JEE Main 2024 April 5 Shift 2 Chemistry Question Paper

Time Allowed :1 Hour	Maximum Marks :100	Total Questions :30

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 90 questions. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has two sections.
   (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and –1 mark for wrong answer.
   (ii) Section-B: This section contains 10 questions. In Section-B, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and –1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

Chemistry

Question 1: Match List-I with List-II.

List-I	List-II
(A) ICl	(I) T-Shape
(B) ICl_3	(II) Square pyramidal
(C) ClF_5	(III) Pentagonal bipyramidal
(D) IF_7	(IV) Linear

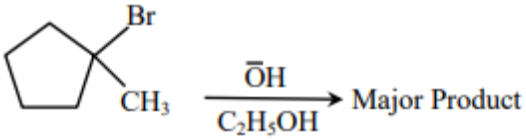
Options:
(1) (A)–(I), (B)–(IV), C–(III), D–(II)
(2) (A)–(I), (B)–(III), C–(II), D–(IV)
(3) (A)–(IV), (B)–(I), C–(II), D–(III)
(4) (A)–(IV), (B)–(III), C–(II), D–(I)

Question 2: While preparing crystals of Mohr's salt, dil. H_2SO_4 is added to a mixture of ferrous sulphate and ammonium sulphate. Before dissolving this mixture in water, dil. H_2SO_4 is added here to:

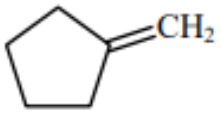
Options:

(1) prevent the hydrolysis of ferrous sulphate
(2) prevent the hydrolysis of ammonium sulphate
(3) make the medium strongly acidic
(4) increase the rate of formation of crystals

Question 3: Identify the major product in the following reaction.



Options:

(1)


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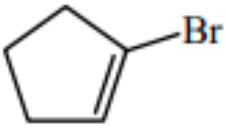

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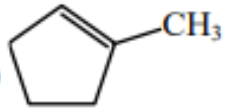

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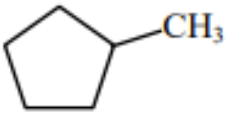
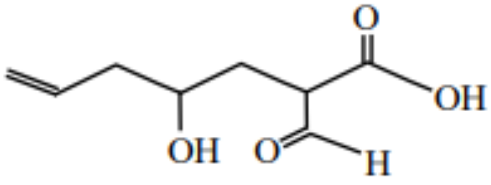


Question 4: The correct nomenclature for the following compound is:



Options:

(1) 2-carboxy-4-hydroxyhept-6-enal
(2) 2-carboxy-4-hydroxyhept-7-enal
(3) 2-formyl-4-hydroxyhept-6-enoic acid
(4) 2-formyl-4-hydroxyhept-7-enoic acid

Question 5: Given below are two statements: one is labeled as Assertion (A) and the other is labeled as Reason (R).

Assertion (A): NH_3 and NF_3 molecules have a pyramidal shape with a lone pair of electrons on the nitrogen atom. The resultant dipole moment of $NH3$ is greater than that of NF_3.
Reason (R): In $NH3$, the orbital dipole due to the lone pair is in the same direction as the resultant dipole moment of the $N-H$ bonds. F is the most electronegative element.

In the light of the above statements, choose the correct answer from the options given below:

Options:
(1) Both (A) and (R) are true, and (R) is the correct explanation of (A).
(2) (A) is false, but (R) is true.
(3) (A) is true, but (R) is false.
(4) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).

Question 6: Given below are two statements:

Statement I: On passing $HCl(g)$ through a saturated solution of $BaCl_2$, at room temperature, white turbidity appears.
Statement II: When $HCl(g)$ is passed through a saturated solution of $NaCl$, sodium chloride is precipitated due to the common ion effect.

In the light of the above statements, choose the most appropriate answer from the options given below:

Options:
(1) Statement I is correct but Statement II is incorrect
(2) Both Statement I and Statement II are incorrect
(3) Statement I is incorrect but Statement II is correct
(4) Both Statement I and Statement II are correct

Question 7:
The metal atom present in the complex $MABXL$ (where A, B, X, and L are unidentate ligands and M is metal) involves sp^3 hybridization. The number of geometrical isomers exhibited by the complex is:

Options:
(1) 4
(2) 0
(3) 2
(4) 3

Question 8: Match List-I with List-II.

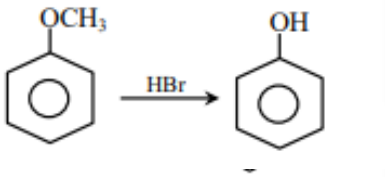
List-I (Pair of Compounds)	List-II (Isomerism)
(A) *n*-propanol and isopropanol	(I) Metamerism
(B) Methoxypropane and ethoxyethane	(II) Chain Isomerism
(C) Propanone and propanal	(III) Position Isomerism
(D) Neopentane and isopentane	(IV) Functional Isomerism

Options:
(1) (A)–(III), (B)–(I), (C)–(IV), (D)–(II)
(2) (A)–(II), (B)–(I), (C)–(IV), (D)–(III)
(3) (A)–(I), (B)–(III), (C)–(IV), (D)–(II)
(4) (A)–(IV), (B)–(I), (C)–(III), (D)–(II)

Question 9: The quantity of silver deposited when one coulomb charge is passed through $AgNO_3$ solution:

Options:
(1) 0.1 g atom of silver
(2) 1 chemical equivalent of silver
(3) 1 g of silver
(4) 1 electrochemical equivalent of silver

Question 10: Which one of the following reactions is NOT possible?

Options:
(1)


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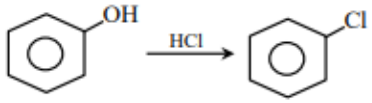

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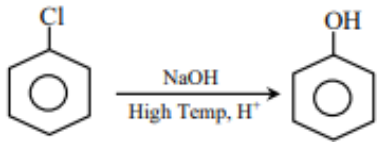

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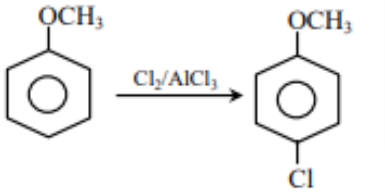


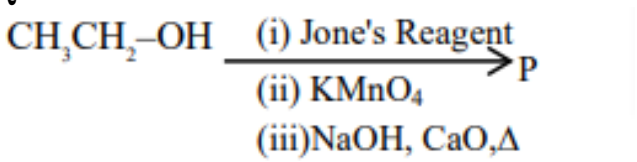
Question 11: Given below are two statements:

Statement I: The metallic radius of Na is 1.86 Å, and the ionic radius of Na^+ is lesser than 1.86 Å.
Statement II: Ions are always smaller in size than the corresponding elements.

In the light of the above statements, choose the correct answer from the options given below:

Options:
(1) Statement I is correct but Statement II is false
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is incorrect but Statement II is true

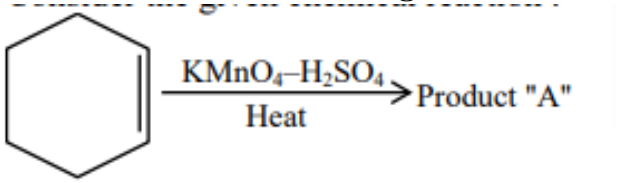
Question 12:



Consider the above reaction sequence and identify the major product P.

Options:
(1) Methane
(2) Methanal
(3) Methoxymethane
(4) Methanoic acid

Question 13: Consider the given chemical reaction:



Product "A" is:

Options:
(1) Picric acid
(2) Oxalic acid
(3) Acetic acid
(4) Adipic acid

Question 14: For the electrochemical cell:

$$M—M^{2+}||X—X^{2-}$$

If:

$$E^\circ(\mathrm{M}^{2+}/\mathrm{M}) = 0.46\,\mathrm{V}, \quad E^\circ(\mathrm{X}/\mathrm{X}^{2-}) = 0.34\,\mathrm{V},$$

Which of the following is correct?

Options:
(1) $E_{\text{cell}} = -0.80\,\mathrm{V}$
(2) $M + X^{2-} -> M^{2+} + X^{2-}$ is a spontaneous reaction
(3) $M^{2+} + X^{2-} -> M + X$ is a spontaneous reaction
(4) $E_{\text{cell}} = 0.80\,\mathrm{V}$

Question 15: The number of moles of methane required to produce 11 g of $CO_2(g)$ after complete combustion is:
(Given molar mass of methane in g mol^{-1}: 16)

Options:
(1) 0.75
(2) 0.25
(3) 0.35
(4) 0.5

Question 16: The number of complexes from the following with no electrons in the t_2 orbital is:

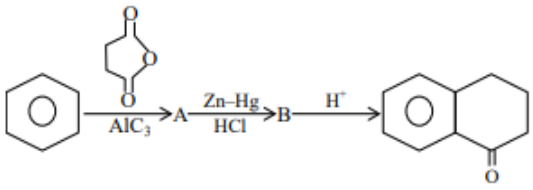
$$TiCl_4, [MnO_4]^-, [FeO_4]^{2-}, [FeCl_4]^-, [CoCl_4]^{2-}$$

Options:
(1) 3
(2) 1
(3) 4
(4) 2

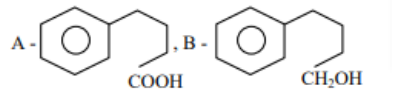
Question 17: The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is _____: $\mathbf{Ti}^{2+}, Cr^{2+}, V^{2+}$

Options:
(1) 0
(2) 2
(3) 3
(4) 1

Question 18: Identify A and B in the given chemical reaction sequence : -



Options:

(1)


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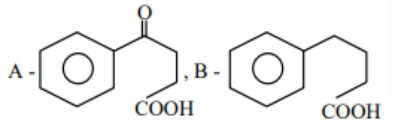

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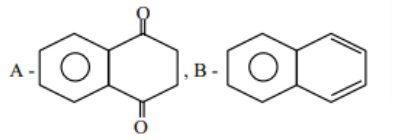

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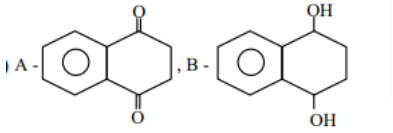


Question 19: The correct statements from the following are:

(A) The decreasing order of atomic radii of group 13 elements is $Tl > In > Ga > Al > B$.
(B) Down the group 13, electronegativity decreases from top to bottom.
(C) Al dissolves in dilute HCl and liberates $H2$, but concentrated $HNO3$ renders Al passive by forming a protective oxide layer on the surface.
(D) All elements of group 13 exhibit a highly stable $+1$ oxidation state.
(E) Hybridization of Al in $[Al(H2O)_6]^{3+}$ ion is sp^3d^2.

Choose the correct answer from the options given below:

Options:
(1) (C) and (E) only
(2) (A), (C) and (E) only
(3) (A), (B), (C) and (E) only
(4) (A) and (C) only

Question 20: Coagulation of egg, on heating, is because of:

Options:
(1) Denaturation of protein occurs
(2) The secondary structure of protein remains unchanged

(3) Breaking of the peptide linkage in the primary structure of protein occurs
(4) Biological property of protein remains unchanged

Question 21: Combustion of 1 mole of benzene is expressed as:

$$C_6H_6(l) + \frac{15}{2}O_2(g) -> 6CO_2(g) + 3H_2O(l)$$

The standard enthalpy of combustion of 2 mol of benzene is $-x$ kJ. Calculate the value of x given the following data:
Standard enthalpy of formation of $C_6H_6(l)$: $48.5\,\text{kJ mol}^{-1}$.
Standard enthalpy of formation of $CO_2(g)$: $-393.5\,\text{kJ mol}^{-1}$.
Standard enthalpy of formation of $H_2O(l)$: $-286\,\text{kJ mol}^{-1}$.

Question 22:
The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of CO_2. The sum of spin-only magnetic moment values of A and B is ____B.M. (Nearest integer).
(Given atomic numbers: $C = 6, Na = 11, O = 8, Fe = 26, Cr = 24$)

Question 23: X of ethanamine was subjected to reaction with $NaNO_2/HCl$ followed by hydrolysis to liberate N_2 and HCl. The HCl generated was completely neutralized by 0.2 moles of $NaOH$. X is ____g.

Question 24: In an atom, the total number of electrons having quantum numbers $n = 4$, $|m_l| = 1$, and $m_s = -\frac{1}{2}$ is:

Question 25: Using the given figure, the ratio of R_f values of sample A and sample C is $x \times 10^{-2}$. Value of x is:

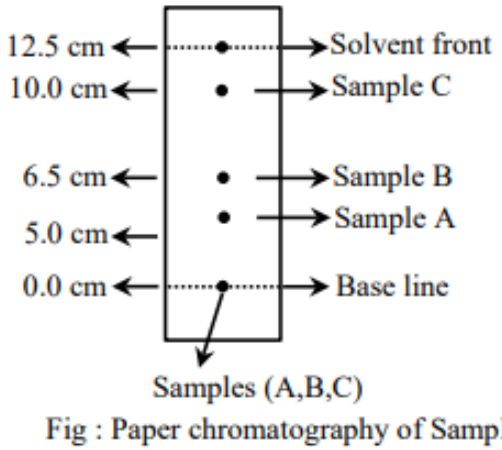


Fig : Paper chromatography of Samples

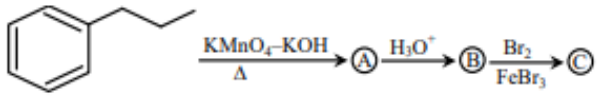
Question 26: In the Claisen-Schmidt reaction to prepare 351 g of dibenzalacetone using 87 g of acetone, the amount of benzaldehyde required is _____g. (Nearest integer)

Question 27: Consider the following single-step reaction in the gas phase at constant temperature:

$$2A_{(g)} + B_{(g)} -> C_{(g)}.$$

The initial rate of the reaction is recorded as r_1, when the reaction starts with $1.5\,\text{atm}$ pressure of A and $0.7\,\text{atm}$ pressure of B. After some time, the rate r_2 is recorded when the pressure of C becomes $0.5\,\text{atm}$. The ratio $\frac{r_1}{r_2}$ is _____ $\times 10^{-1}$ (Nearest integer).

Question 28: The product C in the following sequence of reactions has _____ π bonds:



Question 29: Considering acetic acid dissociates in water, its dissociation constant is 6.25×10^{-5}. If 5 mL of acetic acid is dissolved in 1 litre of water, the solution will freeze at $-x \times 10^{-2}\,^{\circ}\text{C}$, provided pure water freezes at 0°C.
Given:

- K_f of water $= 1.86\,\text{K kg mol}^{-1}$,
- Density of acetic acid $= 1.2\,\text{g cm}^{-3}$,
- Molar mass of water $= 18\,\text{g mol}^{-1}$,
- Molar mass of acetic acid $= 60\,\text{g mol}^{-1}$,
- Density of water $= 1\,\text{g cm}^{-3}$.

Acetic acid dissociates as:

$$CH_3COOH <=> CH_3COO^- + H^+.$$

Question 30: The number of compounds from the following with zero dipole moment is _____:

$$HF, H_2, H_2S, CO_2, NH_3, BF_3, CH_4, CHCl_3, SiF_4, H_2O, BeF_2.$$
