SECTION-I : Single Correct Type

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct. You will be awarded **3 marks** if only the correct option is chosen and zero mark if none of the option is chosen. **(–1)** marks will be awarded for incorrect answers in this section.

Level   : **Easy**
Topic   : **Gaseous State**
Concept   : **Real gases**
Subconcept   : **Real gases**

1. Count the number of correct formulae/equation for Vander Waals gas –

(i) $\left(P - \dfrac{an^2}{V}\right)(V - nb)\ nRT$

(ii) $T_C = \dfrac{a}{27b^2}$

(iii) $V_C = 3b$

(iv) Boyle's temp $= \dfrac{a}{Rb}$

(A) 2   (B) 3   (C) 4   (D) 5

Ans. **(A)**

Sol. Correct formula is $\left(P - \dfrac{an^2}{V^2}\right)(V - nb)\ nRT$

$T_C = \dfrac{8a}{27Rb}$

Answer (A).

Level   : **Easy**
Topic   : **Atomic Structure**
Concept   : **Bohr Model**

Subconcept   : **Bohr Model**

2. What is the wave number of the radiation of lowest frequency in the Lyman series of the spectrum of Li^{2+} ion?

(A) $\dfrac{4}{27R}$ (B) $\dfrac{27R}{4}$ (C) $\dfrac{27RC}{4}$ (D) $\dfrac{4C}{27R}$

Ans. **(B)**

Sol. For lowest frequency in Lyman series, the transition is $2 \rightarrow 1$.

Now, $\bar{V} = Rz^2\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right) = R \times 3^2\left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right)$

$\qquad = \dfrac{27R}{4}$

Level   **: Easy**
Topic   **: Atomic Structure**
Concept   **: Bohr Model**
Subconcept   **: Bohr Model**

3.   What is the wave number of the radiation of lowest frequency in the Lyman series of the spectrum of Li^{2+} ion?

(A) $\dfrac{4}{27R}$ (B) $\dfrac{27R}{4}$ (C) $\dfrac{27RC}{4}$ (D) $\dfrac{4C}{27R}$

Ans.   **(B)**

Sol.   For lowest frequency in Lyman series, the transition is $2 \rightarrow 1$.

Now, $\bar{V} = Rz^2\left(\dfrac{1}{n_1^2} - \dfrac{1}{n_2^2}\right) = R \times 3^2\left(\dfrac{1}{1^2} - \dfrac{1}{2^2}\right)$

$$= \dfrac{27R}{4}$$

Level   **: Easy**
Topic   **: Gaseous State**
Concept   **: Gaseous State**
Subconcept   **: Gaseous State**

4.   Volume of a gaseous compound consisting C, H, O on complete combustion in the presence of 2.5 volume of O_2, 2 vol. of steam and 2vol. of CO_2 what is the formula of the compound if all measurements are made at same temperature?

(A) C_2H_4O (B) CH_3O (C) C_2H_2O (D) $C_2H_3O_2$

Ans.   **(A)**

Sol. $C_xH_yO_z + \left(x + \dfrac{y}{4} - \dfrac{3}{2}\right)O_2 \rightarrow xCO_2(g) + \dfrac{y}{2}H_2O(g)$

Vlit $v\left(x + \dfrac{y}{4} - \dfrac{3}{2}\right)$ lit   Vx lit $v\dfrac{y}{2}$ lit

$v\left(x + \dfrac{y}{4} - \dfrac{3}{2}\right) = 2.5v$ …..(1)

$Vx = 2V$ …..(2)

$\dfrac{vy}{2} = 2V$ …..(3)

$X = 2$, $y = 4$, $z = 1$

Level : **Easy**
Topic : **Chemical Bonding**
Concept : **Hybridization**
Subconcept : **Hybridization**

5. Correct order of hybrid orbital length is :
(A) $sp < sp^2 < sp^3$ (B) $sp < sp^3 < sp^2$ (C) $sp^3 < sp^2 < sp$ (D) $sp^2 < sp^3 < sp$

Ans. **(A)**
Sol. Correct order of hybrid orbital length is: $sp < sp^2 < sp^3$

Level : **Moderate**
Topic : **Chemical Bonding**
Concept : **Hybridization**
Subconcept : **Hybridization**

6. In which of the following molecules hybridisation of central atom is sp^3d.
(A) XeF_6 (B) PCl_6 (C) SF_4 (D) SF_6

Ans:. **(C)**
Sol. In SF_4 hybridisation of central atom is sp^3d.

Level : **Easy**
Topic : **Chemical Bonding**
Concept : **Chemical Bonding**
Subconcept : **Chemical Bonding**

7. Which of the following statement is correct regarding covalent bond ?
(A) Filled orbitals of two or more atoms overlap with one another.
(B) Unoccupied orbitals of two or more atoms overlap with one another
(C) Electrons are simultaneously attracted between more than one nucleus.
(D) Electrons are transferred from one atom to another atom.

Ans. **(C)**
Sol. Electrons are simultaneously attracted between more than one nucleus.

Level : **Tough**
Topic : **Chemical Bonding**
Concept : **VBT**
Subconcept : **VBT**

8. Which of the following statement is false ?
(A) δ-bond is a result of 6-lobe interaction between two d-orbitals.
(B) δ-bond is stronger than π-bond
(C) δ-bond & σ-bond have unequal bond strength
(D) Representative elements do not have tendency to form δ-bond.

Ans. **(B)**
Sol. δ-bond is weaker than π-bond

Level : Moderate
Topic : Chemical Bonding
Concept : VSEPR THOERY
Subconcept : VSEPR THOERY
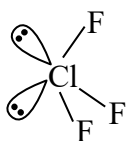
9. What is the shape of the ClF_3 molecule ?

(A) Trigonal planar　　　　　　　　　(B) Trigonal pyramidal

(C) T-shaped　　　　　　　　　　　　(D) Tetrahedral

Ans. **(C)**

Sol. shape of the ClF_3 molecule T-shaped

$C1F_3$

Level : Moderate
Topic : Chemical Bonding

Concept : Hybridization

Subconcept : Hybridization

10. Which of the following molecules/species has the minimum number of lone pairs on central atom?

(A) ICl_3　　　　　(B) BF_4^-　　　　　(C) $SnCl_2$　　　　　(D) XeF_4

Ans. **(B)**

Sol. In BF_4^-　Boron has zero lone pair.

Level : Moderate

Topic : Chemical Bonding

Concept : Dipole Moment

Subconcept : Dipole Moment

11. Which of the following has the highest dipole moment ?

(1) *o*-Dichlorobenzene　　　　　　　(2) *m*-Dichlorobenzene

(3) *p*-Dichlorobenzene　　　　　　　(4) All have equal values

Ans. **(1)**

Sol. o-dichlorobenzene have minimum bond angle.

Hence have maximum dipole moment $\boxed{\mu \propto \dfrac{1}{BA}}$

Level : Moderate
Topic : Chemical Bonding
Concept : Dipole Moment
**Subconcept** : Dipole Moment

12. Carbon tetrachloride has no net dipole moment because of-

(1) Similar electron affinities of C and Cl   (2) its regular tetrahedral geometry

(3) its planar geometry   (4) similar sizes of C and Cl atoms

Ans. (2)
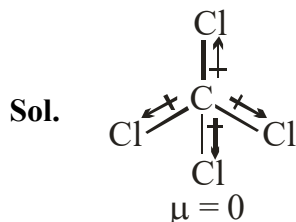
Sol.

$\mu = 0$

Level : Moderate
Topic : General Organic Chemistry
Concept : Acidic Strength
Subconcept : Acidic Strength

13. Most acidic compound among following is
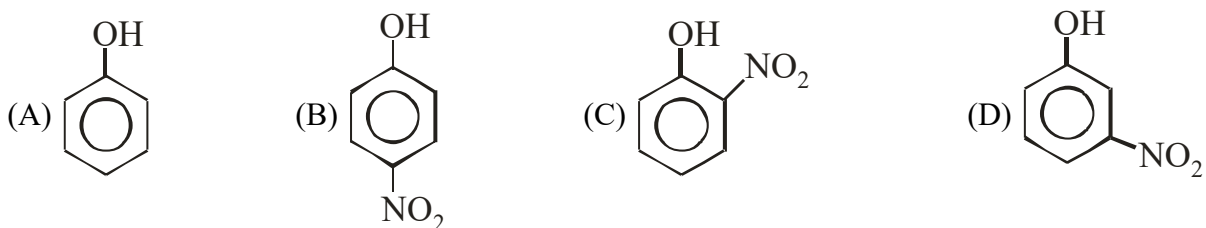
Ans. (B)
Sol. Acidic strength order is B > C > D > A

Level : Moderate
Topic : General Organic Chemistry
Concept : Acidic Strength
Subconcept : Acidic Strength

14. Correct Acidic strength order of following marked H is
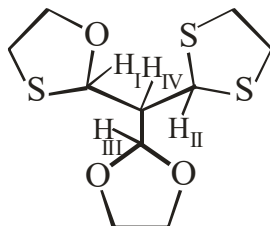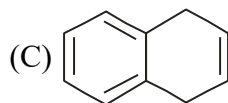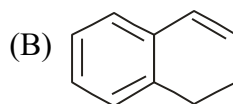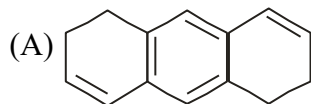

(A) I > II > III > IV   (B) IV > III > II > I   (C) II > I > III > IV   (D) IV > I > III > II

Ans. (C)
Sol. Conjugate base of H_{II} is most stabilized due to higher extent of $p\pi$-$d\pi$ overlapping.

Level : Moderate
Topic : General Organic Chemistry
Concept : Aromatic Compound
Subconcept : Aromatic Compound

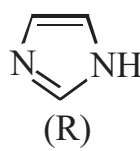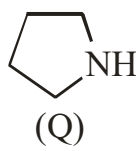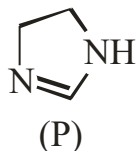**15.** Which of the following compound is not aromatic.

(A)

(B)

(C)

(D)
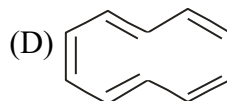
Ans. (D)
Sol. Compound in option "D" is non planer hence not aromatic,

Level : Tough
Topic : General Organic Chemistry
Concept : Basic Strength
Subconcept : Basic Strength

16. Arrange following in decreasing order of basic strength

(P)   (Q)   (R)

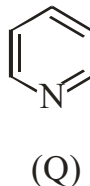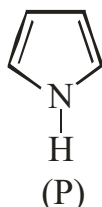(A) P > Q > R   (B) P > R > Q   (C) R > P > Q   (D) Q > P > R

Ans. (A)
Sol. Aromatic Amines are weaker basic hence correct order is P > Q > R

Level : Tough
Topic : General Organic Chemistry
Concept : Basic Strength
Subconcept : Basic Strength

17. Connect statement regarding following

(P)   (Q)

(A) Basic strength of Q is higher them P   (B) Resonanse energy of Q is higher the P
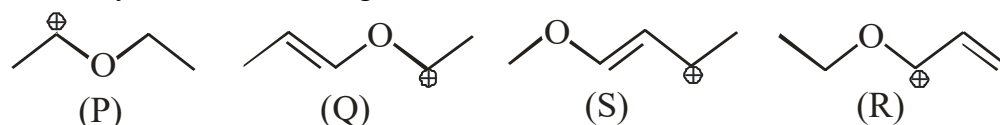(C) Both are hetrocyclic compounds   (D) All of the above

Ans. (D)
Sol. P contains delocalized lone pair where as Q contains localized lone pair hence Q is more basic & more Resonance energy because its contains 6 P orbital

Level : Moderate
Topic : General Organic Chemistry
Concept : Carbocation
Subconcept : Carbocation

18. Correct stability order of following is
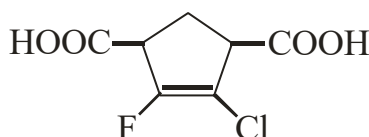

(P) (Q) (S) (R)

(A) P > Q > R > S   (B) R > S > Q > P   (C) R > S > P > Q   (D) S > R > P > Q

Ans. **(D)**
**Sol.** R is most stable due to having high extent of conjugation.

Level : Moderate
Topic : Nomenclature
Concept : Carboxylic acid amine
Subconcept : Carboxylic acid amine

19. Correct IUPAC name of following compound

(A) 2-chloro 3- fluoro cyclopent-2-ene-1,4-dicarboxylic acid
(B) 2-fluoro 3- chloro cyclopent-2-ene-1,4-dicarboxylic acid
(C) 4-chloro 5- fluoro cyclopent-2-ene-1,4-dicarboxylic acid
(D) 5-chloro 4- fluoro cyclopent-2-ene-1,4-dicarboxylic acid

Ans. **(C)**

Sol.
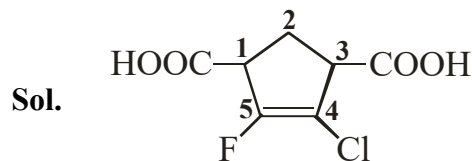
Level : Moderate
Topic : General Organic Chemistry
Concept : Resonating Structure
Subconcept : Resonating Structure

20. Most stable Resonating structure of a compound is . Second most stable resonating structure of this compound is.

(A)

(B)

(C)

(D)
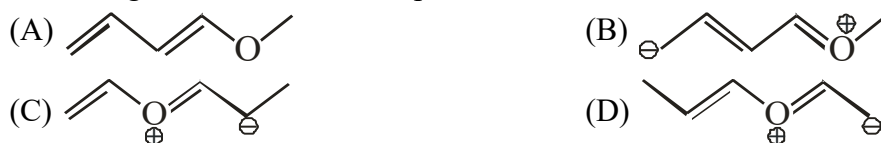
Ans. **(D)**
Sol. Compound in option A & B is different hence D is the most stable Resonating structure.

SECTION-II : Integer Value Correct Type

This section contains **10 questions**. For each question, enter the correct numerical value (in decimal notation, truncated / rounded off to the **second decimal place;** e.g. 6.25, 7.00, –0.33, –0.30, 30.27, –127.30) using the mouse and the on screen virtual numeric keypad in the place designated to enter the answer. You will be awarded **3 marks** if correct numerical value is entered as answer. **No negative marks** will be awarded for incorrect answers in this section.

Level : **Tough**
Topic : **Mole Concept**
Concept : **Concentration terms**
Subconcept : **Concentration terms**

1. Find the sum of molarity of all the ions present in an aqueous solution of 5M $NaNO_3$ and 3m $BeCl_2$. The specific gravity of the given solution is 1.665. Assume 100% dissociation of each salt.

Ans. **(19)**

Sol. Let 1 litre solution
moles $NaNO_3 = 5$
wt. $NaNO_3 = 5 \times 85 = 425$ g
wt. of solution $= 1000 \times 1.665$
$= 1665$ gm
Molality of $BeCl_2 = 3$

$$3 = \frac{\dfrac{w}{80}}{(1665 - 425 - W)} \times 1000$$

$W = 240$ gm

$$M_{(BaCl_2)} = \frac{\dfrac{240}{50}}{1} = 3M$$

$$M_{alkine} = M_{Na^+} + M_{NO_2^-} + M_{BaCl_2} + M_\sigma$$
$$= 5 + 5 + 3 + 2 \times 3 = 19\ M$$

Level : **Easy**
Topic : **Atomic Structure**
Concept : **Planck Quantum theory**
**Subconcept** : **Planck Quantum theory**

2. Wavelength of radio waves is 124 nm. Total number of photons per second produced by a source that consumes energy at the rate of 16W is $x \times 10^{19}$. The value of x is -
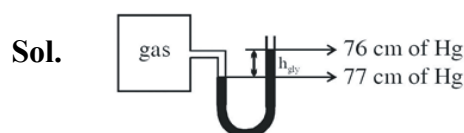
Ans. **(1)**

Sol. Number of photons $= \dfrac{16}{\dfrac{1240}{124} \times 1.6 \times 10^{-19}} = 10^{19}$

Level : **Easy**
Topic : **Gaseous State**
Concept : **Gaseous State**
Subconcept : **Gaseous State**

3. If the gas in container has pressure 77 cm of Hg, then calculate the height difference in manometer (in mm) which contain glycerin (d = 3.4 gm/ml).

Ans. **(0040)**

Sol.
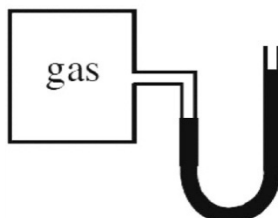
We have to convent 1 cm pf hg into height of glycerine

$$h_{Hg}d_{Hg} = h_{gly}d_{gly}$$

$$h_{gly} = 1 \times \frac{13.6}{3.4} = 4 \text{ cm of glycerine} \Rightarrow 40 \text{ mm}$$

Level : **Easy**
Topic : **Gaseous State**
Concept : **Graham's Law of Effusion**
Subconcept : **Graham's Law of Effusion**

4. Find the number of diffusion steps required to separate the isotopic mixture initially containing some mass of hydrogen gas and 1 mole of deuterium gas in a 3 litre container maintained at 24.63 atm and 300 K to the final mass ratio of hydrogen to deuterium gas equal to 1 : 4.

Ans. **(4)**

Sol. Initial total moles $= \dfrac{PV}{RT} = \dfrac{24.63 \times 3}{0.0821 \times 300} = 3$

∴ Initial mole of H_2 = 3 −1 = 2

Final mole ratio, $\dfrac{n_{H_2}}{n_{D_2}} = \dfrac{1/2}{4/4} = \dfrac{1}{2}$

Now, $\dfrac{n^f H_2}{n^f D_2} = \dfrac{n^i H_2}{n^i D_2} \times \left(\sqrt{\dfrac{M_{D_2}}{M_{H_2}}} \right)^n$

or, $\dfrac{1}{2} = \dfrac{2}{1} \times \left(\sqrt{\dfrac{4}{2}} \right)^n \Rightarrow n = 4$

Level   : Moderate
Topic   : Mole Concept
Concept   : Application of Mole
Subconcept : Application of Mole

5. An impure sample of iron pyrite contains 28% iron, the impurity being silica. If 100g of the sample is roasted to oxidize all the FeS_2 to Fe_2O_3, then what will be the mass of the roasted sample, in g? (Fe = 56)

Ans. **(80)**

Sol. $2FeS_2 + \dfrac{11}{2} O_2 \rightarrow Fe_2O_3 + 4SO_2$
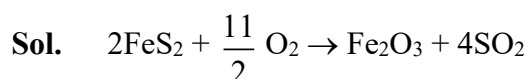
Mass of Fe_2O_3 formed = XO_4^- × 28 = 40g.

Mass of SiO_2 present = $100 - \left(\dfrac{120}{56} \times 28\right) = 48g$

∴ Final mass of roasted sample = 40 + 40 = 80g

Level   : Moderate
Topic   : Mole Concept
Concept   : Mole Concept
Subconcept : Mole Concept

6. The uncertainties in the velocities of two particles, A and B are 0.05 and 0.02 ms^{-1}, respectively. The mass of B is five times of that of the mass of A. What is the ratio of uncertainties $\left(\dfrac{\Delta x_A}{\Delta x_B}\right)$

Ans. **(2)**

Sol. $\dfrac{\Delta x_A \times m_A \times \Delta V_A}{\Delta x_B \times M_A \times \Delta V_B} = \dfrac{h/4\pi}{h/4\pi}$

$\dfrac{\Delta x_A \times m_A \times 0.05}{\Delta x_B \times 5m_B \times 0.02} = 1$

$\dfrac{\Delta x_A}{\Delta x_B} = \dfrac{0.02}{0.01} = \dfrac{2}{1} = 2$

Level : **Tough**

Topic : **Chemical Bonding**

Concept : **Hybridization**

Subconcept : **Hybridization**

7. Number of atomic orbitals involve in hybridisation of anion part of Cl_2O_6 (s) is –

Ans. **(4)**

Sol.

Speicies	Cationic part	Anionic part
$Cl_2O_6(s)$	$ClO_2^+(sp^2)$	$ClO_4^-(sp^3)$

Level : **Easy**

Topic : **Chemical Bonding**

Concept : **Hybridization**

Subconcept : **Hybridization**

8. Find the number of molecules having sp^3d hybridization :

I_3^-, SF$_4$, BeCl$_2$, XeF$_4$,

Ans. **(2)**

Sol.

I_3^- sp^3d

SF$_4$ sp^3d

BeCl$_2$ sp

XeF$_4$ sp^3d^2
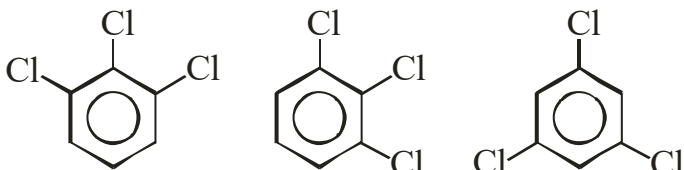
Level : **Easy**

Topic : **Isomerism**

Concept : **Structure Isomerism**

Subconcept : **Structure Isomerism**

9. Total number of Aromatic isomers of molecular formula $C_6H_3Cl_3$ is

Ans. **(3)**

Sol.

Level   : **Moderate**

Topic   : **Isomerism**

Concept   : **Structure Isomerism**

Subconcept   : **Structure Isomerism**

10.   Total number of structure isomers of molecular formula C_7H_{16} having at least one methyl as a substituent as per IUPAC rules :

Ans.   **(7)**

Sol.