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Periodic Classification and Periodic Properties

Topic 1 History and Periodic Classification

Objective Question I (Only one correct option)

1. The IUPAC symbol for the element with atomic number 119 would be **(2019 Main, 8 April II)**

(a) unh (b) uue
(c) uun (d) une

2. The element with $Z = 120$ (not yet discovered) will be an/a **(2019 Main, 12 Jan I)**

(a) transition metal (b) inner-transition metal
(c) alkaline earth metal (d) alkali metal

3. The statement that is not correct for the periodic classification of elements, is **(1992, 1M)**

(a) the properties of elements are the periodic functions of their atomic numbers
(b) non-metallic elements are lesser in number than metallic elements
(c) the first ionisation energies of elements along a period do not vary in a regular manner with increase in atomic number
(d) for transition elements the *d*-subshells are filled with electrons monotonically with increase in atomic number

Objective Question II
(One or more than one correct option)

4. The statements that is/are true for the long form of the periodic table is/are **(1988, 1M)**

(a) it reflects the sequence of filling the electrons in the order of sub-energy level *s*, *p*, *d* and *f*
(b) it helps to predict the stable valency states of the elements
(c) it reflects tends in physical and chemical properties of the elements
(d) it helps to predict the relative ionicity of the bond between any two elements

Topic 2 Periodic Properties

Objective Questions I (Only one correct option)

1. The group number, number of valence electrons and valency of an element with atomic number 15, respectively, are **(2019 Main, 12 April I)**

(a) 16, 5 and 2 (b) 15, 5 and 3
(c) 16, 6 and 3 (d) 15, 6 and 2

2. The element having greatest difference between its first and second ionisation energy, is **(2019 Main, 9 April I)**

(a) Ca (b) Sc
(c) Ba (d) K

3. The correct option with respect to the Pauling electronegativity values of the elements is **(2019 Main, 11 Jan II)**

(a) P > S (b) Si < Al
(c) Te > Se (d) Ga < Ge

4. The correct order of the atomic radii of C, Cs, Al and S is **(2019 Main, 11 Jan I)**

(a) C < S < Al < Cs (b) C < S < Cs < Al
(c) S < C < Cs < Al (d) S < C < Al < Cs

5. In general, the properties that decrease and increase down a group in the periodic table, respectively are **(2019 Main, 9 Jan I)**

(a) electronegativity and atomic radius
(b) electronegativity and electron gain enthalpy
(c) electron gain enthalpy and electronegativity
(d) atomic radius and electronegativity

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

(a) 1.36, 1.40 and 1.71 (b) 1.36, 1.71 and 1.40
(c) 1.71, 1.40 and 1.36 (d) 1.71, 1.36 and 1.40

7. Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy? **(2015 Main)**
(a) $CaSO_4$ (b) $BeSO_4$
(c) $BaSO_4$ (d) $SrSO_4$

8. Which among the following is the most reactive? **(2015 Main)**
(a) Cl_2 (b) Br_2
(c) I_2 (d) ICl

9. Which one has the highest boiling point?
(a) He (b) Ne (c) Kr (d) Xe

10. The first ionisation potential of Na is 5.1 eV. The value of electron gain enthalpy of Na^+ will be **(2013 Main)**
(a) 2.55 eV (b) 5.1 eV
(c) 10.2 eV (d) 2.55 eV

11. Which of the following represents the correct order of increasing first ionisation enthalpy for Ca, Ba, S, Se and Ar? **(2013 Main)**
(a) Ca < S < Ba < Se < Ar (b) S < Se < Ca < Ba < Ar
(c) Ba < Ca < Se < S < Ar (d) Ca < Ba < S < Se < Ar

12. Identify the least stable ion amongst the following. **(2002, 3M)**
(a) Li^+ (b) Be
(c) B (d) C

13. The set representing the correct order of first ionisation potential is **(2001, 1M)**
(a) K Na Li (b) Be Mg Ca
(c) B C N (d) Ge Si C

14. The correct order of radii is **(2000, 1M)**
(a) N < Be < B (b) $F < O^2 < N^3$
(c) Na < Li < K (d) Fe^{3+} Fe^{2+} Fe^{4+}

15. The incorrect statement among the following. **(1997(C), 1M)**
(a) The first ionisation potential of Al is less than the first ionisation potential of Mg
(b) The second ionisation potential of Mg is greater than the second ionisation potential of Na
(c) The first ionisation potential of Na is less than the first ionisation potential of Mg
(d) The third ionisation potential of Mg is greater than third ionisation potential of Na

16. Which of the following has the maximum number of unpaired electrons ? **(1996, 1M)**
(a) Mg^2 (b) Ti^3
(c) V^3 (d) Fe^2

17. Amongst the following elements (whose electronic configurations are given below), the one having the highest ionisation energy is **(1990, 1M)**
(a) [Ne] $3s^2\ 3p^1$ (b) [Ne] $3s^2\ 3p^3$
(c) [Ne] $3s^2\ 3p^2$ (d) [Ar] $3d^{10}\ 4s^2\ 4p^3$

18. Which one of the following is the smallest in size? **(1989, 1M)**
(a) N^3 (b) O^2
(c) F (d) Na^+

19. The first ionisation potential of Na, Mg, Al and Si are in the order **(1988, 1M)**
(a) Na Mg > Al Si (b) Na Mg Al Si
(c) Na < Mg < Al > Si (d) Na Mg Al < Si

20. The electronegativity of the following elements increases in the order **(1987, 1M)**
(a) C, N, Si, P (b) N, Si, C, P
(c) Si, P, C, N (d) P, Si, N, C

21. Atomic radii of fluorine and neon in Angstrom units are respectively given by **(1987, 1M)**
(a) 0.72, 1.60 (b) 1.60, 1.60
(c) 0.72, 0.72 (d) None of these

22. The first ionisation potential in electron volts of nitrogen and oxygen atoms are respectively given by **(1987, 1M)**
(a) 14.6, 13.6 (b) 13.6, 14.6
(c) 13.6, 13.6 (d) 14.6, 14.6

23. The hydration energy of Mg^2 is larger than that of **(1984, 1M)**
(a) Al^3 (b) Na (c) Be^2 (d) Mg^3

24. The element with the highest first ionisation potential is **(1982, 1M)**
(a) boron (b) carbon
(c) nitrogen (d) oxygen

25. The correct order of second ionisation potential of carbon, nitrogen, oxygen and fluorine is **(1981, 1M)**
(a) C > N > O > F (b) O > N > F > C
(c) O > F > N > C (d) F > O > N > C

Objective Questions II
(One or more than one correct option)

26. The option(s) with only amphoteric oxides is(are) **(2017 Adv.)**
(a) NO, B_2O_3, PbO, SnO_2 (b) Cr_2O_3, CrO, SnO, PbO
(c) Cr_2O_3, BeO, SnO, SnO_2 (d) ZnO, Al_2O_3, PbO, PbO_2

27. Ionic radii of **(1999, 3M)**
(a) $Ti^{4+} < Mn^{7+}$ (b) $^{35}Cl^- < ^{37}Cl^-$
(c) $K^+ > Cl^-$ (d) $P^{3+} > P^{5+}$

28. The first ionisation potential of nitrogen and oxygen atoms are related as follows. **(1989, 1M)**
(a) The ionisation potential of oxygen is less than the ionisation potential of nitrogen
(b) The ionisation potential of nitrogen is greater than the ionisation potential of oxygen
(c) The two ionisation potential values are comparable
(d) The difference between the two ionisation potential is too large

29. Sodium sulphate is soluble in water whereas barium sulphate is sparingly soluble because **(1989, 1M)**
(a) the hydration energy of sodium sulphate is more than its lattice energy
(b) the lattice energy of barium sulphate is more than its hydration energy
(c) the lattice energy has no role to play in solubility
(d) the hydration energy of sodium sulphate is less than its lattice energy

Assertion and Reason

Read the following questions and answer as per the direction given below :

(a) Statement I is true; Statement II is true; Statement II is the correct explanation of Statement I.
(b) Statement I is true; Statement II is true; Statement II is not the correct explanation of Statement I.
(c) Statement I is true; Statement II is false.
(d) Statement I is false; Statement II is true.

30. **Statement I** Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.
Statement II The reaction between nitrogen and oxygen requires high temperature. **(2015 Main)**

31. **Statement I** Pb^4 compounds are stronger oxidising agents than Sn compounds.
Statement II The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'. **(2008, 3M)**

32. **Statement I** Band gap in germanium is small.
Statement II The energy spread of each germanium atomic energy level is infinitesimally small. **(2007, 3M)**

33. **Statement I** The first ionisation energy of Be is greater than that of B.
Statement II 2*p*-orbital is lower in energy than 2*s*. **(2000, (S), 1M)**

34. **Statement I** F-atom has a less negative electron affinity than Cl-atom.
Statement II Additional electrons are repelled more effectively by 3*p*-electrons in Cl-atom than by 2*p*-electrons in F-atom. **(1998, 2M)**

Fill in the Blanks

35. Compounds that formally contain Pb^{4+} are easily reduced to Pb^{2+}. The stability of the lower oxidation state is due to …… . **(1997, 1M)**

36. Ca^2 has a smaller ionic radius than K because it has ..... **(1993, 1M**

37. On Mulliken scale, the average of ionisation potential and electron affinity is known as ..... **(1985, 1M)**

38. The energy released when an electron is added to a neutral gaseous atom is called …… . **(1982, 1M)**

True/False

39. The basic nature of the hydroxides of group 13 (III B) decreases progressively down the group. **(1993, 1M)**

40. The decreasing order of electron affinity of F, Cl, Br is F > Cl > Br. **(1993, 1M)**

41. In group IA of alkali metals, the ionisation potential decreases down the group. Therefore, lithium is a poor reducing agent. **(1987, 1M)**

42. The softness of group IA metals increases down the group with increasing atomic number. **(1986, 1M)**

Subjective Questions

43. Arrange the following ions in order of their increasing radii Li^+, Mg^{2+}, K^+, Al^{3+}. **(1997, 1M)**

44. Compare qualitatively the first and second ionisation potentials of copper and zinc. Explain the observation. **(1996, 2M**

45. Arrange the following as stated :
"Increasing order of ionic size'' N^{3-}, Na^+, F , O^2 , Mg^{2+} **(1991, 1M)**

46. Explain the following :
"The first ionisation energy of carbon atom is greater than that of boron atom whereas, the reverse is true for the second ionisation energy.'' **(1989, 2M)**

47. Arrange the following in the order of their increasing size: Cl , S^2 , Ca^{2+}, Ar **(1986, 1M)**

48. Arrange the following in order of their
(i) decreasing ionic size Mg^{2+}, O^2 , Na^+, F
(ii) increasing first ionisation energy Mg, Al, Si, Na
(iii) increasing bond length F_2, N_2, Cl_2, O_2 **(1985, 3M)**

Answers

Topic 1

1. (b) **2.** (c) **3.** (d) **4.** (b,c,d)

Topic 2

1. (b) **2.** (d) **3.** (d) **4.** (a)
5. (a) **6.** (c) **7.** (b) **8.** (d)
9. (d) **10.** (b) **11.** (c) **12.** (b)
13. (b) **14.** (b) **15.** (b) **16.** (d)
17. (b) **18.** (d) **19.** (a) **20.** (c)
21. (a) **22.** (a) **23.** (b) **24.** (c)
25. (c) **26.** (a,b) **27.** (d) **28.** (a,b,c)
29. (a,b) **30.** (a) **31.** (c) **32.** (c)
33. (c) **34.** (c)
35. (inert pair effect)
36. (higher effective nuclear charge)
37. (electronegativity) **38.** (electron affinity)
39. F **40.** F **41.** F **42.** T

Hints & Solutions

Topic 1 History and Periodic Classification

1. Atomic number (119) = 1 1 9
un un en

So, symbol of the element uue

Name of the element ununennium

It is expected to be *s*-block element an alkali metal and the first element in eighth period. It is the lightest element that has not yet been synthesised.

2. The element with Z 120 will be an alkaline earth metal. Recently, oganesson (Og) with atomic number 118 is named by IUPAC is a noble gas and placed just two place before 120. So, the general electronic configuration is represented as [noble gas]ns^2 and element with Z 120 exist as an alkaline earth metal.

3. (a) **Correct statement** According to Moseley's law, the properties of elements are the periodic function of their atomic numbers.

(b) **Correct statement** The whole *s*-block, *d*-block, *f*-block and heavier *p*-block elements are metal.

(c) **Correct statement** Trend is not regular, Be has higher first ionisation energy than B, nitrogen has higher first ionisation energy than oxygen.

(d) **Inccorrect statement** *d*-subshells are not filled monotonically, regularity break at chromium and copper.

4. (a) **Incorrect** Electrons are not filled in sub-energy levels *s*, *p*, *d* and *f* in the same sequence.

(b) **Correct** Number of valence shell electrons usually determine the stable valency state of an element.

(c) **Correct** Physical and chemical properties of elements are periodic function of atomic number which is the basis of modern, long form of periodic table.

(d) **Correct** Relative ionicity of the bond between any two elements is function of electronegativity difference of the bonded atoms which in turn has periodic trend in long form of periodic table.

Topic 2 Periodic Properties

1. The group number, number of valence electrons and valency of an element with atomic number 15 are 15, 5 and 3 respectively. Modern periodic table is based on the atomic number. Number of valence electrons present in an atom decides the group number. Electronic configuration of element having atomic number 15 $1s^2\ 2s^2\ 2p^6\ \underbrace{3s^2\ 3p^3}_{\text{Valence electrons}}$

As five electrons are present in valence shell, its group number is 15. Valency of element having atomic number 15 is +3 (8 5 3).

2. The electronic configuration of given elements are as follows :

K(19) = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 4s^1$

Mg(12) = $1s^2\ 2s^2\ 2p^6\ 3s^2$

Sr(38) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2$

Sc(21) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 4s^2\ 3d^1$

First ionisation enthalpy (I.E.) of K is lowest among the given options. Here, the energy required to remove an electron from $4s^1$ is least as only one electron is present in the outermost shell. I.E. (I) is comparatively high for Mg and Sr and two electrons (fully-filled) are placed in *s*-orbital. Second ionisation enthalpy of K is highest among the given options.

Now, removal of an electron occur from p^6 (fully-filled). So, high energy is required to remove the electron. From the above discussion, it can be concluded that ($I.E_2$ $I.E_1$) value is maximum for K (potassium).

3. The electronegativity values of given elements on the Pauling scale can be shown as follows:

Period No.	Group 13	Group 14	Group 15	Group 16
3	Al (1.5)	Si (1.8)	P (2.1)	S (2.5)
4	Ga (1.6)	Ge (1.8)		Se (2.4)
5				Te (2.01)

On moving from left to right across a period, i.e. from Ga to Se, the effective nuclear charge increases and size decreases.

As a result, the value of electronegativity increases due to increase in the attraction between the outer electrons and the nucleus. Whereas on moving down the group, (i.e. from Se to Te), the atomic size increases.

As a result, the force of attraction between the outer electron and the nucleus decreases. Hence, the electronegativity decreases.

4.

Element	Period No.	Group No.	
C	2nd	14	
Al	3rd	13	Along the period atomic radius decreases, so, radii : Al > S.
S	3rd	16	
Cs	6th	1	

With the addition of a new shell, period number as well as atomic radius increases. It is because of the successive addition of one extra shell of electrons. So, the order of the atomic radii of the given elements will be: C < S < Al < Cs

5. The summary of variation of periodic properties is given in table below:

S.No.	Periodic property	Variation	
		Along a period	Along a group
1.	Atomic radius	Decreases	Increases
2.	Electron gain enthalpy	Increases	Decreases
3.	Electronegativity	Increases	Decreases

Thus, electronegativity decreases and atomic radius increases down a group in the periodic table.

6. Number of electrons in N^3 , 7 3 10

Number of electrons in O^2 8 2 10

Number of electrons in F 9 1 10

Since, all the three species have each 10 electrons, hence they are isoelectronic species.

It is considered that, in case of isoelectronic species as the negative charge increases, ionic radii increases and therefore the value of ionic radii are

N^{3-} 1.71 (highest among the three)

O^{2-} 1.40 F 1.36 (lowest among the three)

Time Saving Technique There is no need to mug up the radius values for different ions. This particular question can be solved through following time saving.

Trick The charges on the ions indicate the size as N^{3-} O^{2-} F . Thus, you have to look for the option in which the above trend is followed. Option(c) is the only one in which this trend is followed. Hence, it is the correct answer.

7. As we move down the group, size of metal increases. Be has lower size while SO_4^{2-} has bigger size, that's why $BeSO_4$ breaks easily and lattice energy becomes smaller but due to lower size of Be, water molecules are gathered around and hence hydration energy increases.

On the other hand, rest of the metals, i.e Ca, Ba, Sr have bigger size and that's why lattice energy is greater than hydration energy.

Time Saving Technique In the question of finding hydration energy only check the size of atom. Smaller sized atom has more hydration energy. Thus, in this question Be is placed upper most in the group has lesser size and not comparable with the size of sulphates. Hence, $BeSO_4$ is the right response.

8. Cl_2, Br_2 and I_2 are homonuclear diatomic molecule in which electronegativity of the combining atoms is same, so they are more stable and less reactive, whereas, I and Cl have different electronegativities and bond between them are polarised and reactive. Therefore, interhalogen compounds are more reactive.

Time Saving Technique In this type of question of halogen, only go through the polarity of the molecules. As we know, diatomic molecule does not have polarity but molecules with dissimilar sizes have polarity resulting in more reactivity.

9. As we move down the group of noble gases, molecular mass increases by which dipole produced for a moment and hence London forces increases from He to Xe.

Therefore, more amount of energy is required to break these forces, thus boiling point also increases from He and Xe.

10. Na Na e First IE

Na^+ e Na

Electron gain enthalpy of Na^+ is reverse of (IE)

Because reaction is reverse so $H(eq)$ 5.1 eV

11. Ionisation energy increases along a period from left to right and decreases down a group. The position of given elements in the periodic table is as

Group No. 2	16	18
Ca	S	Ar
Ba	Se	

Thus, the order of increasing H_{IE_1} is Ba Ca Se S Ar

12. Be is the least stable ion, Be ($1s^2 2s^2$) has stable electronic configuration, addition of electron decreases stability.

13. In a group, ionisation energy decreases down the group

Be > Mg > Ca

14. Among isoelectronic species, greater the negative charge, greater the ionic size, hence F $< O^{2-} < N^{3-}$.

15. (a) **Correct statement** In a period, element of 2nd group has higher first ionisation potential than element of group 13.

(b) **Incorrect statement** Mg^+ require less energy for further ionisation than Na^+ because of noble gas configuration of Na^+.

(c) **Correct statement** Ionisation energy increases from left to right in a period.

16. Mg^{2+} $1s^2\ 2s^2\ 2p^6$ no unpaired electron

Ti^{3+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$ one unpaired electron

V^{3+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$ two unpaired electrons

Fe^{2+} $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$ four unpaired electrons

17. [Ne] $3s^2\ 3p^3$ has highest ionisation energy, periodic trend.

18. Among isoelectronic species, the relation in size is

cation < neutral < anion

Hence, Na^+ has smallest size.

19. Ionisation energy increases from left to right in a period. However, exception occur between group 2 and group 13 elements on account of stability of electronic configuration of valence shell.

IE

Group 2 = $\boxed{\uparrow\downarrow}$ (ns^2) > Group 13 = $\boxed{\uparrow\downarrow}$ (ns^2) $\boxed{\uparrow}\boxed{}\boxed{}$ (np^1)

The desired order is Na < Mg > Al < Si

20. Electronegativity increases from left to right in a period and decreases from top to bottom in a group. Variation is more rapid in group than in a period, hence the desired order is

Electronegativity : Si < P < C < N

21. Atomic radius of noble gases are greater than halogens of same period, hence (a) is the correct answer.

22. First ionisation energy of oxygen is less than that of nitrogen on the ground of stability of valence shell configuration, hence (a) is the correct answer.

23. Hydration energy depends on charge of ion and ionic radius. Higher the charge, greater the hydration energy. On the other hand, smaller the size, greater the hydration energy. Charge is considered first for comparison. Hence, Mg^{2+} has higher hydration energy than Na^+.

24. Nitrogen has highest ionisation potential due to exceptional stability of its valence shell configuration mentioned in question 21.

25. For second ionisation potential, electron will have to be removed from valence shell of the following ions:

C^+ ($5e$) = $1s^2$ $2s^2$ $\boxed{\uparrow}\boxed{}\boxed{}$ ($2p$)

N^+ ($6e$) = $1s^2$ $2s^2$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{}$ ($2p$)

O^+ ($7e$) = $1s^2$ $2s^2$ $\boxed{\uparrow}\boxed{\uparrow}\boxed{\uparrow}$ ($2p$)

F^+ ($8e$) = $1s^2$ $2s^2$ $\boxed{\uparrow\downarrow}\boxed{\uparrow}\boxed{\uparrow}$ ($2p$)

In general, ionisation energy increases from left to right in a period. However, exception occur between adjacent atoms in a period, greater amount energy is required for removal of electron from completely half-filled or completely filled orbital than the same for adjacent atom with either less than completely half-filled or less than completely filled orbital. Therefore,

ionisation potential of O^+ is greater than that of F^+. Also ionisation potential of N^+ is greater than C^+ but less than both O^+ and F^+ (periodic trend). Hence, overall order is 2nd IP : O > F > N > C.

26. (c) is incorrect because NO is neutral oxide.
(d) is incorrect because CrO is basic oxide.

27. (a) $Ti^{4+} > Mn^{7+}$ is the correct order of size due to lower positive charge on Ti^{4+}.
(b) $^{37}Cl = {}^{37}Cl$: Isotopes with same charge have same size because isotopes differ in compositions of nuclei which do not affect the atomic/ionic radius.
(c) $K^+ < Cl$ is the correct order. Among isoelectronic species, anion has greater size than cation.
(d) $P^{3+} > P^{5+}$ is the correct order. For the same elements, lower the positive charge, larger the ions.

28. (a) and (b) are infact the same statements and both are correct. N has slightly greater ionisation energy than oxygen which is against periodic trend. This exception is due to completely half-filled ($2p^3$) orbital in nitrogen that makes ionisation slightly difficult than oxygen.
(c) Also correct : Although N has greater first ionisation potential than oxygen, two values of ionisation potentials are comparable since they are adjacent in a period, i.e. electrons are removed from same orbit during ionisation.
(d) Incorrect – opposite to (c). of the bonded atoms which in turn has periodic trend in long form of periodic table.

29. (a) **Correct** For greater solubility, hydration energy must be greater than lattice energy.
(b) **Correct** Greater lattice energy discourage dissolution of a salt.
(c) **Incorrect** When a salt dissolve, energy is required to break the lattice, which comes from hydration process.
(d) **Incorrect** Explained in (A).

30. Statement I and II are true and Statement II is the correct explanation of statement I.

31. Statement I is true. Stronger oxidising agent is one which itself can easily be reduced. Pb^{4+} is unstable, due to inert pair effect, can easily be reduced to stable Pb^{2+}, hence a stronger oxidising agent than Sn^{4+}.
Statement II is false. Due to inert pair effect, the higher oxidation states of group 14 elements becomes less stable for heavier member.

32. Both statements I and II are true and Statement II is the correct explanation of statement I.

33. Statement I is true Be has higher first ionisation energy than B which is against periodic trend.
Statement II is false 2*s*-orbital is lower in energy than 2*p*, Aufbau's principle.

34. Statement I is true; Statement II is false.
F atom has slightly lower affinity for the electron than chlorine. It is due to the reason that additional electrons are repelled more effectively by 2*p*-electrons in F than by 3*p*-electrons in Cl-atom.

35. Inert pair effect-favours lower oxidation state.

36. Higher effective nuclear charge due to greater *p/e* ratio.

37. Electronegativity $\frac{IP + EA}{2}$ (Mulliken formula)

38. Electron affinity–definition.

39. Basic nature of hydroxides increases down a group.

40. Cl has maximum electron affinity, hence the correct order is Cl > F > Br

41. Ionisation potential decreases down the group but this is not the only criteria of reducing power.

42. In a group, size increases from top to bottom.

43. $Li^+ < Al^{3+} < Mg^{2+} < K^+$. Size decreases from left to right in a period and it increases from top to bottom in a group. Variation is more pronounced in group than in period.

44. Zn $3d^{10}4s^2$, Cu $3d^{10}4s^1$
The first ionisation energy is greater for Zn but reverse is true for 2nd ionisation energy.

45. Ionic size $Mg^{2+} < Na^+ < F$ O^2 N^3
Already explained in question 1 (i).

46. The first ionisation energy of carbon is greater than the same of boron as predicted from periodic trend. However, for 2nd

$B^+ = 1s^2$ $\underset{2s^2}{\boxed{\uparrow\downarrow}}$; more stable than $C^+ = 1s^2$ $2s^2$ $\underset{2p^1}{\boxed{\uparrow}\boxed{\ }\boxed{\ }}$

ionisation trend is reversed due to stability of completely filled 2*s*-orbital of B^+ :

47. Size $Ca^{2+} < Ar < Cl^- < S^2$. Explained in (i), question 6.

48. (i) Mg^{2+}, O^2 , Na^+ and F are all isoelectronic, has 10 electrons each. Among isoelectronic species, the order of size is cation < neutral < anion.
Also, between cations, higher the charge, smaller the size and between anions, greater the negative charge, larger the size. Therefore, the decreasing order of ionic radii : O^2 F Na Mg^2
(ii) First ionisation energy increases from left to right in a period. However, exception occur between group 2 and 13 and group 15 and 16 where trend is reversed on the grounds of stability of completely filled and completely half-filled orbitals. Therefore,
Ionisation energy (1st) : Na < Al < Mg < Si
(iii) If the atoms are from same period, bond length is inversely proportional to bond order. In a group, bond length is related directly to atomic radius. Therefore,
bond length $N_2 < O_2 < F_2 < Cl_2$