DPP - Daily Practice Problems

Date : | **Start Time :** | **End Time :**

CHEMISTRY

CC03

SYLLABUS : Classification of Elements and Periodicity in Properties

Max. Marks : 74 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 20 Questions divided into 5 sections.
  Section I has **6** MCQs with ONLY 1 Correct Option, **3** marks for each correct answer and **–1** for each incorrect answer.
  Section II has **4** MCQs with ONE or MORE THAN ONE Correct options.
  For each question, marks will be awarded in one of the following categories:
  Full marks: **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  Partial marks: **+1** For darkening a bubble corresponding to each correct option provided NO INCORRECT option is darkened.
  Zero marks: If none of the bubbles is darkened.
  Negative marks: **–2** In all other cases.
  Section III has **4** Single Digit Integer Answer Type Questions, **3** marks for each Correct Answer and 0 marks in all other cases.
  Section IV has Comprehension/Matching Cum-Comprehension Type Questions having **4** MCQs with ONLY ONE correct option, **3** marks for each Correct Answer and 0 marks in all other cases.
  Section V has **2** Matching Type Questions, **2** mark for the correct matching of each row and 0 marks in all other cases.
- You have to evaluate your Response Grids yourself with the help of Solutions.

Section I - Straight Objective Type

This section contains 6 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

1. Which is not the correct order for the stated property.

(a) Ba > Sr > Mg ; atomic radius

(b) F > O > N ; first ionization enthalpy

(c) Cl > F > I ; electron affinity

(d) O > Se > Te ; electronegativity

2. The correct decreasing order of first ionisation enthalpies of five elements of the second period is

(a) Be > B > C > N > F (b) N > F > C > B > Be

(c) F > N > C > Be > B (d) N > F > B > C > Be

3. Electron affinity depends on

(a) atomic size

(b) nuclear charge

(c) atomic number

(d) atomic size and nuclear charge both

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ

Space for Rough Work

4. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements gives the correct picture?
   (a) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens
   (b) In alkali metals the reactivity increases but in the halogens it decreases with increase in atomic number down the group
   (c) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group
   (d) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group

5. The formation of $O^{2-}(g)$ starting from O(g) is endothermic by 603 kJ mol^{-1}. If electron affinity of O(g) is –141 kJ mol^{-1}, the second electron affinity of oxygen would be
   (a) 603 kJ mol^{-1} (b) –603 kJ mol^{-1}
   (c) –744 kJ mol^{-1} (d) +744 kJ mol^{-1}

6. The van der Waals radii of O, N, Cl, F and Ne increase in the order
   (a) F, O, N, Ne, Cl (b) Ne, F, O, N, Cl
   (c) F, Cl, O, N, Ne (d) N, O, F, Ne, Cl

Section II - Multiple Correct Answer Type

This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONE OR MORE** is/are correct.

7. If Aufbau principle and Hund's rule were not followed
   (a) Ca would have been *d*-block element with zero dipole moment
   (b) Zn would have been s-block element
   (c) Ti would have been diamagnetic
   (d) Fe^{3+} ion would have 5 unpaired electrons.

8. Choose the correct statement(s)
   (a) The maximum positive oxidation state shown by any element is equal to the total number of electrons (*s* and *p*) in valence shell
   (b) The maximum oxidation state shown by elements in a group is also known as **group oxidation number**
   (c) Group oxidation number is the most common or most stable oxidation state for a particular element
   (d) All the elements in a group form some compounds in which they exhibit their group oxidation number.

9. Which of the following trends of electron affinity are correct?
   (a) O > S > Se (b) Cl > F > Br
   (c) Cl > Br > I (d) O > C > N

10. Which of the following trends of ionic radii are correct.
   (a) $F^- > Na^+ > Mg^{2+}$ (b) $Al^{3+} > O^{2-} > N^{3-}$
   (c) $P^{3-} > S^{2-} > Cl^-$ (d) $H^- > H^+ > He$

Section III - Integer Type

This section contains 4 questions. The answer to each of the questions is a single digit integer ranging from 0 to 9.

11. How many periods are there in the long form of the periodic table ?

12. What is the total number of elements in the group IB ?

13. What is the number of elements in the third period of the periodic table ?

14. How many elements of the following are electropositive element(s) ?
   Sodium, calcium, oxygen and chlorine

RESPONSE GRID					
	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓪①②③④⑤⑥⑦⑧⑨		
	12. ⓪①②③④⑤⑥⑦⑧⑨		13. ⓪①②③④⑤⑥⑦⑧⑨		
	14. ⓪①②③④⑤⑥⑦⑧⑨				

Space for Rough Work

Section IV - Comprehension Type

Directions (Qs. 15-18) : Based upon the given paragraphs, 4 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

PARAGRAPH-1

The electronegativity of an element is a measure of power of the element to attract electron to itself in **chemical compounds.** It is difficult to assign accurate electronegativities to elements, partly because the precise values may vary in different compounds. Our quantitative estimation of electronegativity is the average of ionization energy and the electron affinity for an element in eV. It is known as **Mulliken's scale**.

The trends in electronegativity values are similar to those in ionization energies.

Various measures of electronegativity have been proposed and all give roughly parallel scales. **Pauling scale** is based upon excess bond energies; **Alfred** and **Rochow's** (R/A) is based upon effective nuclear charges. The % age of ionic character in a bond can be estimated by finding the differences in electronegativity values of atoms forming the bond. The % age ionic character and difference in electronegativity values are given below :

Electronegativity difference	% age ionic character
1.0	20%
1.5	40%
2.0	60%
2.5	80%

Pauling and **Mulliken** values of electronegativity are related as

$$X_{Pauling} = 0.336\left[X_{Mulliken} - 0.615\right]$$

15. In the series carbon, nitrogen, oxygen and fluorine, the electronegativity
- (a) decreases from carbon to fluorine
- (b) increases from carbon to fluorine
- (c) remains constant
- (d) decreases from carbon to oxygen and then increases

16. The electronegativity of the following elements increases in the order
- (a) C, N, Si, P
- (b) N, Si, C, P
- (c) Si, P, C, N
- (d) P, Si, N, C

PARAGRAPH-2

Lattice energy (U) is defined as change in internal energy when one mole of a solid is converted into one mole of infinitely separated ions in the gas phase at 0 K.

The Born-Lande expression for lattice energy may be represented as

$$U_0 = \frac{N_0 A.Z^+.Z^-.e^2}{4\pi\varepsilon_0 r_0}\left(1-\frac{1}{n}\right)$$

where N_0 = Avogadro constant

A = Madelung's constant, which depends upon the geometry of the crystal.

Z^+ and Z^- are charges on positive and negative ions respectively.

e = charge on electron

r_0 = interionic distance

n = A constant called Born exponent (often assumed to be equal to 9)

Σ_0 = permittivity of vacuum

In the above equation first term deals with attraction between the ions and the second term $\left(\frac{1}{n}\right)$ is associated with repulsion.

From the above it becomes clear that lattice energy depends upon
- (i) The ionic charges
- (ii) The distance between the ions
- (iii) Crystal structure

17. Choose the correct statement
- (a) The lattice energy depends upon the reciprocal of the distance between the ions $\frac{1}{r_0}$
- (b) For a positive ion, the lattice energy increases as the size of the anion increases.
- (c) For a given anion, the lattice energy increases with increase in the size of positive ion
- (d) For large positive ions, the magnitude of lattice energy is mainly determined by the size of anion.

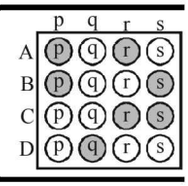
18. The correct arrangement of compounds in increasing order of their lattice energies is
- (a) $TiF_2 < VF_2 < CrF_2 < MnF_2 < FeF_2$
- (b) $TiF_2 < MnF_2 < VF_2 < CrF_2 < FeF_2$
- (c) $VF_2 < TiF_2 < CrF_2 < FeF_2 < MnF_2$
- (d) $FeF_2 < TiF_2 < MnF_2 < VF_2 < CrF_2$

RESPONSE GRID	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ

Space for Rough Work

Section V - Matrix-Match Type

This section contains 2 questions. It contains statements given in two columns, which have to be matched. Statements in column I are labelled as A, B, C and D whereas statements in column II are labelled as p, q, r and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-p, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like the following:



19. Match the elements listed in column I with the period/group listed in column II :

	Column I		**Column II**
(A)	Element having At. No. 47	p.	4^{th} period
(B)	Element with lowest At. No. having configuration $(n\text{-}1)\,d^{10}\,n\,s^2\,np^3$	q.	5^{th} period
(C)	Element with At No. 34	r.	15^{th} group
(D)	Element with lowest At. No. having configuration $(n-1)\,d^{10}\,n\,s^1$	s.	16^{th} group

20. The values of IE_1 and IE_2 (kJ mol^{-1}) of few elements designated by A, B, C, and D are shown below in column I. Match their characteristics listed in column II.

	Column I		**Column II**
(A)	IE_1 2372, IE_2 5251	p.	A reactive metal
(B)	IE_1 520, IE_2 7300	q.	A reactive non-metal
(C)	IE_1 900, IE_2 1760	r.	A noble gas
(D)	IE_1 1680, IE_2 3380	s.	A metal that forms an halide of formula AX_2

RESPONSE GRID	**19. A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ** **20. A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ**

DAILY PRACTICE PROBLEM DPP CHAPTERWISE 3 - CHEMISTRY			
Total Questions	20	Total Marks	74
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	30	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

1. (b) On moving along the period, ionization enthalpy increases.

In second period, the order of ionization enthalpy should be as follows :

F > O > N.

But N has half-filled structure, therefore, it is more stable than O. That is why its ionization enthalpy is higher than O. Thus, the correct order of IE is

F > N > O.

2. (c) As we move along the period, the atomic size decreases due to increase in nuclear charge. Therefore, it is more difficult to remove electron from an atom. Hence the sequence of first ionization enthalpy in decreasing order is

F > N > C > B > Be

But ionization enthalpy of boron is less as compared to beryllium because first electron in boron is to be removed from *p*-orbital while in beryllium, is to be removed from *s*-orbital.

As *s*-orbital is closer to nucleus in comparison to *p*-orbital thus energy required to remove an electron from *s*-orbital is greater.

3. (d) Greater the effective nuclear charge, more is the attraction of nucleus towards the electron and hence higher will be the value of E.A.

Greater the atomic radius of the atom, less will be the attraction of the nucleus to the electron to be added and hence lower will be the value of E.A.

4. (b) The alkali metals are highly reactive because their first ionisation potential is very low and hence they have great tendency to lose electrons to form unipositive ions. On moving down a group from Li to Cs ionisation enthalpy decreases hence the reactivity increases.

The halogens are most reactive elements due to their low bond dissociation energy, high electron affinity and high enthalpy of hydration of halide ion however their reactivity decreases with increase in atomic number. As the size increases, the attraction for an additional electron by the nucleus becomes less. Thus reactivity decreases.

5. (d) $O(g) + 2e^- \rightarrow O^{2-}(g), \Delta H = 603\,kJ\ mol^{-1}$ .....(i);

$O(g) + e^- \rightarrow O^-(g), \Delta H = -141\ kJ\ mol^{-1}$ .....(ii)

(i) - (ii) gives :

$O^- + e^- \rightarrow O^{2-}, \Delta H = 603 - (-141) = 744 kJ\ mol^{-1}$

6. (b) van der Waals radii decrease as we move from left to right in a period. It is due to increasing nuclear charge. The given elements belong to second period (except Cl). The van der Waals radius of Cl will be largest.

7. (a, b, c) For no consideration of Aufbau principle and Hund's rule, the electronic configurations will be as:

Ca(20):$[Ar]3d^2$; Zn(30):$[Ar]3d^{10}4s^2$ (filling of 4*s* subshell after 3*d* subshell); Ti (22): [Ar] $3d^2$ (both electrons paired up)

$Fe^{3+}[23] = [Ar]3d^3 4s^2$

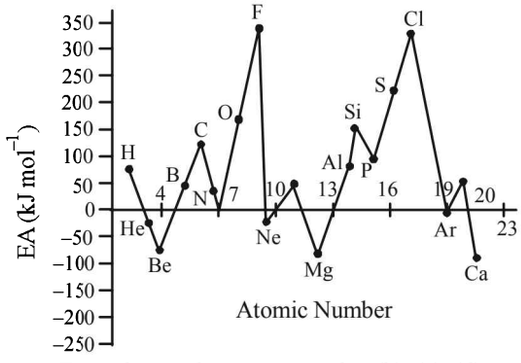
i.e., –3 unpaired electrons

8. (a,b) Group oxidation number (i.e., maximum oxidation state in a group) need not necessarily be the most common or most stable oxidation state for a particular element, so option (c) is **incorrect.**

In fact some elements may have no compounds at all in the group oxidation number state e.g. in case of flourine, so (d) option is incorrect.

9. (b,c,d) Electron affinity increases as we move from left to right in a period and decreases on moving down a group. However there are many exceptions. The periodic trends are less well defined than those for I.E. partly because of lack of reliable data.

The following graph shows the plot of E.A. values against atomic number for some elements.



From the graphs we can see that (b), (c), (d) are correct, (a) is incorrect. E.A. of S > O

10. (a,c) In option (a), (b) and (c) all the species are isoelectronic 10, 10, 18 electrons in each. In isoelectronic species the ionic radii decrease with increase in atomic number so (a) is correct, (b) is incorrect and (c) is correct.

The size of anion is larger than that of neutral atom and that of cation is smaller than the neutral

atom, so $H^- > H^+$. He is a noble gas its ionic radii cannot be measured as the ionic radii are obtained from internuclear distances in ionic compounds. Thus (d) is incorrect.

11. **(7)** Long form of periodic table contains 18 groups and 7 periods.

12. **(3)** Group I B contain Cu, Ag and Au.

13. **(8)** Third period contains total 8 elements

14. **(2)** Two elements sodium and calcium are electropositive metals.

15. **(b)** The electronegativity like ionisation energy increases steadily on moving from left to right in a period.

16. **(c)** Electronegativities increase steadily on moving across a period (N > C) and generally decrease on descending a group (P > Si).

17. **(a)** Both for positive ion and negative ions the lattice energy decreases (and not increases) with increase in the size of the ion, thus statements (b) and (c) are incorrect.

For large positive ion, the magnitude of lattice energy is mainly determined by the size of the positive ion (and not of anion) thus statement (d) is also incorrect.

18. **(b)** The lattice energies of difluorides of first row transition metals increase along the period as would be expected from decrease in ionic radii. However, there is a slight decrease at manganese which is due to d^5 configuration of Mn, which reduces the effective nuclear charge and decreases the lattice energy. Due to this the correct order is (b) and not (a).

The values of the lattice energy for these are

Compound	**Lattice energy (kJ mol^{-1})**
TiF_2	2749
VF_2	2810
CrF_2	2879
MnF_2	2770
FeF_2	2912

i.e., for MnF_2 it is less than VF_2 but more than TiF_2.

19. **A - q; B - p, r; C - p, s; D - p**

(A) At. No. 47 : $[Kr]4d^9\,5s^2$; group : $9+2=11^{th}$; period : 5^{th}

(B) For lowest At. No. having $(n-1)d^{10}ns^2\,np^3$ configuration, $n-1=3 \Rightarrow n=4$
Hence, group : $10+5=15^{th}$; period : 4^{th}

(C) At. No. 34 : [Ar] $3d^{10}\,4s^2\,4p^4$; Group : $10+6=16^{th}$; period $=4^{th}$

(D) For lowest At. No. having $(n-1)\,d^{10}\,n\,s^1$ configuration, $n-1=3 \Rightarrow n=4$
Group $=10+1=11^{th}$; Period $=4^{th}$

20. **A - r; B - p; C - s; D - q**

(A) IE_1 and IE_2 are very high. The element must be inert gas.

(B) IE_1 has low value and IE_2 has very high value. The element must belong to first group (ns^1), hence it is reactive.

(C) IE_1 and IE_2 do not have very high values. The element must belong to 2nd group (ns^2) and must form halide of formula AX_2.

(D) IE_1 and IE_2 values suggest the element to be a non-metal which is not inert.