

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.

- Q.1 The heating of NH_4NO_2 at $60-70^\circ\text{C}$ and NH_4NO_3 at $200-250^\circ\text{C}$ is associated with the formation of nitrogen containing compounds **X** and **Y**, respectively. **X** and **Y**, respectively, are

(A)	N_2 and N_2O
(B)	NH_3 and NO_2
(C)	NO and N_2O
(D)	N_2 and NH_3

Answer: A

- Q.2 The correct order of the wavelength maxima of the absorption band in the ultraviolet-visible region for the given complexes is

(A)	$[\text{Co}(\text{CN})_6]^{3-} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+} < [\text{Co}(\text{NH}_3)_5(\text{Cl})]^{2+}$
(B)	$[\text{Co}(\text{NH}_3)_5(\text{Cl})]^{2+} < [\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{CN})_6]^{3-}$
(C)	$[\text{Co}(\text{CN})_6]^{3-} < [\text{Co}(\text{NH}_3)_5(\text{Cl})]^{2+} < [\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+}$
(D)	$[\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{CN})_6]^{3-} < [\text{Co}(\text{NH}_3)_5(\text{Cl})]^{2+} < [\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{3+}$

Answer: A

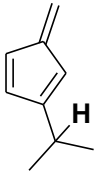
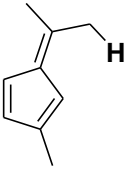
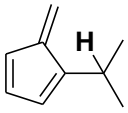
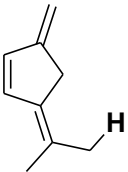
- Q.3 One of the products formed from the reaction of permanganate ion with iodide ion in neutral aqueous medium is

(A)	I_2	(B)	IO_3^-	(C)	IO_4^-	(D)	IO_2^-
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Answer: B

Q.4

Consider the depicted hydrogen (**H**) in the hydrocarbons given below. The most acidic hydrogen (**H**) is

(A)		(B)	
(C)		(D)	

Answer: B

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;
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.
- For example, in a question, if (A), (B) and (D) are the **ONLY** three options corresponding to correct answers, then
 choosing **ONLY** (A), (B) and (D) will get +4 marks;
 choosing **ONLY** (A) and (B) will get +2 marks;
 choosing **ONLY** (A) and (D) will get +2 marks;
 choosing **ONLY** (B) and (D) will get +2 marks;
 choosing **ONLY** (A) will get +1 mark;
 choosing **ONLY** (B) will get +1 mark;
 choosing **ONLY** (D) will get +1 mark;
 choosing no option (i.e. the question is unanswered) will get 0 marks; and
 choosing any other combination of options will get -2 marks.

Q.5 Regarding the molecular orbital (MO) energy levels for homonuclear diatomic molecules, the **INCORRECT** statement(s) is(are)

(A)	Bond order of Ne_2 is zero.
(B)	The highest occupied molecular orbital (HOMO) of F_2 is σ -type.
(C)	Bond energy of O_2^+ is smaller than the bond energy of O_2 .
(D)	Bond length of Li_2 is larger than the bond length of B_2 .

Answer: B, C

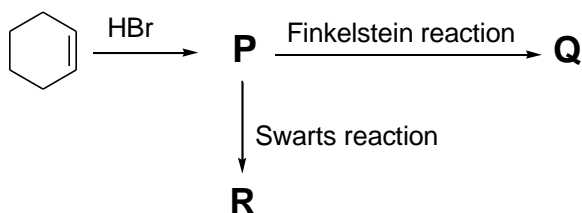
Q.6 The pair(s) of diamagnetic ions is(are)

(A)	La^{3+} , Ce^{4+}
(B)	Yb^{2+} , Lu^{3+}
(C)	La^{2+} , Ce^{3+}
(D)	Yb^{3+} , Lu^{2+}

Answer: A, B

Q.7

For the reaction sequence given below, the correct statement(s) is(are)



(In the options, X is any atom other than carbon and hydrogen, and it is different in **P**, **Q** and **R**)

(A)	C–X bond length in P , Q and R follows the order Q > R > P .
(B)	C–X bond enthalpy in P , Q and R follows the order R > P > Q .
(C)	Relative reactivity toward $\text{S}_{\text{N}}2$ reaction in P , Q and R follows the order P > R > Q .
(D)	$\text{p}K_{\text{a}}$ value of the conjugate acids of the leaving groups in P , Q and R follows the order R > Q > P .

Answer: B

SECTION 3 (Maximum Marks: 24)

- This section contains **SIX (06)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- If the numerical value has more than two decimal places, **truncate/round-off** the value to **TWO** decimal places.
- Answer to each question will be evaluated **according to the following marking scheme**:
Full Marks : +4 If ONLY the correct numerical value is entered in the designated place;
Zero Marks : 0 In all other cases.

- Q.8 In an electrochemical cell, dichromate ions in aqueous acidic medium are reduced to Cr^{3+} . The current (in amperes) that flows through the cell for 48.25 minutes to produce 1 mole of Cr^{3+} is _____.

Use: 1 Faraday = 96500 C mol^{-1}

Answer: 100

- Q.9 At 25°C , the concentration of H^+ ions in $1.00 \times 10^{-3} \text{ M}$ aqueous solution of a weak monobasic acid having acid dissociation constant (K_a) of 4.00×10^{-11} is $X \times 10^{-7} \text{ M}$. The value of X is _____.

Use: Ionic product of water (K_w) = 1.00×10^{-14} at 25°C

Answer: [2.2 to 2.3]

- Q.10 Molar volume (V_m) of a van der Waals gas can be calculated by expressing the van der Waals equation as a cubic equation with V_m as the variable. The ratio (in mol dm^{-3}) of the coefficient of V_m^2 to the coefficient of V_m for a gas having van der Waals constants $a = 6.0 \text{ dm}^6 \text{ atm mol}^{-2}$ and $b = 0.060 \text{ dm}^3 \text{ mol}^{-1}$ at 300 K and 300 atm is _____.

Use: Universal gas constant (R) = $0.082 \text{ dm}^3 \text{ atm mol}^{-1} \text{ K}^{-1}$

Answer: [-7.2 to -7]

- Q.11 Considering ideal gas behavior, the expansion work done (in kJ) when 144 g of water is electrolyzed completely under constant pressure at 300 K is _____.

Use: Universal gas constant (R) = $8.3 \text{ J K}^{-1} \text{ mol}^{-1}$; Atomic mass (in amu): $\text{H} = 1$, $\text{O} = 16$

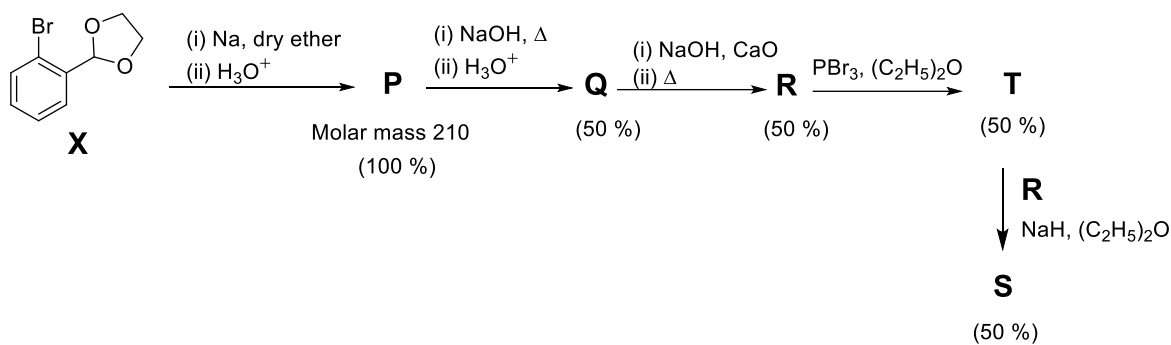
Answer: [-29.95 to -29.8] OR [29.8 to 29.95]

- Q.12 The monomer (X) involved in the synthesis of Nylon 6,6 gives positive carbylamine test. If 10 moles of X are analyzed using Dumas method, the amount (in grams) of nitrogen gas evolved is _____.

Use: Atomic mass of N (in amu) = 14

Answer: 280

- Q.13 The reaction sequence given below is carried out with 16 moles of **X**. The yield of the major product in each step is given below the product in parentheses. The amount (in grams) of **S** produced is _____.



Use: Atomic mass (in amu): H = 1, C = 12, O = 16, Br = 80

Answer: 175

SECTION 4 (Maximum Marks: 12)

- This section contains **THREE (03)** 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 : +4 **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.

Q.14

The correct match of the group reagents in **List-I** for precipitating the metal ion given in **List-II** from solutions, is

List-I

- (P) Passing H_2S in the presence of NH_4OH
 (Q) $(\text{NH}_4)_2\text{CO}_3$ in the presence of NH_4OH
 (R) NH_4OH in the presence of NH_4Cl
 (S) Passing H_2S in the presence of dilute HCl

List-II

- (1) Cu^{2+}
 (2) Al^{3+}
 (3) Mn^{2+}
 (4) Ba^{2+}
 (5) Mg^{2+}

(A)	$\text{P} \rightarrow 3; \text{Q} \rightarrow 4; \text{R} \rightarrow 2; \text{S} \rightarrow 1$
(B)	$\text{P} \rightarrow 4; \text{Q} \rightarrow 2; \text{R} \rightarrow 3; \text{S} \rightarrow 1$
(C)	$\text{P} \rightarrow 3; \text{Q} \rightarrow 4; \text{R} \rightarrow 1; \text{S} \rightarrow 5$
(D)	$\text{P} \rightarrow 5; \text{Q} \rightarrow 3; \text{R} \rightarrow 2; \text{S} \rightarrow 4$

Answer: A

Q.15

The major products obtained from the reactions in **List-II** are the reactants for the named reactions mentioned in **List-I**. Match each entry in **List-I** with the appropriate entry in **List-II** and choose the correct option.

List-I

(P) Stephen reaction

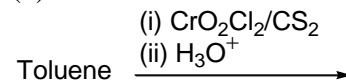
(Q) Sandmeyer reaction

(R) Hoffmann bromamide degradation reaction

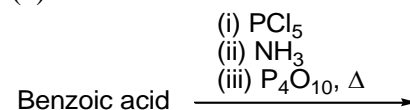
(S) Cannizzaro reaction

List-II

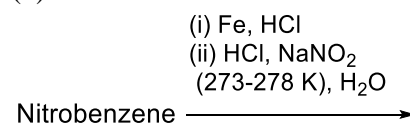
(1)



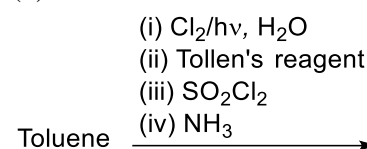
(2)



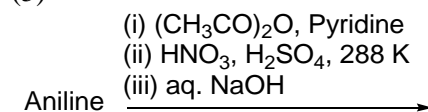
(3)



(4)



(5)



(A)	P \rightarrow 2; Q \rightarrow 4; R \rightarrow 1; S \rightarrow 3
(B)	P \rightarrow 2; Q \rightarrow 3; R \rightarrow 4; S \rightarrow 1
(C)	P \rightarrow 5; Q \rightarrow 3; R \rightarrow 4; S \rightarrow 2
(D)	P \rightarrow 5; Q \rightarrow 4; R \rightarrow 2; S \rightarrow 1

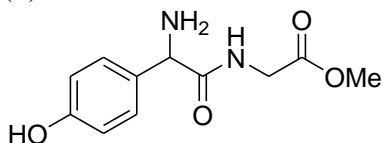
Answer: B

Q.16

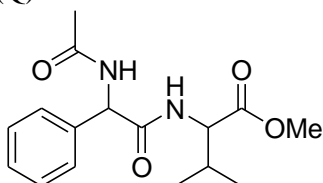
Match the compounds in **List-I** with the appropriate observations in **List-II** and choose the correct option.

List-I

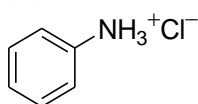
(P)



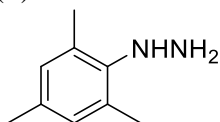
(Q)



(R)



(S)

**List-II**

(1) Reaction with phenyl diazonium salt gives yellow dye.

(2) Reaction with ninhydrin gives purple color and it also reacts with FeCl_3 to give violet color.

(3) Reaction with glucose will give corresponding hydrazone.

(4) Lassaigne extract of the compound treated with dilute HCl followed by addition of aqueous FeCl_3 gives blood red color.

(5) After complete hydrolysis, it will give ninhydrin test and it **DOES NOT** give positive phthalein dye test.

(A)	P \rightarrow 1; Q \rightarrow 5; R \rightarrow 4; S \rightarrow 2
(B)	P \rightarrow 2; Q \rightarrow 5; R \rightarrow 1; S \rightarrow 3
(C)	P \rightarrow 5; Q \rightarrow 2; R \rightarrow 1; S \rightarrow 4
(D)	P \rightarrow 2; Q \rightarrow 1; R \rightarrow 5; S \rightarrow 3

Answer: B**END OF THE QUESTION PAPER**