^-(g)$; $\Delta_{eg}H = -141\ kJmol^{-1}$
$O^-(g) + e^- \longrightarrow O^{2-}(g)$; $\Delta_{eg}H = +780\ kJmol^{-1}$
Thus process of formation of O^{2-} in gas phase is unfavourable even though O^{2-} is isoelectronic with neon. It is due to the fact that :
(1) oxygen is more electronegative.
(2) addition of electron in oxygen results in larger size of the ion.
(3) electron repulsion outweighs the stability gained by achieving noble gas configuration.
(4) O^- ion has comparatively smaller size than oxygen atom.

20. The properties which are not common to both groups 1 and 17 elements in the periodic table are :
(1) Elelctropositive character increase down the gorups.
(2) Reactivity decrease from top to bottom in these groups.
(3) Atomic radii increase as the atomic number increase.
(4) Electronegativity decrease on moving down a group.

SECTION-2

This section contains **5** questions. Each question, when worked out will result in **Numerical Value**.

21. A large difference between the third & fourth ionization energy indicate the presence of how many valence electrons in an atom.

22. The ionization enthalpy will be highest when the electron is to be removed from the orbital with ℓ equals to (if other factors are equal)

23. Out of elements with atomic number = 23, 24, 25 and 26, which one may be expected to have the highest second ionization enthalpy.

24. How many of the following have smaller size than H^- :
Li^+, H^+, F^-, Cl^-, Br^-, I^-

25. Element with electronic configuration $[Ar]3d^{10}4s^1$ belong to which group in modern periodic table.

Practice Test-1 (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25					
Ans.										

PART - II : JEE (MAIN) / AIEEE OFFLINE PROBLEMS (PREVIOUS YEARS)

1. Which one of the following ions has the highest value of ionic radius ? **[AIEEE-2004, 3/225]**
(1) Li^+ (2) B^{3+} (3) O^{2-} (4) F^-

2. The formation of the oxide ion $O^{2-}_{(g)}$ requires first an exothermic and then an endothermic step as shown below :

$O_{(g)} + e^- = O^-_{(g)}$; $\Delta H° = -142$ kJmol^{-1}

$O^-_{(g)} + e^- = O^{2-}_{(g)}$; $\Delta H° = 844$ kJmol^{-1} **[AIEEE-2004, 3/225]**

This is because :
(1) oxygen is more electronegative.
(2) oxygen has high electron affinity.
(3) O^- ion will tend to resist the addition of another electron.
(4) O^- ion has comparatively larger size than oxygen atom.

3. In which of the following arrangements the order is NOT according to the property indicated against it ? **[AIEEE-2005, 3/225]**

(1) $Al^{3+} < Mg^{2+} < Na^{+} < F^{-}$ – increasing ionic size
(2) B < C < N < O – increasing first ionisation enthalpy
(3) I < Br < F < Cl – increasing electron gain enthalpy (with negative sign)
(4) Li < Na < K < Rb – increasing metallic radius

4. Which of the following factors may be regarded as the main cause of lanthanide contraction ?
(1) Greater shielding of 5d electrons by 4f electrons. **[AIEEE 2005, 4½ / 225]**
(2) Poorer shielding of 5d electron by 4f electrons.
(3) Effective shielding of one of 4f electrons by another in the sub-shell.
(4) Poor shielding of one of 4f electron by another in the sub-shell.

5. The lanthanide contraction is responsible for the fact that : **[AIEEE-2005, 3/225]**
(1) Zr and Y have about the same radius (2) Zr and Nb have similar oxidation state
(3) Zr and Hf have about the same radius (4) Zr and Zn have same oxidation state.

6. The increasing order of the first ionization enthalpies of the elements B, P, S and F (lowest first) is : **[AIEEE-2006, 3/165]**
(1) F < S < P < B (2) P < S < B < F (3) B < P < S < F (4) B < S < P < F

7. Lanthanoid contraction is caused due to : **[AIEEE-2006, 3/165]**
(1) the appreciable shielding on outer electrons by $4f$ electrons from the nuclear charge
(2) the appreciable shielding on outer electrons by $5f$ electrons from the nuclear charge
(3) the same effective nuclear charge from Ce to Lu
(4) the imperfect shielding on outer electrons by 4f electrons from the nuclear charge

9. The set representing the correct order of ionic radius is : **[AIEEE-2009, 4/144]**
(1) $Na^{+} > Li^{+} > Mg^{2+} > Be^{2+}$ (2) $Li^{+} > Na^{+} > Mg^{2+} > Be^{2+}$
(3) $Mg^{2+} > Be^{2+} > Li^{+} > Na^{+}$ (4) $Li^{+} > Be^{2+} > Na^{+} > Mg^{2+}$

10. The correct sequence which shows decreasing order of the ionic radii of the elements is : **[AIEEE-2010, 4/144]**
(1) $Al^{3+} > Mg^{2+} > Na^{+} > F^{-} > O^{2-}$ (2) $Na^{+} > Mg^{2+} > Al^{3+} > O^{2-} > F^{-}$
(3) $Na^{+} > F^{-} > Mg^{2+} > O^{2-} > Al^{3+}$ (4) $O^{2-} > F^{-} > Na^{+} > Mg^{2+} > Al^{3+}$

11. The outer electron configuration of Gd (Atomic No : 64) is : **[AIEEE 2011 (Cancelled), 4/120]**
(1) $4f^3\ 5d^5\ 6s^2$ (2) $4f^8\ 5d^0\ 6s^2$ (3) $4f^4\ 5d^4\ 6s^2$ (4) $4f^7\ 5d^1\ 6s^2$

12. The correct order of electron gain enthalpy with negative sign of F, Cl, Br and I, having atomic number 9, 17, 35 and 53 respectively, is: **[AIEEE 2011, 4/120]**
(1) F > Cl > Br > I (2) Cl > F > Br > I (3) Br > Cl > I > F (4) I > Br > Cl > F

13. The increasing order of the ionic radii of the given isoelectronic species is : **[AIEEE-2012, 4/144]**
(1) $Cl^{-}, Ca^{2+}, K^{+}, S^{2-}$ (2) $S^{2-}, Cl^{-}, Ca^{2+}, K^{+}$ (3) $Ca^{2+}, K^{+}, Cl^{-}, S^{2-}$ (4) $K^{+}, S^{2-}, Ca^{2+}, Cl^{-}$

14. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar ? **[JEE(Main)-2013, 4/120]**
(1) Ca < S < Ba < Se < Ar (2) S < Se < Ca < Ba < Ar
(3) Ba < Ca < Se < S < Ar (4) Ca < Ba < S < Se < Ar

15. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^{+} will be : **[JEE(Main)-2013, 4/120]**
(1) –2.55 eV (2) –5.1 eV (3) –10.2 eV (4) +2.55 eV

16. The ionic radii (in Å) of N^{3-}, O^{2-} and F^{-} are respectively : **[JEE(Main)-2015, 4/120]**
(1) 1.36, 1.40 and 1.71 (2) 1.36, 1.71 and 1.40
(3) 1.71, 1.40 and 1.36 (4) 1.71, 1.36 and 1.40

17. Which of the following atoms has the highest first ionization energy? **[JEE(Main)-2016, 4/120]**
(1) Na (2) K (3) Sc (4) Rb

18. The group having isoelectronic species is : **[JEE(Main)-2017, 4/120]**
(1) O^-, F^-, Na, Mg^+ (2) O^{2-}, F^-, Na, Mg^{2+} (3) O^-, F^-, Na^+, Mg^{2+} (4) O^{2-}, F^-, Na^+, Mg^{2+}

PART - III : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. The element whose electronic configuration is $1s^2$, $2s^2$ $2p^6$ $3s^2$ is a/an **[NSEC-2000]**
(A) metal (B) inert gas (C) metalloid (D) non-metal

2. Oxygen shows +2 oxidation state in **[NSEC-2000]**
(A) F_2O (B) H_2O_2 (C) K_2O_2 (D) D_2O_2

3. The oxidation state of Cr in $K_2Cr_2O_7$ is : **[NSEC-2000]**
(A) + 3 (B) + 6 (C) + 4 (D) – 4

4. Which of the following is the smallest in size ? **[NSEC-2001]**
(A) N^{3-} (B) F^- (C) O^{2-} (D) Na^+

5. Oxidation Number of Mn in $[MnO_4]^-$ is : **[NSEC-2001]**
(A) –7 (B) + 7 (C) + 2 (D) – 2

6. From the electronic configuration of the given element K, L, M and N, which one has the highest ionisation potential : **[NSEC-2001]**
(A) M = [Ne] $3s^2$,$3p^2$ (B) L = [Ne]$3s^1$,$3p^3$ (C) K = [Ne]$3s^2$,$3p^1$ (D) N = [Ar]$3d^{10}$,$4s^2$,$4p^3$

7. The formation of anion from a neutral atom X is favoured by : **[NSEC-2001]**
(A) high electron affinity (B) large size of X
(C) low ionisation potential (D) high charge on anion X

8. The outermost electron configuration of one of the element is $5f^2$, $6d^1$, $7s^2$. This element belongs to : **[NSEC-2002]**
(A) s-block (B) transition series (C) lanthanide series (D) actinide series.

9. Which element of 3rd row has biggest atomic size ? **[NSEC-2002]**
(A) chlorine (B) sodium (C) silicon (D) neon.

10. Which oxyacid of chlorine shows oxidation state of + 5 ? **[NSEC-2002]**
(A) hypochlorous acid (B) chloric acid (C) chlorous acid (D) perchloric acid

11. Which element does not show positive oxidation state ? **[NSEC-2002]**
(A) fluorine (B) chlorine (C) oxygen (D) iodine.

12. Due to addition of electrons in d orbital for transition element, the screening effect **[NSEC-2002]**
(A) increases (B) decreases (C) no effect (D) slightly decreases.

13. The diagonal relationship of elements in the periodic table arises because of similarity in **[NSEC-2003]**
(A) ionic radius (B) electronic configuration
(C) crystal structure (D) charge/radius ratio of the corresponding ions.

14. The atom of an element X contains 27 electrons. X is expected to be **[NSEC-2003]**
(A) a non-metal belonginig to p-block (B) paramagnetic belonging to d-block
(C) diamagnetic belonging to d-block (D) an s-block element.

15. The group in the periodic table that contains the elements in all the different physical states at room temperature is **[NSEC-2004]**
(A) V A (B) I A (C) VII A (D) IV A.

16. The ion having a noble gas electronic configuration is **[NSEC-2004]**
(A) Se^{2-} (B) Fe^{3+} (C) Cr^{3+} (D) Cu^{+}.

17. Element with Z = 83 belongs to which block? **[NSEC-2005]**
(A) s (B) p (C) d (D) f.

18. Which of the following has the highest electron affinity ? **[NSEC-2005]**
(A) F (B) Br (C) Cl (D) I.

19. The element having electronegativity next to that of fluorine is **[NSEC-2005]**
(A) oxygen (B) chlorine (C) iodine (D) sodium.

20. The group in the long form of periodic table having three elements together is **[NSEC-2005]**
(A) zero group (B) IIIrd group (C) IVth group (D) VIIIth group.

21. Atom with the largest electron affinity is **[NSEC-2006]**
(A) Na (B) Cl (C) I (D) P.

22. Which of the following sequence of elements is arranged in the order of increasing atomic radii ? **[NSEC-2006]**
(A) Na, Mg, Al, Si (B) C, N, O, F (C) O, S, Se, Te (D) I, Br, Cl, F.

23. As the number of electrons in d-orbitals of transition elements increases, the screening effect on the valence electrons- **[NSEC-2007]**
(A) increases (B) decreases greatly (C) is not observed (D) decreases slightly

24. For the atoms Li, Be, B and Na, the correct order of increasing atomic redius is : **[NSEC-2008]**
(A) B, Be, Li, Na (B) Li, Be, B, Na (C) Be, Li, B, Na (D) Be, B, Li, Na

25. The ion which has 18 electrons in the outermost shell is – **[NSEC-2009]**
(A) Cu^{+} (Z = 29) (B) Al^{3+} (Z = 13) (C) K^{+} (Z = 19) (D) Th^{4+} (Z = 90)

26. The correct order of the size of the species is **[NSEC-2010]**
(A) $Ca^{2+} < Ar < K^{+} < Cl^{-}$ (B) $Ca^{2+} < K^{+} < Ar < S^{2-}$
(C) $K^{+} < Ar < Cl^{-} < S^{2-}$ (D) $Ar < Ca^{2+} < K^{+} < Cl^{-}$

27. The correct order of increasing first ionization energy is **[NSEC-2010]**
(A) Ca < K < Ne < P < F (B) F < Ca < Ne < P < K
(C) K < Ca < P < F < Ne (D) Ne < F < P < Ca < K

28. The group that has the species correctly listed in the order of decreasing radius is : **[NSEC-2011]**
(A) Cu^{2+}, Cu^{+}, Cu (B) V, V^{2+}, V^{3+} (C) F^{-}, Br^{-}, I (D) B, Be, Li

29. The number of valence electrons in an atom with the configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ is: **[NSEC-2011]**
(A) 6 (B) 5 (C) 4 (D) 2

30. The element with the lowest electronegativity is : **[NSEC-2011]**
(A) S (B) I (C) Ba (D) Al

31. Einsteinium has 11 electrons in the 4f subshell. The number of unpaired electrons in the subshell is : **[NSEC-2011]**
(A) 3 (B) 4 (C) 7 (D) 11

32. The outer most electronic configuration of the most electronegative element is : **[NSEC-2012]**
(A) ns^2, np^3 (B) ns^2,np^6 (n– 1) d^2 (C) ns^2, np^5 (D) ns^2,np^6

33. The first ionisation potential of Na, Mg, Al and Si are in the order : **[NSEC-2012]**
(A) Na < Mg > Al < Si (B) Na > Mg > Al > Si
(C) Na < Mg < Al > Si (D) Na > Mg > Al < Si

34. The first four ionization energy values of a metal are 191, 587, 872 and 5962 kcal/mol respectively. The number of valence electrons in the element is : **[NSEC-2012]**

(A) 1 (B) 2 (C) 3 (D) 5

35. Of the following, the ion with the largest size is **[NSEC-2014]**

(A) O^{2-} (B) Na^{+} (C) F^{-} (D) Al^{3+}

36. Which of the following accounts best for the fact that F^{-} is smaller than O^{2-} ? **[NSEC-2018]**

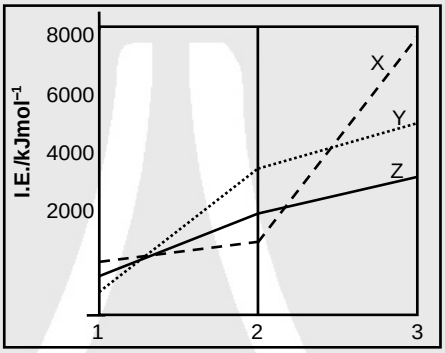
(A) F^{-} has a larger nuclear mass than O^{2-} (B) F^{-} has a larger nuclear charge than O^{2-}

(C) F^{-} is more polarizable than O^{2-} (D) F is more electronegative than O

37. N^{3-}, F^{-}, Na^{+} and Mg^{2+}, have the same number of electrons. Which of them will have the smallest and the largest ionic radii respectively? **[NSEC-2019]**

(A) Mg^{2+} and N^{3-} (B) Mg^{2+} and Na^{+} (C) N^{3-} and Na^{+} (D) F^{-} and N^{3-}

38. The following qualitative plots depict the first, second and third ionization energies (I.E.) of Mg, Al and K. Among the following, the correct match of I.E. and the metal is **[NSEC-2019]**



(A) X-Al; Y-Mg ; Z-K (B) X-Mg; Y-Al ; Z-K (C) X-Mg; Y-K ; Z-Al (D) X-Al; Y-K ; Z-Mg

PART - IV : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr. **Max. Marks : 69**

Important Instructions

A. General :

1. The test is of 1 hour duration.
2. The Test Booklet consists of 23 questions. The maximum marks are 69.

B. Question Paper Format :

3. Each part consists of five sections.
4. Section-1 contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
5. Section-2 contains 6 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
6. Section-3 contains 6 questions. The answer to each of the questions is a single-digit numerical, ranging from 0 to 9 (both inclusive).
7. Section-4 contains 1 paragraphs each describing theory, experiment and data etc. 3 questions relate to paragraph. Each question pertaining to a partcular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
8. Section-5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme :

9. For each question in Section-1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (– 1) mark will be awarded.
10. For each question in Section-2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
11. For each question in Section-3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.

SECTION-1 : (Only One option correct Type)

This section contains 7 Single correct questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.

1. Which set does not shows correct matching according to Modern periodic table :
(A) Cr = [Ar] $3d^5\ 4s^1$; element belongs to 6^{th} group.
(B) Fe^{2+} = [Ar] $3d^6$; element belongs to 8^{th} group.
(C) Sc^{3+} = [Ne] $3s^2\ 3p^6$; element belongs to zero/eighteen group.
(D) All of the above.

2. In which element shielding effect is not possible ?
(A) H (B) Be (C) B (D) N

3. Elements of which block in modern periodic table cannot have –ve oxidation state?
(A) s (B) d (C) p (D) None of these

4. Which of following ions do not exist together in aqueous solution :
(A) Pb^{2+}, F^- (B) Tl^{3+}, I^- (C) Both (A) and (B) (D) None of these

5. Select correct statement(s) :
(A) Across a transition series (from Cr to Cu), there is only a small change in atomic radius from one element to another due to very small change in effective nuclear charge.
(B) The rate of decrease in the size across the lanthanide series is less than the across the first transition series.
(C) Both are correct statements.
(D) None of the statement is correct.

6. Which of the following is the correct order of ionisation enthalpy ?
(A) $Te^{2-} < I^- < Cs^+ < Ba^{2+}$ (B) $I^- < Te^{2-} < Cs^+ < Ba^{2+}$
(C) $Te^{2-} < Cs^+ < I^- < Ba^{2+}$ (D) $Ba^{2+} < Cs^+ < I^- < Te^{2-}$

7. Which is true statement(s) ?
(A) Larger is the value of ionisation enthalpy, easier is the formation of cation.
(B) Larger is the value of electron gain enthalpy, easier is the formation of anion.
(C) Larger is the value of ionisation energy as well as electron affinity, smaller is the Mulliken electronegativity of atom.
(D) Larger is the Z_{eff}, larger is the size of atom.

Section-2 : (One or More than one options correct Type)

This section contains 6 multipole choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

8. Which of the following statement is correct for the d-block elements :
(A) They have general electronic configuration $(n-1)d^{1-10}\ ns^{0-2}$.
(B) They generally exhibit variable valency.
(C) Last electron enters in (n – 1)d sub-shell in them.
(D) They are placed from 3^{rd} to 6^{th} period in modern periodic table.

9. Poor shielding of nuclear charge by d or f-orbital electrons is responsible for which of the following facts?
(A) Atomic radius of Nb (4d-series) is comparable to that of Ta (5d-series)
(B) The Ist ionisation enthalpy of copper is less than that of zinc
(C) The value of electron gain enthalpy is more negative for sulphur than for oxygen.
(D) The Ist ionisation energy for gold is greater than that of silver.

10. Which of the following element(s) have only one non-zero oxidation state.
(A) Be (B) O (C) F (D) N

11. Which of the following is/are true order(s) ?
(A) $B^+ < B < B^-$ Size (B) I < Br < Cl < F Electron gain enthalpy
(C) $O^{--} < O^- < O^+$ Z_{eff} (D) Na < Al < Mg < Si Ionisation potential

12. Select the endothermic step(s) :
(A) $S^-(g) + e^- \longrightarrow S^{2-}(g)$ (B) $Ne(g) + e^- \longrightarrow Ne^-(g)$
(C) $N(g) + e^- \longrightarrow N^-(g)$ (D) $Al^{2+}(g) \longrightarrow Al^{3+}(g) + e^-$

13. Which of the following has/have no unit ?
(A) Electronegativity (B) Electron gain enthalpy
(C) Ionisation enthalpy (D) Metallic character

Section-3 : (One Integer Value Correct Type.)

This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

14. Atomic number of Ag is 47. In the same group the atomic numbers of elements placed above and below Ag in long form of periodic table will be x and y respectively. Give the value of (x + y)/12.

15. What is oxidation states of hydrogen in CaH_2 & CH_4.

16. Most stable oxidation state of Thallium is +n. What is the Value of n.

17. Total number of elements which have more ionization energy as compare to their next higher atomic number elements. Li, Be, C, N, O, F, Ne

18. For the gaseous reaction $K + F \rightarrow K^+ + F^-$, ΔH was calculated to be 18.4 kcal/mol under conditions where the cations and anions were preverted from combining with each other. The ionisation enthalpy of K is 4.3 eV/atom. What is the electron gain enthalpy of F (in eV) ?
If your answer is x report it as –2x.

19. How many elements are more electropositive than Cl.
B, N, O, C, S, P, At, H, Li

SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 3 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

Paragraph for Questions 20 to 22

EA_1 value of some group of p-Block elements are given :

$\xrightarrow{\text{At no.increase}}$

– 8(a)	141(e)	328(i)
– 72(b)	200(f)	349(j)
– 78(c)	193(g)	325(k)
– 103(d)	190(h)	295(l)

a, b, c.....ℓ are non radioactive p-Block elements :

20. Select the correct order of atomic radius :

(A) a < b < c < d (B) a < e < i (C) i > j > k > ℓ (D) e > f > g

21. Select the correct order of 2nd Ionisation energy :

(A) a < e < i (B) a < e < i (C) e < a < i (D) e > i > a

22. Choose correct match :

(A) a, b, c, d = Pnictogens (B) e, f, g, h = Chalogens

(C) i, j, k, l = Halogens (D) All of these

SECTION-5 : Matching List Type (Only One options correct)

This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct

23. Match the electronic configurations of the elements given in **List-I** with their correct characteristic(s) (i.e. properties for given configuration) given in **List-II** and select the correct answer using the code given below the lists.

	List-I		**List-II**
P.	$1s^2$	1.	Element shows highest negative oxidation state.
Q.	$1s^2\ 2s^2\ 2p^5$	2.	Element shows highest first ionisation enthalpy.
R.	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$	3.	Element shows highest electronegativity on Pauling scale.
S.	$1s^2\ 2s^2\ 2p^2$	4.	Element shows maximum electron gain enthalpy (most exothermic).

Code :

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

APSP Answers

PART – I

1.	(3)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(2)
6.	(3)	**7.**	(4)	**8.**	(1)	**9.**	(1)	**10.**	(3)
11.	(2)	**12.**	(4)	**13.**	(4)	**14.**	(3)	**15.**	(4)
16.	(3)	**17.**	(2)	**18.**	(1)	**19.**	(3)	**20.**	(2)
21.	3	**22.**	0	**23.**	24	**24.**	5	**25.**	11

PART - II

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

PART - III

1.	(A)	**2.**	(A)	**3.**	(B)	**4.**	(D)	**5.**	(B)
6.	(B)	**7.**	(A)	**8.**	(D)	**9.**	(B)	**10.**	(B)
11.	(A)	**12.**	(A)	**13.**	(D)	**14.**	(B)	**15.**	(C)
16.	(A)	**17.**	(B)	**18.**	(C)	**19.**	(A)	**20.**	(D)
21.	(B)	**22.**	(C)	**23.**	(A)	**24.**	(A)	**25.**	(A)
26.	(B)	**27.**	(C)	**28.**	(B)	**29.**	(C)	**30.**	(C)
31.	(A)	**32.**	(C)	**33.**	(A)	**34.**	(C)	**35.**	(A)
36.	(B)	**37.**	(A)	**38.**	(C)				

PART - IV

1.	(C)	**2.**	(A)	**3.**	(A)	**4.**	(B)	**5.**	(C)
6.	(A)	**7.**	(B)	**8.**	(ABC)	**9.**	(AD)	**10.**	(AC)
11.	(ACD)	**12.**	(ABCD)	**13.**	(AD)	**14.**	9	**15.**	0
16.	1	**17.**	3	**18.**	7	**19.**	7	**20.**	(A)
21.	(D)	**22.**	(D)	**23.**	(B)				

APSP Solutions

PART – I

1. This is a characteristic feature of transition metals.

2. As and Sb behave as metals as well as nonmetals because they form cations (M^{3+}) and anions (M^{3-}). Their oxides and hydroxides react with acid as well as base forming corresponding salts.

3. The first member of the lanthanide series is Cerium (Z= 58).

4. Z = 15 = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$; so element belongs to p-block. Thus its group number will be 10 + 2 + 3 = 15.
Z = 33 = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^3$; so element belongs to p-block. Thus its group number will be 10 + 2 + 3 = 15.
Z = 51 = $[Kr]^{36}\ 4d^{10}\ 5s^2\ 5p^3$; so element belongs to p-block. Thus its group number will be 10 + 2 + 3 = 15.
Hence, all these elements belongs to 15^{th} group i.e. nitrogen family.

9. Due to 4f-orbital electrons (poor shielding effect), there is increase in effective nuclear charge which leads to the contraction of the size of atoms. This is called lanthanide contraction.

12. As elements are ionized, the proton to electron ratio increases, so the attraction between valence shell electron and nucleus increases and as a result the size decreases. Therefore, the removal of electron from smaller cation requires higher energy. Hence the second ionisation enthalpy is greater than its first ionisation enthalpy.

15. (1) The elements having large negative values of electron gain enthalpy generally act as strong oxidising agents. E.g. Halogens.
(2) The elements having low values of ionisation enthalpies act as strong reducing agents.E.g. Alkali metals.
(3) The formation of $S^{2-}(g)$ from S(g) is an endothermic process. ($\Delta_{eg}H_1$ = small negative value, $\Delta_{eg}H_2$ = large positive value).

16. Order of $\Delta_{eg}H$ for halogens : Cl > F > Br > I & Order of $\Delta_{eg}H$ for chalcogens : S > Se > Te > Po > O.
Cl and F have the highest and II^{nd} highest values in Modern periodic table.

17. Be and N has $1s^2\ 2s^2$ and $1s^2\ 2s^2\ 2p^3$ stable configurations respectively. So addition of extra electron is difficult in their valence shell. The atomic size of C is smaller than B and also C has higher nuclear charge; so addition of electron will be easier in C than B.

18. $X(g) \longrightarrow X^+(g) + e^-$
If I.E. is ionisation enthalpy, then
$\therefore \quad \frac{N_0}{2}\ (I.E.) = E_1$
$\therefore \quad I.E. = \frac{2E_1}{N_0}$

$X(g) + e^- \longrightarrow X^-(g)$
If $\Delta_{eg}H$ is electron gain enthalpy, then
$\therefore \quad 2N_0(E.A.) = -E_2$
$\therefore \quad \Delta_{eg}H = -\frac{E_2}{2N_0}$.

19. There is electrostatic repulsion between the two species having same type of charge. So energy has to be given for the addition of additional electron to O^-.

21. (3) For possible $ns^2\ np^1$ configuration, the removal of fourth electron will be possibly from an inert gas electron configuration. So there will be high jump in the fourth ionisation enthalpy than the third ionisation enthalpy which will take place from ns^1 electron configuration.

22. The increasing order of 1st ionisation energy is f < d < p < s because of the increasing order of the penetration of the electrons as f < d < p < s if all other factors are same.

PART - II

1. O^{2-} and F^- have two shells while Li^+ and B^{3+} have only one shell. Also, $O^{2-} > F^-$ (for isoelectronic species, as Z increases, size decreases).

2. The addition of second electron in an atom or ion is always endothermic because of repulsion between two negative charges.

3. Nitrogen has half filled stable configuration, ns^2np^3. So, ionization enthalpy of nitrogen is greater than oxygen. On moving down the group, metallic radius increases due to increase in number of shells.

4. Lanthanide contraction is due to poor shielding of one of $4f$ electron by another in the sub-shell.

5. The atomic radii of the second and third transition series are almost the same. This phenomenon is associated with the intervention of the 4f orbitals which must be filled before the 5d series of elements begin. The filling of 4f before 5d orbital results in a regular decrease in atomic radii called **Lanthanide contraction** which essentially compensates for the expected increase in atomic size with increasing atomic number. The net result of the lanthanide contraction is that the second and the third d series exhibit similar radii (e.g., Zr 160 pm, Hf 159 pm).

6.

Element :	B	S	P	F
I.E.(kJ mol^{-1}) :	801	1000	1011	1681

In general as we move from left to right in a period, the ionization enthalpy increases with increasing atomic number. The ionization enthalpy decreases as we move down a group. P ($1s^2$, $2s^2$, $3s^2$ $3p^3$) has a stable half filled electronic configuration than S ($1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^4$). For this reason, ionization enthalpy of P is greater than S.

7. Lanthanoid contraction is due to ineffective shielding produced by larger f-subshell.

9. Down the group, ionic radii increases with increasing atomic number because of the increase in the number of shells. But across the period, the ionic radii decreases due to increase in effective nuclear charge as electrons are added in the same shell. Li^+ and Mg^{2+} are diagonally related but Mg^{2+} having higher charge is smaller than Li^+, so correct order is $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$.

Be^{2+} = 0.31 Å
Mg^{2+} = 0.72 Å
Li^+ = 0.76 Å
Na^+ = 1.02 Å

10. For isoelectronic species, ionic radii $\propto \frac{1}{\text{Nuclear charge}}$.

So, correct order of ionic radii is ${}_8O^{2-} > {}_9F^- > {}_{11}Na^+ > {}_{12}Mg^{2+} > {}_{13}Al^{3+}$.

11. Gadolinium (${}_{64}Gd$) = $[Xe]^{54}\ 4f^7 5d^1 6s^2$

12. As we move in a group from top to bottom, electron gain enthalpy becomes less negative because the size of the atom increases and the added electron would be at larger distance from the nucleus. Negative electron gain enthalpy of F is less than Cl. This is due to the fact that when an electron is added to F, the added electron goes to the smaller n = 2 energy level and experiences significant repulsion from the other electrons present in this level. In Cl, the electron goes to the larger n = 3 energy level and consequently occupies a larger region of space leading to much less electron-electron repulsion. So the correct order is Cl > F > Br > I.

13. Order of ionic radii $Ca^{2+} < K^+ < Cl^- < S^{2-}$
In isoelectronic species, as Z increases, size decreases.

14. Order of increasing ΔH_{IE_1} : Ba < Ca < Se < S < Ar

Ba < Ca; Se < S: On moving top to bottom in a group, size increases. So ionisation enthalpy decreases.
Ar : Maximum value of ionisation enthalpy, since it is an inert gas.

15. $Na \longrightarrow Na^+ + e^-$ I^{st} I.E. = 5.1 eV

$Na^+ + e^- \longrightarrow Na$ Electron gain enthalpy of Na^+

Because reaction is reverse, so $\Delta_{eg}H = -5.1$ eV.

16. These are isoelectronic species.

As negative charge increases, ionic radius increases.

17. $I.P_1 = Sc > Na > K > Rb$

18. Isoelectronic species :

O^{2-}, F^-, Na^+, Mg^{2+} (All contain 10 electrons)

PART - IV

1. (A) $_{21}Sc^{3+}$; $[Ar]^{18}\ 3d^0\ 4s^0$ and $_{21}Sc$; $[Ar]^{18}\ 3d^1\ 4s^2$

As last electron enters in d-subshell so it belongs to d-block and thus its group number = 2 + 1 = 3.

Element belong to 3rd group of Modern periodic table, not zero group.

2. It has only one orbital and single electron. So, **shielding effect is not possible.**

4. Tl^{3+} gets reduced to Tl^+ because of I^- and then it forms the compound TlI.

5. (A) Successive addition of d-electrons screen the outermost electrons (4s) from the inward pull of the nucleus. As a result of this, the size of the atom does not change much from Cr to Cu.

(B) This is due to lanthanide contraction.

6. All are isoelectronic species but as number of protons i.e. atomic number increases, the attraction between electron (to be removed) and nucleus increases and thus ionisation enthalpies increase.

Order of Z : Te^{2-} (52) < I^- (53) < Cs^+ (55) < Ba^{2+} (56). So same will be the order of IE.

7. (A) Larger the value of ionisation enthalpy, more difficult will be the removal of electron to form cation.

(B) Electron gain enthalpy is the measure of the ease with which an atom receives the additional electron in its valence shell in gaseous phase. So, larger is the value of electron gain enthalpy, easier is the formation of anion.

(C) Electronegativity (Mulliken) $= \frac{\text{Ionisation energy} + \text{Electron affinity}}{2}$.

(D) As Z_{eff} increases, the valence shell as well as inner shells electrons are more strongly attracted by the nucleus. This causes the contraction in atomic size.

9. The d and f orbitals do not shield the nuclear charge very effectively .Therefore there is significant reduction in the size of the ions, just after d or f orbitals have been filled completely. This is called lanthanide contraction. Atomic radii of Nb (Nb^{3+} = 0.72 Å) and Ta (Ta^{3+} = 0.72 Å) are almost identical due to lanthanide contraction.

This is also the reason for the higher ionisation energy of gold than silver.

11. Consider the factors on which these properties depend :

(A) Cation is smaller while anion is bigger than its parent atom.

(B) Correct order is Cl > F > Br > I.

(C) Cation is smaller as it is formed by the loss of electron(s). The anion is formed by the gain of electron(s). The size of anion increases with increase in charge on anion i.e. as the Z/e ratio decreases the size increases.

(D) Across the period the size decreases and nuclear size increases. So, ionisation energy increases. However, the first ionisation energy of Mg is greater than Al because of high penetration power of $2s^2$ electrons of Mg as compared to that of $2p^1$ electron of Al.

12. (A) $S^-(g) \longrightarrow S^{2-}(g)$; ΔH_{eg} = (+) ve because of electrostatic repulsion.

(B) $Ne(g) + e^-(g) \longrightarrow Ne^-(g)$; ΔH_{eg} = (+) ve because of stable completely filled electron configuration.

(C) $N(g) \longrightarrow N^-(g)$; ΔH_{eg} = (+) ve because of stable half filled electron configuration.

(D) $Al^{2+}(g) \longrightarrow Al^{3+}(g)$; ΔH_{IE} = (+) ve because of the removal of electron from cation.

14. Atomic number of Cu is 29 = x

Atomic number of Au is 79 = y

x + y = 108

$\frac{X+y}{12} = \frac{108}{12} = 9.$

17. Be, N, Ne

18. $K(g) + F(g) \rightarrow F^-(g) + K^+(g)$ $\Delta H = 18.4$ kCal = 0.8 eV

$K(g) \rightarrow K^+(g) + e^-$ IE = 4.3 eV

$F(g) + e^- \rightarrow F^-(g)$ $\Delta_{eg}H = IE - \Delta H = 0.8 - 4.3 = -3.5$ eV

x = –3.5

2x = 7.

19. B, C, S, P, At, H, Li

22.

a is N	b is P	c is As	d is Sb	e is O	f is S
g is Se	h is Te	i is F	j is Cl	k is Br	k is I

23. (A) This configuration belongs to He which has highest first ionisation enthalpy amongst all the elements of the periodic table. This is attributed to stable configuration and its small size.

(B) and (C) Group 17^{th} has $ns^2\ np^5$ valence shell electron configuration. They have highest EN values and very high negative electron gain enthalpy because they can attain stable noble gas electronic configuration by picking up an electron. (B) configuration belongs to fluorine and F has highest electronegativity on Pauling scale. (C) configuration belongs to Cl, which has hte maximum negative electron gain enthalpy (even greater than F ; due to its larger size and lesser interelectronic repulsion).

(D) This configuration belongs to C and it shows –4 oxidation state because it attains inert gas configuration of neon by gaining four electrons.