

PART-III : CHEMISTRY

SECTION 1 (Maximum Marks : 12)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 If **ONLY** the correct option is chosen;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : -1 In all other cases.

1. A closed vessel contains 10 g of an ideal gas **X** at 300 K, which exerts 2 atm pressure. At the same temperature, 80 g of another ideal gas **Y** is added to it and the pressure becomes 6 atm. The ratio of root mean square velocities of **X** and **Y** at 300 K is

(A) $2\sqrt{2} : \sqrt{3}$

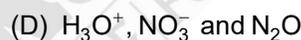
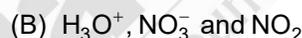
(B) $2\sqrt{2} : 1$

(C) 1 : 2

(D) 2 : 1

Answer (D)

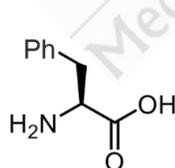
2. At room temperature, disproportionation of an aqueous solution of *in situ* generated nitrous acid (HNO_2) gives the species



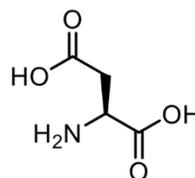
Answer (A)

3. Aspartame, an artificial sweetener, is a dipeptide aspartyl phenylalanine methyl ester. The structure of aspartame is

Structures of phenylalanine and aspartic acid are given below.



Phenylalanine



Aspartic acid

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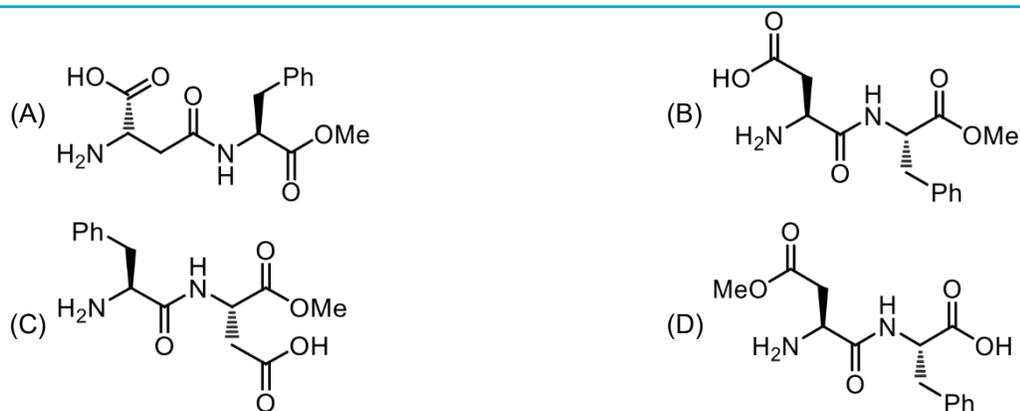


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Answer (B)

4. Among the following options, select the option in which each complex in **Set-I** shows geometrical isomerism and the two complexes in **Set-II** are ionization isomers of each other.

[en = H₂NCH₂CH₂NH₂]

(A) **Set-I:** [Ni(CO)₄] and [PdCl₂(PPh₃)₂]

Set-II: [Co(NH₃)₅Cl]SO₄ and [Co(NH₃)₅(SO₄)]Cl

(B) **Set-I:** [Co(en)(NH₃)₂Cl₂] and [PdCl₂(PPh₃)₂]

Set-II: [Co(NH₃)₆][Cr(CN)₆] and [Cr(NH₃)₆][Co(CN)₆]

(C) **Set-I:** [Co(NH₃)₃(NO₂)₃] and [Co(en)₂Cl₂]

Set-II: [Co(NH₃)₅Cl]SO₄ and [Co(NH₃)₅(SO₄)]Cl

(D) **Set-I:** [Cr(NH₃)₅Cl]Cl₂ and [Co(en)(NH₃)₂Cl₂]

Set-II: [Cr(H₂O)₆]Cl₃ and [Cr(H₂O)₅Cl]Cl₂·H₂O

Answer (C)

SECTION 2 (Maximum Marks : 12)

- This section contains **THREE (03)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 **ONLY** if (all) the correct option(s) is(are) chosen;

Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen;

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- Partial Marks** : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct;
- Partial Marks** : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
- Zero Marks** : 0 If none of the options is chosen (i.e. the question is unanswered);
- Negative Marks** : -2 In all other cases.

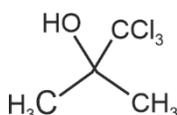
5. Among the following the correct statement(s) for electrons in an atom is(are)
- (A) Uncertainty principle rules out the existence of definite paths for electrons.
- (B) The energy of an electron in 2s orbital of an atom is lower than the energy of an electron that is infinitely far away from the nucleus.
- (C) According to Bohr's model, the most negative energy value for an electron is given by $n = 1$, which corresponds to the most stable orbit.
- (D) According to Bohr's model, the magnitude of velocity of electrons increases with increase in values of n .

Answer (A, B, C)

6. Reaction of *iso*-propylbenzene with O_2 followed by the treatment with H_3O^+ forms phenol and a by-product **P**. Reaction of **P** with 3 equivalents of Cl_2 gives compound **Q**. Treatment of **Q** with $Ca(OH)_2$ produces compound **R** and calcium salt **S**.

The correct statement(s) regarding **P**, **Q**, **R** and **S** is(are)

- (A) Reaction of **P** with **R** in the presence of KOH followed by acidification gives



- (B) Reaction of **R** with O_2 in the presence of light gives phosgene gas
- (C) **Q** reacts with aqueous NaOH to produce Cl_3CCH_2OH and $Cl_3CCOONa$
- (D) **S** on heating gives **P**

Answer (A, B, D)

7. The option(s) in which at least three molecules follow Octet Rule is(are)
- (A) CO_2 , C_2H_4 , NO and HCl
- (B) NO_2 , O_3 , HCl and H_2SO_4
- (C) BCl_3 , NO, NO_2 and H_2SO_4
- (D) CO_2 , BCl_3 , O_3 and C_2H_4

Answer (A, D)

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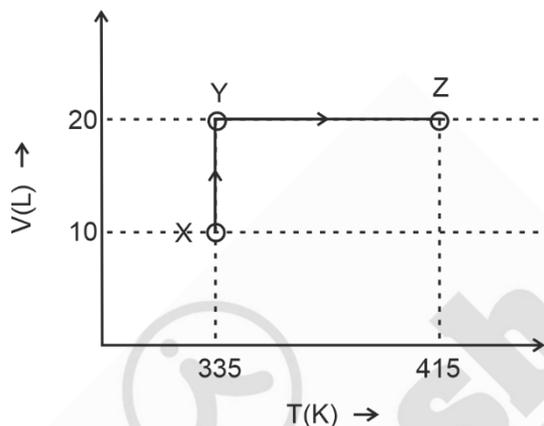
SECTION 3 (Maximum Marks : 24)

- This section contains **SIX (06)** questions.
- The answer to each question is a **NON-NEGATIVE INTEGER**.
- For each question, enter the correct integer corresponding to the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4 If **ONLY** the correct integer is entered;

Zero Marks : 0 In all other cases.

8. Consider the following volume–temperature (V – T) diagram for the expansion of 5 moles of an ideal monoatomic gas.

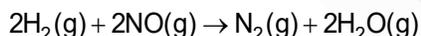


Considering only P-V work is involved, the total change in enthalpy (in Joule) for the transformation of state in the sequence $X \rightarrow Y \rightarrow Z$ is _____.

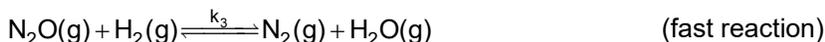
[Use the given data: Molar heat capacity of the gas for the given temperature range, $C_{V,m} = 12 \text{ J K}^{-1} \text{ mol}^{-1}$ and gas constant, $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

Answer (8120)

9. Consider the following reaction,



which following the mechanism given below:



The order of the reaction is _____.

Answer (3)

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10. Complete reaction of acetaldehyde with excess formaldehyde, upon heating with conc. NaOH solution, gives **P** and **Q**. Compound **P** does not give Tollens' test, whereas **Q** on acidification gives positive Tollens' test. Treatment of **P** with excess cyclohexanone in the presence of catalytic amount of p-toluenesulfonic acid (PTSA) gives product **R**.

Sum of the number of methylene groups ($-\text{CH}_2-$) and oxygen atoms in **R** is _____.

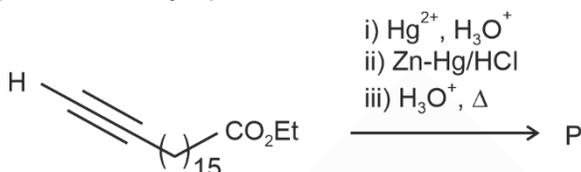
Answer (18)

11. Among $\text{V}(\text{CO})_6$, $\text{Cr}(\text{CO})_5$, $\text{Cu}(\text{CO})_3$, $\text{Mn}(\text{CO})_5$, $\text{Fe}(\text{CO})_5$, $[\text{Co}(\text{CO})_3]^{3-}$, $[\text{Cr}(\text{CO})_4]^{4-}$, and $\text{Ir}(\text{CO})_3$, the total number of species isoelectronic with $\text{Ni}(\text{CO})_4$ is _____.

[Given atomic number : V = 23, Cr = 24, Mn = 25, Fe = 26, Co = 27, Ni = 28, Cu = 29, Ir = 77]

Answer (1)

12. In the following reaction sequence, the major product **P** is formed.



Glycerol reacts completely with excess **P** in the presence of an acid catalyst to form **Q**. Reaction of **Q** with excess NaOH followed by the treatment with CaCl_2 yields Ca-soap **R**, quantitatively. Starting with one mole of **Q**, the amount of **R** produced in gram is _____.

[Given, atomic weight: H = 1, C = 12, N = 14, O = 16, Na = 23, Cl = 35, Ca = 40]

Answer (909)

13. Among the following complexes, the total number of diamagnetic species is _____.



[Given, atomic number: Mn = 25, Fe = 26, Co = 27; en = $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$]

Answer (1)

SECTION 4 (Maximum Marks : 12)

- This section contains **FOUR (04)** Matching List Sets.
- Each set has **ONE** Multiple Choice Question.
- Each set has **TWO** lists: **List-I** and **List-II**.
- **List-I** has **Four** entries (P), (Q), (R) and (S) and **List-II** has **Five** entries (1), (2), (3), (4) and (5).
- **FOUR** options are given in each Multiple Choice Question based on **List-I** and **List-II** and **ONLY ONE** of these four options satisfies the condition asked in the Multiple Choice Question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +3 **ONLY** if the option corresponding to the correct combination is chosen;

Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

Negative Marks : -1 In all other cases.

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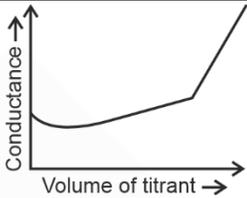
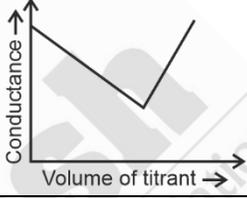
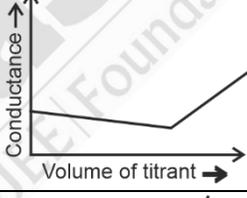
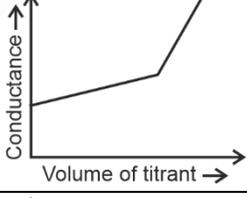
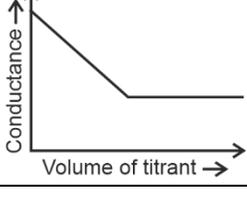
14. In a conductometric titration, small volume of titrant of higher concentration is added stepwise to a larger volume of titrate of much lower concentration, and the conductance is measured after each addition.

The limiting ionic conductivity (Λ_0) values (in $\text{mS m}^2 \text{mol}^{-1}$) for different ions in aqueous solutions are given below:

| | | | | | | | | | |
|-------------|---------------|--------------|---------------|--------------|-----------------|---------------|--------------------|---------------|---------------------------|
| Ions | Ag^+ | K^+ | Na^+ | H^+ | NO_3^- | Cl^- | SO_4^{2-} | OH^- | CH_3COO^- |
| Λ_0 | 6.2 | 7.4 | 5.0 | 35.0 | 7.2 | 7.6 | 16.0 | 19.9 | 4.1 |

For different combinations of titrates and titrants given in **List-I**, the graphs of 'conductance' versus 'volume of titrant' are given in **List-II**.

Match each entry in **List-I** with the appropriate entry in **List-II** and choose the correct option.

| | List-I | | List-II |
|-----|---|-----|--|
| (P) | Titrate: KCl Titrant: AgNO_3 | (1) |  |
| (Q) | Titrate: AgNO_3 Titrant: KCl | (2) |  |
| (R) | Titrate: NaOH Titrant: HCl | (3) |  |
| (S) | Titrate: NaOH Titrant: CH_3COOH | (4) |  |
| | | (5) |  |

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(A) P-4, Q-3, R-2, S-5

(B) P-2, Q-4, R-3, S-1

(C) P-3, Q-4, R-2, S-5

(D) P-4, Q-3, R-2, S-1

Answer (C)

15. Based on VSEPR model, match the xenon compounds given in **List-I** with the corresponding geometries and the number of lone pairs on xenon given in **List-II** and choose the correct option.

| | List-I | | List-II |
|-----|---------------------------------|-----|---|
| (P) | XeF ₂ | (1) | Trigonal bipyramidal and two lone pair of electrons |
| (Q) | XeF ₄ | (2) | Tetrahedral and one lone pair of electrons |
| (R) | XeO ₃ | (3) | Octahedral and two lone pair of electrons |
| (S) | XeO ₃ F ₂ | (4) | Trigonal bipyramidal and no lone pair of electrons |
| | | (5) | Trigonal bipyramidal and three lone pair of electrons |

(A) P-5, Q-2, R-3, S-1

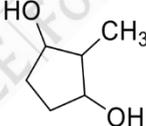
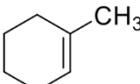
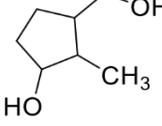
(B) P-5, Q-3, R-2, S-4

(C) P-4, Q-3, R-2, S-1

(D) P-4, Q-2, R-5, S-3

Answer (B)

16. **List-I** contains various reaction sequences and **List-II** contains the possible products. Match each entry in **List-I** with the appropriate entry in **List-II** and choose the correct option.

| | List-I | | List-II |
|-----|--|-----|--|
| (P) |  <p>i) O₃, Zn ii) aq. NaOH, Δ iii) ethylene glycol, PTSA iv) a) BH₃, b) H₂O₂, NaOH v) H₃O⁺ vi) NaBH₄</p> | (1) |  |
| (Q) |  <p>i) O₃, Zn ii) aq. NaOH, Δ iii) ethylene glycol, PTSA iv) a) BH₃, b) H₂O₂, NaOH v) H₃O⁺ vi) NaBH₄</p> | (2) |  |

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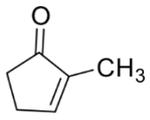
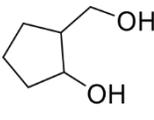
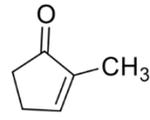
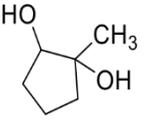
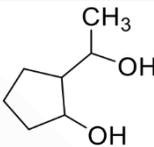
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|-----|---|-----|--|
| (R) |  i) ethylene glycol, PTSA ii) a) $\text{Hg}(\text{OAc})_2$, H_2O , b) NaBH_4 iii) H_3O^+ iv) NaBH_4 | (3) |  |
| (S) |  i) ethylene glycol, PTSA ii) a) BH_3 , b) H_2O_2 , NaOH iii) H_3O^+ iv) NaBH_4 | (4) |  |
| | | (5) |  |

(A) P-3, Q-5, R-4, S-1

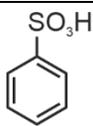
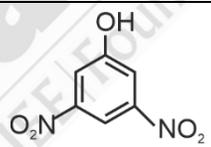
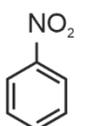
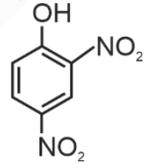
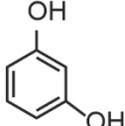
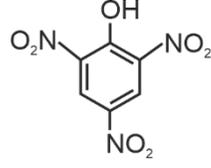
(B) P-3, Q-2, R-4, S-1

(C) P-3, Q-5, R-1, S-4

(D) P-5, Q-2, R-4, S-1

Answer (A)

17. **List-I** contains various reaction sequences and **List-II** contains different phenolic compounds. Match each entry in **List-I** with the appropriate entry in **List-II** and choose the correct option.

| | List-I | | List-II |
|-----|---|-----|--|
| (P) |  (i) molten NaOH , H_3O^+ (ii) Conc. HNO_3 | (1) |  |
| (Q) |  (i) Conc. HNO_3 / Conc. H_2SO_4 (ii) Sn/HCl (iii) NaNO_2/HCl , $0-5^\circ\text{C}$, (iv) H_2O (v) Conc. HNO_3 / Conc. H_2SO_4 | (2) |  |
| (R) |  (i) Conc. H_2SO_4 (ii) Conc. HNO_3 (iii) H_3O^+ , Δ | (3) |  |

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AIR 15
M. Sai Divya Teja Reddy
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19
AIR 19
Rishi Shekher Shukla
2 Year Classroom
100 PERCENTILE OVERALL

Punjab Topper

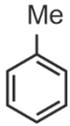
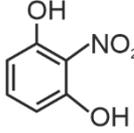
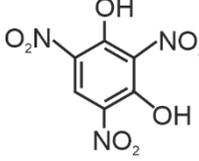
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| | | | | |
|-----|---|--|-----|--|
| (S) |  | (i) (a) $\text{KMnO}_4/\text{KOH}, \Delta$; (b) H_3O^+ (ii) Conc. HNO_3 / Conc. $\text{H}_2\text{SO}_4, \Delta$ (iii) (a) SOCl_2 , (b) NH_3 $\xrightarrow{\hspace{10em}}$ (iv) Br_2, NaOH (v) $\text{NaNO}_2/\text{HCl}, 0-5^\circ\text{C}$ (v) H_2O | (4) |  |
| | | | (5) |  |

(A) P-2, Q-3, R-4, S-5

(C) P-3, Q-5, R-4, S-1

(B) P-2, Q-3, R-5, S-1

(D) P-3, Q-2, R-5, S-4

Answer (C)



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