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 71$^{st}$ 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

# Chapter 3

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1. Answer (1)

   $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

2. Answer (1)

   $O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$ $\longrightarrow$

   Decreasing ionic radii with increasing effective nuclear charge for isoelectronic species.

3. Answer (4)

   Fact.

4. Answer (2)

5. Answer (3)

   The increasing order of first ionisation enthalphy of the given elements is Ba < Ca < Se < S < Ar .

6. Answer (3)

   Radius of $N^{3-}$, $O^{2-}$ and $F^-$ follow order

   $N^{3-} > O^{2-} > F^-$

   As per inequality only option (3) is correct

   that is 1.71 Å, 1.40 Å and 1.36 Å

7. Answer (3)

   Sc is d-block element having high $Z_{eff}$ hence high ionisation enthalpy.

8. Answer (3)

   $Mg^{2+}$, $Na^+$, $O^{2-}$ and $F^-$ all have 10 electrons each.

9. Answer (4)

   Down the group

   Electronegativity decrease as size increases

   $$EN \propto \frac{1}{size}$$

10. Answer (4)

    Second electron gain enthalpy of oxygen is positive.

11. Answer (1)

    Be and Al show diagonal relationship.

12. Answer (1)

    Atomic number = 71

    Electronic configuration:

    $[Xe]6s^2\,4f^{14}\,5d^1 \leftarrow$ last electron

    $\therefore$ Orbital occupied by last $e^-$ is 5d

13. Answer (4)

    Carbon is smallest being 2nd period element and Cs belongs to 6th period so largest. On moving from left to right, size decreases so C < S < Al < Cs

14. Answer (4)

    Correct order of electronegativity is

    Si > Al

    S > P

    Se > Te

    Ge > Ga.

15. Answer (3)

    Element with Z = 120 will belong to alkaline earth metals.

16. Answer (1)

    Iso-electronic species differ in size due to different effective nuclear charge.

17. Answer (3)

    Symbol for 1 is u

    and for 9 is e

    $\therefore$ IUPAC symbol for 119 is Uue.

18. Answer (1)

    Alkali metals have high difference in the first ionisation and the second ionisation energy as they achieve stable noble gas configuration after first ionisation.

19. Answer (3)

    Atomic numbers of N, O, F and Na are 7, 8, 9 and 11 respectively. Therefore, total number of electrons in each of $N^{3-}$, $O^{2-}$, $F^-$ and $Na^+$ is 10 and hence they are isoelectronic.

20. Answer (3)

Order for I.E. is

Ti < Mn < Ni < Zn

21. Answer (1)

Phosphorus has atomic number equal to 15. Its group number is 15, it has 5 valence electrons and valency equal to 3.

22. Answer (3)

Nuclear charge B > Be

Ionisation energy Be > B

↓

(due to $ns^2$ outer electronic configuration)

Be = $1s^2\ 2s^2$ (more stable)

B = $1s^2\ 2s^2\ 2p^1$

23. Answer (4)

Electron gain enthalpy is most negative for chlorine followed by fluorine and bromine and least negative for iodine among given elements.

So, F(–333 kJ $mol^{-1}$)

Cl(–349 kJ $mol^{-1}$)

Br(–325 kJ $mol^{-1}$)

I(–296 kJ $mol^{-1}$)

24. Answer (3)

Order of energy released upon electron gain

F < Cl

S > Se

Li > Na

25. Answer (3)

Ionisation energy of elements belonging to period III in general increases as we move from left to right with the exception of Group-2 and Group-15 elements due to their stable configuration. The increasing order of first ionisation energy of the given elements is

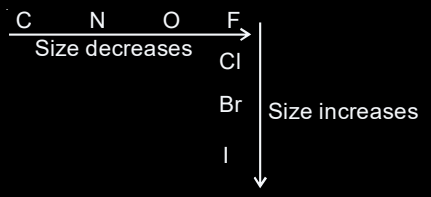
Na < Al < Mg < Si

Ionisation energy of the given metals are

Na : 496 kJ/mol ; Al : 577 kJ/mol

Mg : 737 kJ/mol ; Si : 786 kJ/mol

26. Answer (3)




Correct increasing order of atomic radii i

F < O < C < Cl < Br

27. Answer (4)

| Oxide(s) | Nature |
|---|---|
| $Na_2O$, CaO, MgO, $Li_2O$ | Basic |
| $SO_3$, $Cl_2O$, $P_4O_{10}$, $N_2O_3$ | Acidic |
| $Al_2O_3$ | Amphoteric |

28. Answer (3)

1st I.E. of Be > B

In case of Be, electron is removed from 2s orbital which has more penetration power, while in case of B electron is removed from 2p orbital which has less penetration power.

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

∴ It is easier to remove 2p electron than 2s electron.

29. Answer (4)

Atomic radius decreases on moving left to right in periodic table, while other three properties given increases (in magnitude) on moving left to right across a period.

30. Answer (4)

In periodic table in a period on moving from left to right as atomic number increases the nature of oxide follows the order basic, amphoteric and acidic i.e., oxide of X is basic, oxide of Y amphoteric oxide of Z is acidic

Hence atomic number follows the order

Z > Y > X

31. Answer (1)

For Unnilennium

IUPAC symbol – Une

Atomic No. – 109

32. Answer (4)

Under hypothetical situation, the value of l is greater than n which varies from 0 to n + 1

n for n = 1, l = 0, 1, 2

n = 2, l = 0, 1, 2, 3

Elements follow the following electronic configuration

1s 1p 1d 2s 2p 2d 2f

Atomic number (Z) = 9

$1s^2\ 1p^6\ 1d^1$

Atomic number 6

$1s^2\ 1p^4$

Atomic number 8

$1s^2\ 1p^6$

Atomic number 13

$1s^2\ 1p^6\ 1d^5$

Here atomic number of first noble gas will be 18

33. Answer (2)

Be < Mg (atomic radius)

Be > Al ($I.E_1$)

Be ≃ Al (Charge/radius ratio)

Both Be and Al form mainly covalent compound.

34. Answer (1)

There is a sudden jump after 3rd I.E. due to attainment of noble gas configuration. So, the number of valence electrons in this element are 3.

35. Answer (2)

Actinoids contains 14 elements with atomic number 90 to 103. Hence element with atomic number 101 is Actinoids.

Element with atomic number 104 is a d-block element of group 4

36. Answer (4)

Among isoelectronic species, greater the Zeff smaller will be the radius.

Order of Zeff : $O^{2-} < F^- < Na^+ < Mg^{2+}$

Order of Ionic Radii : $O^{2-} > F^- > Na^+ > Mg^{2+}$

37. Answer (2)

$Ar(g) + e^- \longrightarrow Ar^-(g)$ (Endothermic)

$H(g) + e^- \longrightarrow H^-(g)$ (exothermic)

$Na(g) \longrightarrow Na^+(g) + e^-$ (endothermic)

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

- EGE of H(g) is negative while that of Ar(g) is positive due to $ns^2np^6$ configuration.

  2nd EGE is always positive for an atom

- Ionization potential of an atom is positive

38. Answer (1)

Filling of electrons in orbitals in any period takes place as:

ns, (n – 2)f (if possible) (n – 1)d (if possible) np

∴ for sixth period n = 6,

orbitals that are filled are 6s, 4f, 5d and 6p

39. Answer (1)

For isoelectronic species, as the no. of protons increases, size of ions decreases.

∴ Correct order of ionic radii

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

40. Answer (4)

Elements with atomic number 21, 25, 42 and 72 belongs to transition metals.

41. Answer (101)

Unnilunium

IUPAC symbol = Unu

Atomic no. (Z) = 101

42. Answer (4)

Across the period, generally ionization enthalpy increases but half filled and fully filled configuration are stable and may change the regular trend.

P has more $IE_1$ than S because of half filled.

Al has lower $IE_1$ than Mg because of effective shielding of 3P electrons from the nucleus by 3s-electrons.

Finally order should be

P > S > Si > Mg > Al

43. Answer (4)

On moving left to right in periodic table, ionisation energy increases (generally) but group-13 elements have lesser I.E than group-2 due to stable $ns^2$ electronic configuration of group-2 elements and group-15 elements have greater I.E than group-16 elements due to half-filled stable $np^3$ configuration of group-15 elements.

∴ Overall order of I.E should be

c > b > a > d

44. Answer (3)

CaO – Basic

$SiO_2$ – Acidic

$B_2O_3$ – Acidic

$N_2O$ – Neutral

BaO – Basic

45. Answer (4)

Correct order of electron gain enthalpy is

S > Se > Te > O

46. Answer (2)

X(Z = 33) = As (metalloid)

Y(Z = 53) = I (non-metal)

Z(Z = 83) = Bi (metal)

47. Answer (4)

The magnitude of electron gain enthalpy of halogen atoms down the group shows abnormal behaviour. The $|\Delta H_{eg}|$ of F is lower than that of Cl due to its smaller size. The incoming electron experiences higher repulsive force due to valence electrons of F than Cl. The correct order is Cl > F > Br > I

48. Answer (1)

Order of ionic size $Na^+ > Mg^{2+} > Al^{3+}$

49. Answer (3)

First ionisation energy of Mg is small than Argon and chlorine but higher than Na.

So X $\rightarrow$ Argon

Y $\rightarrow$ Chlorine

Z $\rightarrow$ Sodium

50. Answer (4)

The element E belongs to group-13 and period-4. The element belonging to period-5 and placed diagonally to E has the electronic configuration $[Kr]4d^{10}5s^25p^2$

51. Answer (3)

At the time of D.I. Mendeleev, structure of atom was not known.

Element with atomic number 101 is known as Mendelevium.

52. Answer (3)

| | **Ionic radii (in pm)** |
|---|---|
| $Na^+$ | 102 |
| $K^+$ | 138 |
| $Mg^{2+}$ | 72 |
| $Al^{3+}$ | 53.5 |

Generally higher the charge on cation smaller will be its ionic radius.

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

53. Answer (3)

For isoelectronic species, as the charge on nucleus increases, the ionic radius decreases $F^-$, $O^{2-}$ and $N^{3-}$ has 10 electrons each. The decreasing order of their ionic radii is

$N^{3-} > O^{2-} > F^-$

$\therefore$ $N^{3-}$ is bigger than both $O^{2-}$ and $F^-$

54. Answer (4)

NaOH – Basic

$Ca(OH)_2$ – Basic

$Be(OH)_2$ – Amphoteric

$Al(OH)_3$ – Amphoteric

$B(OH)_3$ – Acidic

55. Answer (1)

All elements belong to 3rd period in periodic table.

Al < Mg < S < P

Mg: Electron is removing from *s* subshell

P: $3s^23p^3$ Half filled configuration

56. Answer (3)

For isoelectronic species, as nuclear charge increases radius decreases.

Greater the positive charge, lesser the size of ion. Greater the negative charge, larger the size of ion.

$\therefore$ $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$

57. Answer (2)

Metallic character decreases on moving left to right and non-metallic character increases, it is due to increase in ionisation enthalpy. But electron gain enthalpy also increases from left to right.

Reason is not correct.

58. Answer (2)

Oxides

$Na_2O \longrightarrow$ Basic

$As_2O_3 \longrightarrow$ Amphoteric

$N_2O \longrightarrow$ Neutral

$NO \longrightarrow$ Neutral

$Cl_2O_7 \longrightarrow$ Acidic

Hence, only one amphoteric oxide is present.

59. Answer (2) or (4)

Te $\rightarrow$ –190 kJ mol$^{-1}$

Po $\rightarrow$ –174 kJ mol$^{-1}$

F $\rightarrow$ –333 kJ mol$^{-1}$

Cl $\rightarrow$ –349 kJ mol$^{-1}$

By considering only magnitude of electron gain enthalpy order is Po < Te < F < Cl

By Considering electron gain enthalpy with sign order is Cl < F < Te < Po

60. Answer (4)

Tellurium is metalloid

61. Answer (1)

Element E is Selenium

The element which is just above 'E' in periodic table is sulphur, its electronic configuration is $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^4$

62. Answer (4)

The element with electronic configuration [Rn] $5f^{14}6d^17s^2$ has atomic number $\rightarrow$ 103

$\therefore$ Its IUPAC name is : Unniltrium

63. Answer (4)

The first ionisation energy increase from left to right along 2$^{nd}$ period with the following exceptions

$IE_1$ : Be > B and N > O

This is due to stable configuration of Be in comparison to B and that of N in comparison to O.

Hence the correct order is N > O > Be > B

64. Answer (2)

NO, $N_2O$, CO – neutral oxides

$B_2O_3$, $N_2O_5$, $SO_3$, $P_4O_{10}$ – acidic oxides

65. Answer (4)

- Covalent radius is not double of atomic radius.
- Radius of anionic species is always greater than their parent atomic radius as nuclear charge decreases in anionic counterpart.

66. Answer (4)

On moving down in a group ionisation energy decrease

$\therefore$ 1$^{st}$ ionisation enthalpy order is Li > Na > K

Zn has more ionisation energy as compared to Ga because of their pseudo inert gas configuration.

67. Answer (2)

Orbitals with fully filled and half-filled electronic configuration are stable, and require more energy for ionization

Elements with greater electronegativity require more energy for ionisation

Hence the correct order is C > D > A > B

68. Answer (3)

| Element | Electron gain enthalpy (kJ mol$^{-1}$) |
|---|---|
| Rb | –47 |
| Cs | –46 |

Electron gain enthalpy of noble gases is almost zero.

Hence the correct option is (3).

69. Answer (1)

Metallic character increases top to bottom in group and decreases left to right in a period.

Mg is from second group it will be less metallic than Na. Be comes above Mg hence less metallic than Mg. Si is more metallic than phosphorous.

70. Answer (3)

The first ionisation enthalpy of Al would be more than that of (sodium) Na but less than that of (silicon) Si and (magnesium) Mg.

Thus first ionisation enthalpy of Al would be 577 kJ/mole.

71. Answer (4)

Correct order of ionic radii:

$$O^{-2} > Mg^{+2}$$

This is because among isoelectronic species, the size of anions are greater than the size of cations. Statement (II) is correct as both $O^{-2}$ and $Mg^{+2}$ are isoelectronic.

72. Answer (1)

For isoelectronic species

$$\text{Ionic radii } \mu \frac{(-)\text{ve charge}}{(+)\text{ve charge}}$$

Hence, correct order of ionic radii is

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

73. Answer (2)

Nitrogen has half filled p-orbitals which is stable. Due to this it's 1st ionization energy is more than oxygen.

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