THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) 2025

Signature of Invigilator

Roll. No.

Paper - II
Chemical Sciences

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Maximum Marks: 50   **No. Of Printed Pages: 8**

Instruction for the Candidate:

1. This paper consists of **FIFTY (50)** multiple choice type questions. Each Question carries **ONE (1)** mark.
2. There is no Negative Marking for Wrong Answer.
3. A separate OMR Answer Sheet has been provided to answer questions. Your answers will be evaluated based on your response in the OMR Sheet only. No credit will be given for any answering made in question booklet.
4. Defective question booklet or OMR if noticed may immediately replace by the concerned invigilator.
5. Write roll number, subject code, booklet type, category and other information correctly in the OMR Sheet else your OMR Sheet will not be evaluated by machine.
6. Select most appropriate answer to the question and darken appropriate oval on the OMR answer sheet, with black / blue ball pen only. DO NOT USE PENCIL for darkening. In case of over writing on any answer, the same will be treated as invalid. Each question has exactly one correct answer and has four alternative responses (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example:(A) ● (C) (D) where (B) is correct response.
7. Rough Work is to be done in the end of this booklet.
8. If you write your Name, Roll Number, Phone Number or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, or use abusive language or employ any other unfair means, such as change of response by scratching or using white fluid, you will render yourself liable to disqualification.
9. Calculators, Log tables any other calculating devices, mobiles, slide rule, text manuals etc are NOT allowed in the examination hall. If any of above is seized from the candidates during examination time; he/ she will be immediately debarred from the examination and corresponding disciplinary action will be initiated by the Center Supervisor as deemed fit.
10. DO NOT FOLD or TEAR OMR Answer sheet as machine will not be able to recognize torn or folded OMR Answer sheet.
11. **You have to return the OMR Answer Sheet to the invigilator at the end of the examination compulsorily** and must not carry it with you outside the Examination Hall. You are however, allowed to carry original question booklet on conclusion of examination.

Paper - II
Chemical Sciences

Note: This paper contains **FIFTY (50)** multiple-choice questions. Each Question carries **ONE (1)** mark.

Q. 1   Which of the following has the maximum number of unpaired electrons?
A. Mg^{2+} B. Ti^{3+}
C. V^{3+} D. Fe^{2+}

Q. 2   The shapes of IF_5 and IF_7 are, respectively, _____.
A.   Octahedral and tetrahedral   B. Trigonal bipyramidal and Square antiprismatic
C.   Square pyramidal and   D.   Distorted square planar and distorted octahedral
pentagonal bipyramidal

Q. 3   Identify the species that does not produce oxygen when heated.
A. $(NH_4)_2Cr_2O_7$ B. $K_2Cr_2O_7$
C. $KClO_3$ D. $Zn(ClO_3)_2$

Q. 4   Itai-itai disease caused by
A. Mercury poisoning   B. Lead poisoning
C. Cadmium poisoning   D. Arsenic poisoning

Q. 5   Which alloy forms the fine-grained solid catalyst known as Raney nickel, commonly used in various industrial applications?
A. Ni-Zr   B. Al-Si
C. Ni-Al   D. Ti-Ni

Q. 6   Identify the pair of compounds where both metals exhibit their highest possible oxidation states.
A. CrO_2Cl_2, MnO_4^- B. TiO_2, MnO_2
C. $[Co(CN)_6]^{3-}$, MnO_2 D. $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$

Q. 7 $[PdCl_3(C_2H_4)]^- + H_2O \longrightarrow CH_3CHO + Pd + 2HCl + Cl^-$
Identify the above reaction as _____.
A. Oxidative addition reaction   B. Reductive elimination reaction
C. Insertion reaction   D. Nucleophilic replacement reaction

Q. 8   The structure of $Fe_3(CO)_{12}$ consists of:
A. 0 bridging and 12 terminal CO   B. 1 bridging and 11 terminal CO groups
groups
C. 2 bridging and 10 terminal CO   D. 3 bridging and 9 terminal CO groups
groups

Q. 9   What are the oxidation state and coordination number of the metal in Wilkinson's catalyst?
A. 1 and 4   B. 2 and 6
C. 3 and 6   D. 3 and 4

Q. 10   Lanthanides can be separated by
A. Ion exchange method   B. Oxidation method
C. Reduction method   D. Magnetic method

Q. 11   The STYX code of B_4H_{10} is _____.
A. 4012   B. 4120
C. 4220   D. 3210

Q. 12   When a radioactive substance is placed in a vacuum, its disintegration rate per second _____.
A. Suffers a slight decrease   B. Increased considerably
C. Increase only if the products are   D. Not affected
gaseous.

Q. 13   Carboxypeptidase contains
A. Zn(II) and hydrolyses peptide   B. Mg(II) and hydrolyses peptide bonds
bonds
C. Zn(II) and hydrolyses CO_2 D. Mg(II) and hydrolyses CO_2

Q. 14 For a molecule that is able to permeate the gel to some extent but not freely in SEC, the K value will be:
A. Less than zero
B. Less than one
C. between zero and one
D. Either zero or one

Q. 15 What is the role of suppressor column in suppressed ion chromatography using conductivity detection?
A. To reduce noise in detector
B. To partially separate the ions before they enter analytical column
C. To reduce background conductance
D. To clean the mobile phase before it enters the analytical column

Q. 16 The actual shape of the curve for the normal distribution of measurements and its symmetry around the mean is a function of:
A. Mean
B. spread
C. number of measurements
D. standard deviation

Q. 17 Which of the following chromatographic purification methods can give quantitative yields for separation of native proteins without denaturation?
A. Gel permeation
B. Gel filtration
C. RP-HPLC
D. Ion exchange chromatography

Q. 18 Determination of DDT pesticide residue in vegetables is to be carried out using GC. Which detector will you choose to detect the smallest concentration of the pesticide?
A. FID
B. TCD
C. ECD
D. NPD

Q. 19 A method of analysis yields weights for gold that are low by 0.4 mg. What is the percent relative error caused (nearest) by this uncertainty if the weight of gold in the sample is 700 mg?
A. 0.999
B. 0.057
C. 1.000
D. 1.057

Q. 20 If a GC is operated in temperature program mode rather than isothermal mode for an analysis, which parameter in chromatogram is not affected?
A. Retention time
B. Elution order
C. Retention factor
D. Selectivity factor

Q. 21 The quantity that defines a population or distribution is called:
A. Mean
B. Statistic
C. Standard deviation
D. Parameter

Q. 22 Which of the following conditions is true when there in no weight loss in a DTG curve?_____.
A. $dW/dt \neq 0$
B. $dW/dt = 0$
C. $dW/dt > 1$
D. $dW/dt < 1$

Q. 23 Which of the following is NOT considered a cause of deviation in the Beer's Law in uv-vis absorption spectroscopy?
A. When solution concentration is greater than 0.01 M
B. Along with the analyte, another chemical species present also has absorbance
C. The incident radiation is completely monochromatic
D. Mismatched cells are used in double beam instrument

Q. 24 Which of the following electroanalytical methods is NOT Interfacial method?
A. Voltammetry
B. potentiometry
C. Electrogravimetry
D. conductometry

Q. 25 An equation in chromatography theory dealing with various phenomena occurring in the column, contributing to zone broadening, yields a plot showing relationship between:
A. Theoretical plates and flow rate of mobile phase
B. Resolution and plate height
C. Plate height and linear velocity of mobile phase
D. Resolution and velocity of mobile phase

Q. 26 According to Lindemann's theory of Unimolecular gaseous reaction, the order of reaction under low pressure limit is
A. First
B. Second
C. Third
D. Zero

Q. 27 For a reaction, A → products, a graph of [A] versus time is found to be a straight line. What is the order of this reaction?
A. zero order
B. first order
C. second order
D. third order

Q. 28 What would happen to the following reaction, when pressure is increased
$$A(g) + 2B(g) \rightleftharpoons C(g) + D(g)$$
A. Equilibrium shifts towards left
B. Equilibrium shifts towards right
C. No change in equilibrium position
D. Equilibrium constant value will become zero

Q. 29 The relationship between entropy and thermodynamic probability (W) is (where k is Boltzmann's constant)
A. $S = k + W$
B. $S = k - W$
C. $S = k + \ln W$
D. $S = k \ln W$

Q. 30 The salt bridge in the electrochemical cell serves to (B) (C) (D)
A. increase the rate at which equilibrium is attained
B. increase the voltage of the cell
C. maintain electrical neutrality
D. increase the oxidation/reduction rate

Q. 31 At what angle (in radians) first order diffraction occurs if the spacing between two planes is $\lambda/2$
A. $\pi/4$
B. $\pi/2$
C. π
D. 0

Q. 32 According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is
A. Greater than the mean velocity
B. Equal to the mean velocity
C. Equal to root mean square velocity
D. Less than the root mean square velocity

Q. 33 The total energy operator can be written as
A. $-i$
B. i
C. $-$
D. $+$

Q. 34 Mark-Houwink equation ($[\eta] = KM a$) is used for the determination of
A. Number average molar mass
B. weight average molar mass
C. viscosity average molar mass
D. Sedimentation average molar mass

Q. 35 The molar conductivities of KCl, NaCl and KNO_3 are 152, 128 and 111 S cm 2 mol -1 respectively, What is the molar conductivity of $NaNO_3$?
A. 101 S cm^2 mol^{-1}
B. 87 S cm^2 mol^{-1}
C. -101 S cm^2 mol^{-1}
D. -391 S cm^2 mol^{-1}

Q. 36 The number of degree of freedom in an equilibrium between liquid water and water vapor at a pressure of 1atm
A. 0
B. 1
C. 2
D. 3

Q. 37 The term symbol for ground state electronic configuration of nitrogen atom is
A. 6 S
B. 4 S
C. 5 D
D. 4 F

Q. 38 Statistical thermodynamics is a branch of Chemistry combining two branches namely

A. Classical thermodynamics and Chemical Kinetics

B. Classical thermodynamics and Electrochemistry

C. Classical thermodynamics and Quantum Chemistry

D. Quantum Chemistry and Electrochemistry

Q. 39 What is the IUPAC name of the following?
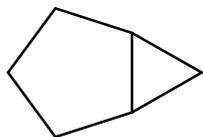
A. bicyclo [5.3.0] nonane
B. bicyclo [5.1.0] hexane
C. bicyclo [3.1.0] hexane
D. bicyclo [4.3.1] heptane

Q. 40 NMR spectrum of cyclohexane at -100 °C shows ____ signal/s.

A.   1
B.   12
C.   6
D.   2

Q. 41 Which of the following is most selective when it reacts with alkanes in the presence of light?

A. F_2
B. Br_2
C. Cl_2
D. H_2

Q. 42 Which of the following range of electromagnetic radiation is the Fingerprint Region in IR spectroscopy?

A. 625 to 1300 cm^{-1}
B. 2500 to 4000 cm^{-1}
C. 250 to 625 cm^{-1}
D. 600 to 4000 cm^{-1}

Q. 43 A compound with the formula $C_6H_{12}O$ gives a negative Tollen's test and a positive iodoform test. It produces a semicarbazone and can be reduced to hexane. What is the identity of the compound?

A. $CH_3CH_2CH_2CH_2CH_2CHO$
B. $CH_3CH_2CH_2CH_2COCH_3$
C. $CH_3CH_2CH_2COCH_2CH_3$
D. $CH_3CH_2CH_2CH_2CH_2CH=CHCH_2CH_2CH_2CH_2CH_3$

Q. 44 Which of the following has the highest potential energy for pentane?

A. gauche conformation
B. totally eclipsed conformation
C. anti conformation
D. partly eclipsed conformation

Q. 45 The order of acidity of acids (i), (ii) and (iii) shown below is
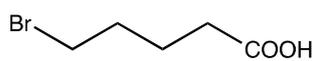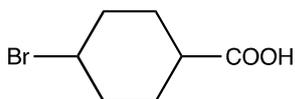
A. (iii) > (ii) > (i)
B. (ii) > (i) > (iii)
C. (iii) > (i) > (ii)
D. (i) > (ii) > (iii)

Q. 46 Which of the following is a chiral molecule?

A. 2,3-Octadiene
B. 2,4-Octadiene
C. 2,4-dimethyl-1,3-hexadiene
D. 1,7-Octadiene

Q. 47 Rate of hydrolysis of $Me_2NCH_2CH_2Cl$ is faster than that of $Me_2CHCH_2CH_2Cl$. This is due to involvement of

A. Free radical
B. Carbocation
C. Non-classical carbocation
D. Carbene

Q. 48 Which of the following is not a reducing agent?

A. HN=NH
B. $LiAlH(OR)_3$
C. Chloranil
D. Ph_3SnH

Q. 49 Cycloaddition of two molecules of ethylene to form cyclobutane is allowed under conditions
A. Aqueous   B. Redox
C. Thermal   D. Photochemical

Q. 50 The shape of cyclooctatetraene molecule is like a
A. Star   B. Circle
C. Umbrella   D. Tub

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Rough Work: