Chapter 3

Classification of Elements and Periodicity in Properties

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

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

3. 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]**
   (1) Br > Cl > I > F (2) I > Br > Cl > F
   (3) F > Cl > Br > I (4) Cl > F > Br > I

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

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

6. The ionic radii (in Å) of N^{3-}, O^{2-} and F^- are respectively **[JEE (Main)-2015]**
   (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

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

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

9. In general, the properties that decrease and increase down a group in the periodic table, respectively, are **[JEE (Main)-2019]**
   (1) Electronegativity and electron gain enthalpy
   (2) Atomic radius and electronegativity
   (3) Electron gain enthalpy and electronegativity
   (4) Electronegativity and atomic radius

10. When the first electron gain enthalpy ($\Delta_{eg}H$) of oxygen is –141 kJ/mol, its second electron gain enthalpy is **[JEE (Main)-2019]**
    (1) Almost the same as that of the first
    (2) A more negative value than the first
    (3) Negative, but less negative than the first
    (4) A positive value

11. The electronegativity of aluminium is similar to **[JEE (Main)-2019]**
    (1) Beryllium (2) Carbon
    (3) Lithium (4) Boron

12. The 71st electron of an element X with an atomic number of 71 enters into the orbital **[JEE (Main)-2019]**
    (1) 5 d (2) 6 p
    (3) 4 f (4) 6 s

13. The correct order of the atomic radii of C, Cs, Al, and S is **[JEE (Main)-2019]**
    (1) S < C < Al < Cs (2) C < S < Cs < Al
    (3) S < C < Cs < Al (4) C < S < Al < Cs

14. The correct option with respect to the Pauling electronegativity values of the elements is **[JEE (Main)-2019]**

(1) Si < Al (2) P > S

(3) Te > Se (4) Ga < Ge

15. The element with Z = 120 (not yet discovered) will be an/a **[JEE (Main)-2019]**

(1) Inner-transition metal

(2) Transition metal

(3) Alkaline earth metal

(4) Alkali metal

16. The size of the iso-electronic species Cl^-, Ar and Ca^{2+} is affected by **[JEE (Main)-2019]**

(1) Nuclear charge

(2) Principal quantum number of valence shell

(3) Azimuthal quantum number of valence shell

(4) Electron-electron interaction in the outer orbitals

17. The IUPAC symbol for the element with atomic number 119 would be **[JEE (Main)-2019]**

(1) Une (2) Uun

(3) Uue (4) Unh

18. The element having greatest difference between its first and second ionization energies, is **[JEE (Main)-2019]**

(1) K (2) Sc

(3) Ca (4) Ba

19. The isoelectronic set of ions is **[JEE (Main)-2019]**

(1) N^{3-}, Li^+, Mg^{2+} and O^{2-}

(2) Li^+, Na^+, O^{2-} and F^-

(3) N^{3-}, O^{2-}, F^- and Na^+

(4) F^-, Li^+, Na^+ and Mg^{2+}

20. The correct order of the first ionization enthalpies is **[JEE (Main)-2019]**

(1) Mn < Ti < Zn < Ni

(2) Ti < Mn < Zn < Ni

(3) Ti < Mn < Ni < Zn

(4) Zn < Ni < Mn < Ti

21. The group number, number of valence electrons, and valency of an element with atomic number 15, respectively, are **[JEE (Main)-2019]**

(1) 15, 5 and 3 (2) 15, 6 and 2

(3) 16, 5 and 2 (4) 16, 6 and 3

22. In comparison to boron, berylium has **[JEE (Main)-2019]**

(1) Greater nuclear charge and lesser first ionisation enthalpy.

(2) Greater nuclear charge and greater first ionisation enthalpy.

(3) Lesser nuclear charge and greater first ionisation enthalpy.

(4) Lesser nuclear charge and lesser first ionisation enthalpy.

23. The electron gain enthalpy (in kJ/mol) of fluorine, chlorine, bromine and iodine, respectively, are **[JEE (Main)-2020]**

(1) –296, –325, –333 and –349

(2) –333, –325, –349 and –296

(3) –349, –333, –325 and –296

(4) –333, –349, –325 and –296

24. Within each pair of elements F & Cl, S & Se, and Li & Na, respectively, the elements that release more energy upon an electron gain are **[JEE (Main)-2020]**

(1) F, S and Li (2) F, Se and Na

(3) Cl, S and Li (4) Cl, Se and Na

25. The first ionization energy (in kJ/mol) of Na, Mg, Al and Si respectively, are **[JEE (Main)-2020]**

(1) 786, 737, 577, 496 (2) 496, 577, 786, 737

(3) 496, 737, 577, 786 (4) 496, 577, 737, 786

26. The increasing order of the atomic radii of the following elements is **[JEE (Main)-2020]**

(a) C (b) O

(c) F (d) Cl

(e) Br

(1) (d) < (c) < (b) < (a) < (e)

(2) (b) < (c) < (d) < (a) < (e)

(3) (c) < (b) < (a) < (d) < (e)

(4) (a) < (b) < (c) < (d) < (e)

27. The acidic, basic and amphoteric oxides, respectively, are **[JEE (Main)-2020]**

(1) Na_2O, SO_3, Al_2O_3 (2) Cl_2O, CaO, P_4O_{10}

(3) MgO, Cl_2O, Al_2O_3 (4) N_2O_3, Li_2O, Al_2O_3

28. B has a smaller first ionization enthalpy than Be. Consider the following statements.

(I) It is easier to remove 2p electron than 2s electron

(II) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be

(III) 2s electron has more penetration power than 2p electron

(IV) Atomic radius of B is more than Be

(atomic number B = 5, Be = 4)

The correct statements are **[JEE (Main)-2020]**

(1) (I), (II) and (IV) (2) (I), (III) and (IV)

(3) (I), (II) and (III) (4) (II), (III) and (IV)

29. In general the property (magnitudes only) that show an opposite trend in comparison to other properties across a period is **[JEE (Main)-2020]**

(1) Electron gain enthalpy

(2) Electronegativity

(3) Ionization enthalpy

(4) Atomic radius

30. Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic numbers of X, Y and Z is **[JEE (Main)-2020]**

(1) X < Z < Y (2) Y < X < Z

(3) Z < Y < X (4) X < Y < Z

31. The atomic number of the element unnilennium is **[JEE (Main)-2020]**

(1) 109 (2) 119

(3) 102 (4) 108

32. Consider the hypothetical situation where the azimuthal quantum number, l, takes value 0, 1, 2, ... n + 1, where n is the principal quantum number. Then, the element with atomic number **[JEE (Main)-2020]**

(1) 9 is the first alkali metal

(2) 6 has a 2p-valence subshell

(3) 8 is the first noble gas

(4) 13 has a half-filled valence subshell

33. Among the statements (I – IV), the correct ones are

(I) Be has smaller atomic radius compared to Mg.

(II) Be has higher ionization enthalpy than Al.

(III) Charge/radius ratio of Be is greater than that of Al.

(IV) Both Be and Al form mainly covalent compounds. **[JEE (Main)-2020]**

(1) (I), (III) and (IV)

(2) (I), (II) and (IV)

(3) (I), (II) and (III)

(4) (II), (III) and (IV)

34. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is **[JEE (Main)-2020]**

(1) 3 (2) 4

(3) 2 (4) 5

35. The elements with atomic numbers 101 and 104 belong to, respectively, **[JEE (Main)-2020]**

(1) Group 6 and Actinoids

(2) Actinoids and Group 4

(3) Group 11 and Group 4

(4) Actinoids and Group 6

36. The ionic radii of O^{2-}, F^-, Na^+ and Mg^{2+} are in the order **[JEE (Main)-2020]**

(1) $F^- > O^{2-} > Na^+ > Mg^{2+}$

(2) $Mg^{2+} > Na^+ > F^- > O^{2-}$

(3) $O^{2-} > F^- > Mg^{2+} > Na^+$

(4) $O^{2-} > F^- > Na^+ > Mg^{2+}$

37. The process that is NOT endothermic in nature is **[JEE (Main)-2020]**

(1) $Ar_{(g)} + e^- \longrightarrow Ar^-_{(g)}$

(2) $H_{(g)} + e^- \longrightarrow H^-_{(g)}$

(3) $Na_{(g)} \longrightarrow Na^+_{(g)} + e^-$

(4) $O^-_{(g)} + e^- \longrightarrow O^{2-}_{(g)}$

38. In the sixth period, the orbitals that are filled are **[JEE (Main)-2020]**

(1) 6s, 4f, 5d, 6p

(2) 6s, 5d, 5f, 6p

(3) 6s, 6p, 6d, 6f

(4) 6s, 5f, 6d, 6p

39. The correct order of the ionic radii of O^{2-}, N^{3-}, F^-, Mg^{2+}, Na^+ and Al^{3+} is

[JEE (Main)-2020]

(1) $Al^{3+} < Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

(2) $Al^{3+} < Na^+ < Mg^{2+} < O^{2-} < F^- < N^{3-}$

(3) $N^{3-} < F^- < O^{2-} < Mg^{2+} < Na^+ < Al^{3+}$

(4) $N^{3-} < O^{2-} < F^- Na^+ < Mg^{2+} < Al^{3+}$

40. The set that contains atomic numbers of only transition elements, is **[JEE (Main)-2020]**

(1) 21, 32, 53, 64 (2) 9, 17, 34, 38

(3) 37, 42, 50, 64 (4) 21, 25, 42, 72

41. The atomic number of Unnilunium is _____.

[JEE (Main)-2020]

42. Consider the elements Mg, Al, S, P and Si, the correct increasing order of their first ionization enthalpy is : **[JEE (Main)-2021]**

(1) Mg < Al < Si < P < S

(2) Mg < Al < Si < S < P

(3) Al < Mg < S < Si < P

(4) Al < Mg < Si < S < P

43. Match List-I with List-II.

List-I	List-II
Electronic configuration of elements	$\Delta_i H$ in kJ mol^{-1}
(a) $1s^2\ 2s^2$	(i) 801
(b) $1s^2\ 2s^2\ 2p^4$	(ii) 899
(c) $1s^2\ 2s^2\ 2p^3$	(iii) 1314
(d) $1s^2\ 2s^2\ 2p^1$	(iv) 1402

Choose the most appropriate answer from the options given below : **[JEE (Main)-2021]**

(1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)

(2) (a) → (i), (b) → (iv), (c) → (iii), (d) → (ii)

(3) (a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

(4) (a) → (ii), (b) → (iii), (c) → (iv), (d) → (i)

44. Which pair of oxides is acidic in nature?

[JEE (Main)-2021]

(1) CaO, SiO_2 (2) B_2O_3, CaO

(3) B_2O_3, SiO_2 (4) N_2O, BaO

45. The correct order of electron gain enthalpy is:

[JEE (Main)-2021]

(1) O > S > Se > Te

(2) Te > Se > S > O

(3) S > O > Se > Te

(4) S > Se > Te > O

46. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53 and 83 are

[JEE (Main)-2021]

(1) X and Y are metalloids and Z is a metal

(2) X is a metalloid, Y is a non-metal and Z is a metal

(3) X and Z are non-metals and Y is a metalloid.

(4) X, Y and Z are metals.

47. The absolute value of the electron gain enthalpy of halogens satisfies : **[JEE (Main)-2021]**

(1) Cl > Br > F > I (2) I > Br > Cl > F

(3) F > Cl > Br > I (4) Cl > F > Br > I

48. The ionic radius of Na^+ ion is 1.02 Å. The ionic radii (in Å) of Mg^{2+} and Al^{3+}, respectively, are

[JEE (Main)-2021]

(1) 0.72 and 0.54 (2) 1.05 and 0.99

(3) 0.68 and 0.72 (4) 0.85 and 0.99

49. The first ionization energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. The elements X, Y and Z, respectively, are **[JEE (Main)-2021]**

(1) Chlorine, lithium and sodium

(2) Argon, lithium and sodium

(3) Argon, chlorine and sodium

(4) Neon, sodium and chlorine

50. Outermost electronic configuration of a group 13 element, E, is $4s^2$, $4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is: **[JEE (Main)-2021]**

(1) $[Xe]5d^{10}6s^26p^2$ (2) $[Kr]3d^{10}4s^24p^2$

(3) $[Ar]3d^{10}4s^24p^2$ (4) $[Kr]4d^{10}5s^25p^2$

51. Which one of the following statements for D.I. Mendeleev, is incorrect? **[JEE (Main)-2021]**

(1) He authored the textbook-Principles of Chemistry

(2) He invented accurate barometer

(3) At the time, he proposed Periodic Table of elements structure of atom was known

(4) Element with atomic number 101 is named after him

52. The ionic radii of K^+, Na^+, Al^{3+} and Mg^{2+} are in the order **[JEE (Main)-2021]**

(1) $Na^+ < K^+ < Mg^{2+} < Al^{3+}$

(2) $Al^{3+} < Mg^{2+} < K^+ < Na^+$

(3) $Al^{3+} < Mg^{2+} < Na^+ < K^+$

(4) $K^+ < Al^{3+} < Mg^{2+} < Na^+$

53. The ionic radii of F^- and O^{2-} respectively are 1.33 Å and 1.4 Å, while the covalent radius of N is 0.74 Å. **[JEE (Main)-2021]**

The correct statement for the ionic radius of N^{3-} from the following is :

(1) It is smaller than O^{2-} and F^-, but bigger than of N

(2) It is bigger than F^- and N, but smaller than of O^{2-}

(3) It is bigger than O^{2-} and F^-

(4) It is smaller than F^- and N

54. Match **List-I** with **List-II**

List-I	**List-II**
(a) NaOH	(i) Acidic
(b) $Be(OH)_2$	(ii) Basic
(c) $Ca(OH)_2$	(iii) Amphoteric
(d) $B(OH)_3$	
(e) $Al(OH)_3$	

Choose the **most appropriate** answer from the options given below **:** **[JEE (Main)-2021]**

(1) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(i), (e)-(iii)

(2) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(iii)

(3) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(iii)

(4) (a)-(ii), (b)-(iii), (c)-(ii), (d)-(i), (e)-(iii)

55. The CORRECT order of first ionisation enthalpy is: **[JEE (Main)-2021]**

(1) Al < Mg < S < P

(2) Mg < Al < P < S

(3) Mg < S < Al < P

(4) Mg < Al < S < P

56. The correct order of ionic radii for the ions, P^{3-}, S^{2-}, Ca^{2+}, K^+, Cl^- is **[JEE (Main)-2021]**

(1) $K^+ > Ca^{2+} > P^{3-} > S^{2-} > Cl^-$

(2) $P^{3-} > S^{2-} > Cl^- > Ca^{2+} > K^+$

(3) $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$

(4) $Cl^- > S^{2-} > P^{3-} > Ca^{2+} > K^+$

57. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : Metallic character decreases and non-metallic character increases on moving from left to right in a period.

Reason (R) : It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.

In the light of the above statements, choose the **most appropriate** answer from the options given below : **[JEE (Main)-2021]**

(1) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(2) (A) is true but (R) is false

(3) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(4) (A) is false but (R) is true

58. Given below are the oxides

Na_2O, As_2O_3, N_2O, NO and Cl_2O_7

Number of amphoteric oxides is:

[JEE (Main)-2022]

(1) 0 (2) 1

(3) 2 (4) 3

59. The correct order of electron gain enthalpies of Cl, F, Te and Po is **[JEE (Main)-2022]**

(1) F < Cl < Te < Po (2) Po < Te < F < Cl

(3) Te < Po < Cl < F (4) Cl < F < Te < Po

60. Which of the following elements is considered as a metalloid? **[JEE (Main)-2022]**

(1) Sc (2) Pb

(3) Bi (4) Te

61. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above "E" in the group is

[JEE (Main)-2022]

(1) $3s^2, 3p^4$ (2) $3d^{10}, 4s^2, 4p^4$

(3) $4d^{10}, 5s^2, 5p^4$ (4) $2s^2, 2p^4$

62. The IUPAC nomenclature of an element with electronic configuration [Rn] $5f^{14}6d^17s^2$ is

[JEE (Main)-2022]

(1) Unnilbium (2) Unnilunium

(3) Unnilquadium (4) Unniltrium

63. The first ionization enthalpies of Be, B, N and O follow the order

[JEE (Main)-2022]

(1) O < N < B < Be (2) Be < B < N < O

(3) B < Be < N < O (4) B < Be < O < N

64. The total number of acidic oxides from the following list is

$NO, N_2O, B_2O_3, N_2O_5, CO, SO_3, P_4O_{10}$

[JEE (Main)-2022]

(1) 3 (2) 4

(3) 5 (4) 6

65. Given two statements below:

Statement I : In Cl_2 molecule the covalent radius is double of the atomic radius of chlorine.

Statement II : Radius of anionic species is always greater than their parent atomic radius.

Choose the **most appropriate** answer from options given below:

[JEE (Main)-2022]

(1) Both **Statement I** and **Statement II** are correct.

(2) Both **Statement I** and **Statement II** are incorrect.

(3) **Statement I** is correct but **Statement II** is incorrect.

(4) **Statement I** is incorrect but **Statement II** is correct.

66. The **incorrect** statement is **[JEE (Main)-2022]**

(1) The first ionization enthalpy of K is less than that of Na and Li.

(2) Xe does not have the lowest first ionization enthalpy in its group.

(3) The first ionization enthalpy of element with atomic number 37 is lower than that of the element with atomic number 38.

(4) The first ionization enthalpy of Ga is higher than that of the d-block element with atomic number 30.

67. Outermost electronic configurations of four elements A, B, C, D are given below :

(A) $3s^2$ (B) $3s^23p^1$

(C) $3s^23p^3$ (D) $3s^23p^4$

The **correct** order of fist ionization enthalpy for them is: **[JEE (Main)-2022]**

(1) (A) < (B) < (C) < (D) (2) (B) < (A) < (D) < (C)

(3) (B) < (D) < (A) < (C) (4) (B) < (A) < (C) < (D)

68. In which of the following pairs, electron gain enthalpies of constituent elements are nearly the same or identical?

(A) Rb and Cs (B) Na and K

(C) Ar and Kr (D) I and At

Choose the **correct** answer from the options given below: **[JEE (Main)-2022]**

(1) (A) and (B) only (2) (B) and (C) only

(3) (A) and (C) only (4) (C) and (D) only

69. The correct decreasing order for metallic character is **[JEE (Main)-2022]**

(1) Na > Mg > Be > Si > P

(2) P > Si > Be > Mg > Na

(3) Si > P > Be > Na > Mg

(4) Be > Na > Mg > Si > P

70. The first ionization enthalpy of Na, Mg and Si, respectively, are : 496, 737 and 786 kJ mol^{-1}. The first ionization enthalpy (kJ mol^{-1}) of Al is:

[JEE (Main)-2022]

(1) 487 (2) 768

(3) 577 (4) 856

71. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R).**

Assertion (A) : The ionic radii of O^{2-} and Mg^{2+} are same.

Reason (R) : Both O^{2-} and Mg^{2+} are isoelectronic species.

In the light of the above statements, choose the **correct** answer from the options given below.

[JEE (Main)-2022]

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

72. The correct order of increasing ionic radii is

[JEE (Main)-2022]

(1) $Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$

(2) $N^{3-} < O^{2-} < F^{-} < Na^{+} < Mg^{2+}$

(3) $F^{-} < Na^{+} < O^{2-} < Mg^{2+} < N^{3-}$

(4) $Na^{+} < F^{-} < Mg^{2+} < O^{2-} < N^{3-}$

73. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: The first ionization enthalpy for oxygen is lower than that of nitrogen.

Reason R: The four electrons in 2p orbitals of oxygen experience more electron-electron repulsion.

In the light of the above statements, choose the *correct* answer from the options given below.

[JEE (Main)-2022]

(1) Both A and R are correct and Rj is the correct explanation of A

(2) Both A and R are correct but R is NOT the correct explanation of A

(3) A is correct but R is not correct

(4) A is not correct but R is correct