DPP - Daily Practice Problems

Name : ☐ **Date :** ☐

Start Time : ☐ **End Time :** ☐

CHEMISTRY 07

SYLLABUS : Valence bond theory, Hybridisation, VSEPR theory, Dipole moment, Hydrogen Bond, Van der Waals forces, Molecular Orbital Theory (MOT), Metallic bond

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 The hybridization and geometry of BrF_3 molecule is -

(a) sp^3d and T-shaped

(b) sp^3d^2 and tetragonal

(c) sp^3d and bent

(d) None of these

Q.2 In which of the following, central atom has different hybridisation than others ?

(a) Cl_2O (b) OF_2 (c) H_2O (d) SO_2

Q.3 In following hydrocarbons, which one has 75% p character and 25% s character -

(a) C_2H_4 (b) C_2H_2 (c) CH_4 (d) CH_2

Q.4 Which of the following statement is incorrect?

(a) Non-bonding pairs occupy more space than bonding pairs

(b) The bonding orbitals in a trigonal bipyramidal molecule are described as sp^3d hybrid

(c) $SnCl_2$ has linear shape

(d) PCl_4^+ and $AlCl_4^-$ are isoelectronic

Q.5 Shape of NH_3 is very similar to -

(a) CH_4 (b) CH_3^- (c) BH_3 (d) CH_3^+

RESPONSE GRID 1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ 4. ⓐⓑⓒⓓ 5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 Which of the following has pyramidal shape?

(a) XeO_3 (b) XeF_4
(c) XeF_2 (d) XeF_6

Q.7 The correct order regarding the electronegativity of hybrid orbitals of carbon is :

(a) $sp < sp^2 > sp^3$ (b) $sp < sp^2 < sp^3$
(c) $sp > sp^2 < sp^3$ (d) $sp > sp^2 > sp^3$

Q.8 Which of the following bonds is most polar ?

(a) O – H (b) P – H (c) C – F (d) S – Cl

Q.9 Which of the following does not exist on the basis of molecular orbital theory ?

(a) H_2^+ (b) He_2^+ (c) He_2 (d) Li_2

Q.10 The dipole moment of the ammonia molecule is 1.48D. The length of the dipole is -

(a) 3.08×10^{-11} m (b) 5×10^2 m
(c) 308m (d) None of these

Q.11 Which one of the following does not have intermolecular H-bonding ?

(a) H_2O (b) o-Nitrophenol
(c) HF (d) CH_3

Q.12 Arrange in incresing order of the boiling point-

HF, HCl, HBr, HI.

(a) HCl < HBr < HI < HF (b) HCl > HBr > HI > HF
(c) HCl < HBr > HI < HF (d) None of these

Q.13 The hybridization of carbon atoms in C – C single bond in $H-C\equiv C-CH=CH_2$ is -

(a) sp^3-sp^3 (b) sp^2-sp (c) sp-sp^2 (d) sp^3-sp

Q.14 C – C bond in C_2H_6 undergoes heterolytic fission, the hybridisation of carbon is/are -

(a) sp^2 (b) sp^3 (c) sp^2, sp^3 (d) sp, sp^2

Q.15 The enolic form of acetone contains σ bond (a), π bond (b) and lone pair of electrons (c) -

(a) 9a, 1b, 2c (b) 8a, 2b, 2c
(c) 10a, 1b, 1c (d) 9a, 2b, 1c

Q.16 The bond order of N_2^- anion is -

(a) 1 (b) 2 (c) 2.5 (d) 3

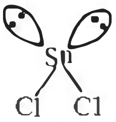
Q.17 Which of the following has maximum bond strength ?

(a) O_2 (b) O_2^+ (c) O_2^- (d) O_2^{2-}

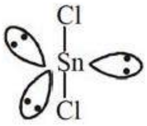
Q.18 The atomic number of Sn is 50. The shape of gaseous $SnCl_2$ molecule is :

(a) Cl – Sn – Cl

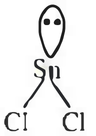
(b)



(c)



(d)



Q.19 The molecular orbital configuration of a diatomic molecule is $\sigma 1s^2\sigma^* 1s^2\sigma 2s^2\sigma^* 2s^2\sigma 2p_x^2\begin{cases}\pi 2p_y^2\\ \pi 2p_z^2\end{cases}$

Its bond order is

(a) 3 (b) 2.5 (c) 2 (d) 1

Q.20 Which is not true according to VBT ?

(a) A covalent bond is formed by the overlapping of orbitals with unpaired electrons of opposite spins
(b) A covalent bond is formed by the overlapping of orbitals with unpaired electrons of same spin
(c) The greater the extent of overlapping the stronger is the bond
(d) Overlapping takes place only in the direction of maximmn electron density of the orbital

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	20. ⓐⓑⓒⓓ

Q.21 Allyl cyanide has-

(a) 9 sigma bonds and 4 Pi bonds

(b) 9 sigma bonds, 3 pi bonds and 1 lone pair

(c) 8 sigma bonds and 5 pi bonds

(d) 8 sigma bonds, 3 pi bonds an 4 non-bonding electrons

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct

(b) 1 and 2 are correct

(c) 2 and 4 are correct

(d) 1 and 3 are correct

Q.22 Which of the following have identical bond order ?

(1) CN^- (2) O_2^-

(3) NO^+ (4) CN^+

Q.23 The molecules that will have dipole moment are

(1) *trans*-2-Pentene

(2) *cis*-3-Hexene

(3) 2, 2-Dimethylpropane

(4) 2, 2, 3, 3-Tetramethylbutane

Q.24 N_2 and O_2 are converted into monoanions N_2^- and O_2^- respectively, which of the following statements are correct?

(1) In N_2^-, the N – N bond weakens

(2) In O_2^-, bond length increases

(3) N_2^- becomes paramagnetic

(4) In O_2^-, the O – O bond order increases

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

The distribution of electrons among various molecular orbitals is called the electronic configuration of the molecule which provides us the following very important information about the molecule.

(I) Stability of molecule : The molecule is stable if number of bonding molecular orbital electrons (N_b) is greater than the number of antibonding molecular orbital electrons (N_a).

(II) Bond order : Bond order = $\frac{1}{2}(N_b - N_a)$

A positive bond order means a stable molecule while a negative or zero bond order means an unstable molecule.

(III) Nature of the bond : Bond order 1, 2 and 3 corresponds to single, double and triple bonds respectively.

(IV) Bond length : Bond length decreases as bond order increases.

(V) Magnetic nature : If molecular orbitals in a molecule are doubly occupied, the substance is diamagnetic and if one or more molecular orbitals are singly occupied, it is paramagnetic.

Q.25 Which of the following statements is incorrect ?

(a) Among O_2^+, O_2 and O_2^- the bond length decreases as $O_2^- > O_2 > O_2^+$

(b) He_2 molecule does not exist as the bonding and anti-bonding orbitals cancel each other

(c) C_2, O_2^{2-} and Li_2 are diamagnetic

(d) In F_2 molecule, the energy of $\sigma 2p_x$ is more than that of $\pi 2p_y$ and $\pi 2p_z$

Q.26 The following molecules/species have been arranged in the order of their increasing bond orders. Identify the correct order : (I) O_2 ; (II) O_2^- (III) O_2^{2-} ; (IV) O_2^+

(a) III < II < I < IV (b) IV < III < II < I

(c) III < II < IV < I (d) II < III < I < IV

RESPONSE GRID	
	21.ⓐⓑⓒⓓ 22.ⓐⓑⓒⓓ 23.ⓐⓑⓒⓓ 24.ⓐⓑⓒⓓ 25.ⓐⓑⓒⓓ 26.ⓐⓑⓒⓓ

Space for Rough Work

Q.27 N_2 has greater dissociation energy than N_2^+, whereas O_2 has a lower dissociation energy than O_2^+ because –

(a) bond order is decreased when O_2 is ionized to O_2^+ and bond order is increased when N_2 is ionized to N_2^+

(b) bond order is increased when O_2 is ionized to O_2^+ and bond order is decreased when N_2 is ionized to N_2^+

(c) bond order is decreased when O_2 is ionized to O_2^+ and bond order is decreased when N_2 is ionized to N_2^+

(d) None of these

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

Q.28 Statement-1 : $N_2F_3^+$ is planar at each nitrogen atom.

Statement-2 : In N_3H, the bond angle H– N – N is 120° and both the N – N bond lengths are not equal.

Q.29 Statement-1 : Geometry of SF_4 molecule can be termed as distorted tetrahedron, a folded square or see saw.

Statement-2 : Four fluorine atoms surround or form bond with sulphur atom.

Q.30 Statement-1 : The nearly tetrahedral arrangement of the orbitals about the oxygen atom allows each water molecule to form hydrogen bonds with as many as four neighbouring water molecules.

Statement-2 : In ice each molecule forms four hydrogen bonds as each molecule is fixed in the space.

RESPONSE GRID	27.ⓐⓑⓒⓓ	28.ⓐⓑⓒⓓ	29.ⓐⓑⓒⓓ	30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 7 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	36	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

07

(1) (a) BrF_3 has sp^3d hybridization and T-shaped.

(2) (d) Because it has sp^2 hybridisation. Other three have sp^3 hybridisation.

(3) (c) CH_4 because it has sp^3 hybridisation.

(4) (c) $SnCl_2$ is a bent shape molecule due to presence of lone pair of electrons.

(5) (b) Both have the same state of hybridization with one lone pair of e^- each.

(6) (a) Due to presence of lone pair of electrons.

XeF_4 – Square planar
XeF_2 – Linear
XeF_6 – Pentagonal pyramidal

(7) (d) Smaller the size of the hybrid orbital, greater is the electronegativity. Thus, the correct order is :
$sp > sp^2 > sp^3$.

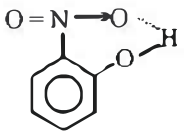
(8) (c) Due to maximum electronegativity difference between two atoms.

(9) (c) Helium molecule does not exist as it has bond order of zero.

(10) (a) $M = 1.48 \times 3.33 \times 10^{-30}$ cm
$= 4.93 \times 10^{-30}$ cm.
$q = 1.6 \times 10^{-19} C$

$$\ell = \frac{\mu}{q} = \frac{4.93 \times 10^{-30}}{1.6 \times 10^{-19}} = 3.08 \times 10^{-11}\,m = 0.0308\,nm$$

(11) (b) *o*-Nitrophenol has intramolecular H bonding as shown below



(12) (a) HCl < HBr < HI < HF

Boiling point depends upon the magnitude of van der Waal's forces operating between the molecules. As the size of the halogen increases from Cl to I, magnitude of attractive forces increases and hence, boiling point increases.

∴ Boiling point of HI > HBr > HCl

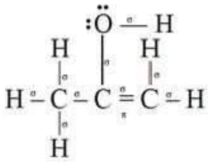
However, boiling pt of HF is exceptionally high due to strong hydrogen bonding present between the H-F molecules. Thus, the correct order is :

HF > HI > HBr > HCl

(13) (c) As the first carbon has triple bond and second one has double bond with other carbon atoms.

(14) (c) During heterolytic fission there will be formation of CH_3^+ and CH_3^- which has sp^2 and sp^3 hybridization respectively.

(15) (a) This is clear from its structure as shown below :



(16) (c) N_2^- : $\sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2 \begin{pmatrix} \pi 2p_x^2 \\ \pi 2p_y^2 \end{pmatrix}$

$\sigma 2p_z^2 \begin{pmatrix} \pi^* 2p_x^1 \\ \pi^* 2p_y^0 \end{pmatrix}$

$$BO = \frac{1}{2}(N_b - N_a) = \frac{1}{2}(10-5) = \frac{5}{2} = 2.5$$

∴ (c) is the correct choice.

(17) (b) Bond strength (BS) $\propto$ Bond order (BO)

$$O_2 : \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_2^2 \begin{pmatrix} \pi 2p_x^2 \\ \pi 2p_y^2 \end{pmatrix} \begin{pmatrix} \pi^* 2p_x^1 \\ \pi^* 2p_y^1 \end{pmatrix}$$

$$BO = \frac{1}{2}(10-6) = \frac{4}{2} = 2$$

$$O_2^+ (15e^-) : BO = \frac{1}{2}(10-5) = \frac{5}{2} = 2.5$$

$$O_2^- (17e^-) : BO = \frac{1}{2}(10-7) = \frac{3}{2} = 1.5$$

$$O_2^{2-} (18e^-) : BO = \frac{1}{2}(10-8) = \frac{2}{2} = 1$$

∴ BO is $O_2^+ > O_2 > O_2 > O_2^2$

Hence, BS is $O_2^+ > O_2 > O_2^- > O_2^{2-}$

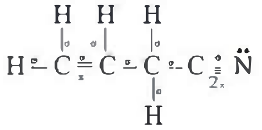
(18) (d) Sn[Z = 50], [Kr] $\overset{5s}{\boxed{\uparrow\downarrow}}\ \overset{5p}{\boxed{\uparrow}\boxed{\uparrow}\boxed{}}$

sp^2 – hybridisation : $\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}\boxed{\uparrow\downarrow}$

(19) (a) $B.O. = \frac{N_b - N_a}{2} = \frac{10-4}{2} = 3.$

(20) (b) Electrons of same spin never combine to form a bond. Other facts are true for VBT.

(21) (b) This is clear from structure of allyl cyanide



(22) (d) Bond order = $\frac{1}{2}$ (number of electrons in bonding molecular orbital – number of electrons in antibonding molecular orbital).

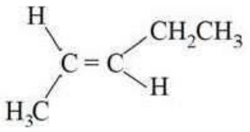
Bond order of $O_2^- = \frac{1}{2}(10-7) = 1.5$

Bond order of $NO^+ = \frac{1}{2}(10-4) = 3$

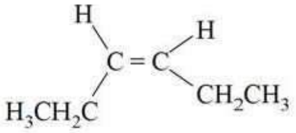
Bond order of $CN^+ = \frac{1}{2}(8-4) = 2$

Bond order of $CN^- = \frac{1}{2}(10-7) = 3$

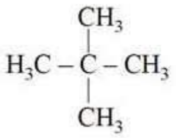
(23) (b)



$(\mu \neq 0)$

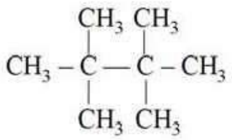


$(\mu \neq 0)$



$H_3C-C(CH_3)_2-CH_3$

$(\mu = 0)$



$CH_3-C(CH_3)_2-C(CH_3)_2-CH_3$

$(\mu = 0)$

(24) (a) Bond order (BO) ∝ Bond strength (BS)

and, Bond order (BO) ∝ $\frac{1}{\text{Bond length (BL)}}$

Now (1) $N_2\,(14e^-): \sigma 1s^2\,\sigma^*1s^2\,\sigma 2s^2\,\sigma^*2s^2 \begin{pmatrix}\pi 2p_x^2\\ \pi 2p_y^2\end{pmatrix} \sigma 2p_z^2$

$BO = \frac{1}{2}(10-4) = \frac{6}{2} = 3$

$N_2^-\,(15e^-): BO = \frac{1}{2}(10-5) = \frac{5}{2} = 2.5$

$\Rightarrow BO(N_2) > BO(N_2^-)$

$\therefore BS(N_2) > BS(N_2^-)$

i.e. N–N in N_2^- is weaker than that in N_2

(2) $O_2\,(16e^-): \sigma 1s^2\,\sigma^*1s^2\,\sigma 2s^2\,\sigma^*2s^2\,\sigma 2p_z^2 \begin{pmatrix}\pi 2p_x^2\\ \pi 2p_y^2\end{pmatrix} \begin{pmatrix}\pi^* 2p_x^1\\ \pi^* 2p_y^1\end{pmatrix}$

$BO = \frac{1}{2}(10-6) = \frac{4}{2} = 2$

$O_2^-\,(17e^-): BO = \frac{1}{2}(10-7) = \frac{3}{2} = 1.5$

$\Rightarrow BO(O_2^-) < BO(O_2)$

$\therefore BL(O_2^-) > BL(O_2)$

(3) $N_2^-\,(15e^-): \sigma 1s^2\,\sigma^*1s^2\,\sigma 2s^2\,\sigma^*2s^2 \begin{pmatrix}\pi 2p_x^2\\ \pi 2p_y^2\end{pmatrix} \sigma 2p_z^2 \begin{pmatrix}\pi^* 2p_x^1\\ \pi^* 2p_y^1\end{pmatrix}$

Due to presence of unpaired e^- in (π^*2px),

N_2^- is paramagnetic

(4) B.O. of O_2^- is less than the BO of O_2.

$\therefore$ only(4) is incorrect.

(25) (d)

(a) Bond order ∝ 1/bond length

Bond order $O_2^+ = 2.5,\ O_2 = 2,\ O_2^- = 1.5$

So correct order of bond length is

$O_2^- > O_2 > O_2^+$

(b) Bond order of $He_2 = \frac{2-2}{2} = 0$

So He_2 does not exist

(c) In all these molecules all electrons are paired in molecular orbitals. So they are all diamagnetic.

(d) F_2 (MOT configuration):

$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_x^2, \pi 2p_y^2, \pi^*2p_y^2, \pi 2p_z^2, \pi^*2p_z^2$

Thus $\sigma 2p_x$ is lower in energy than $\pi 2p_y$ and $\pi 2p_z$.

(26) (a)

	O_2	O_2^-	O_2^{2-}	O_2^+
Bond order	2	1.5	1	2.5

(27) (b) Bond order ∝ Dissociation energy (BDE)

$\rightarrow N_2\,(14e^-): \sigma 1s^2\,\sigma^*1s^2\,\sigma 2s^2\,\sigma^*2s^2 \begin{pmatrix}\pi 2p_x^2\\ \pi 2p_y^2\end{pmatrix} \sigma 2p_z^2$

$BO = \frac{1}{2}(10-4) = \frac{6}{2} = 3$

$$N_2^+(13e^-): BO=\frac{1}{2}(9-4)=\frac{5}{2}=2.5$$

$$BO(N_2) > BO(N_2^+)$$

$$\therefore\ BDE(N_2) > BDE(N_2^+)$$

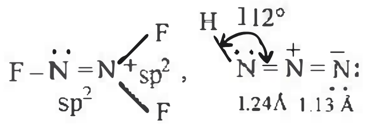
$$\rightarrow O_2(16e^-): \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2 \begin{pmatrix} \pi 2p_x{}^2 \\ \pi 2p_y{}^2 \end{pmatrix} \begin{pmatrix} \pi^* 2p_x{}^1 \\ \pi^* 2p_y{}^1 \end{pmatrix}$$

$$BO=\frac{1}{2}(10-6)=\frac{4}{2}=2$$

$$O_2^+(15e^-): BO=\frac{1}{2}(10-5)=\frac{5}{2}=2.5$$

$$BO(O_2^+) > BO(O_2)$$

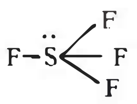
$$\therefore\ BDE(O_2^+) > BDE(O_2)$$

(28) (d) 

(i) In N_3H, bond angle is 112° due to $\ell p-bp$ repulsion.

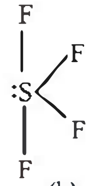
(ii) Smaller bond length (1.13Å) due to attraction between the opposite poles.

(29) (b) Sulphur has fivepairs of electrons whose arrangement should be trigonal bipyramidal according to VSEPR theory. Two structures are possible.



(a)

Lone pair in the axial position (three l.p - b.p repulsion at 90°)



(b)

Lone pair in the equatorial position (two l.p - b.p repulsion)

Accepted structure see-saw geometry

(30) (a) At any given instant, at room temperature each water molecule forms hydrogen bonds with other water molecules. The water, H_2O molecules are in continuous motion, so hydrogen bonds are constantly & rapidly broken & formed. In ice, H_2O molecules are however fixed in the space lattice.