Periodic Properties (Booklet Solution)

Foundation Builders (Objective)

1. (B)
Law of triads states that in the set of three elements arranged in increasing order of atomic weight, having similar properties, the atomic weight of middle element is the arithmetic mean of other two.

2. (C)
Transition elements are those in which electron are filled in d–orbitals.

3. (D)
P–block elements are also known as representative element.

4. (A)
Covalent radii < crystal radii < vanderwaal radii.

5. (B)
Noble gases are placed in zero group but has 2 or 3 electrons in its valence shell.

6. (B)
$N_2 = 14e^- \ \& \ CO = 14e^-$

7. (C)
Fact

8. (C)
Fourth period of periodic table has 3d electron filling, not 4d.

9. (D)
Fe^{2+} has 4 unpaired electron.

10. (B)
For compound to be coloured either cation or anion has unpaired electron.
$_{29}Cu^{2+} : [Ar]3d^9$

11. (D)
C & N^+ has 6 electrons in it.

12. (B)
All the species has $14e^-$ in it.

13. (B)
For iso–electronic species, more negatively charged ion is more bigger in size.

14. (C)
Same as above.

15. (B)
Same as above.

16. (D)
For same atom more positive charged species is smaller one.

17. **(B)**
For an isoelectronic species, negatively charged species is more bigger than positively charged species.

18. **(A)**
More is the P/e ratio smaller is the radius.

19. **(B)**
$r_{Na^+} < r_{F^-}$
$r_{F^-} < r_{Cl^-}$
$r_{Cl^-} < r_{S^{2-}}$
$\therefore r_{Na^+} < r_{F^-} < r_{Cl^-} < r_{S^{2-}}$

20. **(B)**
Across a period, as Zeff increases. Atomic radii decreases.

21. **(A)**
For isoelectronic species
Radius of cation < radius of neutral
Atom < radius of anion

22. **(C)**
For same atom
$r_{cation} < r_{atom} < r_{anion}$

23. **(A)**
Na > Mg (Across a period size decreases)
$Na > Na^+$
$Mg > Mg^{2+}$

24. **(B)**
For an isoelectronic species, more positive charged ion, smaller in the size. More is the negative charge on anion, more is the size.

25. **(D)**
Li ↔ Be
Na ↔ Mg ↔ A*l*
K

26. **(C)**
$\text{Ionisation energy} \propto \frac{1}{\text{size}}$
But in a period stable configuration is preferred as size change is not very significant.

27. **(B)**
$Mg \longrightarrow Mg^+ + e^-$ $\quad \Delta H_1 = 1P_1 = 178\ \text{kcal mol}^{-1}$
$Mg^+ \longrightarrow mg^{2+} + e^-$ $\quad \Delta H_2 = 1P_2 = 348\ \text{kcal mol}^{-1}$
$Mg \longrightarrow Mg^{2+} + 2e^-$ $\quad \Delta H = \Delta H_1 + \Delta H_2$
$= 178 + 348$

$= 526 \text{ kcal mol}^{-1}$

28. (B)

$\because {}_1P_5$ is very high i.e removal of 5^{th} electron is very difficult. If means after removal of $4e^-$ species has acquired very stable configuration.

29. (B)

$I.E_n > I.E_{n-1} > I.E_{n-2} ... > I.E_2 > I.E_1$

30. (B)

I.E for electron in 3p > 4p

$3p^3$ is half filled than p^1 & p^2

31. (B)

$\underset{(2,8,1)}{Mg^+} \longrightarrow \underset{(2,8)}{Mg^{2+}} + e^- \left(I.E_2\right) Mg$

$\underset{(2,8)}{Na^+} \longrightarrow \underset{(2,7)}{Na^{2+}} + e^- \left(I.E_2\right) Na$

Inert gas configuration.

$\therefore \left(I.E\right)_2 Na > \left(I.E_2\right) Mg$

32. (A)

$\text{Electronegativity} \propto \frac{1}{\text{size}}$

$\text{Ionisation Energy} \propto \frac{1}{\text{size}}$

$\therefore$ I. E is less for left side, metal as their size is more, so they are more reactive.
down the group. I. E decreases & hence reducing power decreases.

33. (C)

${}_5B : 1s^2\ 2s^2\ 2p^1$

${}_4Be : 1s^2\ 2s^2$: Full filled configuration is more stable.

34. (B)

If $\left(I.E_2 - I.E_1\right) > 16ev$ / atom, then lower oxidation state is more stable.

35. (D)

For isoelectronic species,

$$I.E \propto \frac{1}{\text{size}}$$

S^{2-} has maximum ionic radii & hence lowest I.E.

36. (C)

$I.E \propto \frac{1}{\text{size}}$

$\because$ size of Na is between Li & K.

It I. E will also be in between the I.E. value of Li & K.

37. (C)

I.E. increases tremendously when no. of reduces.

$I.E_4 >>> I.E_3$, means valence electron is 3

38. **(A)**

$Na \longrightarrow Na^+ + e^- \qquad \Delta H_1 = (I.E_1)_{Na}$

$Na^+ + e^- \longrightarrow Na \qquad \Delta H_2 = -(E.A)_{Na^+}$

$|\Delta H_1| = |\Delta H_2|$

39. **(C)**

$O \xrightarrow{+e^-} O^- \quad \Delta H_{eg_1} = (-ve)$

$O^- \xrightarrow{+e^-} O^{2-} \; \Delta H_{eg_2} = +ve$

$O^- \xrightarrow{+2e^-} O^{2-} \; (\Delta H_{eg})_{total} = +ve$

$\therefore \Delta H_{eg_2}$ for all element is positive.

40. **(A)**

$\chi_O > \chi_N$

$\therefore (E.A)_O > (E.A)_N \quad \because$ Repulsion offered to incoming

e^- in 3p orbital will be very less as compared to 2p orbital.

41. **(D)**

Negative anion species will repel incoming electron due to same charge repulsion.

42. **(B)**

Be is more stable due to fulfilled as subshell. Be^- is formed over coming this stability, so more energy is taken by Be. Hence it is least stable.

43. **(C)**

Electron affinity (E. A)

E. A $\propto$ depends on repulsion to incoming electron mainly.

E. A $\propto$ electronegativity

44. **(B)**

Refer 39

45. **(B)**

In C, electronic repulsion is very high. So EA is very less. For S & Se, repulsion difference is not significant.

$\chi_S > \chi_{Se}$

$\therefore$ S > Se > O

46. **(C)**

In same period

E.A $\propto$ electronegativity

$\therefore$ N < C < O < F

47. **(C)**

Due to high electronegativity

$(E.A)_F > (E.A)_{Br}$

$\therefore$ Fluorine undergoes reduction easily than bromine, so it is better oxidizing agent.

48. **(C)**

Electronegativity decreases down the group, but decrease is less in case of alkali metal as compared to halogen groups.

49. (B)

According to Pauling scale

$\chi_P = \frac{I.E + E.A}{5.6}$ where I.E & E.A is expressed in ev/atom.

50. (D)

$X_P = \frac{X_m}{2.8}$ X_P: electronegativity on Pauling scale

X_m: electronegativity on Mulliken's scale.

51. (C)

Electronegativity increases along a period and decreases down the group.

52. (A)

$X_M = \frac{I.P + E.A}{2}$ I.P & E.A in eV/atom.

53. (A)

More is the electronegativity difference, more is the ionic character. For same atom, electronegativity ≈ 0.

54. (D)

$\text{Hydration energy} \propto \frac{\text{charge}}{\text{size}}$

55. (A)

56. (D)

Electronegativity difference increases, it means acidic strength of different element decreases.

57. (C)

Group 13^{th} element oxides are generally amphoteric.

Get equipped for JEE Main

1. (D)

Exception to aufbau's principle.

2. (D)

Valency of X is 1

Valency of Y is 3

3. (D)

Oxygen group is known as chalcogens.

4. (B)

$M^{3+} : [Ar] 3d^{10} 4s^2$

$M : [Ar] 3d^{10} 4s^2 4p^3$.

5. **(B)**

$26Fe:[Ar]4s^2\ 3d^6$

$26Fe^{3+}:[Ar]3d^5$

6. **(B)**

7. **(C)**

Due to inert pair effect Bi^{3+} is more stable as compared to +5 state for others.

8. **(A)**

w.r.t oxygen
halogen family : +7
oxygen family : O
Nitrogen family : +5
Boron family : +3

9. **(D)**

Valency of A is 3
Valency of B is 2
$\therefore$ compound formed is A_2B_3.

10. **(C)**

I.E increases from left to right.

11. **(C)**

Zeff difference between consecutive elements in transition element is less as compared to s & p-block elements. Same is the case with lanthanide series,
'd' orbitals electron offers less shielding effect as compared to s & p-block
'f' orbitals electrons offers less shielding effect as compared to s, p & d block.

12. **(D)**

$Fe = Co = Ni$; Increase in effective atomic number is balanced by increase in repulsion between electrons.
$Ni < Cu < Zn$ Increase in Z_{eff} is overcomed by electronic repulsion size increases.

13. **(B)**

As P/e ratio increase, Z_{eff} increases so 2^{nd} ionization energy is always higher than 1^{st} I. E.

14. **(C)**

For alkali metal $(I.E)_2 >> (I.E)_1$

15. **(A)**

Atomic radius is determining factor for I. E down the group Z_{eff} and stable configuration important factor for I. E across period.

16. **(B)**

Smaller size of atoms, more is the I. E

17. **(B)**

Hydration energy depends on $\frac{\text{charge}}{\text{size}}$ ratio.

18. **(A)**

Metal oxide are basic while non metal oxides are acidic in nature generally.

19. (C)

$_{24}Cr^{2+} : [Ar]3d^4$

$_{23}V^{2+} : [Ar]3d^3$

$_{25}Mn^{2+} : [Ar]3d^5 \leftarrow$ Half-filled 'd' orbitals are more stable than other configuration.

$_{26}Fe^{2+} : [Ar]3d^b$.

20. (B)

More is the no. of unpaired electrons, more is the paramagnetism.

21. (D)

Lawrencium $_{103}Lr : [Rn]7s^2 6d^1 5f^{14}$.

22. (C)

In a group, atomic number differs by 2, 8, 8, 18, 32……. Etc.

23 (B)

Isoelectronic species

24. (B)

$_3Li^+ : 1s^2$

$_4Be^+ : 1s^2 2s^1$

$_5B^+ : 1s^2 2s^2$.

$\therefore (I.E)_2$ order

$Be < B < Li$ or $Li > B > Be$

25. (C)

Difference between $(I. E)_6$ and $(I. E)_7$ is very large. So, there is $6e^-$ in valence shell of atom at this element.

$\therefore$ It belongs to 16^{th} group.

26. (A)

II < IV < III < I ← Inert gas configuration.

↓	↘	↘
Half filled configuration is disturbed	subshell is fulfilled	Achievement of inert gas configuration but repulsion is also there as electron is entering in 2nd shell.

27. (A)

Hydrated radius $\alpha \frac{\text{Charge}}{\text{size}}$

$\therefore K^+(aq) < Na^+(aq) < Li^+(aq)$

28. (C)

Lattice energy $\alpha \frac{q^+ q^-}{r}$

r is least for NaF

29. **(B)**
For alkaline, earth metal
2, 4, 12, 20, 38, 56, 78, 120.

30. **(C)**
Less is electronegativity difference between atoms forming a bond, more is the covalent character. So
If $|X_m - X_C| > |X_O - X_H|$, the m – O bond break is polar solvent.

31. **(C)**

$$\text{Moles of } X = \frac{110\times10^{-3}}{7}$$

$$\text{Energy required} = \frac{110\times10^{-3}}{7}\times 720\,\text{kJ}$$
$$= 11.3\,\text{kJ}.$$

32. **(A)**

$$Cl \underset{(I.E)_{Cl^-}}{\overset{(E.A)Cl}{\rightleftharpoons}} Cl^-$$
$$\therefore |(E.A)_{Cl}| = |(I.E)_{Cl^-}|$$

33. **(B)**
Cl^- is more stable than F^-
$\therefore (I.E)_{Cl^-} > (I.E)_{F^-}$
$(I.E)_{Cl} > (I.E)_{Cl^-}$ - $(I.E)_{\text{neutral atom}} > (I.E)_{\text{anion}}$.
$(I.E)_F > (I.E)_{Cl}$. $\quad I.E\ \alpha \frac{1}{\text{size}}$

34. **(B)**

35. **(C)**
$(I.E)_{np} < (I.E)_{ns}$

36. **(B)**

37. **(A)**

$$\text{Electronegativity } \alpha \frac{1}{\text{size}}$$

38. **(B)**
$|X_A - X_B| \geq 2.1$ A – B is ionic bond
< 2.1 A – B is covalent bond theoretically.
Practically
$|X_A - X_B| < 1.7$ covalent bond will be formed
> 1.7 Ionic bond is formed.

39. **(B)**

According to Mulliken's scale

$$X = \frac{I.E + E.A}{2}$$

$$2X - Y = I.E$$

40. **(B)**

Hydration energy $\alpha \frac{\text{charge}}{\text{size}}$

41. **(D)**

42. **(D)**

$O^{2-} > F^-$ isoelectronic species

$O > F$ along period size decreases.

43. **(D)**

Be^{2+} has maximum charge / size ratio

44. **(B)**

45. **(C)**

Nitrogen has half – filled 2p – orbitals.

46. **(A)**

In a period size decreases, So I. E increases. Magnesium has completely 3s subshell

47. **(B)**

48. **(C)**

$O^- \xrightarrow{+e^-} O^{2-}$

$S^- \xrightarrow{+e^-} S^{2-}$

Incoming electron is repelled by anionic electrons.

49. **(B)**

$(\Delta Heg)_2$ is always endothermic

WINDOW TO JEE MAIN

1. **(B)**

$_{106}Unn : _{86}[Rn]7s^2 5f^{14} 6d^4$

2. **(C)**

$_{29}Cu : 1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

3. **(A)**

In a period, from left to right, atomic radius decreases while E. A. increases.

4. **(A)**

Phosphorous exist as solid at room temperature.

5. **(D)**

$_{20}Ca^{2+} : 2, 8, 8$

6. **(A)**

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

Isoelectronic with Ne has 3 shell i.e they have two filled shell

7. **(B)**

E. A α electronegativity of element

8. **(D)**

For alkali earth metal $(I.E)_3 >> (I.E)_2$.

9. **(B)**

$(I.E)_2$ of Mg $<$ $(I.E)_2$ of Na as Na^{+} has acquired noble gas configuration.

10. **(A)**

All species are isoelectronic with argon i.e has $18e^{-}$ in them

11. **(D)**

$(I.E)_s < (I.E)_p$ as p has half filled 3p subshell

12. **(D)**

In alkali metal, electronegativity or I. E. decreases down the group.
So, it oxidises easily. Hence reactivity increases down the group.
In halogens, $\chi \downarrow$ down the group,
Hence E. A $\downarrow$ so reactivity decreases.

13. **(C)**

Fact

14. **(B)**

Theory

15. **(D)**

Anion > neutral > cation

16. **(C)**

17. **(C)**

For isoelectronic species as number of protons increase attraction between outer most orbit electron and nucleus increases that is size decreases.

18. **(B)**

Down the group ionization energy decreases.

19. **(B)**

For isoelectronic species as number of protons increase attraction between outer most orbit electron and nucleus increases that is size decreases.

20. **(C)**

Down the group ionization energy decreases.