JEE (Main) QUESTION PAPER 2024

27th January Shift 1

Time : 3 Hours **Total Marks : 300**

General Instructions :

1. *There are three subjects in the question paper consisting of Chemistry Q. no. 1 to 6.*
2. *This Paper is divided into two sections:*
   - *Section A Consists of 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.*
   - *Section B consist of 10 questions, **Numerical Value Type Questions** - In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.*
3. *There will be only one correct choice in the given four choices in Section A. For each question 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice for Section A questions and zero mark will be awarded for not attempted question.*
4. *For Section B questions, 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.*

Chemistry

Section A

Q. 1. The correct statement regarding nucleophilic substitution reaction in a chiral alkyl halide is:

(1) Racemisation occurs in S_N1 reaction and inversion occurs in S_N2 reaction.

(2) Retention occurs in S_N1 reaction and inversion occurs in S_N2 reaction.

(3) Racemisation occurs in S_N1 reaction and retention occurs in S_N2 reaction.

(4) Racemisation occurs in both S_N1 and S_N2 reactions.

Q. 2. Given below are two statement:

Statement (I): The 4f and 5f series of elements are placed separately in the periodic table to preserve the principle of classification.

Statement (II): s-block element can be found in pure form in nature.

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

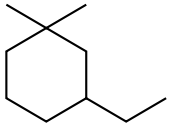
(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are false

(3) Both Statement I and Statement II are true

(4) Statement I is true but Statement II is false

Q. 3. IUPAC name of following compound (P) is:



(P)

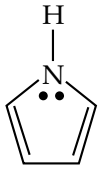
(1) 1-Ethyl-3, 3-dimethylcyclohexane

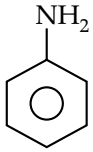
(2) 1-Ethyl-5, 5-dimethylcyclohexane

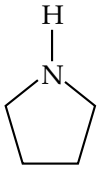
(3) 1, 1-Dimethyl-3-ethylcyclohexane

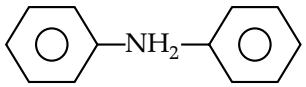
(4) 3-Ethyl-1, 1-dimethylcylohexane

Q. 4. Which of the following is strongest Bronsted base ?

(1) 

(2) 

(3) 

(4) 

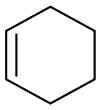
Q. 5. NaCl reacts with conc. H_2SO_4 and $K_2Cr_2O_7$ to give reddish fumes (B), which react with NaOH to give yellow solution (C). (B) and (C) respectively are:

(1) CrO_2Cl_2 , $KHSO_4$

(2) Na_2CrO_4, CrO_2Cl_2

(3) CrO_2Cl_2 , Na_2CrO_4

(4) CrO_2Cl_2, $Na_2Cr_2O_7$

Q. 6. Cyclohexene  is ..... type of an organic compound.

(1) Benzenoid non-aromatic
(2) Benzenoid aromatic
(3) Alicyclic
(4) Acyclic

Q. 7. Given below are two statement :

Statement (I): Aqueous solution of ammonium carbonate is basic.

Statement (II): Acidic/basic nature of salt solution of a salt of weak acid and weak base depends on K_a and K_b value of acid and the base forming it.

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

(1) Both Statement **I** and Statement **II** are correct.
(2) Statement **I** is correct but Statement **II** is incorrect.
(3) Statement **I** is incorrect but Statement **II** is correct.
(4) Both Statement **I** and Statement **II** are in correct.

Q. 8. Two nucleotides are joined together by a linkage known is :

(1) Peptide linkage
(2) Disulphide linkage
(3) Phosphodiester linkage
(4) Glycosidic linkage

Q. 9. The electronic configuration for Neodymium is :

[Atomic Number for Neodymium 60]

(1) $[Xe]\ 5f^7\ 7s^2$ **(2)** $[Xe]\ 4f^6\ 6s^2$
(3) $[Xe]\ 4f^4\ 6s^2$ **(4)** $[Xe]\ 4f^1\ 5d^1\ 6s^2$

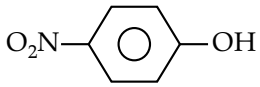
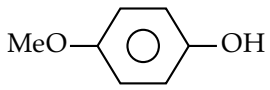
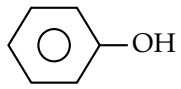
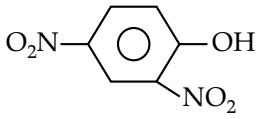
Q. 10. A solution of two miscible liquids showing negative deviation from Raoult's law will have ?

(1) decreased vapour pressure, increased boiling point
(2) increased vapour pressure, decreased boiling point
(3) increased vapour pressure, decreased boiling point
(4) increased vapour pressure, increased boiling point

Q. 11. Choose the polar molecule from the following :

(1) $CHCl_3$ **(2)** CCl_4
(3) CO_2 **(4)** $CH_2 = CH_2$

Q. 12. The ascending order of acidity of –OH group in the following compounds is :

(a) Bu – OH
(b) 
(c) 
(d) 
(e) 

Choose the correct answer from the option given below :

(1) (c) < (a) < (d) < (b) < (e)
(2) (c) < (d) < (b) < (a) < (e)
(3) (a) < (d) < (c) < (b) < (e)
(4) (a) < (c) < (d) < (b) < (e)

Q. 13. Given below are two statement:

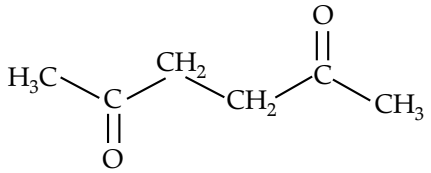
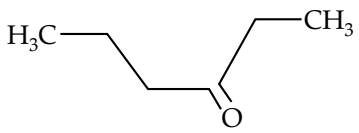
Statement (I): p-nitrophenol is more acidic than m-nitrophenol and o-nitrophenol.

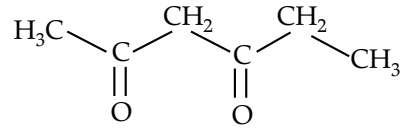
Statement (II): Ethanol will give immediate turbidity with Lucas reagent.

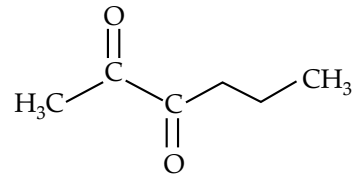
In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both Statement I and Statement II are true.
(2) Statement I is false but Statement II is true.
(3) Statement I is true but Statement II is false.
(4) Both Statement I and Statement II are false.

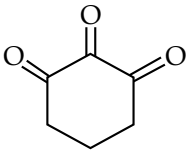
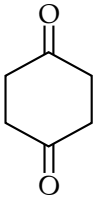
Q. 14. Which of the following has highly acidic hydrogen ?

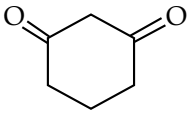
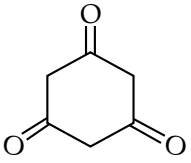
(1) 
(2) 

(3) 

(4) 

Q. 15. Highest enol content will be shown by :

(1)  **(2)** 

(3)  **(4)** 

Q. 16. Which of the following electronic configuration would be associated with the highest magnetic moment ?

(1) [Ar] $3d^6$ **(2)** [Ar] $3d^7$
(3) [Ar] $3d^3$ **(4)** [Ar] $3d^8$

Q. 17. Element not showing variable oxidation state is :

(1) Chlorine **(2)** Iodine
(3) Bromine **(4)** Fluorine

Q. 18. Given below are two statement : one is labelled as Assertion (A) and the other is labelled as Reason (R)

Assertion (A) : Melting point of Boron (2453 K) is unusually high in group 13 elements

Reason (R): Solid Boron has very strong crystalline lattice.

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

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(2) (A) is false but (R) is true
(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(4) (A) is true but (R) is false

Q. 19. Yellow compound of lead chromate gets dissolved on treatment with hot NaOH solution. The product of lead formed is a :

(1) Tetraanionic complex with coordination number six
(2) Dianionic complex with coordination number six
(3) Neutral complex with coordination number four
(4) Dianionic complex with coordination number four

Q. 20. Consider the following complex ions

P = $[FeF_6]^{3-}$

Q = $[V(H_2O)_6]^{2+}$

R = $[Fe(H_2O)_6]^{2+}$

The correct order of the complex ions, according to their spin only magnetic moment values in (B.M.) is:

(1) R < Q < P **(2)** Q < R < P
(3) R < P < Q **(4)** Q < P < R

Section B

Q. 21. Among the following total number of meta directing functional group is ..... .

(Integer based)

$-OCH_3$, $-NO_2$, –CN, $-CH_3$, $-NHCOCH_3$, –COR, –OH, – COOH, –Cl

Q. 22. The mass of silver (Molar mass of Ag : 108 $gmol^{-1}$) displaced by a quantity of electricity which displace 5600 mL of O_2 at S.T.P will be ..... g.

Q. 23. 3-Methylhex-2-ene on reaction with HBr in presence of peroxide forms an addition product (A). The number of possible stereoisomers for 'A' is ..... .

Q. 24. Sum of bond order of CO and NO^+ is .....

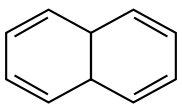
Q. 25. From the given list, the number of compounds with +4 oxidation state of Sulphur is .....

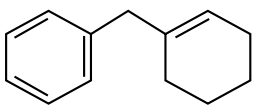
SO_3, H_2SO_3, $SOCl_2$, SF_4, $BaSO_4$, $H_2S_2O_7$

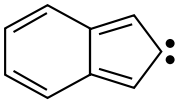
Q. 26. The number of electrons present in all the completely filled subshells having $n = 4$ and S = +1/2 is ..... .

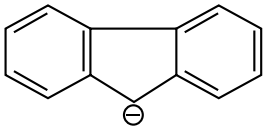
Q. 27. Mass of methane required to produce 22g of CO_2 after complete combustion is ..... g.
(Given Molar mass in g mol^{-1} C = 12.0
H = 1.0
O = 16.0)

Q. 28. Among the given organic compounds, the total number of aromatic compounds is ..... .

(1) 

(2) 

(3) 

(4) 

Q. 29. If three moles of an ideal gas at 300 k expand isothermally from 30 dm^3 to 45 dm^3 against a constant opposing pressure of 80 kPa, then the amount of heat transferred is ..... J.

Q. 30. Consider the following data for the given reaction

$$2HI(g) \longrightarrow H_2(g) + I_2(g)$$

	1	2	3
HI (mol L^{-1})	0.005	0.01	0.02
Rate (mol L^{-1} S^{-1})	7.5×10^{-4}	3.0×10^{-3}	1.2×10^{-2}

The order of the reaction is ..... .

■■■

Answer Key

Chemistry			
Q. No.	**Answer**	**Topic Name**	**Chapter Name**
1	(1)	Mechanisms of substitution reactions.	Organic Compounds Containing Halogens
2	(4)	s, p. d and f block elements	Classification Of Elements And Periodicity In Properties
3	(4)	Nomenclature	Some Basic Principles Of Organic Chemistry
4	(3)	Ionic equilibrium	Equilibrium
5	(3)	Uses of $K_2Cr_2O_7$	d - and f- Block Elements
6	(3)	Nomenclature	Some Basic Principles Of Organic Chemistry
7	(1)	Ionic equilibrium	Equilibrium
8	(3)	NUCLEIC ACIDS	Biomolecules
9	(3)	periodic table	Classification Of Elements And Periodicity In Properties
10	(1)	Colligative properties	Solutions
11	(1)	Carbon family	P- Block Elements
12	(4)	Alcohols, Phenols	Organic Compounds Containing Oxygen
13	(3)	Phenols	Organic Compounds Containing Oxygen
14	(3)	Ketones	Organic Compounds Containing Oxygen
15	(4)	Enol form	Organic Compounds Containing Oxygen
16	(1)	Magnetic moment	Coordination Compound
17	(4)	Halogens	P- Block Elements
18	(3)	Boron family	P- Block Elements
19	(4)	Formation	Coordination Compound
20	(2)	Magnetic moment	Coordination Compound
21	[4]	Resonance	Some Basic Principles of Organic Chemistry
22	[108]	mole concept	Some Basic Concepts In Chemistry
23	[4]	Markovnikof Rule	Hydrocarbon
24	[6]	Bond Order	Chemical Bonding and Molecular Structure
25	[3]	Oxidation Number	P- Block Elements
26	[16]	Quantum numbers	Atomic Structure
27	[8]	Mole concept	Some Basic Concepts In Chemistry
28	[3]	Aromaticity	Some Basic Principles of Organic Chemistry
29	[1200]	heat capacity	Chemical Thermodynamics
30	[2]	Order of reactions	Chemical Kinetics

JEE (Main) SOLVED PAPER

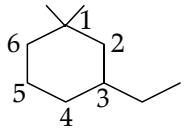
2024
27th January Shift 1

ANSWERS WITH EXPLANATIONS

1. **Option (1) is correct.**
Racemisation occurs in S_N1 reaction, and inversion occurs in S_N2 Reaction

2. **Option (4) is correct.**
s-block elements does not found in pure form, they are found as ore or minerals

3. **Option (4) is correct.**



According to IUPAC,
3-Ethyl-1,1-dimethylcylohexane

4. **Option (3) is correct.**
In the option (3) the lone pair of Nitrogen is not participating in resonance whereas in options (1), (2) and (4) the lone pair of nitrogen participating in resonance that's why (3) is more basic.
Since, *s*-character α 1/Basicity
So, In option (3) *s*-character in 25% where as in options (1), (2) & (4) *s*-character is 33.3% that's why option (3) is more basic.

5. **Option (3) is correct.**
$$4NaCl + K_2Cr_2O_7 + 6H_2SO_4\,(conc) \rightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2 + 3H_2O$$
(red)
$$CrO_2Cl_2 \rightarrow 4NaOH(aq) \rightarrow Na_2CrO_4 + 2NaCl + 2H_2O$$
(Yellow)

6. **Option (3) is correct.**
Given compound has a ring which is not aromatic or antiaromatic so such types of compounds are called alicyclic.

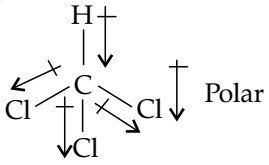
7. **Option (1) is correct.**
$Na_2CO_3 + H_2O$ = NaOH + carbonic acid since carbonic acid is week acid so solution is basic in nature
$$pH_{WBWA} = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

8. **Option (3) is correct.**
The bond formed between two nucleotide is called as phospodiester bond.

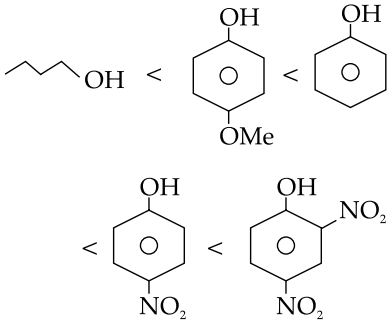
9. **Option (3) is correct.**
Electronic configuration of 'Nd' [Xe] $4f^4 6s^2$

10. **Option (1) is correct.**
A solution at two miscible liquid showing negative deviation from Raoult's law then vapour pressure will decrease, increasing its boiling point.

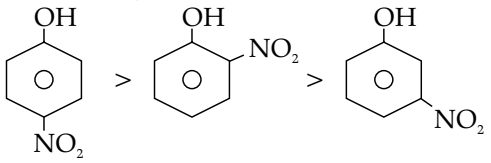
11. **Option (1) is correct.**



12. **Option (4) is correct.**
The ascending order of acidity of –OH group

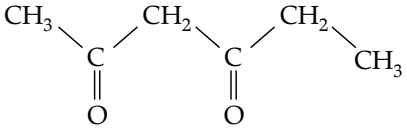


13. **Option (3) is correct.**
Acidic strength order

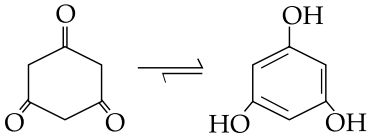


Statement II: Ethanol is 1°-alcohol, do not gives immediate turbidity with Lucas reagent.

14. **Option (3) is correct.**



15. **Option (4) is correct.**



(Aromatic)

16. **Option (1) is correct.**
Highest magnetic moment means more number of unpaired e^- . According to option is [Ar] $3d^6$. Containing 4 unpaired electrons. Hence, option (1) shows highest spin magnetic moment.

17. Option (4) is correct.

Fluorine in it's compound shows only –1 oxidation state. As it's electronegativity is highest and it has no vacant d-orbital.

18. Option (3) is correct.

Boron is non-metallic in nature. It is extremely hard and black coloured solid. Due to very strong crystalline lattice, boron has unusually high melting point. Rest of the members are soft metals with low melting point and high electrical conductivity.

19. Option (4) is correct.

$PbCrO_4 + 4NaOH \rightarrow Na_2CrO_4 + Na_2[Pb(OH)_4]$.

Complex of $Na_2[Pb(OH)_4]$ is Dianonic with CN = 4

20. Option (2) is correct.

F^- with Fe^{+3} behaves as WFL, Hence pairing does not take place, so it forms high spin complex.

$[FeF_6]^{3-} \rightarrow sp^3d^2$ hybridisation

Number of unpaired electrons = 5

$\therefore$ sp^3d^2 hybridisation

Number of unpaired electrons = 1

$[Fe(H_2O)_6]^{2+} \rightarrow sp^3d^2$

$Fe^{+2} = 3d^6$

Number of unpaired electrons = 4

$[V(H_2O)_6]^{+2} \rightarrow sp^3d^2$ hybridisation

$V^{+2} = 3d^3$

Number of unpaired electrons = 3

Spin angular momentum = S = total spin quantum no.

More the number of unpaired electrons more will be spin angular momentum. $[FeF_6]^{3-}$ has 5 unpaired electron hence maximum spin angular momentum value

21. Correct answer is [4].

– NO_2, –CN, –COR, –COOH are m-directing group.

22. Correct answer is [108].

Moles of $O_2 = \frac{5600}{22400} = 0.25$

Eq. of $O_2 = 0.25 \times 4 = 1$

Eq. of Ag = 1

Moles of Ag = 1

Mass of Ag = 108g

23. Correct answer is [4].

$$CH_3-CH=\underset{\underset{CH_3}{|}}{C}-CH_2-CH_2-CH_3 \xrightarrow[\text{Peroxide}]{HBr}$$

$$CH_3-\overset{*}{\underset{\underset{Br}{|}}{C}}H-\overset{*}{\underset{\underset{CH_3}{|}}{C}}H-CH_2-CH_2-CH_3$$

24. Correct answer is [6].

Species	Total number of electrons	Bond order
NO	14	3
CO	14	3

25. Correct answer is [3].

$H_2SO_3 \Rightarrow +4$

$SOCl_2 \Rightarrow +4$

$SF_4 \Rightarrow +4$

$SO_3 \Rightarrow +6$

$H_2S_2O_7 \Rightarrow +6$

$BaSO_4 \Rightarrow +6$

26. Correct answer is [16].

For $n = 4$

$l = 0, 1, 2, 3$

Possible subshells are 4*s*, 4*p*, 4*d* and 4*f*.

Number of electron have $S = +\frac{1}{2}$

$4s = 1$

$4p = 3$

$4d = 5$

$4f = 7$

Total number of electron with $S = +\frac{1}{2}$ for $n = 4 = 16$

27. Correct answer is [8].

Mass of CO_2 produced = 22 g

Moles of CO_2 produced = $\frac{22}{44}$ mol = 0.5 mol

1 mol of CO_2 produced by 1 mol of CH_4

0.5 mol of CO_2 can be produced by 0.5 mol of CH_4

Mole of CH_4 consumed = 0.5 mol

Mass of CH_4 consumed = 0.5 × 16 g = 8 g

28. Correct answer is [3].

The 3 compounds are aromatic as they have $4n + 2$ delocalizing π-electrons associated to that ring.

29. Correct answer is [1200].

$W = -P(V_2 - V_1) = -80\ (45 - 30) = -1200$ J

$Q = -w$

Q = 1200 J

30. Correct answer is [2].

$r \alpha [HI]^n$.

From (1) & (2) data

$$\frac{(7\times10^{-4})}{(3\times10^{-3})} = \left[\frac{(5\times10^{-3})}{(1\times10^{-2})}\right]^x$$

X = 2

■■■