THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA, VADODARA

Ph. D. ENTRANCE TEST (PET) –27th January 2019

Signature of Invigilators

_____

Roll. No. | | | | | | |

(in figures as in Hall Ticket)

Roll No. _____

_____

(in words)

Chemical Sciences
(19/25)

Maximum Marks: 50No. Of Printed Pages :8

Instruction for the Candidate:

1. Write your Roll Number in the space provided on the top of this page.
2. This paper consists of **FIFTY (50)**multiple choice type questions. Each Question carries**ONE (1)** mark.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below:
    a. To have access to the Question Booklet, tear off the paper seal on the edge of this cover page, Do not accept a booklet without sticker seal and do not accept an open booklet.
    b. Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faculty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.
    c. After this verification is over, the Test Booklet Number should be entered on the OMR Answer Sheet and the OMR Answer Sheet Number should be entered on this Test Booklet.
4. Each item has four alternative responses marked (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.

5. Your responses to the items are to be indicated on the OMR Answer Sheet under Paper – II only. If you mark your response at any place other than in the circle in the OMR Answer Sheet, it will not be evaluated.
6. Read instructions given inside carefully.
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. You have to return the original 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 and duplicate copy of OMR Answer Sheet on conclusion of examination
10. Use only Blue/ Black Ball point pen.
11. Use of any calculator or log table etc., is prohibited.
12. There shall be no negative marking.

Chemical Sciences
(19/25)

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

01) The separation mechanism operating in GLC is:
- A) Partition
- B) Adsorption
- C) Size exclusion
- D) Ion exchange

02) Of the following statements, which ones will be ***true*** for a high pressure ternary gradient HPLC system?

i. Three solvent reservoirs are required

ii. In-line degasser is required

iii. One pump and a proportionating valve are required

iv. Three pumps and a mixing tee are required

- A) Only i, iii
- B) Only i, ii, iii
- C) Only i, ii, iv
- D) Only i, iv

03) The method of least squares for determining the best straight line through a collection of data points is based on what principle?
- A) R^2 should be equal to one.
- B) Both s_m and s_b are negligible
- C) The slope should be close to 1 and intercept should equal 0.
- D) The sum of the squared y-residuals is minimized.

04) Mass analyzer in mass spectrometer is similar to which of the following in optical spectrometer?
- A) Source
- B) Monochromator
- C) Detector
- D) Slit

05) Which of the following statements is ***incorrect***?
- A) UV absorption is due to electronic transitions
- B) UV spectra provide information about valence electrons
- C) IR absorption is attributable to transitions between rotational energy levels of whole molecules
- D) NMR spectrometers use radiofrequency electromagnetic radiation

06) Which of the following is ***true***?
- A) The area under a DTA peak represents the enthalpy of the change
- B) In DTA, both the reference and sample undergo change with temperature
- C) DTA is an abbreviation for Direct Thermal Analysis
- D) Change in mass of sample with respect to that of reference is determined in DTA

07) Which of the following is ***not true*** about galvanic method of oxygen analysis?
- A) Electrodes are composed of noble and base metals
- B) It can measure dissolved content of oxygen
- C) Its principle is based on electrolysis
- D) It utilizes an electronic cell

08) The molarity of anNaOH solution was determined by titration vs KHP. Individual titrations gave the following concentrations: 0.1127 M, 0.1126 M, 0.1132 M, 0.1174 M, 0.1173 M. With respect to rejection of data using Q test, and considering Qcrit at 90% confidence level as 0.642, which of the following statements is ***true***?
- A) Both the values, 0.1126M and 0.1174 M, are retained
- B) The value 0.1126 M is rejected while 0.1174 is retained
- C) The value 0.1126 M is retained while 0.1174 M is rejected
- D) The value 0.1132 M is rejected

09) Arrange the following oxides in order of their increasing acidic character:
- A) $N_2O < Na_2O < As_2O_3 < Cl_2O_7$
- B) $N_2O < Cl_2O_7 < As_2O_3 < Na_2O$
- C) $Na_2O < N_2O < Cl_2O_7 < As_2O_3$
- D) $Na_2O < As_2O_3 < N_2O < Cl_2O_7$

10) Which of the following species does not give oxygen on heating?
- A) $KClO_3$
- B) $Zn(ClO_3)_2$
- C) $(NH_4)_2Cr_2O_7$
- D) $K_2Cr_2O_7$

11) On the basis of VSEPR theory, the geometry of $XeOF_4$ can be described as _____.
A) Trigonalbipyramidal with O in axial position
B) Trigonalbipyramidal with O in equatorial position
C) Square planar with O and a lone pair cis to each other
D) Square bipyramidal with O and a lone pair trans to each other

12) The pair of compounds in which both the metals are in the highest possible oxidation state is _____.
A) CrO_2Cl_2, MnO_4^-
B) $[Co(CN)_6]^{3-}$, MnO_2
C) $[Fe(CN)_6]^{3-}$, $[Co(CN)_6]^{3-}$
D) TiO_2, MnO_2

13) The compound X on heating gives a colourless gas and a residue that is dissolved in water to give compound Y. Excess of CO_2 is bubbled through aqueous solution of Y, Z is formed. Solid Z on gentle heating gives back X. Then the compound is _____.
A) Na_2CO_3
B) $CaCO_3$
C) K_2CO_3
D) $CaSO_4.2H_2O$

14) Which of the following symmetries of CO stretching vibrations in $Fe(CO)_5$ (D_{3h}) are IR active?
A) A_1' and E'
B) A_2'' and E'
C) A_1' and A_2''
D) A_1', A_2'' and E'

15) Which of the following is a soft base?
A) CO_3^{2-}
B) OH^-
C) H^-
D) CH_3COO^-

16) Identify the nido-borane from the following:
A) B_5H_9
B) $[B_6H_6]^{2-}$
C) B_4H_{10}
D) B_5H_{11}

17) Which of the following substituted silane on hydrolysis gives cross-linked silicone polymer?
A) $(CH_3)_4Si$
B) $(CH_3)_3SiCl$
C) $(CH_3)_2SiCl_2$
D) CH_3SiCl_3

18) The ligand field bands of lanthanide complexes are sharper than those of transition metal complexes because_____.
A) *f*-orbitals compared to the *d*-orbitals interact less effectively with ligands
B) *f*-orbitals have higher energy than *d*-orbitals
C) Transitions are allowed for lanthanide complexes
D) Intensity for the bands are higher for lanthanide complexes

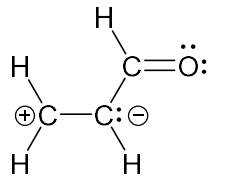
19) The total number of metal-metal bonds in $Os_3(CO)_{12}$ and $Co_4(CO)_{12}$, respectively are _____.
A) 0 and 4
B) 3 and 4
C) 3 and 5
D) 3 and 6

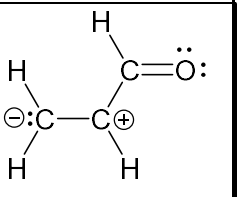
20) If any radioactive substance is subjected to vacuum, the rate of disintegration per second _____.
A) Suffers a slight decrease.
B) Increased considerably.
C) Increase only if the products are gaseous.
D) Not affected.

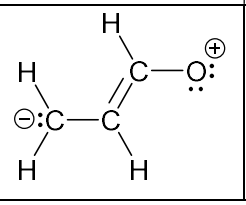
21) _____ metal is present at the active site of protein carboxypeptidase A.
A) Molybdenum
B) Iron
C) Zinc
D) Copper

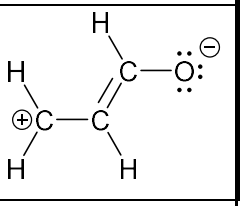
22) When $Fe(CO)_5$ reacts with OH^- to form compound X, which on oxidative with MnO_2 gives compound Y. Compounds X and Y respectively are _____.
A) $[HFe(CO)_4]^-$ and Fe_2O_3
B) $[HFe(CO)_4]^-$ and $Fe_3(CO)_{12}$
C) $[Fe(CO)_5OH]^-$ and $Fe_2(CO)_9$
D) $[Fe(CO)_4]^{2-}$ and $Mn(CO)_5$

23) Which of the following forms best represent the most stable resonance structure for acroline (CH_2=CH-CHO)?

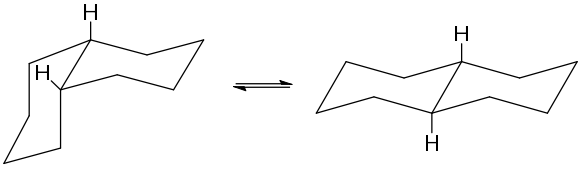
A) 

B) 

C) 

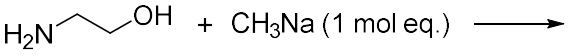
D) 

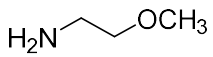
24) How will you best describe the change in the following two structures?

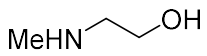


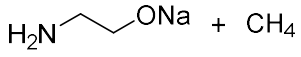
A) Change in configuration
B) Change in conformation
C) There is no change
D) Positional isomerism

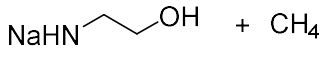
25) What is the major product obtained in the following reaction?



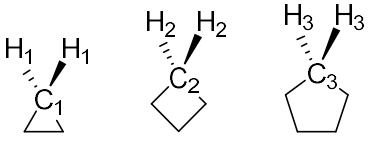
A) 

B) 

C) 

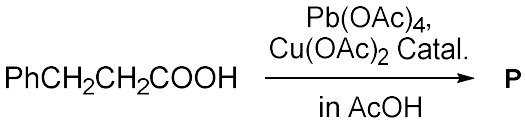
D) 

26) Arrange the bond angles of indicated H-C-H in the following compounds.



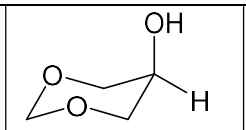
A) H_1-C_1-H_1> H_2-C_2-H_2 > H_3-C_3-H_3
B) H_1-C_1-H_1> H_3-C_3-H_3 > H_2-C_2-H_2
C) H_2-C_2-H_2> H_3-C_3-H_3 > H_1-C_1-H_1
D) H_3-C_3-H_3> H_2-C_2-H_2 > H_1-C_1-H_1

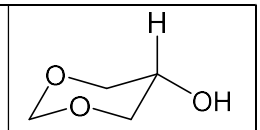
27) Predict the main product **P** in the following reaction:

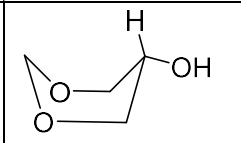


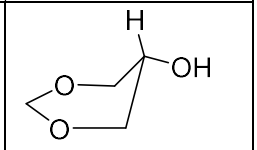
A) $PhCH_2CH_2OAc$
B) PhCH=CHOAc
C) $PhCH(OAc)CH_3$
D) $PhCH(COOH)CH_3$

28) The most stable conformation of 5-hydroxy-1,3-dioxane will be.

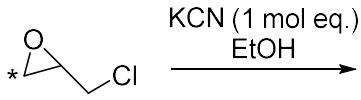
A) 

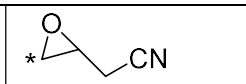
B) 

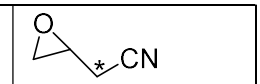
C) 

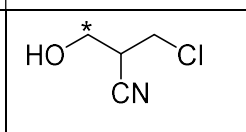
D) 

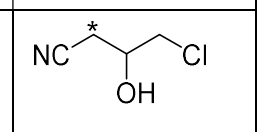
29) If the following compound with ^{13}C labelled (indicated with *) undergoes given reaction, what product is expected?



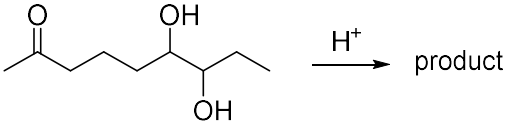
A) 

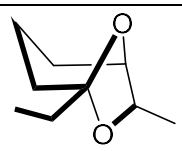
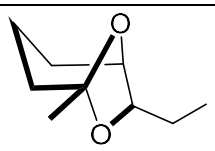
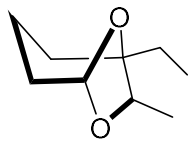
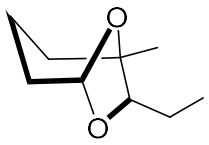
B) 

C) 

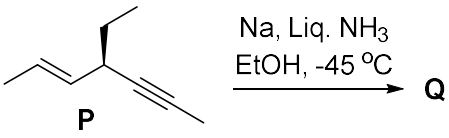
D) 

30) Predict the product of the following reaction.



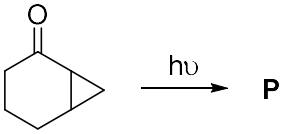
A)		B)	
C)		D)	

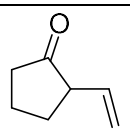
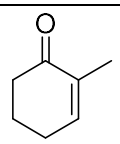
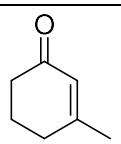
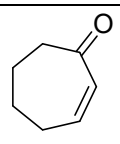
31) In the following reaction, the stereochemical description of P and Q will be.



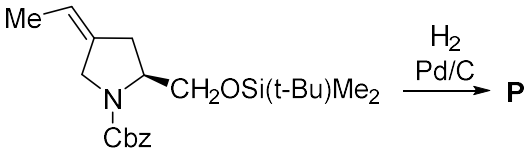
A) P is 'R' and Q is 'R'
B) P is 'R' and Q is achiral
C) P is 'S' and Q is 'S'
D) P is 'S' and Q is achiral

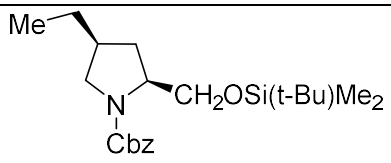
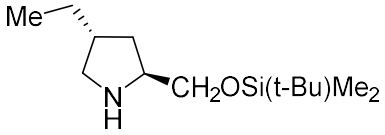
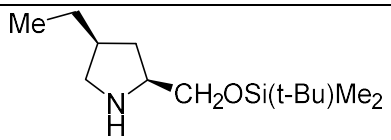
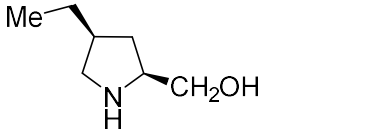
32) Predict the major product **P** in the following reaction.



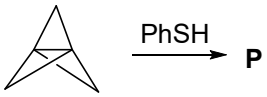
A)		B)	
C)		D)	

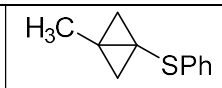
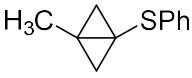
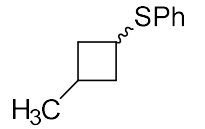
33) Predict the major product **P** in the following reaction.



A)	
B)	
C)	
D)	

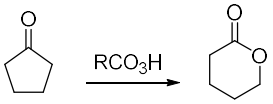
34) Predict the major product **P** in the following reaction.



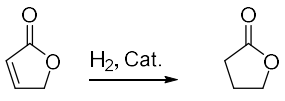
A)		B)	
C)		D)	

35) Which statement will accurately describe the changes taking place in the IR absorption frequencies of the following reactions?

i.

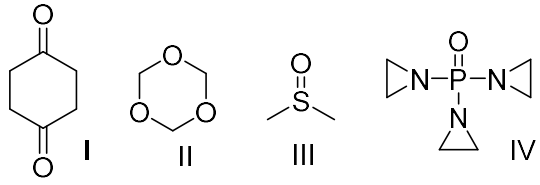


ii.



A) The IR frequency for carbonyl will decrease in both reactions (**i** and **ii**).
B) The IR frequency for carbonyl will decrease in **i** while increase in **ii**.
C) The IR frequency for carbonyl will increase in both reactions (**i** and **ii**).
D) The IR frequency for carbonyl will increase in **i** while decrease in **ii**.

36) For the following set of compounds, which statement is correct?



A) All compounds will show single signal in ^{1}H-NMR spectra, while compound III will show most down field signal, while it will appear most up field for IV.
B) In ^{1}H-NMR as well as ^{13}C-NMR analysis all compounds will show one signal only.
C) All compounds will show a single singlet signal in ^{1}H-NMR spectral analysis. The most down field signal will be for II, then for III, then for I and the most up field will be for IV.
D) All compounds will show a single singlet signal in ^{1}H-NMR spectral analysis. The most down field signal will be for III, then for II, then for IV and the most up field will be for I.

37) Order of steps in a typical polymerisation reaction is
A) Termination, Initiation and Progression
B) Progression, Initiation and Termination
C) Initiation, Progression and Termination
D) Progression, Termination and Initiation

38) Which statement is correct about polymer
A) Polymer can dissolve like a salt
B) polymer have fixed molecular weight
C) Polymer has average molecular weight
D) number and weight average molecular weights are equal

39) pH of a 10^{-7}HCl is equal to
A) 7
B) < 7
C) > 7
D) 1

40) Micelles can be called
A) Precipitates
B) Association colloids
C) Emulsions
D) Bilayers

41) Units of molecular partition function are
A) Cm^{-1}
B) S^{-1}
C) $J\ K^{-1}\ mol^{-1}$
D) dimensionless

42) Chemisorption is a
A) Multilayer adsorption
B) Monolayer adsorption
C) Bilayer adsorption
D) Desorption

43) Reduced phase rule is given by
A) F= P - C+ 2
B) F= C - P + 2
C) P = F-C+2
D) F= C-P+1

44) Electrochemical series is based on
A) Reduction Potential on Hydrogen scale
B) pH scale
C) Cell Voltage
D) Temperature Scale

45) $t_{1/2}$ of a reaction is doubled as the initial [reactant] is doubled. The order of the reaction is
A) 1
B) 0
C) 2
D) 3/2

46) According to Third law of thermodynamics, if T $\rightarrow$0 then
A) G = 0
B) H = 0
C) U = 0
D) S = 0

47) A crystal having unit cell dimensions $a \neq b \neq c$, $\alpha=\beta=\gamma= 90°$ is
A) Cubic
B) Tetragonal
C) Orthorhombic
D) Monoclinic

48) Which of the following solutions will have the lowest freezing point
A) 0.1 M NaCl
B) 0.1 M KNO_3
C) 0.2 M glucose
D) 0.1 M $Ca(NO_3)_2$

49) $K_a$of a weak acid is 10^{-5}. pK_b of the conjugate base is
A) 6
B) 9
C) 5
D) 7

50) Raman effect is
A) Absorption of light
B) Emission of light
C) Elastic scattering of light
D) Inelastic scattering of light

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Rough Work: