THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) – 7th August 2022

Signature of Invigilator

Roll. No. | | | | | | |

Paper - II
Chemical Sciences (22/25)

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 (22/25)

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

01) How is the working principle of amperometry different from polarography ?
   A) It is based on the principle of polarography , except that the voltage is altered during the titration
   B) It is based on the principle of polarography , except that the current is maintained constant during the titration.
   C) It is based on the principle of polarography , except that the current is altered during the titration.
   D) It is based on the principle of polarography , except that the voltage is maintained constant during the titration

02) The regression line always passes through-------
   A) Mean point of X and Y
   B) Median point of X and Y
   C) Origin
   D) Mean of X values and Median of Y values

03) The polydispersity index of a polymer whose number average molecular mass and weight average molecular mass are respectively 35000 and 45000 would be
   A) Greater than 1
   B) Less than 1
   C) 1
   D) -1

04) Which of the following is NOT an assumption and consequence of B.E.T Theory?
   A) The adsorption at one site is dependent on adsorption at the neighboring site
   B) Multilayers are formed by physisorption
   C) Surface possesses uniform localized sites
   D) Surface area can be calculated

05) Which of the following methods are used for determination of size of colloidal particles?
   A) Turbidimetry, polarography, ultramicroscopy
   B) Nephelometry, turbidimetry, ultramicroscopy
   C) Polarography, refractometry, nephelometry
   D) Refractometry, ultramicroscopy, turbidimetry

06) What is the rate of reaction for a bimolecular elementary reaction?
   A) $Z_{AB}e^{-Ea/RT}$
   B) $Z_{AB}e^{Ea/RT}$
   C) $-Z_{AB}e^{-Ea/RT}$
   D) $-Z_{AB}e^{Ea/RT}$

07) If mass of A is 4 times that of B, what is the ratio of their mean velocities?
   A) 1:4
   B) 4:1
   C) 1:2
   D) 1:3

08) Above which line, a liquid phase exists for all compositions in a phase diagram?
   A) Solvus
   B) Solidus
   C) Liquidus
   D) Solubus

09) Which of the following molecules among H_2, HCl, CH_4 and H_2O can show a rotational Raman spectrum?
   A) H_2, HCl
   B) H_2, HCl, H_2O
   C) H_2, CH_4, H_2O
   D) H_2, CH_4

10) For neutron activation analysis of an element, the desirable characteristics of both the target and product are:
   A) High neutron cross section area of target and long half-life of product
   B) Low neutron cross section area of target and long half-life of product
   C) Low neutron cross section area of target and short half-life of product
   D) High neutron cross section area of target and short half-life of product

11) The number of lines expected in the electron paramagnetic resonance (epr) spectrum of $^{63}Cu^{2+}$ ion

14) Typical precursors used in sol-gel preparation method of nanomaterials are _____
A) Metal oxides
B) Metal dioxides
C) Metal alkoxides
D) Metal fluorides

15) The rule of 3 R's to get rid of waste includes which of the following:
A) Recycle
B) Regeneration
C) Refill
D) Refabricate

16) What will be the number of orbitals when principal quantum number n = 5?
A) 5
B) 10
C) 25
D) 50

17) Based on VSEPR theory, the predicted shapes of $[XeF_5]^-$ and BrF_5, respectively are:
A) Square pyramidal and trigonal bipyramidal
B) Trigonal bipyramidal and square pyramidal
C) Pentagonal planar and square pyramidal
D) Square pyramidal and pentagonal planar

18) The eigen value of which of the following operator is always real?
A) Hermitian operator
B) Commutative operator
C) Laplacian operator
D) Hamiltonian operator

19) The unperturbed energy levels of a system are $_0 = 0$, $_1 = 2$ and $_2 = 4$. The second order corrections to energy for the ground state in pressure of the perturbation V for which $V_{10} = 2$, $V_{20} = 4$ and $V_{12} = 6$ has been found to be:
A) -6
B) 0
C) +6
D) -8

20) The term symbol for ground state electronic configuration of nitrogen atom is
A) ^6S
B) ^4S
C) ^5D
D) ^4F

21) Hydrated ferric oxide sol is prepared with a slight excess of NaOH solution. The ion that will coagulate the sol is
A) Sulphate
B) Chloride
C) Barium
D) Nitrate

22) Triclinic crystal system has the following unit cell dimensions
A) o
B) o
C) o o
D) o

23) Which of the following class is used for the treatment of peptic ulcer?
A) Antibiotics
B) Anti-inflammatory
C) Antihistamine
D) Hypnotics

24) The correct statement with respect to the bonding of the ligands, Me_3N and Me_3P with the metal ions Be^{+2} and Pd^{+2} is
A) The ligands bind equally strong with both the metal ions as they are di-cationic.
B) The ligands bind equally strong with both the metal ions as both ligands are pyramidal.
C) The binding is stronger for Me_3N with Be^{+2} and Me_3P with Pd^{+2}.
D) The binding is stronger for Me_3N with Pd^{+2} and Me_3P with Be^{+2}.

25) Treatment of hydrogen peroxide with chlorosulphonic acid (in the molar ratio of 1:2), yields _____.
A) $H_2S_2O_3$
B) H_2SO_5
C) $H_2S_2O_7$
D) $H_2S_2O_8$

26) Which of the following statement is NOT true for lanthanides?
A) Decrease in ionic radii of lanthanides with increasing atomic number.
B) Imperfect shielding and shape of -orbitals.
C) Increase in hydrated ionic radii of lanthanides with increasing atomic number.
D) Decrease in hydrated ionic radii of lanthanides with increasing atomic number.

27) Sodium nitroprusside, $Na_2[Fe(NO)CN_5]$ reagent is used in qualitative analysis in the detection of _____ ions with which it gives deep purple coloration.
A) NO_3^-
B) I^-
C) S^{-2}
D) SO_3^{-2}

28) Total number of vertices in metal clusters $Rh_6(CO)_{16}$ and $[Os_5C(CO)_{15}]$ are 6 and 5, respectively. The predicted structures of these complexes respectively are
A) Closo and nido
B) Arachno and nido
C) Nido and closo
D) Closo and arachno

29) How many numbers of ligand group orbitals (LGOs) are present in Ferrocene?
A) 6
B) 8
C) 10
D) 12

30) Ruthacene has a sandwich structure with two C_5H_5 rings that are exactly parallel to each other. The symmetry of this molecule is _____.
A)
B)
C)
D)

31) The INCORRECT statement about the Jahn-Teller distortion is-
A) It is automatic and is not imposed on the system.
B) Jahn-Teller effect shown by orbitals is much stronger than that of orbitals.
C) It removes degeneracy.
D) It decreases the symmetry.

32) An accumulation of _____ metal ion in the liver leads to 'Cirrhosis'- a chronic disease in the liver by degeneration of cells and fibrous thickening of tissues.
A) Cd
B) Cu
C) Zn
D) Pb

33) An organophosphate insecticide inhibits _____ vital enzyme
A) Carbonic anhydrase
B) Cytochrome oxidase
C) Acetylcholine stearase
D) Carboxypeptidase

34) The similarity transformation theorem is used to find out
A) Number of reducible representations in a group
B) Conjugate elements and number of characters in a group
C) Number of operations in a group
D) Conjugate elements and number of classes in a group

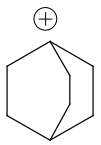
35) Consider the following statements for the structure of the zinc enzyme carboxy peptidase:
I) Zn central metal ion is bonded to three imidazole rings of histidine group.
II) A water molecule is weakly bonded to the fourth coordination site Zn^{+2} ion.
III) A globular protein residue of the epoenzyme is bonded to Zn^{+2} ion.

The INCORRECT statements are
A) I and II
B) II and III
C) I and III
D) I, II and III

36) The CORRECT -molecular orbitals of benzene is _____.
A) Only the lowest energy MO is doubly degenerate.
B) Only LUMO is doubly degenerate.
C) Only HOMO is doubly degenerate.
D) Both HOMO and LUMO are doubly degenerate.

37) $C_2H_4 + 1/2\ O_2$ $_2H_4O$ (Ethylene oxide). This reaction will take place under the presence of a catalyst, so the % atom economy is _____.
A) 25%
B) 50%
C) 75%
D) 100%

38) The order of stability of the cations shown below is



I

$(CH_3)_3\overset{\oplus}{C}$

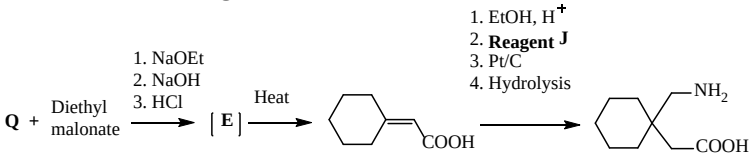
II

$(CH_3)_2\overset{\oplus}{C}H-CH=CH-CH_3$

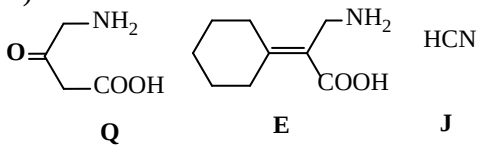
III

A) I > II > III
B) I < II < III
C) I < II > III
D) I > II < III

39) In the following synthesis of Gabapentin, identify **Q**, **E** and reagent **J**.

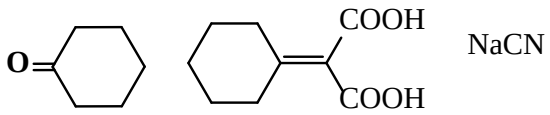


A)



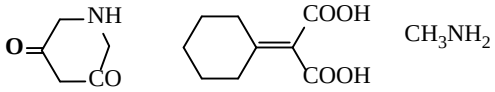
Q **E** **J**

B)



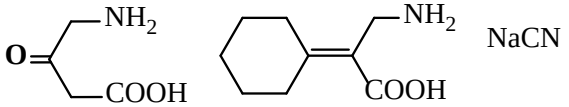
Q **E** **J**

C)



Q **E** **J**

D)



Q **E** **J**

40) 2,2-Dimethylcyclopropanone when attacked by methoxide ion gives the product X having the following spectral properties: IR 1740 (s), 1160 (s), ^{1}H NMR, 3.6 (3H, singlet), 1.2 (9H, singlet); UV, transparent above 200 nm; mass, m/z 116, 85, 59, 31 is formed.
An alternative product Y might have also arisen a different mechanism. The compounds X and Y are

A)

X = $(CH_3)_3CCOOCH_3$'

Y = $(CH_3)_2CHCH_2COOCH_3$

B)

X = $CH_3COOC(CH_3)_3$

Y = $(CH_3)_2CHCH_2COOCH_3$

C)

X = $CH_3COOC(CH_3)_3$

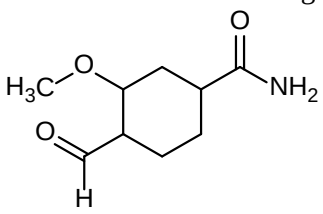
Y = $CH_3CH_2COOCH(CH_3)_2$

D)

X = $CH_3COOC(CH_3)_3$

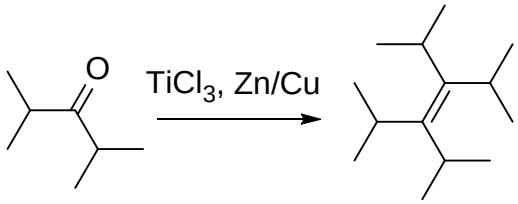
Y = $CH_3COOCH_2CH(CH_3)_2$

41) The correct name for the following compound is



A) 3-carboxamido-6-formyl-1-methoxycyclohexane
B) 4-formyl-3-methoxycyclohexanecarboxamide
C) 2-methoxy-4-carboxamidocyclohexane carboxaldehyde
D) 1-carboxamido-4-formyl-3-methoxycyclohexane

42) Following reaction is an example of a name reaction



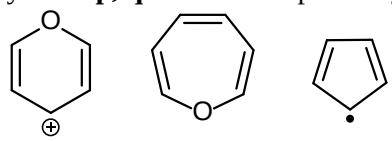
called

A) Ullmann coupling
B) Suzuki coupling
C) McMurry coupling
D) Sonogashira cross-coupling

43) Biotin is involved in the following function ------- and its deficiency leads to ------

A) Carboxylation, anemia
B) Amination, dementia
C) Vision, blindness
D) Oxidation-reduction, beri-beri

44) The following systems **p, q** and **r** are respectively ----

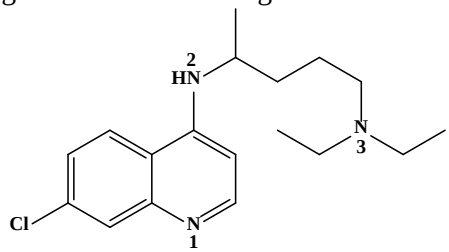


p **q** **r**

, -----, and -----.

A) p = aromatic, q = antiaromatic, r = nonaromatic
B) p = antiaromatic, q = aromatic, r = nonaromatic
C) p = aromatic, q = nonaromatic, r = nonaromatic
D) p = nonaromatic, q = antiaromatic, r = aromatic

45) The compound shown below is a/an ------. Which of the nitrogen atoms is the strongest base?



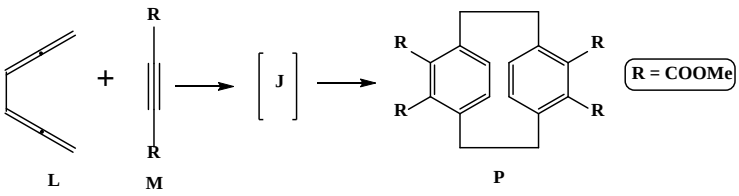
A) Anti-malarial, N1
B) Analgesic, N2
C) Anti-malarial, N3
D) Mosquitocidal, N3

46) A sample of 2-methyl-1-butanol has an observed specific rotation, [ ] is +1.151. The enantiomeric excess (% ee) of the sample is ---- and the actual stereoisomeric composition of the mixture is ----- (The specific rotation of the pure enantiomer is + 5.756°).
A) 40 %, 40 % of (+) and 60 % of (-)
B) 25 %, 40 % of (+) and 60 % of (-)
C) 80 %, 40 % of (+) and 60 % of (-)
D) 20 %, 60 % of (+) and 40 % of (-)

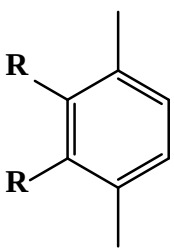
47) Treatment of $CHClBr_2$ and CHF_2Br separately with t-BuOK gives respectively
A) :CClBr and :CF_2
B) :CBr_2 and :CF_2
C) :CClBr and :CFBr
D) :CBr_2 and :CFBr

48) When hexa-1,2,4,5-tetraene **L**is treated with dimethyl acetylenedicarboxylate **M**, the initially formed intermediate **J**dimerizes to yield the [2.2] paracyclophane **P**.

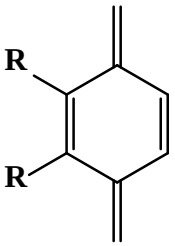
J has the structure



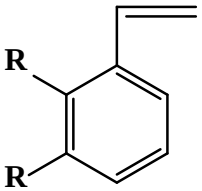
A)



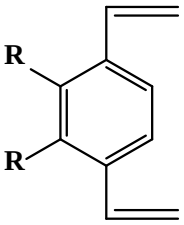
B)



C)



D)



49) Which of the following would not be used to achieve a stereospecific reaction?
A) Use of chiral starting materials
B) Use of enzyme catalysts
C) Use of chiral auxiliaries
D) Use of a resolving agent

50) Which of the following would not be used as a carbocation synthon?
A) Alcohol
B) Amide
C) Grignard reagent
D) Alkyl halide

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Rough Work: