THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) 2023

Signature of Invigilator

Roll. No.

Paper - II
Chemical Sciences

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: Ⓐ ● Ⓒ Ⓓ 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.

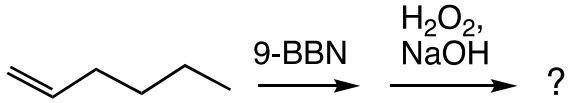
01) What is path length of UV detector in conventional HPLC system?			
A	8 nm	B	0.1 nm
C	1.8 nm	D	1 nm
02) The working pH range for a conventional silica-based C - 8 RP HPLC column is:			
A	4 - 10	B	3 - 11
C	2 - 8	D	1 - 14
03) If *s* is a good approximation of σ (sigma), the confidence interval can be significantly ------than if the estimate of σ (sigma) is based on only a few measurement values.			
A	broader	B	reliable
C	narrower	D	variable
04) An environmental air sample is to be analyzed for quantitative determination of hydrocarbons. It is suspected to contain light hydrocarbons ($C_1 - C_5$) along with the following other compounds: SO_2, H_2S, H_2O. Which carrier gas and detector combination will be most appropriate for the analysis?			
A	Helium, TCD	B	Nitrogen, TCD
C	Helium, FID	D	Nitrogen, FID
05) Sample solution is introduced in a gas chromatograph with the help of a micro liter syringe through / by:			
A	silicone septum	B	column hole
C	carrier gas supply	D	stop flow method
06) An organic acid, with pKa = 4.2, is to be extracted from its aqueous solution into chloroform. What should be pH of the aqueous solution for efficient extraction?			
A	2.0	B	4.0
C	4.2	D	6.2
07) Which of the following micro extraction techniques is considered solventless technique?			
A	SPE	B	SPME
C	SDME	D	DLLME
08) Which one of the following is NOT a method for measurement of solution pH?			
A	Glass electrode	B	Antimony electrode
C	Semiconductor sensor	D	Infra-red
09) Which of the following additives can be used to extract an ion such as perchlorate from an aqueous phase to an organic phase:			
A	No additive	B	Crown ether
C	Ion pair reagent (like tetrabutyl ammonium chloride)	D	Anionic ligand
10) Identify the electroanalytical method in which the difference in electrode potential is measured in an electrochemical cell containing analyte.			
A	voltammetry	B	coulometry
C	potentiometry	D	polarography
11) NQR is also called “zero field NMR” because:			
A	the electronic transitions have no influence on coupling	B	both the techniques deal with nuclear transitions
C	maximum resonance is observed at high density magnetic field	D	the nuclear transitions can be detected in the absence of a magnetic field

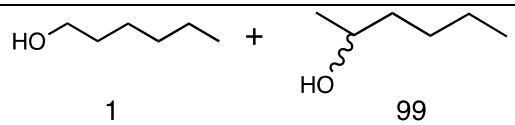
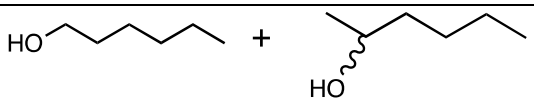
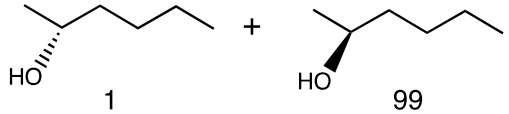
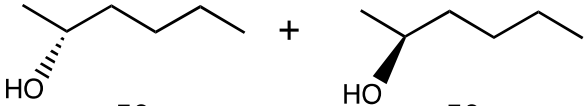
12) Which electroanalytical method depends on measurement of the cell's current over time?			
A	voltammetry	B	potentiometry
C	coulometry	D	polarography
13) What does the Pearson's product correlation coefficient express?			
A	strength and direction of a linear relationship between two variables x and y	B	strength of a linear relationship between two variables, x and y
C	proportion of the variance of one variable x that is predictable from the other variables	D	parabolic relationship between two variables x and y
14) An analytical technique in which the heat flow difference between the sample and reference material is monitored while both are subjected to the controlled temperature program is called:			
A	differential scanning calorimetry	B	differential thermal analysis
C	thermogravimetric analysis	D	thermogravimetric titration
15) The ionic radii of iso-electronic ions follow the order as			
A	$Mg^{2+} > O^{2-} > Na^{+} > N^{3-}$	B	$N^{3-} > O^{2-} > Na^{+} > Mg^{2+}$
C	$O^{2-} < N^{3-} > Mg^{+2} > Na^{+}$	D	$Mg^{2+} > Na^{+} < N^{3-} < O^{2-}$
16) Which molecule has both nonpolar intramolecular and nonpolar intermolecular bonds?			
A	F_2	B	CCl_4
C	CO	D	HF
17) Which of the following solutions has the highest boiling point?			
A	2.0 M $CaCl_2$	B	1.5 M NaCl
C	1.0 M $Al_2(SO_4)_3$	D	2.0 M $C_6H_{12}O_6$
18) Which of the following has the shortest bond length?			
A	NO	B	NO^{+}
C	NO^{2+}	D	NO^{-}
19) The geometries of CO_3^{2-} and SO_4^{2-} ions are, respectively as			
A	Linear and trigonal planar	B	Tetrahedral and trigonal planar
C	Tetrahedral and octahedral	D	Trigonal planar and tetrahedral
20) Identify the correct order of magnetic moments (spin only values in B.M.) in the following:			
A	$[MnCl_4]^{2-} > [CoCl_4]^{2-} > [Fe(CN)_6]^{4-}$	B	$[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$
C	$[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$	D	$[Fe(CN)_6]^{4-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$
21) The interaction between hard acids and hard bases is predominantly _____ in nature.			
A	Ionic	B	Covalent
C	Coordinate covalent	D	Dative π-bonding
22) Which of the following metal ions has suitable size to fit in the hole forming stable complex with cryptate-222?			
A	Li^{+}	B	Na^{+}
C	K^{+}	D	Cs^{+}
23) A yellow precipitate of $(NH_4)_2U_2O_7$, while on calcination, it yields-			
A	UO_2	B	UO_3
C	UH_3	D	U_3O_8
24) The complex ion $[Co(H_2O)_6]^{2+}$ is pinkish violet in aqueous solution and shows three adsorption bands in the electronic spectrum. As per Orgel diagram, which of the following electronic transitions is not observed?			
A	$^4T_{1g}(F) \rightarrow {}^4T_{2g}$	B	$^4T_{1g}(F) \rightarrow {}^4A_{2g}$
C	$^4T_{1g}(F) \rightarrow {}^4T_{1g}(P)$	D	$^4T_{1g}(F) \rightarrow {}^4A_{1g}$

25) A well-known naturally occurring organometallic compound is			
A	Vitamin B_{12} coenzyme	B	Myoglobin
C	Cytochrome P-450	D	Chlorophyll
26) Which statement about solids $Co_4(CO)_{12}$ and $Rh_4(CO)_{12}$ is **True**?			
A	Number of bridging CO groups in $Rh_4(CO)_{12}$ is 4.	B	Number of terminal CO groups in $Co_4(CO)_{12}$ is 9.
C	Number of terminal CO groups in $Rh_4(CO)_{12}$ is 8.	D	Number of bridging CO groups in $Co_4(CO)_{12}$ is zero.
27) Oxidative addition and reductive elimination steps are favoured by			
A	Electron deficient and electron rich metal centers respectively	B	Electron rich and electron deficient metal centers respectively
C	Electron rich metal centers	D	Electron deficient metal centers

28) 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
29) Which of the following is not a reducing agent?			
A	HN=NH	B	$LiAlH(OR)_3$
C	Chloranil	D	Ph_3SnH
30) Cycloaddition of two molecules of ethylene to form cyclobutane is allowed under conditions			
A	Aqueous	B	Redox
C	Thermal	D	Photochemical
31) Which of the following does not contain –COOH group?			
A	Tryptophan	B	Biotin
C	Picric acid	D	Lipoic acid
32) Cyclooctatetraene reacts with two moles of potassium to yield a stable compound whose nmr would indicate --------- line/s in the spectrum.			
A	Two	B	Three
C	One	D	Four

33) Find out the correct mixture of products in the following reaction.



A		B	
C		D	

34) The compound all-cis-9-Aza-1,3,5,7-cyclononatetraene will be _____ and _____ stable than the corresponding N-carboxylic acid ethyl ester.			
A	Anti-aromatic, less	B	Aromatic, more
C	Alicyclic, more	D	Non-aromatic, less

35) Which of the following compound shows captodative effect (push-pull effect)?

A	Phenyl hydrazine	B	Diphenyl picryl hydrazide (DPPH)
C	Picric acid	D	p-Dinitrobenzene

36) Nitro compounds are generally explosive in nature because

A	Nitro group is electronegative and polar	B	Nitro group has unstable N-O bond
C	Nitro group has nitrogen at significantly higher level and is also a source of oxygen	D	Nitro group is resonance stabilized and burns easily

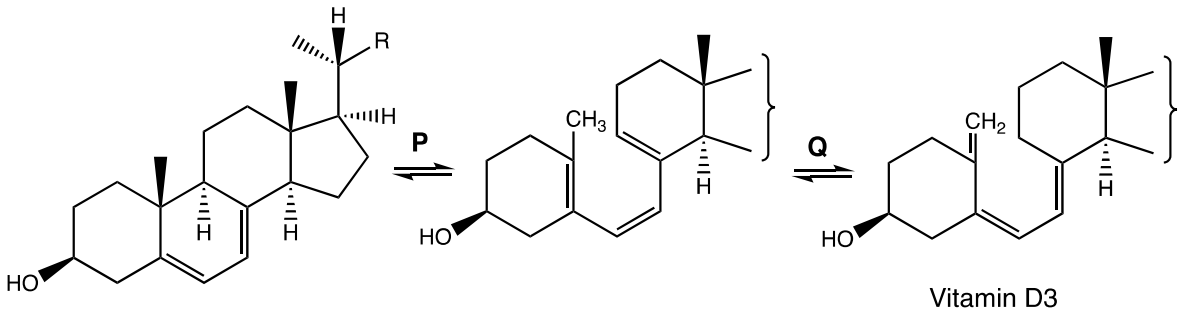
37) The complimentary color of red is

A	White	B	Black
C	Blue-green	D	Yellow-green

38) NMR spectrum of cyclohexane at -100 °C shows ____ signal/s.

A	Six	B	Twelve
C	One	D	Two

39) The conditions of the reaction P and Q are

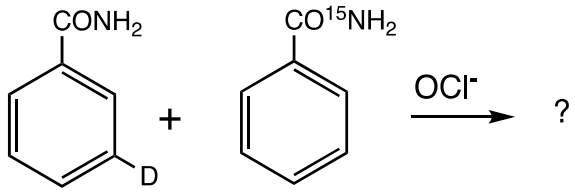


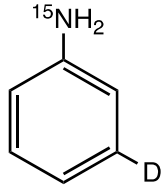
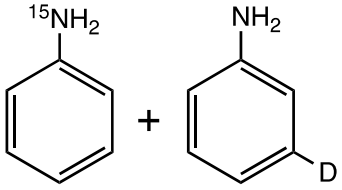
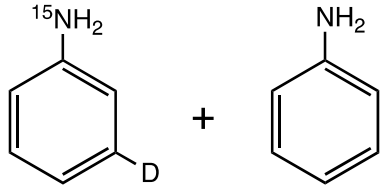
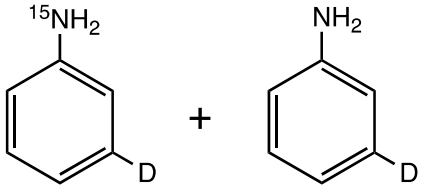
7-Dehydrocholesterol

Vitamin D3

A	P = Electrocyclic, Thermal CON Q = Electrocyclic, Photochemical, DIS	B	P = Electrocyclic, Thermal, CON Q = Sigmatropic, Photochemical, suprafacial
C	P = Electrocyclic. Photochemical, CON Q = Sigmatropic, Thermal, antarafacial	D	P = Electrocyclic Photochemical, DIS Q = Electrocyclic, Thermal CON.

40) The products of the Hofmann degradation of a mixture of labeled benzamides shown below would give



A	 alone	B	
C		D	

41) When CO_2 (g) is passed over red-hot coke it partially gets reduced to CO(g). Upon passing 0.5 litre of CO_2 (g) over red hot coke, the total volume of the gases increased to 700 mL. The composition of the gaseous mixture at STP is :			
A	CO_2 = 200 mL; CO= 500 mL	B	CO_2 = 350 mL; CO= 350 mL
C	CO_2 = 0.0 mL; CO= 700 mL	D	CO_2 = 300 mL; CO= 400 mL
42) During a reaction of oxalic acid, potassium chlorate and sulphuric acid, the oxidation number of which of the element undergoes a maximum change			
A	H	B	S
C	C	D	Cl
43) A metal crystallizes in a face centered cubic structure. If the edge length of its cell is 'a', the closest approach between two atoms in metallic crystals will be			
A	2a	B	$2\sqrt{a}$
C	$\sqrt{2a}$	D	$\frac{a}{\sqrt{2}}$
44) Value of molarity of pure water is			
A	45.7	B	22.7
C	55.5	D	11.27
45) van der Waals gas equation is given by $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$. The ratio of van der Waals gas constants 'a/b' has dimension of			
A	$Lmol^{-1}$	B	atm L^{-1}
C	atm L mol^{-1}	D	atm^{-1}
46) A certain reaction is spontaneous at 85°C. The reaction is endothermic by 34kJ. The minimum value of ΔS for the reaction is			
A	497.2 J/K	B	-497.2 J/K
C	+2094 J/K	D	+94.972 J/K
47) Adsorption of gases on solid surface is exothermic			
A	Free energy increases	B	Entropy decreases
C	Entropy increases	D	Interaction developed between solid and gas particles
48) The half-cell potential of a hydrogen electrode at pH=10 will be			
A	0.59 V	B	-0.59 V
C	0.059 V	D	-0.059 V
49) If arbitrary wave function is used to calculate the energy of a quantum mechanical system, the values calculated is never less than the true energy. Which is the given theory?			
A	Perturbation theory	B	Variation principle
C	Heisenberg uncertainty Principle	D	Quantization energy
50) The number average molar mass ($\overline{M_n}$) and weight average molar mass ($\overline{M_w}$) of a polymer are obtained respectively by			
A	Osmometry and light scattering measurement	B	Osmometry and viscosity measurement
C	Light scattering and sedimentation measurement	D	Viscosity and light scattering measurement

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Rough Work: