



ਪੰਜਾਬ ਟੈਕਨੀਕਲ ਯੂਨੀਵਰਸਿਟੀ ਜਲੰਧਰ  
PUNJAB TECHNICAL UNIVERSITY JALANDHAR

Max. Marks: 90

Time: 90 Mins.

**Entrance Test for Enrollment in Ph.D. Programme**

*Important Instructions*

- Fill all the information in various columns, in capital letters, with blue/black ball point pen.
- Use of calculators is not allowed.
- All questions are compulsory. No negative marking for wrong answers.
- Each question has only one right answer.
- Questions attempted with two or more options/answers will not be evaluated.

**Stream:** (Engg/Arch/Pharm/Mgmt/App.Sci/lif .....  
Sci/Lang./Hum.)

**Discipline** .....**CHEMISTRY**.....

**Name** .....

**Fathers Name** .....

**Roll Number** .....**Date: 15-07-2012**

**Signature of Candidate:** .....

**Signature of Invigilator** .....

1. The number of neutrons in the nucleus of Zn atom with atomic number 30 and atomic weight 65 are :

- A) 30
- B) 95
- C) 35
- D) 65

2. The number of unpaired electrons in molecular oxygen are:

- A) 1
- B) 2
- C) 0
- D) 4

3. Molecular iodine is

- A) Lewis base

- B) neutral
- C) Lewis acid
- D) both Lewis acid and Lewis base

4. In CH<sub>3</sub>Cl, the atom which shows NQR spectrum is:

- A) <sup>12</sup>C (I = 0)
- B) <sup>13</sup>C (I = 1/2)
- C) <sup>1</sup>H (I = 1/2)
- D) <sup>35</sup>Cl (I = 3/2)

5. In the ESR spectrum of high spin Mn<sup>II</sup> (I = 5/2), the number of signals observed are:

- A) 1
- B) 5
- C) 30

- D) 6
6. A solution of compound A was studied for scattering and it showed a Rayleigh line at 350nm and a Stokes line at 370nm. The difference in energy ( $1544 \text{ cm}^{-1}$ ) corresponds to:
- rotational transition
  - vibrational transition
  - electron transition
  - none of these.
7.  $\text{K}_4[\text{Fe}(\text{CN})_6]$  (low spin complex) shows number of Mössbauer signals as:
- 1
  - 2
  - 3
  - 0
8. The  $^{31}\text{P}$  NMR spectrum of compound B was recorded and it showed a signal at  $\delta = 10 \text{ ppm}$  (probe frequency 120 MHz). In hertz unit, the signal corresponds to:
- 1200
  - 1260
  - 1230
  - 60
9.  $\text{Me}_2\text{SO}$  has two donor atoms, O and S. The IR spectrum of complex of  $\text{Me}_2\text{SO}$  with  $\text{HgCl}_2$  showed shift in  $\nu(\text{S}=\text{O})$  to high energy region. It supports the formation of :
- Hg-O bond
  - Hg-S bond
  - both Hg-S and Hg-O bonds
  - none of these
10. If  ${}_6\text{C}^{14}$  undergoes electron emission, the resulting atom is :
- ${}_6\text{C}^{13}$
  - ${}_6\text{C}^{12}$
  - ${}_7\text{N}^{14}$
  - ${}_7\text{N}^{15}$
11. The metal ion present in hemoglobin is:
- $\text{Fe}^{2+}$
  - $\text{Fe}^{3+}$
  - $\text{Fe}^+$
  - $\text{Fe}^{4+}$
12. The nitrogen fixation is best carried out by :
- Fe protein
  - Mo protein
  - MoFe protein
  - Ru protein
13. In  $\text{Fe}_3(\text{CO})_{12}$  cluster, there are:
- one Fe-Fe bond
  - two Fe-Fe bonds
  - three Fe-Fe bonds
  - none of these
14. The carborane 1,12- $\text{C}_2\text{B}_{10}\text{H}_{12}$  has following structure:
- Octahedral
  - Icosahedraon
  - Octadecahedron
  - bi-capped square prism
15. Bromobenzene reacts with magnesium powder in dry ether in presence of iodine. The product formed is:
- $\text{Ph}_2\text{Mg}$
  - $\text{PhMgBr}$
  - $(\text{c})\text{PhMgI}$
  - $\text{MgBr}_2$
16. Methyl lithium exists as a tetramer,  $(\text{MeLi})_4$ . The bonding involved between methyl and lithium ion is:
- 3c-2e bond
  - 2c-1e bond
  - $(\text{c})3\text{c}-3\text{e}$  bond
  - ionic bond
- (c = center, e-electron)
17. The  $\text{cis-PtCl}_2(\text{NH}_3)_2$  is :
- paramagnetic

- B) diamagnetic  
C) ferromagnetic  
D) antiferromagnetic
18. The structure of  $[\text{AuCl}_4]^-$  anion is:  
A) tetrahedral  
B) octahedral  
C) square planar  
D) square pyramidal
19. Silver chloride dissolves in  $\text{NH}_4\text{OH}$  due to the formation of :  
A)  $[\text{AgCl}] \cdot 2\text{NH}_3$   
B)  $[\text{Ag}(\text{NH}_3)\text{Cl}] \cdot \text{NH}_3$   
C)  $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$   
D)  $[\text{Ag}(\text{NH}_2)(\text{NH}_3)]$ .
20. When  $\text{H}_2\text{S}$  is passed through aqueous solution of copper sulfate. It forms :  
A)  $\text{Cu}_2\text{S}$   
B)  $\text{CuS}$   
C)  $\text{CuSO}_4 \cdot \text{H}_2\text{S}$   
D)  $[\text{Cu}(\text{H}_2\text{S})_4](\text{SO}_4)$
21. The effective atomic number of Cr in  $\text{Cr}(\text{CO})_6$  is:  
A) 24  
B) 12  
C) 36  
D) 35
22. Copper(II) acetate monohydrate is dimeric. It shows magnetic moment of :  
A) 1.73 BM  
B) 3.46 BM  
C) 1.34 BM  
D) 0 BM
23. The bonding in  $\text{O}_2$  was explained by:  
A) VB theory  
B) MOT theory  
C) CFT theory  
D) Both by VB and MOT theory  
( VB = valence bond; MOT = molecular orbital theory; CFT = crystal field theory)
24. When  $\text{NaCl}$  is added to  $\text{H}_2\text{O}$ , it forms:  
A)  $\text{NaOH}$  and  $\text{HCl}$   
B)  $[\text{Na}(\text{aq})]^+ + [\text{Cl}(\text{aq})]^-$   
C)  $\text{NaCl} \cdot 4\text{H}_2\text{O}$   
D)  $\text{NaCl} \cdot 6\text{H}_2\text{O}$
25. Reaction of  $\text{HgS}$  with  $\text{HNO}_3$  gives:  
A)  $\text{Hg}(\text{NO}_3)_2$  and  $\text{H}_2\text{S}$   
B)  $(\text{b})\text{H}_2[\text{HgS}(\text{NO}_3)_2]$   
C)  $[\text{Hg}(\text{SH})_2]$   
D) none of these
26. The golden yellow flame shown by  $\text{NaCl}$  in flame test is due to :  
A)  $3s \rightarrow 3p$  transition  
B)  $\text{Cl}^- \rightarrow \text{Na}^+$   
C)  $4s \rightarrow 3s$  transition  
D)  $3p \rightarrow 3s$  transition
27. Fusion of H atoms gives:  
A)  $\text{H}_2$   
B)  $\text{H}_2^+$   
C) He atoms  
D) none of these
28. The order of d-orbital splitting in a crystal field is:  
A)  $3d > 4d > 5d$   
B)  $4d > 3d > 5d$   
C)  $5d > 3d > 4d$   
D)  $5d > 4d > 3d$ .
29. The addition of ethylene diamine (en) to  $\text{NiCl}_2$  dissolved in water gives:  
A)  $[\text{Ni}(\text{en})(\text{H}_2\text{O})_4]\text{Cl}_2$   
B)  $[\text{Ni}(\text{en})_2(\text{H}_2\text{O})_2]\text{Cl}_2$   
C)  $[\text{Ni}(\text{en})_3]\text{Cl}_2$   
D)  $[\text{Ni}(\text{en})_2\text{Cl}_2]$
30. The lowest oxidation state of iron is found in:  
A)  $[\text{Fe}(\text{CO})_4]^{2-}$   
B)  $\text{Fe}(\text{CO})_5$   
C)  $\text{K}_3[\text{Fe}(\text{CN})_6]$

D)  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

31. During the *syn*-addition of YW to a *cis*-alkene (ABC=CBA) one will get

- A) Erythro dl pair
- B) Meso compound
- C) Threo dl pair
- D) A and C

32. What is the name of the reaction in which of an aldehyde usually not containing an  $\alpha$ -hydrogen condenses with compounds of the form Z-CH<sub>2</sub>-Z'

- A) Perkin reaction
- B) Knoevenagel reaction
- C) Aldol condensation
- D) Stobbe condensation

33. For Sharpless epoxidation what type of substrate is required

- A) An alkene
- B) An allyl alcohol
- C) An alkyne
- D) An aldehyde

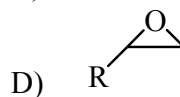
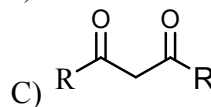
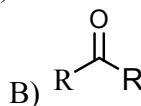
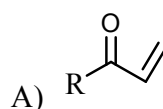
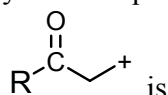
34. What type of reactions carbon-heteroatom multiple bonds undergo normally

- A) Electrophilic addition
- B) Nucleophilic additions
- C) Free Radical additions
- D) Nucleophilic substitution

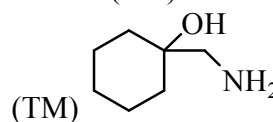
35. Cyanide ion is reagent for which of the following synthons?

- A)  $\text{O}=\text{C}-\text{OH}$
- B)  $\text{O}=\text{C}^--\text{H}$  (formyl anion)
- C) (C)  $\text{O}=\text{C}-\text{R}$
- D) None of the above

36. The synthetic equivalent of



37. Synthesis of (TM) will involve



- A) One group C-X disconnection
- B) Two group C-X disconnection
- C) One group C-C disconnection
- D) Two group C-C disconnection

38. When a molecule contains two reactive groups and you want to react one of them but not the other then which type of problem arises

- A) Regioselectivity
- B) Chemoselectivity
- C) Stereoselectivity
- D) Stereospecificity

39. Which of the following can not be used for the protection of alcoholic groups

- A) Ketals or acetals
- B) Trialkylsilyl ethers
- C) Esters
- D) amines

40. Steroids on dehydrogenation with selenium at 360°C gives

- A) Chrysene

- B) 1,2-cyclopentenophenanthrene  
 C) Diel's hydrocarbon  
 D) Cholesterol.

41. Molecular formula of cholesterol is

- A)  $C_{27}H_{46}O$   
 B)  $C_{27}H_{48}O$   
 C)  $C_{27}H_{48}O_3$   
 D)  $C_{27}H_{44}O_2$ .

42. When there are two functional groups of unequal reactivity present in a molecule and you are interested in carrying out the reaction at the less reactive functional group the what will you do with the other functional group

- A) Protection  
 B) Deprotection  
 C) Hydrolysis  
 D) Wittig reaction

43. The site where enzyme catalyzed reaction takes place is called?

- A) Active site  
 B) Catalytic site  
 C) Activity site  
 D) Functional site

44. What type of reaction will be followed during the addition of HY to a substrate of the type  $-C=C-Z$ , where Z is electron withdrawing group

- A) Free radical  
 B) Electrophilic addition  
 C) Nucleophilic addition  
 D) Nucleophilic substitution

45. Which one of the following compounds give E1cb reaction

- 1)  $CF_3-CHCl_2$  2)  $C_6H_5-CH_2-CH_2F$  3)  $CH_3-CH(OH)-CH_2-CH_2-CH_3$

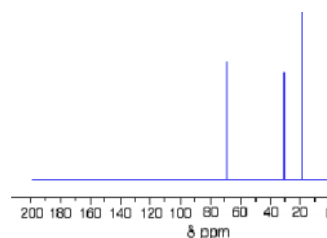
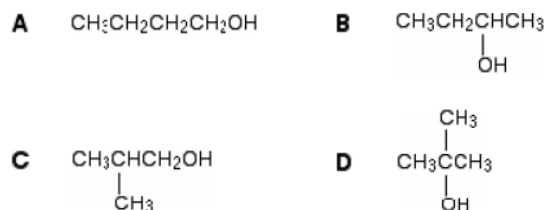
Select the correct answer from the codes given below

- A) Only 1 and 2  
 B) Only 2 and 3  
 C) Only 3 and 4  
 D) 1,2 and 3

46. What is the end product of glycolysis?

- A) BPG  
 B) Pyruvate  
 C) Lactate  
 D) Acetyl-CoA

47. There are four alcohols with the molecular formula  $C_4H_{10}O$ .



Which one produced the C-13 NMR spectrum shown above?

48. Using the following codes, arrange the given compounds in order of their decreasing reactivity towards  $S_N1$  reaction. A) Benzyl chloride B) *p*-methoxybenzyl chloride C) *p*-nitrobenzyl chloride

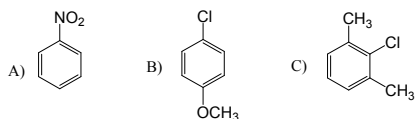
- A)  $A > B > C$   
 B)  $B > A > C$   
 C)  $C > B > A$   
 D)  $B > C > A$

49. The following is the rate law of an SN2 reaction:

Rate =  $[MeI][OH^-]$  what will be the effect on the rate of the reaction if the concentration of the MeI is doubled and that of  $OH^-$  is halved

- A) The rate becomes two times faster  
 B) The rate becomes four times faster  
 C) No Change in the rate  
 D) The rate becomes half
50. Which amongst the following will be least reactive in SE2 (back) reaction (L = Leaving reaction)
- A) Me-L  
 B)  $Me_2CH-L$   
 C)  $Me_3C-L$   
 D)  $CH_3CH_2-L$

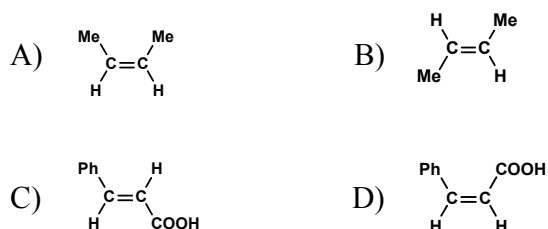
51. Which of the following compounds will undergo aromatic nucleophilic substitution through benzyne intermediate?



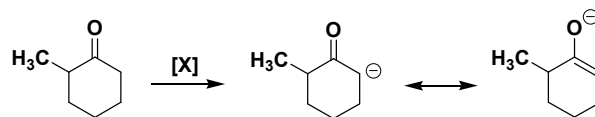
52. The numbers of geometrical isomers of compound

$PhCH=CH-CH=CH-COOH$  is:

- A) 1  
 B) 2  
 C) 6  
 D) 4
53. Which of the following will give *meso* with  $Br_2$  :



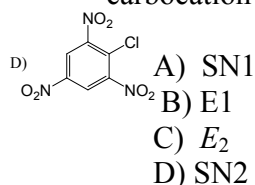
54. In the given reaction



[X] Will be

- A) LDA  
 B)  $(C_6H_5)_3CLi$   
 C)  $C_2H_5ONa$   
 D) Both (a) and (b)
55. In which reaction, reaction intermediate is carbanion?
- A) Reformatsky reaction  
 B) Pinacol-Pinacolone rearrangement  
 C) Aldol addition  
 D) All of these

56. Which of the following reaction takes place *via* formation of carbocation as reaction intermediate?



Select the correct answer from the codes given below:

- A) Only 1  
 B) Only 2  
 C) 1 and 2  
 D) 1, 2 and 4
57. In which rearrangement, reaction intermediate is carbene?
- A) Pinacol-Pinacolone  
 B) Stevens  
 C) Wolf  
 D) Wagner-Meerwein
58. Enamines give which of the following reactions:
- A) Alkylation

- B) Acylation  
C) Michael addition  
D) All of these
59. Addition of electrophiles to substituted cyclopropanes follow  
A) Anti-Markovnikov's rule  
B) Markovnikov's rule  
C) Sayteff rule  
D) Hofmann rule
60. What type of a product is formed during hydroboration-oxidation of an alkene  
A) An alcohol  
B) An aldehyde  
C) A carboxylic acid  
D) An  $\alpha,\beta$  - unaturated carbonyl compound
61. The minimum energy required for reactant molecules to enter into chemical reaction is known as:  
A) Kinetic energy  
B) Potential energy  
C) Activation energy  
D) Threshold energy
62. In a reaction  $A \rightarrow B$ , the reaction rate is doubled on increasing the concentrations of reactants four times. The order of reaction is:  
A) 0.5  
B) 0  
C) 1  
D) 3
63. In the equilibrium  $2A+3B \rightleftharpoons 3C+2D$ , an increase of pressure will:  
A) Shift the equilibrium towards the left  
B) Shift the equilibrium towards the right  
C) Have no effect  
D) May shift the equilibrium in both directions.
64. The variation of equilibrium constant with temperature is given by:  
A) Van't Hoff isotherm  
B) Van't Hoff isochore  
C) Law of mass action  
D) None of these
65. The number of nodes possible in radial wavefunction of 3d orbital is:  
A) 0  
B) 1  
C) 2  
D) 3
66. The black body emits:  
A) Line spectrum  
B) Band spectrum  
C) Mixed spectrum  
D) Continuous spectrum
67. Statistical mechanics is applicable to:  
A) macroscopic systems  
B) microscopic systems  
C) both of these  
D) none of these
68. Classical mechanics does not take into account:  
A) pressure  
B) volume  
C) temperature  
D) time
69. Partition function is given by:  
A)  $\sum g_i e^{-\epsilon_i/RT}$   
B)  $\sum g_i e^{-\epsilon_i/kT}$   
C)  $\sum e^{-\epsilon_i/kT}$   
D) None of these
70. Which of the following eigen functions are non-zero at the hydrogen nucleus:  
A) s-eigen function  
B) p-eigen function  
C) d-eigen function  
D) f-eigen function
71. Wavelength of microwaves used in mobile phones varies:  
A) 1m-1km  
B) 1nm-100nm  
C) 1mm-30cm  
D) 400nm-800nm
72. Overtone is:

- A) intense IR band  
 B) weak IR band  
 C) strong Raman band  
 D) rotational band
73.  $^1\text{H}$  NMR of  $[\text{NH}_4]^+$  shows:  
 A) one signal  
 B) three signals of equal intensity and shape  
 C) three broad signals of equal intensity  
 D) three signals of intensity 1:2:1
74. A red shift is:  
 A) a shift of  $\lambda_{max}$  to shorter wavelengths  
 B) a shift of  $\lambda_{max}$  to longer wavelengths  
 C) accompanied by a increase of intensity of the absorption band  
 D) accompanied by a decrease of intensity of the absorption band
75. The chemical shift of proton on the ' $\delta$ ' scale is 4. The value on the ' $\tau$ ' scale will be:  
 A) 14  
 B) 6  
 C) 3.5  
 D) 4
76. Who got noble prize in the field of adsorption:  
 A) Freundlich  
 B) Langmuir  
 C) Tempkin  
 D) Hinshelwood
77. Which of the following is not a surface phenomenon?  
 A) heterogeneous catalysis  
 B) corrosion  
 C) fusion of solids  
 D) electrolysis process
78. Debye-Huckel theory is employed for the determination of activity coefficients of:  
 A) weak electrolytes  
 B) strong electrolytes  
 C) for both type of electrolytes  
 D) none of these
79. Debye-Huckel limiting law is applicable to:  
 A) dilute solutions  
 B) concentrated solutions  
 C) colloidal solutions  
 D) none of these
80. Which of the following will not give pure rotational spectra:  
 A)  $\text{H}_2\text{O}$   
 B)  $\text{N}_2\text{O}$   
 C) HCl  
 D)  $\text{CO}_2$
81. The computer memory is measured in:  
 A) units  
 B) bytes  
 C) binary  
 D) none of these
82. Which of the following reaction will give colloidal solution:  
 A)  $\text{Cu} + \text{HgCl}_2 \rightarrow \text{Hg} + \text{CuCl}_2$   
 B)  $\text{Cu} + \text{CuCl}_2 \rightarrow \text{Cu}_2\text{Cl}_2$   
 C)  $2\text{Mg} + \text{CO}_2 \rightarrow 2\text{MgO} + \text{C}$   
 D)  $2\text{HNO}_3 + 3\text{H}_2\text{S} \rightarrow 3\text{S} + 4\text{H}_2\text{O} + 2\text{NO}$
83. Which of these is hydrophobic colloid:  
 A) gelatin  
 B) gum  
 C) sulphur  
 D) starch
84. Ferrite materials are regarded as:  
 A) ferromagnetic  
 B) ferrimagnetic  
 C) antiferromagnetic  
 D) none of these
85. X-Ray of wavelength 0.134nm gave a first order diffraction from the crystal surface when the value of  $\theta$  was  $10.5^\circ$ . If  $\sin 10.5^\circ = 0.1822$ , the distance between the planes will be:  
 A) 3.68nm  
 B) 0.368nm  
 C) 0.0368nm  
 D) none of these



86. If the energy of the particle in a cubic box is  $9h^2/8ma^2$ , the degeneracy can be:

- A) 1
- B) 2
- C) 3
- D) 4

87. A polydisperse protein contains equal masses of monomers with molar masses 20000 and 30000  $\text{g mol}^{-1}$  respectively. Its number average and weight average molar masses should be:

- A) 24000 and 25000  $\text{g mol}^{-1}$
- B) 25000 and 26000  $\text{g mol}^{-1}$
- C) 30000 and 32000  $\text{g mol}^{-1}$
- D) none of these

88. The boundary conditions of particle in one dimension box are:

- A)  $\psi = 0$  at  $x=0$  and  $x=a/2$
- B)  $\psi = 0$  at  $x=a/4$  and  $x=a/2$
- C)  $\psi = 0$  at  $x=0$  and  $x=a/4$
- D)  $\psi = 0$  at  $x=0$  and  $x=a$

89. The shapes of atomic orbitals are:

- A) hypothetical ones
- B) based on the plots of wave functions
- C) based on the plots of square of the wave functions
- D) based on the plots of square root of the wave functions

90. Chemical shift of hydrogen in  $^1\text{H}$  NMR spectrum primarily depends upon:

- A) operating frequency of NMR spectrometer
- B) molecular weight of the molecule
- C) electronic environment of hydrogen
- D) surface area of the molecule