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A

SET-Y

Ph.D./URS-EE-Jan-2022

SUBJECT : Chemistry

10045

Sr. No. _____

Time : 1¼ Hours

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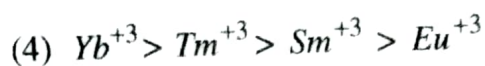
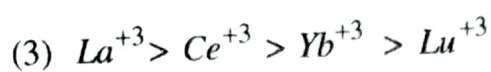
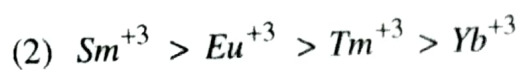
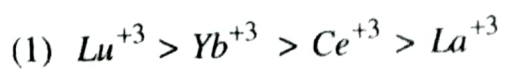
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PHD/URS-EE-2022/(Chemistry)(SET-Y)/(A)

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1. In ion-exchange resin method, the order of elution of lanthanides is :



2. Which of the following statements is **false** ?

(1) Lanthanides have poor tendency to form complexes

(2) Lanthanides closely resemble each other

(3) M^{+} and M^{+2} are less stable than M^{+3} ion in lanthanides

(4) Basic strength of lanthanide oxides increases with increasing atomic number

3. Biological function of Haemocyanin and metal involved in it :

(1) Oxygen transport and Fe

(2) Oxygen transport and Cu

(3) Electron transport and Fe

(4) Electron transport and Cu

4. If an enzyme fixes Nitrogen in plants by evolving H_2 , the number of electrons and protons associated respectively are :

(1) 6 and 6

(2) 8 and 8

(3) 6 and 8

(4) 8 and 6

5. The half-life of Cobalt-60 is 5.26 years. What will be the remaining percentage activity after 4 years ?

(1) 76%

(2) 32%

(3) 59%

(4) 18%

6. Radioisotopes of Iodine are used in :

(1) Tagging leukocytes and labelling of blood platelets

(2) Diagnosis and treatment of the diseases of thyroid glands

(3) Diagnosis and treatment of the heart diseases

(4) Diagnosis and treatment of brain tumours

7. The rate of disintegration of radioactive substances depends only on the and follows the kinetics of order.
- (1) Nature of radioactive substance and first
 - (2) Amount of radioactive substance and second
 - (3) Temperature and zero
 - (4) Half-life of the radioactive substance and first
8. Which of the complex is an active catalyst and a $16 e^-$ species ?
- (1) $[HRh(CO)(PPh_3)_3]$
 - (2) $[HCo(CO)_3]$
 - (3) $[Rh(CO)_2I_4]^-$
 - (4) $[Pd(PPh_3)_4]$
9. The catalyst used for polymerization of olefins is :
- (1) Wilkinson's catalyst
 - (2) Zeise's salt complex
 - (3) Ziegler-Natta catalyst
 - (4) Tetraethyl lead
10. In the hydrogenation of alkenes using Wilkinson's catalyst, the active catalyst is $RhCl(PPh_3)_2$. The first step in its catalytic cycle is :
- (1) Alkene co-ordination
 - (2) Oxidative addition of H_2
 - (3) Loss of PPh_3
 - (4) Loss of Cl^-
11. John-Teller effect is in the field of :
- (1) Nuclear physics
 - (2) Vibronic interactions
 - (3) Thermodynamics
 - (4) Kinetic theory of gases
12. Which of the following is a soft acid ?
- (1) Ag^+
 - (2) Pt^{2+}
 - (3) Au^+
 - (4) All
13. Which of the following will combine with BH_3 to form a stable complex ?
- (1) CO
 - (2) Pt^{2+}
 - (3) OH^-
 - (4) Methane
14. The electronic ground state term for the chromium ion in $[Cr(CN)_6]^{-4}$ is :
- (1) 3F
 - (2) 3H
 - (3) 3G
 - (4) 3D

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15. The hapticity of cycloheptatriene (C_7H_8) in $Mo(C_7H_8)(CO)_3$ is :
- (1) 6 (2) 5 (3) 4 (4) 9
16. If Δ_0 is octahedral splitting energy and P is electron pairing energy then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{+2}$ is :
- (1) $-0.8 \Delta_0 + 2 P$ (2) $-0.8 \Delta_0 + 1 P$
 (3) $-0.8 \Delta_0$ (4) $-1.8 \Delta_0 + 3 P$
17. The shapes of XeF_5^+ and XeF_5^- respectively, are :
- (1) Pentagonal planar and square pyramidal
 (2) Pentagonal planar and trigonal bipyramidal
 (3) Square pyramidal and pentagonal bipyramidal
 (4) Square pyramidal and pentagonal planar
18. The number of terminal carbonyl groups present in $Fe_2(CO)_9$ are :
- (1) 2 (2) 5 (3) 6 (4) 3
19. The order of polarity of NH_3 , NF_3 and BF_3 is :
- (1) $NH_3 < NF_3 < BF_3$
 (2) $BF_3 < NF_3 < NH_3$
 (3) $BF_3 < NH_3 < NF_3$
 (4) $NF_3 < BF_3 < NH_3$
20. **Correct** statement for Coulometry is :
- (1) It is based on Faraday's law of electrolysis.
 (2) It is a type of voltammetry.
 (3) It is based on Ohm's law.
 (4) It uses ion selective electrode.

21. The calibration curve in spectrofluorimetric analysis becomes non-linear when :

- (1) Molecular weight of analyte is high
- (2) Intensity of light source is high
- (3) Concentration of analyte is high
- (4) Molar absorptivity of analyte is high

22. Mossbauer spectrum of a metal complex gives information about :

- (a) Oxidation state and spin state of metal
- (b) Types of ligands co-ordinated of metal
- (c) Nuclear spin state of metal
- (d) Geometry of metal

Correct answer is :

- (1) (a) and (c) (2) (b) and (c) (3) (a), (b) and (d) (4) (b) and (d)

23. Intense band generally observed for a carbonyl group in the IR spectrum is due to :

- (1) The force constant of CO bond is large
- (2) The force constant of CO bond is small
- (3) There is no change in dipole moment for CO bond stretching
- (4) The dipole moment change due to CO bond stretching is large

24. The species having the strongest gas phase proton affinity among the following :

- (1) N^{3-} (2) NF_3 (3) NH_3 (4) $N(CH_3)_3$

25. According to Wade's theory, the anion $[B_{12}H_{12}]^{2-}$ adopts :

- (1) Closo structure
- (2) Arachno structure
- (3) Hypo structure
- (4) Nido structure

26. When an electron is added to a gaseous atom :
- (1) Its size decreases (2) Energy is released
(3) It changes to positive ion (4) Its tendency to accept electron increases
27. Aufbau principle is *not* violated in :
- (1) d-block elements (2) s and p-block elements
(3) Lanthanides (4) Actinides
28. The highest value of n for the elements present in periodic table is :
- (1) 6 (2) 7 (3) 10 (4) 9
29. During the change of NO^+ to NO , the electron is added in a :
- (1) σ -orbital (2) π -orbital (3) σ^* -orbital (4) π^* -orbital
30. Alkali metals dissolve in liquid ammonia to form blue coloured solutions. The blue colour is due to :
- (1) Alkali metals (2) Alkali metal ions
(3) Ammoniated electrons (4) Ammoniated alkali metal ions
31. Which of the species has a permanent dipole moment ?
- (1) SF_4 (2) SiF_4 (3) BF_3 (4) XeF_4
32. Which of the ion has maximum hydration energy ?
- (1) Sr^{2+} (2) Ca^{2+} (3) Mg^{2+} (4) Be^{2+}
33. Oxymyoglobin $Mb(O_2)$ and oxyhaemoglobin $Hb(O_2)_4$ respectively, are :
- (1) Paramagnetic and paramagnetic
(2) Diamagnetic and diamagnetic
(3) Paramagnetic and diamagnetic
(4) Diamagnetic and paramagnetic

34. Three identical non interacting particles each of spin $1/2$ and mass m are moving in one dimensional infinite potential well of length a . The energy of the lowest energy state of the system is :

(1) $\frac{\pi^2 \hbar^2}{ma^2}$ (2) $\frac{2\pi^2 \hbar^2}{3ma^2}$ (3) $\frac{3\pi^2 \hbar^2}{ma^2}$ (4) $\frac{5\pi^2 \hbar^2}{2ma^2}$

35. The difference in angular momentum of the electron in two adjacent orbitals of the hydrogen atom is :

(1) $h/2\pi$ (2) h/π (3) $(n+1)h/2\pi$ (4) $(n-1)h/2\pi$

36. Apply molecular orbital theory to predict which species has the strongest bond ?

(1) N_2 (2) N_2^- (3) N_2^+ (4) All are equivalent

37. The charge density at each carbon atom in butadiene is :

(1) 2 (2) 0 (3) 4 (4) 1

38. In NMR spectroscopy, the difference between the field necessary for resonance in the sample and in some arbitrary chosen compound is which of the following ?

(1) Field shift (2) Chemical shift
(3) Matrix shift (4) Resonance shift

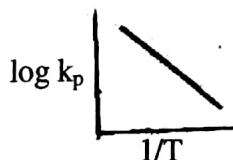
39. The vibrational frequency of a homonuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be half that of the ground state is given by (k is Boltzmann constant) :

(1) $(h \nu \ln 2)/k$ (2) $\ln 2 / (h \nu k)$ (3) $h \nu / (k \ln 2)$ (4) $h \nu \ln k$

40. What are the point groups of tetrahedral and octahedral molecules ?

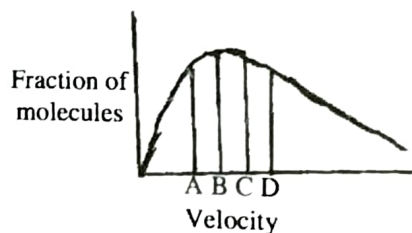
(1) D_{3h} and D_{4h} respectively
(2) T_d and O_h , respectively
(3) C_{3h} and C_{4h} respectively
(4) C_{4h} and D_{4h} respectively

41. The rotational constant B for the HCl molecule is 10.6 cm^{-1} . The frequency for the pure rotation transition $J = 0 \rightarrow J = 1$ is equal to :
- (1) 10.6 cm^{-1} (2) 5.3 cm^{-1}
(3) 21.2 cm^{-1} (4) No absorption
42. If the reduced mass of a diatomic molecule is doubled without changing its force constant, the vibrational frequency of the molecule with respect to the original frequency will be :
- (1) Unchanged (2) $\sqrt{2}$ times
(3) 2 times (4) $\frac{1}{\sqrt{2}}$ times
43. Identify which of the following pairs of molecules exhibit both a pure rotational spectrum and a rotational Raman spectrum ?
- (1) O_2 and H_2O (2) CO_2 and N_2O
(3) CO and CH_4 (4) NO and $DCCH$
44. The variation of $\log K_p$ with temperature $1/T$ for the equilibrium; $NH_4HS (s) \rightleftharpoons NH_3 (g) + H_2S (g)$; is as shown in the plot. The equilibrium is displaced in the forward direction on :

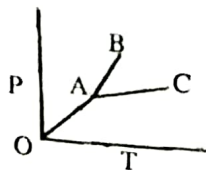


- (1) Increasing the temperature and decreasing the pressure
(2) Increasing the temperature and pressure both
(3) Decreasing the temperature and pressure both
(4) Decreasing the temperature and increasing the pressure

45. The upper critical solution temperature is defined as :
- (1) The maximum temperature at which two components will remain immiscible as two distinct liquids
 - (2) The minimum temperature at which two components will remain immiscible as two distinct liquids
 - (3) The maximum temperature at which two components remain miscible
 - (4) The minimum temperature at which two components remain miscible
46. Which of the following is *true* regarding non-ideal solutions with negative deviation ?
- (1) The interactions between the components are lesser than in the pure components
 - (2) $\Delta V_{\text{mixing}} = +ve$
 - (3) $\Delta H_{\text{mixing}} = +ve$
 - (4) They form maximum boiling azeotropes
47. Which out of A, B, C and D corresponds to the most probable speed ?



- (1) A
 - (2) B
 - (3) C
 - (4) D
48. 8 distinguishable particles are distributed in two equal sized compartments. The probability of the macro state (4, 4) is equal to :
- (1) $35/128$
 - (2) $7/128$
 - (3) $7/16$
 - (4) $35/256$
49. The slopes of the lines OA, AC and AB are $\tan \pi/4$, $\tan \pi/6$ and $\tan \pi/3$ respectively. If the melting point and ΔH melting are 27°C and 3 kJ mol^{-1} respectively, the change in volume upon melting is :



- (1) $10 \tan \pi/4$
- (2) $10 \cot \pi/3$
- (3) $10 \tan \pi/3$
- (4) $10 \cot \pi/4$

Standard enthalpy of vapourisation ΔH_{vap} for water at 100°C is 40.66 kJ mol^{-1} . Assuming water vapour to behave like an ideal gas, the internal energy of vapourisation of water at 100°C (in kJ mol^{-1}) will be equal to :

- (1) +37.56 (2) -40.66 (3) +43.76 (4) -43.76

51. 10 mL aliquots of a mixture of HCl and HNO_3 are titrated conductometrically using a 0.1M NaOH and a 0.1M AgNO_3 separately. The titer volumes are V_1 and V_2 respectively. The concentration of HNO_3 in the mixture is obtained from the combination :

- (1) $V_1 - V_2$ (2) $V_2 - V_1$ (3) $2V_1 - V_2$ (4) $2V_2 - V_1$

52. The electrode potential of which electrode depends upon the H^+ ion concentration ?

- (1) Hydrogen electrode (2) Quinhydrone electrode
(3) Glass electrode (4) All of the above

53. One mole of an ideal gas is allowed to expand isothermally and reversibly from 0.02 m^3 to 0.20 m^3 at 300 K. The entropy change for the system will be in (JK^{-1}) :

- (1) 4.61 (2) 57.42 (3) 19.14 (4) -19.14

54. What is the half-life of N_2O_5 if it decomposes with a rate constant of $5.7 \times 10^{-4}\text{ s}^{-1}$?

- (1) 20 minutes (2) 10 minutes
(3) 0.05 minutes (4) Insufficient data

55. The activation energies of two reactions are E_1 and E_2 ($E_1 > E_2$) respectively. If the temperature of the system is increased from T_1 to T_2 , the rate constants of the reactions change from k_1 to k_1' in the first reaction and k_2 to k_2' in the second reaction. Predict which of the following is **correct** ?

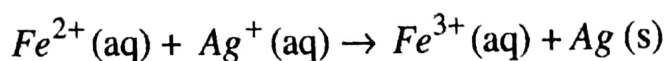
- (1) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$ (2) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2} = 1$
(3) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$ (4) None of the above

56. Arrhenius equation to determine the activation energy is :

$$(1) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad (2) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$$

$$(3) \ln\left(\frac{k_1}{k_2}\right) = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad (4) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}(T_1 T_2)$$

57. The following reaction takes place in a cell :



$$\text{Given that : } E_{Ag^+/Ag}^0 = xV; E_{Fe^{2+}/Fe}^0 = yV; E_{Fe^{3+}/Fe}^0 = zV$$

The standard potential of the cell in volts (V) will be :

- (1) $x - z$ (2) $x - y$
 (3) $x + 2y - 3z$ (4) $x + y - z$

58. What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.22 V at standard temperature and pressure ?

- (1) 2.98 (2) 2.17 (3) 3.14 (4) 3.73

59. The energy of the ground state of a particle in a box within first order perturbation theory of a system with the following potential energy will be :

$$V(x) = \begin{cases} V_0 & 0 \leq x \leq L \\ \infty & x < 0 \text{ and } x > L \end{cases}$$

- (1) $\frac{h^2}{8mL^2}$ (2) V_0
 (3) $\frac{h^2}{8mL^2} + V_0$ (4) $\frac{h^2}{4mL^2} + \frac{V_0}{2}$

(4) None of the above

62. Which of the following statements is *not* true ?

(1) Step-growth polymerization requires a bifunctional monomer

(2) Nylon 6 is an example of step-growth polymerization

(3) Chain growth polymerization includes both homo-polymerization and copolymerization

(4) Chain growth polymerization involves homo-polymerization only

63. Which of the following salts show maximum value of equivalent conductance in their fused state ?

(1) KCl

(2) NaCl

(3) CsCl

(4) RbCl

64. In terms of energy bands, insulators have :

(1) Full conduction band

(2) Very small energy gap

(3) Full valence band

(4) Moderate energy gap

method for crystal structure determination ?

- (1) The d spacings become smaller
- (2) Bragg angles of reflections increase
- (3) The diffraction pattern expands
- (4) Some previously accessible reflections can no longer be measured

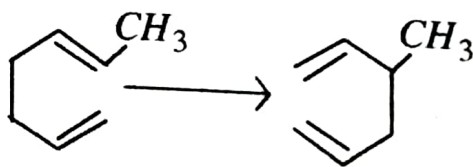
66. A committee has 6 members having weights in (kg) as 45, 50, 65, 72, 63 and 65. What will be the standard deviation ?

- (1) $\sqrt{115}$ (2) $\sqrt{152}$ (3) $\sqrt{88}$ (4) $\sqrt{176}$

67. Most stable carbocation is :

- (1) Tropylium ion (2) Benzylcation
(3) Allylcation (4) Vinylcation

68. The given reaction is an example of :



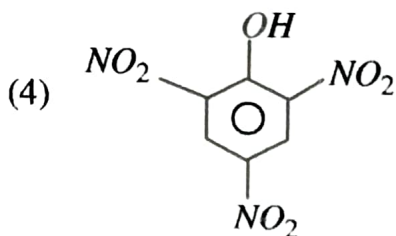
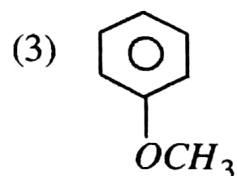
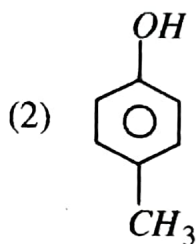
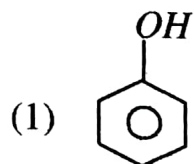
- (1) Cope rearrangement (2) The claisen rearrangement
(3) Diels-Alder reaction (4) Cheletropic reaction
69. Which of the following reagents react with phenol at 298K to form salt ?

- (1) NaHCO_3 (2) Cl_2
(3) H_2SO_4 (4) NaOH

70. A single strong absorption near 1800 cm^{-1} in IR spectroscopy indicates the presence of :

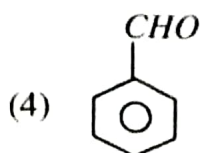
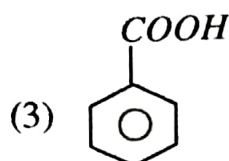
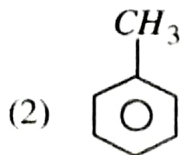
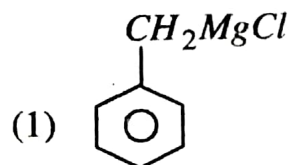
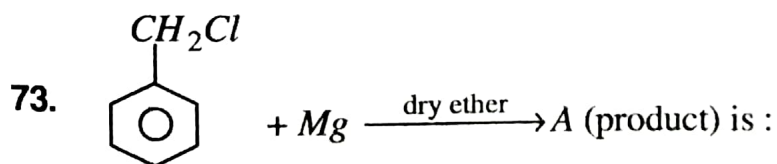
- (1) Azo compound (2) Acid halides
 (3) Sulphoxide (4) Thioketones

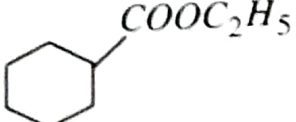
71. Which one of the following is strongest acid ?



72. The ^{13}C NMR spectrum of ethyl benzene exhibits :

- (1) 8 signals (2) 6 signals (3) 5 signals (4) 4 signals



74. The IUPAC name of  is :

- (1) Cyclohexane carboxamide
 - (2) Cyclohexane ethyl carboxylate
 - (3) Ethyl cyclohexane carboxylate
 - (4) Aminocyclo hexane carboxylate
75. Which one of the following statement is *correct* ?

- (1) Allene and biphenyls show optical activity.
- (2) Allene and biphenyls do'nt show optical activity.
- (3) Only allene show optical activity not biphenyls.
- (4) Only biphenyls show optical activity not allene.

76. Chlorination of furan is carried out by :

- | | |
|-----------------------------|-------------------------------|
| (1) Cl_2 at $-40^\circ C$ | (2) Cl_2 , at $-30^\circ C$ |
| (3) Cl_2 | (4) $FeCl_3$ |

77. Which one of the following is aldoses ?

- | | |
|--------------|---------------|
| (1) Fructose | (2) Galactose |
| (3) Ribulose | (4) Sorbose |

78. Match the **list-I** and **list-II** and select the **correct** answer using codes given below the list :

List - I

- (i) Citral
- (ii) Linalool
- (iii) α -terpineol
- (iv) Limonene

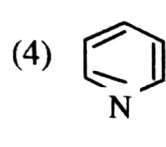
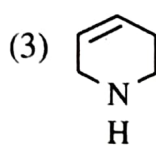
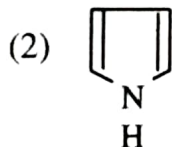
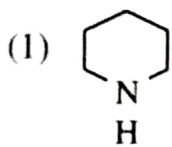
List - II

- A. p-cymene
- B. Carvoxime
- C. Tert. alcohol
- D. Lemon grass

Correct answer is :

- (1) i-B, ii-A, iii-D, iv-C
- (2) i-D, ii-C, iii-A, iv-B
- (3) i-C, ii-D, iii-B, iv-A
- (4) i-A, ii-B, iii-C, iv-D

79. $\begin{array}{c} CH \\ ||| \\ CH \end{array} + NH_3 \quad \begin{array}{c} CH \\ ||| \\ CH \end{array} \xrightarrow{\text{Red hot tube}} A, A \text{ is :}$



80. Nicotine alkaloid belong to :

- (1) Phenyl ethylamine group
- (2) Pyrrolidine - pyridine group
- (3) Isoquinoline group
- (4) Indol group

81. Which one of the following is mainly responsible for eutrophication ?

(1) Nitrate

(2) Phosphate

(3) Carbamate

(4) Sulphate

82. Which one of the following is used as tranquilizer ?

(1) Omepyrazole

(2) 2-acetoxy benzoic acid

(3) Chloromycetin

(4) Barbituric acid

83. In IR spectrum, primary amines show two bands around the region :

(1) 3350 cm^{-1}

(2) 2950 cm^{-1}

(3) 1630 cm^{-1}

(4) 2100 cm^{-1}

84. Green chemistry protects the environment by reducing :

(1) Forest

(2) Temperature

(3) Pollution

(4) Weeds

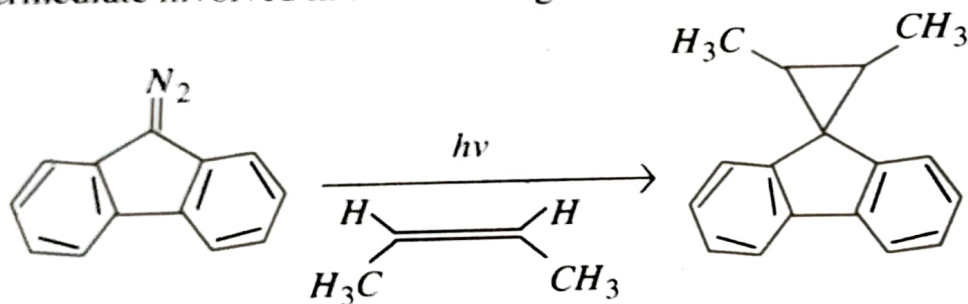
86. The reaction $CH_3CCH_2CH_3 \xrightarrow[\text{conc. HCl}]{Zn-Hg} CH_3CH_2CH_2CH_3$ is known as :

- (1) Perkin reaction
- (2) Aldol condensation
- (3) Clemmensen reduction
- (4) Pechmann condensation

87. Which of the following carbonyl give a haloform test ?

- (1) Hexan-2-one
- (2) Propanal
- (3) Pentan-3-one
- (4) 2-Methyl butanal

88. The intermediate involved in the following reaction is :



- (1) Carbocation
- (2) Carbene
- (3) Nitrene
- (4) Free radical

89. Spiro compounds are optically active due to :

- (1) Chiral axis
- (2) Chiral plane
- (3) Chiral carbon
- (4) Helicity

90. Which one of the following reagent gives *syn* addition with alkene ?

- (1) Br_2
- (2) Cl_2
- (3) Dil $KMnO_4 / OH^-$
- (4) DDQ

list :

List-I

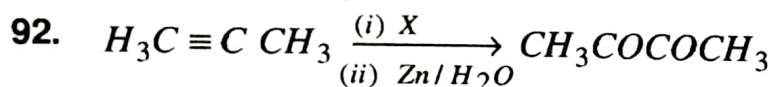
- (i) Lipoprotein
- (ii) Glycoprotein
- (iii) Collagen
- (iv) Chromoprotein

List-II

- A. Sugars
- B. Tendons
- C. Lipids
- D. Pigment

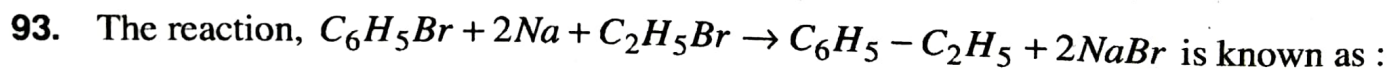
Correct answer is :

- (1) i-B, ii-C, iii-A, iv-D
- (2) i-C, ii-B, iii-D, iv-A
- (3) i-A, ii-B, iii-C, iv-D
- (4) i-C, ii-A, iii-B, iv-D



In the above reaction X is :

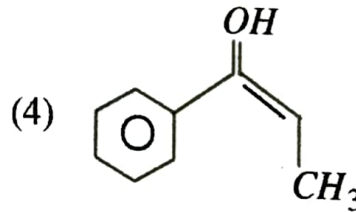
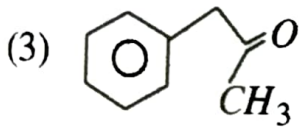
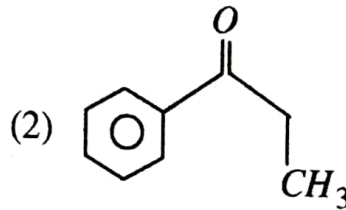
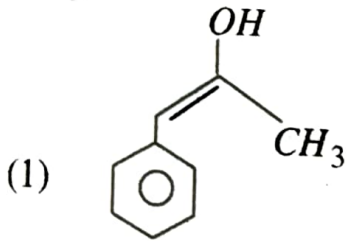
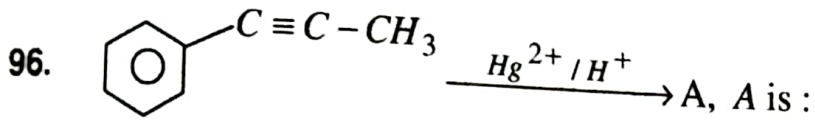
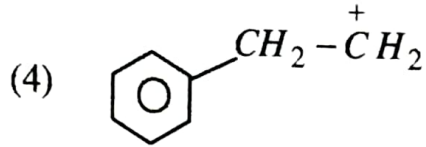
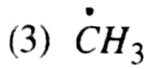
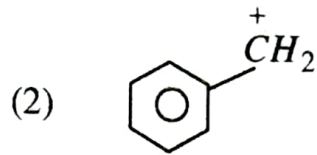
- (1) $K_2Cr_2O_7$
- (2) O_2
- (3) O_3
- (4) H_2SO_4



- (1) Cannizzaro reaction
- (2) Wurtz reaction
- (3) Oppenaur oxidation
- (4) Wurtz-Fittig reaction

94. What is the condensation product of ethylacetate ?

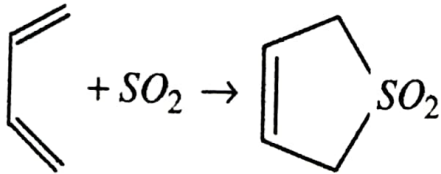
- (1) Aceto acetic ester
- (2) Ethyl cyanide
- (3) Ethyl aceto acetate
- (4) Ethyl propanoate



97. Which of the following undergoes a Diels-Alder reaction ?

- (1) Thiophene (2) Pyrrole (3) Pyridine (4) Furan

98. Reaction :



- (1) Cheletropic reaction (2) Cycloaddition
(3) Sigmatropic rearrangement (4) The enereaction

99. When camphor is heated with KOH, the major product obtained is
- (1) Isocampholic acid
 - (2) Camphene
 - (3) Campholic acid
 - (4) Camphoric acid

100. Which of the following reaction is favoured by polar aprotic solvent ?

- | | |
|-----------------------|--|
| (1) S_{N2} reaction | (2) S_{N1} |
| (3) Addition reaction | (4) Both S_{N1} & S_{N2} reactions |

Total No. of Printed Pages : 21

(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

B

Ph.D./URS-EE-Jan-2022

SET-Y

SUBJECT : Chemistry

10042

Sr. No.

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

(Signature of the Candidate)

(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. **All questions are compulsory.**
2. The candidates **must return** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
5. The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
6. **There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
7. Use only **Black or Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. **Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.**

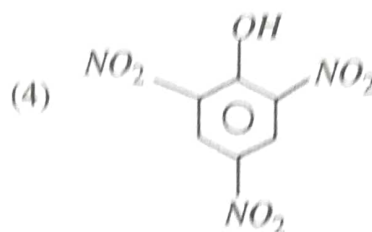
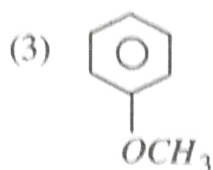
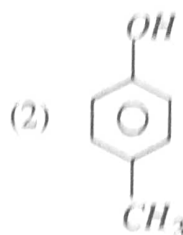
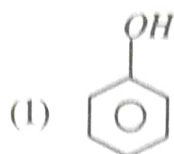
PHD/URS-EE-2022/(Chemistry)(SET-Y)/(B)

SEAL

B

1

1. Which one of the following is strongest acid ?



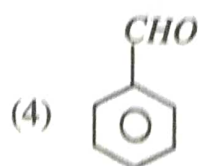
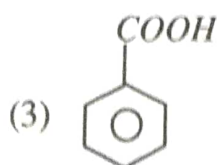
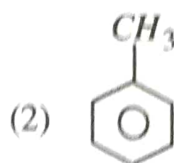
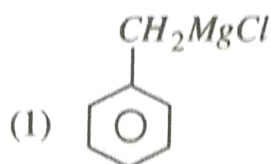
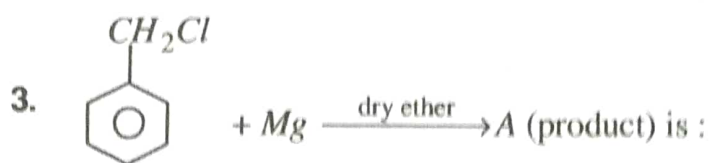
2. The ^{13}C NMR spectrum of ethyl benzene exhibits :

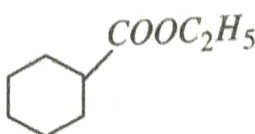
(1) 8 signals

(2) 6 signals

(3) 5 signals

(4) 4 signals



4. The IUPAC name of  is :

- (1) Cyclohexane carboxamide
 - (2) Cyclohexane ethyl carboxylate
 - (3) Ethyl cyclohexane carboxylate
 - (4) Aminocyclo hexane carboxylate
5. Which one of the following statement is *correct* ?
- (1) Allene and biphenyls show optical activity.
 - (2) Allene and biphenyls do'nt show optical activity.
 - (3) Only allene show optical activity not biphenyls.
 - (4) Only biphenyls show optical activity not allene.
6. Chlorination of furan is carried out by :
- (1) Cl_2 at $-40^\circ C$
 - (2) Cl_2 , at $-30^\circ C$
 - (3) Cl_2
 - (4) $FeCl_3$
7. Which one of the following is aldoses ?
- | | |
|--------------|---------------|
| (1) Fructose | (2) Galactose |
| (3) Ribulose | (4) Sorbose |

8. Match the list-I and list-II and select the *correct* answer using codes given below the list :

List - I

- (i) Citral
 (ii) Linalool
 (iii) α -terpineol
 (iv) Limonene

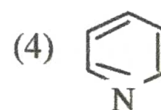
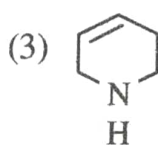
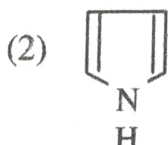
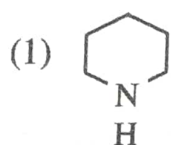
List - II

- A. p-cymene
 B. Carvoxime
 C. Tert. alcohol
 D. Lemon grass

Correct answer is :

- (1) i-B, ii-A, iii-D, iv-C
 (2) i-D, ii-C, iii-A, iv-B
 (3) i-C, ii-D, iii-B, iv-A
 (4) i-A, ii-B, iii-C, iv-D

9. $\begin{array}{c} CH \\ ||| \\ CH \end{array} + NH_3 \xrightarrow{\text{Red hot tube}} \begin{array}{c} CH \\ ||| \\ CH \end{array} \rightarrow A, A \text{ is :}$



10. Nicotine alkaloid belong to :

- (1) Phenyl ethylamine group
 (2) Pyrrolidine - pyridine group
 (3) Isoquinoline group
 (4) Indol group

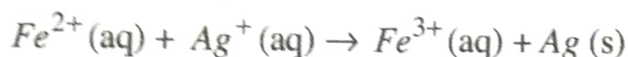
11. 10 mL aliquots of a mixture of HCl and HNO_3 are titrated conductometrically using a 0.1M $NaOH$ and a 0.1M $AgNO_3$ separately. The titer volumes are V_1 and V_2 respectively. The concentration of HNO_3 in the mixture is obtained from the combination :
- (1) $V_1 - V_2$ (2) $V_2 - V_1$
(3) $2V_1 - V_2$ (4) $2V_2 - V_1$
12. The electrode potential of which electrode depends upon the H^+ ion concentration ?
- (1) Hydrogen electrode
(2) Quinhydrone electrode
(3) Glass electrode
(4) All of the above
13. One mole of an ideal gas is allowed to expand isothermally and reversibly from 0.02 m^3 to 0.20 m^3 at 300 K. The entropy change for the system will be in (JK^{-1}) :
- (1) 4.61 (2) 57.42 (3) 19.14 (4) -19.14
14. What is the half-life of N_2O_5 if it decomposes with a rate constant of $5.7 \times 10^{-4}\text{ s}^{-1}$?
- (1) 20 minutes (2) 10 minutes
(3) 0.05 minutes (4) Insufficient data
15. The activation energies of two reactions are E_1 and E_2 ($E_1 > E_2$) respectively. If the temperature of the system is increased from T_1 to T_2 , the rate constants of the reactions change from k_1 to k_1' in the first reaction and k_2 to k_2' in the second reaction. Predict which of the following is **correct** ?
- (1) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$ (2) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2} = 1$
(3) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$ (4) None of the above

16. Arrhenius equation to determine the activation energy is :

$$(1) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad (2) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$$

$$(3) \ln\left(\frac{k_1}{k_2}\right) = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right) \quad (4) \ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}(T_1 T_2)$$

17. The following reaction takes place in a cell :



Given that : $E_{Ag^+/Ag}^0 = xV$; $E_{Fe^{2+}/Fe}^0 = yV$; $E_{Fe^{3+}/Fe}^0 = zV$

The standard potential of the cell in volts (V) will be :

- (1) $x - z$ (2) $x - y$
 (3) $x + 2y - 3z$ (4) $x + y - z$

18. What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.22 V at standard temperature and pressure ?

- (1) 2.98 (2) 2.17 (3) 3.14 (4) 3.73

19. The energy of the ground state of a particle in a box within first order perturbation theory of a system with the following potential energy will be :

$$V(x) = \begin{cases} V_0 & 0 \leq x \leq L \\ \infty & x < 0 \text{ and } x > L \end{cases}$$

$$(1) \frac{h^2}{8mL^2}$$

$$(2) V_0$$

$$(3) \frac{h^2}{8mL^2} + V_0$$

$$(4) \frac{h^2}{4mL^2} + \frac{V_0}{2}$$

20. Which of the following dispersions does not have liquid continuous phase ?
- (1) Foam (2) Nanosuspension
(3) Microemulsion (4) Gel
21. Which of the species has a permanent dipole moment ?
- (1) SF_4 (2) SiF_4 (3) BF_3 (4) XeF_4
22. Which of the ion has maximum hydration energy ?
- (1) Sr^{2+} (2) Ca^{2+} (3) Mg^{2+} (4) Be^{2+}
23. Oxymyoglobin $Mb(O_2)$ and oxyhaemoglobin $Hb(O_2)_4$ respectively, are :
- (1) Paramagnetic and paramagnetic
(2) Diamagnetic and diamagnetic
(3) Paramagnetic and diamagnetic
(4) Diamagnetic and paramagnetic
24. Three identical non interacting particles each of spin $1/2$ and mass m are moving in one dimensional infinite potential well of length a . The energy of the lowest energy state of the system is :
- (1) $\frac{\pi^2 \hbar^2}{ma^2}$ (2) $\frac{2\pi^2 \hbar^2}{3ma^2}$
(3) $\frac{3\pi^2 \hbar^2}{ma^2}$ (4) $\frac{5\pi^2 \hbar^2}{2ma^2}$
25. The difference in angular momentum of the electron in two adjacent orbitals of the hydrogen atom is :
- (1) $h/2\pi$ (2) h/π (3) $(n+1)h/2\pi$ (4) $(n-1)h/2\pi$
26. Apply molecular orbital theory to predict which species has the strongest bond ?
- (1) N_2 (2) N_2^- (3) N_2^+ (4) All are equivalent
27. The charge density at each carbon atom in butadiene is :
- (1) 2 (2) 0 (3) 4 (4) 1

28. In NMR spectroscopy, the difference between the field necessary for resonance in the sample and in some arbitrary chosen compound is which of the following ?
- (1) Field shift (2) Chemical shift
(3) Matrix shift (4) Resonance shift
29. The vibrational frequency of a homonuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be half that of the ground state is given by (k is Boltzmann constant) :
- (1) $(h \nu \ln 2)/k$ (2) $\ln 2 / (h \nu k)$
(3) $h \nu / (k \ln 2)$ (4) $h \nu \ln k$
30. What are the point groups of tetrahedral and octahedral molecules ?
- (1) D_{3h} and D_{4h} respectively
(2) T_d and O_h , respectively
(3) C_{3h} and C_{4h} respectively
(4) C_{4h} and D_{4h} respectively
31. John-Teller effect is in the field of :
- (1) Nuclear physics
(2) Vibronic interactions
(3) Thermodynamics
(4) Kinetic theory of gases
32. Which of the following is a soft acid ?
- (1) Ag^+ (2) Pt^{2+} (3) Au^+ (4) All
33. Which of the following will combine with BH_3 to form a stable complex ?
- (1) CO (2) Pt^{2+} (3) OH^- (4) Methane
34. The electronic ground state term for the chromium ion in $[Cr(CN)_6]^{-4}$ is :
- (1) 3F (2) 3H (3) 3G (4) 5D

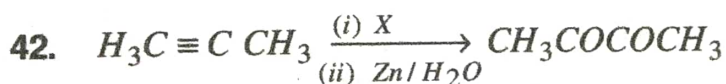
35. The hapticity of cycloheptatriene (C_7H_8) in $Mo(C_7H_8)(CO)_3$ is :
(1) 6 (2) 5 (3) 4 (4) 9
36. If Δ_0 is octahedral splitting energy and P is electron pairing energy then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{+2}$ is :
(1) $-0.8 \Delta_0 + 2P$ (2) $-0.8 \Delta_0 + 1P$
(3) $-0.8 \Delta_0$ (4) $-1.8 \Delta_0 + 3P$
37. The shapes of XeF_5^+ and XeF_5^- respectively, are :
(1) Pentagonal planar and square pyramidal
(2) Pentagonal planar and trigonal bipyramidal
(3) Square pyramidal and pentagonal bipyramidal
(4) Square pyramidal and pentagonal planar
38. The number of terminal carbonyl groups present in $Fe_2(CO)_9$ are :
(1) 2 (2) 5 (3) 6 (4) 3
39. The order of polarity of NH_3 , NF_3 and BF_3 is :
(1) $NH_3 < NF_3 < BF_3$
(2) $BF_3 < NF_3 < NH_3$
(3) $BF_3 < NH_3 < NF_3$
(4) $NF_3 < BF_3 < NH_3$
40. **Correct** statement for Coulometry is :
(1) It is based on Faraday's law of electrolysis.
(2) It is a type of voltammetry.
(3) It is based on Ohm's law.
(4) It uses ion selective electrode.

41. Match the **List-I** and **List-II** and select the *correct* answer using codes given below the list :

List-I	List-II
(i) Lipoprotein	A. Sugars
(ii) Glycoprotein	B. Tendons
(iii) Collagen	C. Lipids
(iv) Chromoprotein	D. Pigment

Correct answer is :

- (1) i-B, ii-C, iii-A, iv-D
 (2) i-C, ii-B, iii-D, iv-A
 (3) i-A, ii-B, iii-C, iv-D
 (4) i-C, ii-A, iii-B, iv-D



In the above reaction X is :

- (1) $K_2Cr_2O_7$ (2) O_2
 (3) O_3 (4) H_2SO_4

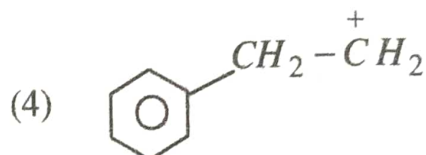
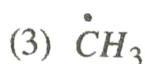
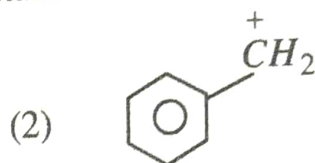
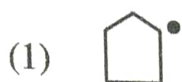
43. The reaction, $C_6H_5Br + 2Na + C_2H_5Br \rightarrow C_6H_5 - C_2H_5 + 2NaBr$ is known as :

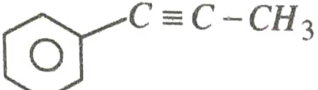
- (1) Cannizzaro reaction (2) Wurtz reaction
 (3) Oppenaur oxidation (4) Wurtz-Fittig reaction

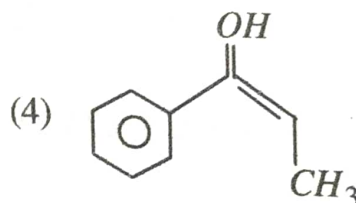
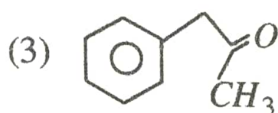
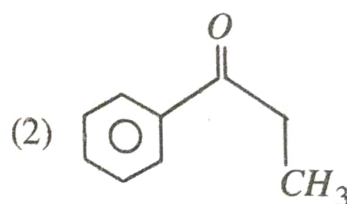
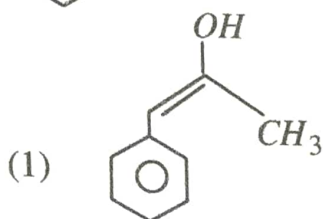
44. What is the condensation product of ethylacetate ?

- (1) Aceto acetic ester (2) Ethyl cyanide
 (3) Ethyl aceto acetate (4) Ethyl propanoate

45. Which of the following synthon is most stable ?



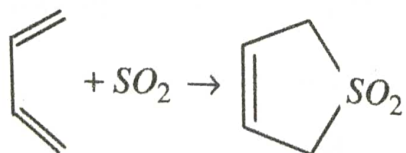
46.  $\xrightarrow{Hg^{2+}/H^+}$ A, A is :



47. Which of the following undergoes a Diels-Alder reaction ?

- (1) Thiophene (2) Pyrrole (3) Pyridine (4) Furan

48. Reaction :



- (1) Cheletropic reaction (2) Cycloaddition
 (3) Sigmatropic rearrangement (4) The enereaction

49. When camphor is heated with KOH, the major product obtained is :
- (1) Isocampholic acid (2) Camphene
(3) Campholic acid (4) Camphoric acid
50. Which of the following reaction is favoured by polar aprotic solvent ?
- (1) S_{N2} reaction
(2) S_{N1}
(3) Addition reaction
(4) Both S_{N1} & S_{N2} reactions
51. Freundlich adsorption isotherm can be used to model :
- (1) Monolayer adsorption
(2) Multilayer adsorption
(3) Both monolayer and multilayer adsorption
(4) None of the above
52. Which of the following statements is *not* true ?
- (1) Step-growth polymerization requires a bifunctional monomer
(2) Nylon 6 is an example of step-growth polymerization
(3) Chain growth polymerization includes both homo-polymerization and copolymerization
(4) Chain growth polymerization involves homo-polymerization only
53. Which of the following salts show maximum value of equivalent conductance in their fused state ?
- (1) KCl (2) NaCl (3) CsCl (4) RbCl

54. In terms of energy bands, insulators have :

- (1) Full conduction band
- (2) Very small energy gap
- (3) Full valence band
- (4) Moderate energy gap

55. If the value of the wavelength is doubled, which of the following is *not* true in Bragg's method for crystal structure determination ?

- (1) The d spacings become smaller
- (2) Bragg angles of reflections increase
- (3) The diffraction pattern expands
- (4) Some previously accessible reflections can no longer be measured

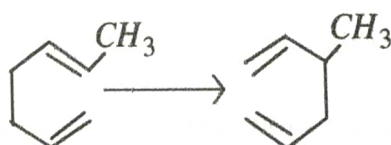
56. A committee has 6 members having weights in (kg) as 45, 50, 65, 72, 63 and 65. What will be the standard deviation ?

- (1) $\sqrt{115}$ (2) $\sqrt{152}$ (3) $\sqrt{88}$ (4) $\sqrt{176}$

57. Most stable carbocation is :

- (1) Tropylium ion
- (2) Benzylcation
- (3) Allylcation
- (4) Vinylcation

58. The given reaction is an example of :



- (1) Cope rearrangement
- (2) The claisen rearrangement
- (3) Diels-Alder reaction
- (4) Cheletropic reaction

59. Which of the following reagents react with phenol at 298K to form salt ?
- (1) NaHCO_3 (2) Cl_2
(3) H_2SO_4 (4) NaOH
60. A single strong absorption near 1800 cm^{-1} in IR spectroscopy indicates the presence of :
- (1) Azo compound (2) Acid halides
(3) Sulphoxide (4) Thioketones
61. Which one of the following is mainly responsible for eutrophication ?
- (1) Nitrate (2) Phosphate
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62. Which one of the following is used as tranquilizer ?
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64. Green chemistry protects the environment by reducing :
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65. Which of the following has the highest bond dissociation energy ?

- (1) Hydrogen bond
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- (4) Vander Waals forces

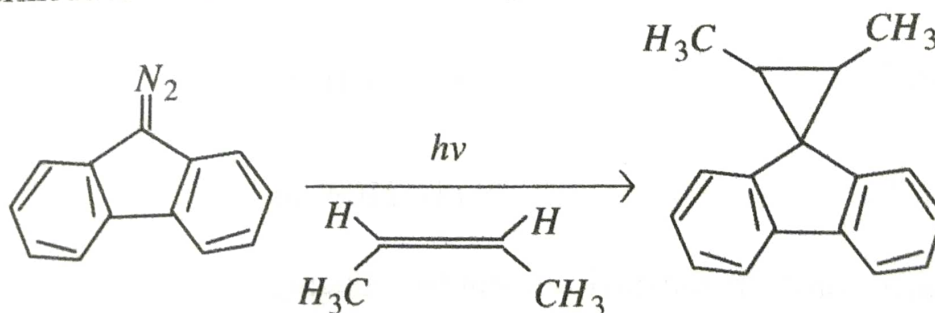
66. The reaction $CH_3\overset{O}{\parallel}CCH_2CH_3 \xrightarrow[\text{conc. HCl}]{Zn-Hg} CH_3CH_2CH_2CH_3$ is known as :

- (1) Perkin reaction
- (2) Aldol condensation
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- (4) Pechmann condensation

67. Which of the following carbonyl give a haloform test ?

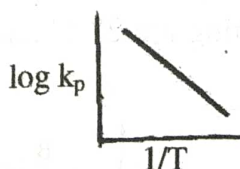
- | | |
|------------------|----------------------|
| (1) Hexan-2-one | (2) Propanal |
| (3) Pentan-3-one | (4) 2-Methyl butanal |

68. The intermediate involved in the following reaction is :



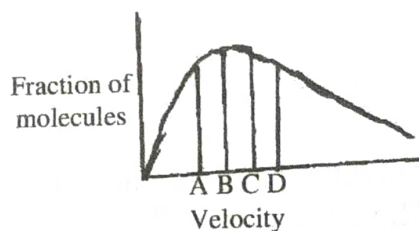
- | | |
|-----------------|------------------|
| (1) Carbocation | (2) Carbene |
| (3) Nitrene | (4) Free radical |

69. Spiro compounds are optically active due to :
- (1) Chiral axis (2) Chiral plane
(3) Chiral carbon (4) Helicity
70. Which one of the following reagent gives *syn* addition with alkene ?
- (1) Br_2 (2) Cl_2
(3) Dil $KMnO_4/OH^-$ (4) DDQ
71. The rotational constant B for the HCl molecule is 10.6 cm^{-1} . The frequency for the pure rotation transition $J = 0 \rightarrow J = 1$ is equal to :
- (1) 10.6 cm^{-1} (2) 5.3 cm^{-1} (3) 21.2 cm^{-1} (4) No absorption
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- (1) Unchanged (2) $\sqrt{2}$ times (3) 2 times (4) $\frac{1}{\sqrt{2}}$ times
73. Identify which of the following pairs of molecules exhibit both a pure rotational spectrum and a rotational Raman spectrum ?
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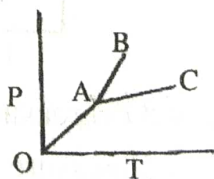


- (1) Increasing the temperature and decreasing the pressure
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- (a) Oxidation state and spin state of metal
(b) Types of ligands co-ordinated of metal
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Correct answer is :

- (1) (a) and (c) (2) (b) and (c)
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(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU
ARE ASKED TO DO SO)

C

SET-Y

Ph.D./URS-EE-Jan-2022

SUBJECT : Chemistry

10043

Sr. No. _____

Time : 1¼ Hours

Max. Marks : 100

Total Questions : 100

Roll No. (in figures) _____ (in words) _____

Name _____ Father's Name _____

Mother's Name _____ Date of Examination _____

(Signature of the Candidate)

(Signature of the Invigilator)

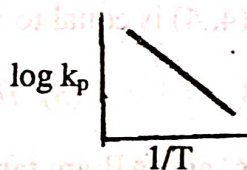
**CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE
STARTING THE QUESTION PAPER.**

1. *All questions are compulsory.*
2. The candidates **must return** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
5. The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
6. **There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
7. Use only Black or Blue Ball Point Pen of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.*

PHD/URS-EE-2022/(Chemistry)(SET-Y)/(C)

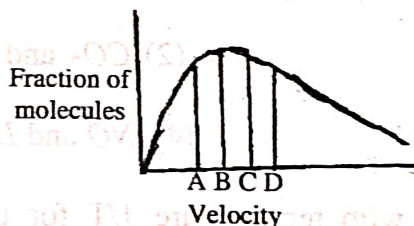
SEAL

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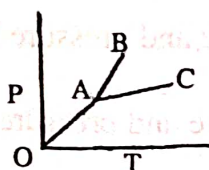


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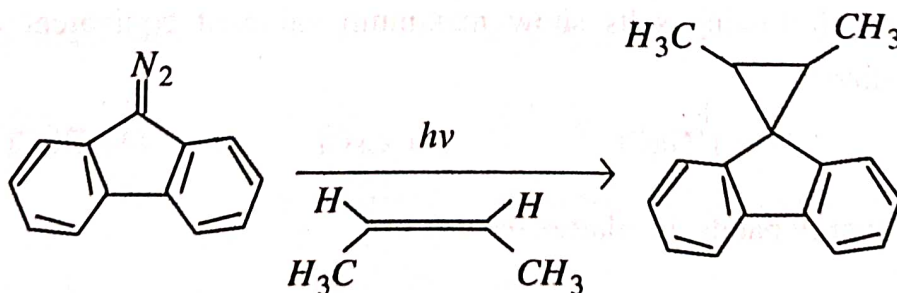
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- (1) Carbocation (2) Carbene
(3) Nitrene (4) Free radical

39. Spiro compounds are optically active due to :
- (1) Chiral axis (2) Chiral plane
(3) Chiral carbon (4) Helicity
40. Which one of the following reagent gives *syn* addition with alkene ?
- (1) Br_2 (2) Cl_2
(3) Dil $KMnO_4/OH^-$ (4) DDQ
41. Freundlich adsorption isotherm can be used to model :
- (1) Monolayer adsorption
(2) Multilayer adsorption
(3) Both monolayer and multilayer adsorption
(4) None of the above
42. Which of the following statements is *not* true ?
- (1) Step-growth polymerization requires a bifunctional monomer
(2) Nylon 6 is an example of step-growth polymerization
(3) Chain growth polymerization includes both homo-polymerization and copolymerization
(4) Chain growth polymerization involves homo-polymerization only
43. Which of the following salts show maximum value of equivalent conductance in their fused state ?
- (1) KCl (2) NaCl (3) CsCl (4) RbCl
44. In terms of energy bands, insulators have :
- (1) Full conduction band (2) Very small energy gap
(3) Full valence band (4) Moderate energy gap

45. If the value of the wavelength is doubled, which of the following is *not* true in Bragg's method for crystal structure determination ?

- (1) The d spacings become smaller
- (2) Bragg angles of reflections increase
- (3) The diffraction pattern expands
- (4) Some previously accessible reflections can no longer be measured

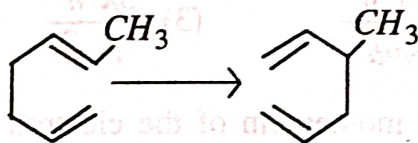
46. A committee has 6 members having weights in (kg) as 45, 50, 65, 72, 63 and 65. What will be the standard deviation ?

- (1) $\sqrt{115}$ (2) $\sqrt{152}$ (3) $\sqrt{88}$ (4) $\sqrt{176}$

47. Most stable carbocation is :

- (1) Tropylium ion
- (2) Benzylcation
- (3) Allylcation
- (4) Vinylcation

48. The given reaction is an example of :



- (1) Cope rearrangement
- (2) The Claisen rearrangement
- (3) Diels-Alder reaction
- (4) Cheletropic reaction

49. Which of the following reagents react with phenol at 298K to form salt ?

- (1) NaHCO_3
- (2) Cl_2
- (3) H_2SO_4
- (4) NaOH

50. A single strong absorption near 1800 cm^{-1} in IR spectroscopy indicates the presence of :
- (1) Azo compound (2) Acid halides
(3) Sulphoxide (4) Thioketones
51. Which of the species has a permanent dipole moment ?
- (1) SF_4 (2) SiF_4 (3) BF_3 (4) XeF_4
52. Which of the ion has maximum hydration energy ?
- (1) Sr^{2+} (2) Ca^{2+} (3) Mg^{2+} (4) Be^{2+}
53. Oxymyoglobin $Mb(O_2)$ and oxyhaemoglobin $Hb(O_2)_4$ respectively, are :
- (1) Paramagnetic and paramagnetic
(2) Diamagnetic and diamagnetic
(3) Paramagnetic and diamagnetic
(4) Diamagnetic and paramagnetic
54. Three identical non interacting particles each of spin $1/2$ and mass m are moving in one dimensional infinite potential well of length a . The energy of the lowest energy state of the system is :
- (1) $\frac{\pi^2 \hbar^2}{ma^2}$ (2) $\frac{2\pi^2 \hbar^2}{3ma^2}$ (3) $\frac{3\pi^2 \hbar^2}{ma^2}$ (4) $\frac{5\pi^2 \hbar^2}{2ma^2}$
55. The difference in angular momentum of the electron in two adjacent orbitals of the hydrogen atom is :
- (1) $h/2\pi$ (2) h/π (3) $(n+1)h/2\pi$ (4) $(n-1)h/2\pi$
56. Apply molecular orbital theory to predict which species has the strongest bond ?
- (1) N_2 (2) N_2^- (3) N_2^+ (4) All are equivalent
57. The charge density at each carbon atom in butadiene is :
- (1) 2 (2) 0 (3) 4 (4) 1

58. In NMR spectroscopy, the difference between the field necessary for resonance in the sample and in some arbitrary chosen compound is which of the following ?

- (1) Field shift (2) Chemical shift
(3) Matrix shift (4) Resonance shift

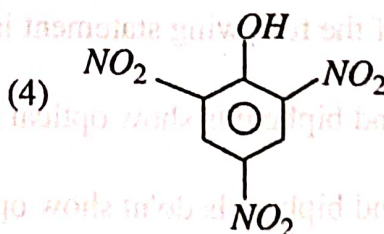
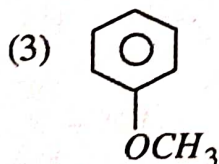
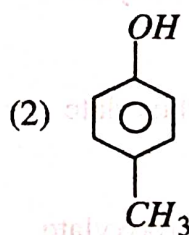
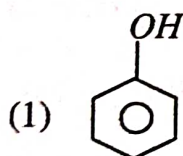
59. The vibrational frequency of a homonuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be half that of the ground state is given by (k is Boltzmann constant) :

- (1) $(h \nu \ln 2)/k$ (2) $\ln 2 / (h \nu k)$ (3) $h \nu / (k \ln 2)$ (4) $h \nu \ln k$

60. What are the point groups of tetrahedral and octahedral molecules ?

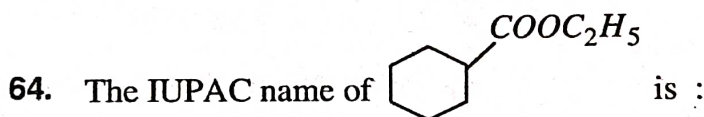
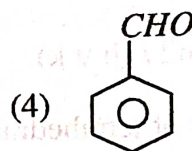
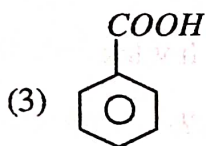
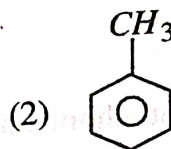
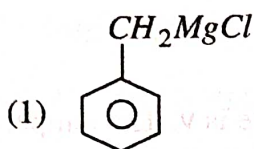
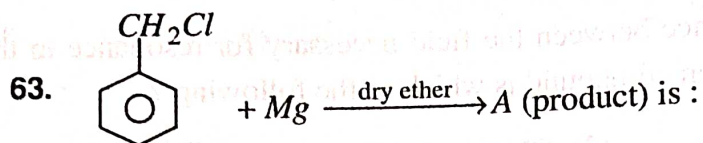
- (1) D_{3h} and D_{4h} respectively
(2) T_d and O_h , respectively
(3) C_{3h} and C_{4h} respectively
(4) C_{4h} and D_{4h} respectively

61. Which one of the following is strongest acid ?



62. The ^{13}C NMR spectrum of ethyl benzene exhibits :

- (1) 8 signals (2) 6 signals (3) 5 signals (4) 4 signals



(1) Cyclohexane carboxamide

(2) Cyclohexane ethyl carboxylate

(3) Ethyl cyclohexane carboxylate

(4) Aminocyclo hexane carboxylate

65. Which one of the following statement is *correct* ?

(1) Allene and biphenyls show optical activity.

(2) Allene and biphenyls do'nt show optical activity.

(3) Only allene show optical activity not biphenyls.

(4) Only biphenyls show optical activity not allene.

66. Chlorination of furan is carried out by :

- (1) Cl_2 at $-40^\circ C$ (2) Cl_2 , at $-30^\circ C$
 (3) Cl_2 (4) $FeCl_3$

67. Which one of the following is aldoses ?

- (1) Fructose (2) Galactose (3) Ribulose (4) Sorbose

68. Match the list-I and list-II and select the *correct* answer using codes given below the list :

List - I

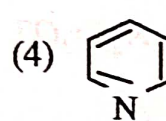
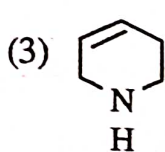
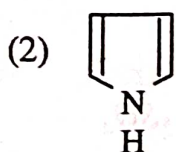
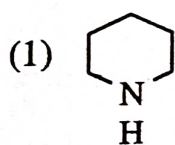
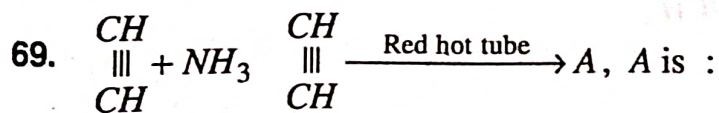
- (i) Citral
 (ii) Linalool
 (iii) α -terpineol
 (iv) Limonene

List - II

- A. p-cymene
 B. Carvoxime
 C. Tert. alcohol
 D. Lemon grass

Correct answer is :

- (1) i-B, ii-A, iii-D, iv-C
 (2) i-D, ii-C, iii-A, iv-B
 (3) i-C, ii-D, iii-B, iv-A
 (4) i-A, ii-B, iii-C, iv-D



14

70. Nicotine alkaloid belong to :

- (1) Phenyl ethylamine group
- (2) Pyrrolidine - pyridine group
- (3) Isoquinoline group
- (4) Indol group

71. Match the **List-I** and **List-II** and select the **correct** answer using codes given below the list :

List-I

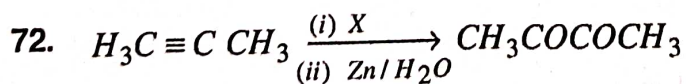
- (i) Lipoprotein
- (ii) Glycoprotein
- (iii) Collagen
- (iv) Chromoprotein

List-II

- A. Sugars
- B. Tendons
- C. Lipids
- D. Pigment

Correct answer is :

- (1) i-B, ii-C, iii-A, iv-D
- (2) i-C, ii-B, iii-D, iv-A
- (3) i-A, ii-B, iii-C, iv-D
- (4) i-C, ii-A, iii-B, iv-D



In the above reaction X is :

- (1) $K_2Cr_2O_7$
- (2) O_2
- (3) O_3
- (4) H_2SO_4

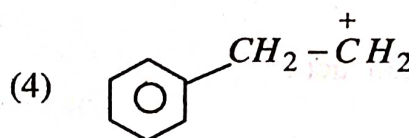
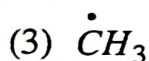
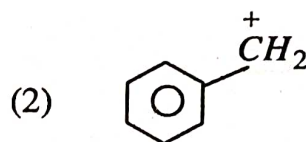
73. The reaction, $C_6H_5Br + 2Na + C_2H_5Br \rightarrow C_6H_5 - C_2H_5 + 2NaBr$ is known as :

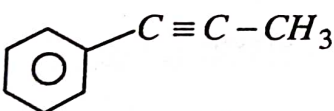
- (1) Cannizzaro reaction (2) Wurtz reaction
(3) Oppenaur oxidation (4) Wurtz-Fittig reaction

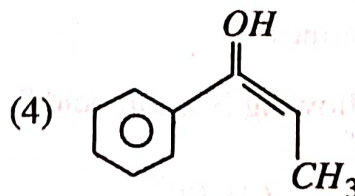
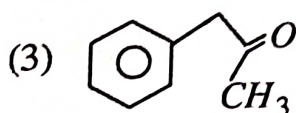
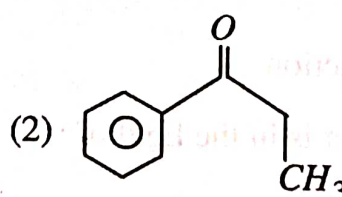
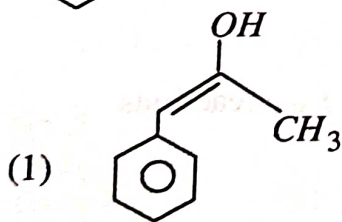
74. What is the condensation product of ethylacetate ?

- (1) Aceto acetic ester (2) Ethyl cyanide
(3) Ethyl aceto acetate (4) Ethyl propanoate

75. Which of the following synthon is most stable ?



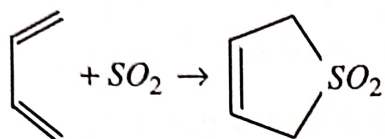
76.  $\xrightarrow{Hg^{2+}/H^+}$ A, A is :



77. Which of the following undergoes a Diels-Alder reaction ?

- (1) Thiophene (2) Pyrrole (3) Pyridine (4) Furan

78. Reaction :



- (1) Cheletropic reaction (2) Cycloaddition
 (3) Sigmatropic rearrangement (4) The enereaction
79. When comphor is heated with KOH, the major product obtained is :
- (1) Isocampholic acid
 (2) Camphene
 (3) Campholic acid
 (4) Camphoric acid
80. Which of the flowing reaction is favoured by polar aprotic solvent ?
- (1) S_{N2} reaction (2) S_{N1}
 (3) Addition reaction (4) Both S_{N1} & S_{N2} reactions
81. John-Teller effect is in the field of :
- (1) Nuclear physics (2) Vibronic interactions
 (3) Thermodynamics (4) Kinetic theory of gases
82. Which of the following is a soft acid ?
- (1) Ag^+ (2) Pt^{2+} (3) Au^+ (4) All
83. Which of the following will combine with BH_3 to form a stable complex ?
- (1) CO (2) Pt^{2+} (3) OH^- (4) Methane

84. The electronic ground state term for the chromium ion in $[Cr(CN)_6]^{-4}$ is :
- (1) 3F (2) 3H (3) 3G (4) 5D
85. The hapticity of cycloheptatriene (C_7H_8) in $Mo(C_7H_8)(CO)_3$ is :
- (1) 6 (2) 5 (3) 4 (4) 9
86. If Δ_0 is octahedral splitting energy and P is electron pairing energy then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{+2}$ is :
- (1) $-0.8 \Delta_0 + 2P$ (2) $-0.8 \Delta_0 + 1P$
- (3) $-0.8 \Delta_0$ (4) $-1.8\Delta_0 + 3P$
87. The shapes of XeF_5^+ and XeF_5^- respectively, are :
- (1) Pentagonal planar and square pyramidal
- (2) Pentagonal planar and trigonal bipyramidal
- (3) Square pyramidal and pentagonal bipyramidal
- (4) Square pyramidal and pentagonal planar
88. The number of terminal carbonyl groups present in $Fe_2(CO)_9$ are :
- (1) 2 (2) 5 (3) 6 (4) 3
89. The order of polarity of NH_3 , NF_3 and BF_3 is :
- (1) $NH_3 < NF_3 < BF_3$
- (2) $BF_3 < NF_3 < NH_3$
- (3) $BF_3 < NH_3 < NF_3$
- (4) $NF_3 < BF_3 < NH_3$

90. **Correct** statement for Coulometry is :

- (1) It is based on Faraday's law of electrolysis.
- (2) It is a type of voltammetry.
- (3) It is based on Ohm's law.
- (4) It uses ion selective electrode.

91. 10 mL aliquots of a mixture of HCl and HNO_3 are titrated conductometrically using a 0.1M $NaOH$ and a 0.1M $AgNO_3$ separately. The titer volumes are V_1 and V_2 respectively. The concentration of HNO_3 in the mixture is obtained from the combination :

- (1) $V_1 - V_2$
- (2) $V_2 - V_1$
- (3) $2V_1 - V_2$
- (4) $2V_2 - V_1$

92. The electrode potential of which electrode depends upon the H^+ ion concentration ?

- (1) Hydrogen electrode
- (2) Quinhydrone electrode
- (3) Glass electrode
- (4) All of the above

93. One mole of an ideal gas is allowed to expand isothermally and reversibly from 0.02 m^3 to 0.20 m^3 at 300 K. The entropy change for the system will be in (JK^{-1}):

- (1) 4.61
- (2) 57.42
- (3) 19.14
- (4) -19.14

94. What is the half-life of N_2O_5 if it decomposes with a rate constant of $5.7 \times 10^{-4}\text{ s}^{-1}$?

- (1) 20 minutes
- (2) 10 minutes
- (3) 0.05 minutes
- (4) Insufficient data

95. The activation energies of two reactions are E_1 and E_2 ($E_1 > E_2$) respectively. If the temperature of the system is increased from T_1 to T_2 , the rate constants of the reactions change from k_1 to k_1' in the first reaction and k_2 to k_2' in the second reaction. Predict which of the following is **correct** ?

- (1) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$
- (2) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2} = 1$
- (3) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$
- (4) None of the above

100. Which of the following dispersions does not have liquid continuous phase ?

- (1) Foam
- (2) Nanosuspension
- (3) Microemulsion
- (4) Gel

1. **All questions are compulsory.**
2. The candidates **must return** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code will be got uploaded on the University website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E.Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.
5. The candidate **must not** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers **must not** be ticked in the question booklet.
6. **There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.**
7. Use only **Black or Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. **Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained 30 minutes after starting of the examination.**

PHD/URS-EE-2022/(Chemistry)(SET-Y)/(D)

- John-Teller effect is in the field of :
 - Nuclear physics
 - Vibronic interactions
 - Thermodynamics
 - Kinetic theory of gases
- Which of the following is a soft acid ?
 - Ag^+
 - Pt^{2+}
 - Au^+
 - All
- Which of the following will combine with BH_3 to form a stable complex ?
 - CO
 - Pt^{2+}
 - OH^-
 - Methane
- The electronic ground state term for the chromium ion in $[Cr(CN)_6]^{-4}$ is :
 - 3F
 - 3H
 - 3G
 - 5D
- The hapticity of cycloheptatriene (C_7H_8) in $Mo(C_7H_8)(CO)_3$ is :
 - 6
 - 5
 - 4
 - 9
- If Δ_0 is octahedral splitting energy and P is electron pairing energy then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{+2}$ is :
 - $-0.8 \Delta_0 + 2 P$
 - $-0.8 \Delta_0 + 1 P$
 - $-0.8 \Delta_0$
 - $-1.8 \Delta_0 + 3 P$
- The shapes of XeF_5^+ and XeF_5^- respectively, are :
 - Pentagonal planar and square pyramidal
 - Pentagonal planar and trigonal bipyramidal
 - Square pyramidal and pentagonal bipyramidal
 - Square pyramidal and pentagonal planar
- The number of terminal carbonyl groups present in $Fe_2(CO)_9$ are :
 - 2
 - 5
 - 6
 - 3

9. The order of polarity of NH_3 , NF_3 and BF_3 is :

- (1) $NH_3 < NF_3 < BF_3$
- (2) $BF_3 < NF_3 < NH_3$
- (3) $BF_3 < NH_3 < NF_3$
- (4) $NF_3 < BF_3 < NH_3$

10. **Correct** statement for Coulometry is :

- (1) It is based on Faraday's law of electrolysis.
- (2) It is a type of voltammetry.
- (3) It is based on Ohm's law.
- (4) It uses ion selective electrode.

11. Match the **List-I** and **List-II** and select the **correct** answer using codes given below the list :

List-I

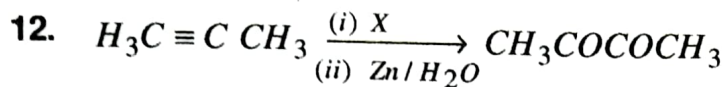
- (i) Lipoprotein
- (ii) Glycoprotein
- (iii) Collagen
- (iv) Chromoprotein

List-II

- A. Sugars
- B. Tendons
- C. Lipids
- D. Pigment

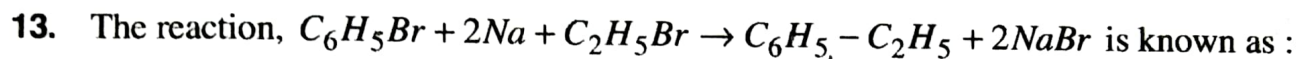
Correct answer is :

- (1) i-B, ii-C, iii-A, iv-D
- (2) i-C, ii-B, iii-D, iv-A
- (3) i-A, ii-B, iii-C, iv-D
- (4) i-C, ii-A, iii-B, iv-D



In the above reaction X is :

- (1) $K_2Cr_2O_7$ (2) O_2 (3) O_3 (4) H_2SO_4


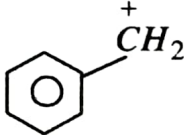
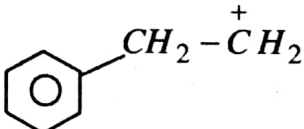


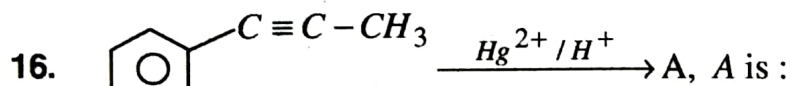
- (1) Cannizzaro reaction (2) Wurtz reaction
(3) Oppenaur oxidation (4) Wurtz-Fittig reaction

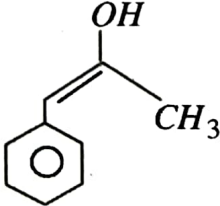
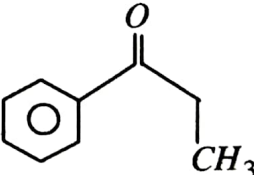
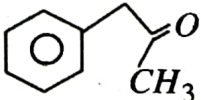
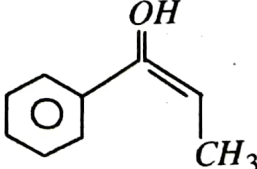
14. What is the condensation product of ethylacetate ?

- (1) Aceto acetic ester (2) Ethyl cyanide
(3) Ethyl aceto acetate (4) Ethyl propanoate

15. Which of the following synthon is most stable ?

- (1)  (2) 
(3) $\dot{C}H_3$ (4) 

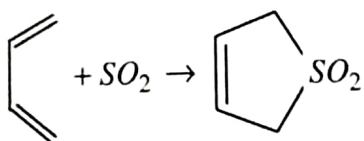


- (1)  (2) 
(3)  (4) 

17. Which of the following undergoes a Diels-Alder reaction ?

- (1) Thiophene (2) Pyrrole (3) Pyridine (4) Furan

18. Reaction :



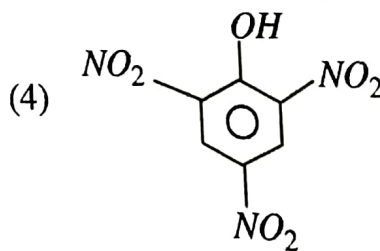
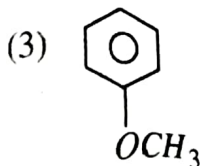
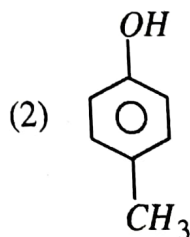
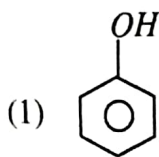
- (1) Cheletropic reaction (2) Cycloaddition
 (3) Sigmatropic rearrangement (4) The enereaction
19. When comphor is heated with KOH, the major product obtained is :

- (1) Isocampholic acid (2) Camphene
 (3) Campholic acid (4) Camphoric acid

20. Which of the flowing reaction is favoured by polar aprotic solvent ?

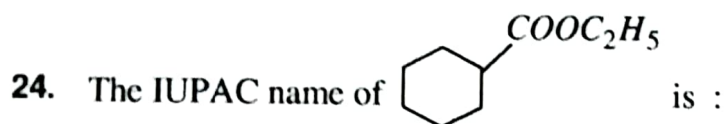
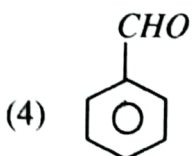
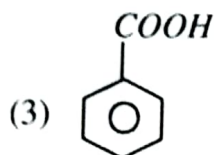
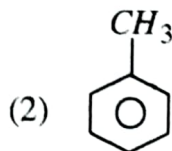
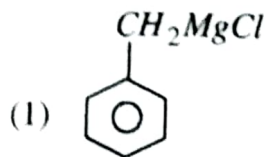
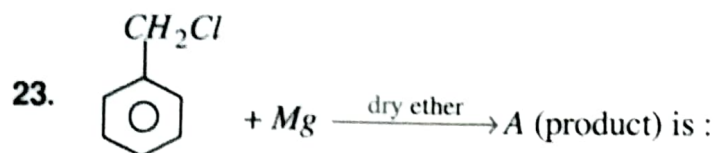
- (1) S_{N2} reaction (2) S_{N1}
 (3) Addition reaction (4) Both S_{N1} & S_{N2} reactions

21. Which one of the following is strongest acid ?



22. The ^{13}C NMR spectrum of ethyl benzene exhibits :

- (1) 8 signals (2) 6 signals (3) 5 signals (4) 4 signals



- (1) Cyclohexane carboxamide
- (2) Cyclohexane ethyl carboxylate
- (3) Ethyl cyclohexane carboxylate
- (4) Aminocyclo hexane carboxylate

25. Which one of the following statement is **correct** ?

- (1) Allene and biphenyls show optical activity.
- (2) Allene and biphenyls don't show optical activity.
- (3) Only allene show optical activity not biphenyls.
- (4) Only biphenyls show optical activity not allene.

26. Chlorination of furan is carried out by :

- (1) Cl_2 at $-40^\circ C$
- (2) Cl_2 , at $-30^\circ C$
- (3) Cl_2
- (4) $FeCl_3$

27. Which one of the following is aldoses ?

- (1) Fructose
- (2) Galactose
- (3) Ribulose
- (4) Sorbose

28. Match the **list-I** and **list-II** and select the **correct** answer using codes given below the list :

List - I

- (i) Citral
 (ii) Linalool
 (iii) α -terpineol
 (iv) Limonene

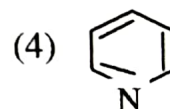
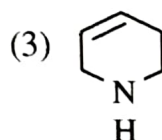
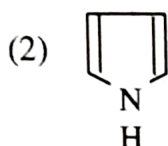
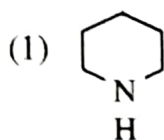
List - II

- A. p-cymene
 B. Carvoxime
 C. Tert. alcohol
 D. Lemon grass

Correct answer is :

- (1) i-B, ii-A, iii-D, iv-C
 (2) i-D, ii-C, iii-A, iv-B
 (3) i-C, ii-D, iii-B, iv-A
 (4) i-A, ii-B, iii-C, iv-D

29. $\begin{array}{c} \text{CH} \\ ||| \\ \text{CH} \end{array} + \text{NH}_3 \quad \begin{array}{c} \text{CH} \\ ||| \\ \text{CH} \end{array} \xrightarrow{\text{Red hot tube}} \text{A, A is :}$



30. Nicotine alkaloid belong to :

- (1) Phenyl ethylamine group
 (2) Pyrrolidine - pyridine group
 (3) Isoquinoline group
 (4) Indol group

31. 10 mL aliquots of a mixture of HCl and HNO_3 are titrated conductometrically using a 0.1M NaOH and a 0.1M AgNO_3 separately. The titer volumes are V_1 and V_2 respectively. The concentration of HNO_3 in the mixture is obtained from the combination :

- (1) $V_1 - V_2$ (2) $V_2 - V_1$ (3) $2V_1 - V_2$ (4) $2V_2 - V_1$

32. The electrode potential of which electrode depends upon the H^+ ion concentration ?

- (1) Hydrogen electrode
 (2) Quinhydrone electrode
 (3) Glass electrode
 (4) All of the above

33. One mole of an ideal gas is allowed to expand isothermally and reversibly from 0.02 m^3 to 0.20 m^3 at 300 K . The entropy change for the system will be in (JK^{-1}) :
- (1) 4.61 (2) 57.42 (3) 19.14 (4) -19.14
34. What is the half-life of N_2O_5 if it decomposes with a rate constant of $5.7 \times 10^{-4} \text{ s}^{-1}$?
- (1) 20 minutes (2) 10 minutes (3) 0.05 minutes (4) Insufficient data
35. The activation energies of two reactions are E_1 and E_2 ($E_1 > E_2$) respectively. If the temperature of the system is increased from T_1 to T_2 , the rate constants of the reactions change from k_1 to k_1' in the first reaction and k_2 to k_2' in the second reaction. Predict which of the following is *correct* ?
- (1) $\frac{k_1'}{k_1} > \frac{k_2'}{k_2}$ (2) $\frac{k_1'}{k_1} = \frac{k_2'}{k_2} = 1$
- (3) $\frac{k_1'}{k_1} < \frac{k_2'}{k_2}$ (4) None of the above
36. Arrhenius equation to determine the activation energy is :
- (1) $\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$ (2) $\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}\left(\frac{1}{T_2} + \frac{1}{T_1}\right)$
- (3) $\ln\left(\frac{k_1}{k_2}\right) = -\frac{E_a}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$ (4) $\ln\left(\frac{k_1}{k_2}\right) = \frac{E_a}{R}(T_1 T_2)$
37. The following reaction takes place in a cell :
- $$\text{Fe}^{2+}(\text{aq}) + \text{Ag}^+(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{Ag}(\text{s})$$
- Given that : $E_{\text{Ag}^+/\text{Ag}}^0 = x\text{V}$; $E_{\text{Fe}^{2+}/\text{Fe}}^0 = y\text{V}$; $E_{\text{Fe}^{3+}/\text{Fe}}^0 = z\text{V}$
- The standard potential of the cell in volts (V) will be :
- (1) $x - z$ (2) $x - y$ (3) $x + 2y - 3z$ (4) $x + y - z$
38. What is the pH of HCl solution when the hydrogen gas electrode shows a potential of -0.22 V at standard temperature and pressure ?
- (1) 2.98 (2) 2.17 (3) 3.14 (4) 3.73

39. The energy of the ground state of a particle in a box within first order perturbation theory of a system with the following potential energy will be :

$$V(x) = \begin{cases} V_0 & 0 \leq x \leq L \\ \infty & x < 0 \text{ and } x > L \end{cases}$$

(1) $\frac{h^2}{8mL^2}$

(2) V_0

(3) $\frac{h^2}{8mL^2} + V_0$

(4) $\frac{h^2}{4mL^2} + \frac{V_0}{2}$

40. Which of the following dispersions does not have liquid continuous phase ?

(1) Foam

(2) Nanosuspension

(3) Microemulsion

(4) Gel

41. Which of the species has a permanent dipole moment ?

(1) SF_4

(2) SiF_4

(3) BF_3

(4) XeF_4

42. Which of the ion has maximum hydration energy ?

(1) Sr^{2+}

(2) Ca^{2+}

(3) Mg^{2+}

(4) Be^{2+}

43. Oxymyoglobin Mb(O_2) and oxyhaemoglobin Hb(O_2)₄ respectively, are :

(1) Paramagnetic and paramagnetic

(2) Diamagnetic and diamagnetic

(3) Paramagnetic and diamagnetic

(4) Diamagnetic and paramagnetic

44. Three identical non interacting particles each of spin 1/2 and mass m are moving in one dimensional infinite potential well of length a . The energy of the lowest energy state of the system is :

(1) $\frac{\pi^2 \hbar^2}{ma^2}$

(2) $\frac{2\pi^2 \hbar^2}{3ma^2}$

(3) $\frac{3\pi^2 \hbar^2}{ma^2}$

(4) $\frac{5\pi^2 \hbar^2}{2ma^2}$

45. The difference in angular momentum of the electron in two adjacent orbitals of the hydrogen atom is :
- (1) $h/2\pi$ (2) h/π (3) $(n + 1)h/2\pi$ (4) $(n - 1)h/2\pi$
46. Apply molecular orbital theory to predict which species has the strongest bond ?
- (1) N_2 (2) N_2^- (3) N_2^+ (4) All are equivalent
47. The charge density at each carbon atom in butadiene is :
- (1) 2 (2) 0 (3) 4 (4) 1
48. In NMR spectroscopy, the difference between the field necessary for resonance in the sample and in some arbitrary chosen compound is which of the following ?
- (1) Field shift (2) Chemical shift
(3) Matrix shift (4) Resonance shift
49. The vibrational frequency of a homonuclear diatomic molecule is ν . The temperature at which the population of the first excited state will be half that of the ground state is given by (k is Boltzmann constant) :
- (1) $(h \nu \ln 2)/k$ (2) $\ln 2 / (h \nu k)$ (3) $h \nu / (k \ln 2)$ (4) $h \nu \ln k$
50. What are the point groups of tetrahedral and octahedral molecules ?
- (1) D_{3h} and D_{4h} respectively
(2) T_d and O_h , respectively
(3) C_{3h} and C_{4h} respectively
(4) C_{4h} and D_{4h} respectively
51. The calibration curve in spectrofluorimetric analysis becomes non-linear when :
- (1) Molecular weight of analyte is high
(2) Intensity of light source is high
(3) Concentration of analyte is high
(4) Molar absorptivity of analyte is high

52. Mossbauer spectrum of a metal complex gives information about :

- (a) Oxidation state and spin state of metal
- (b) Types of ligands co-ordinated of metal
- (c) Nuclear spin state of metal
- (d) Geometry of metal

Correct answer is :

- (1) (a) and (c) (2) (b) and (c) (3) (a), (b) and (d) (4) (b) and (d)

53. Intense band generally observed for a carbonyl group in the IR spectrum is due to :

- (1) The force constant of CO bond is large
- (2) The force constant of CO bond is small
- (3) There is no change in dipole moment for CO bond stretching
- (4) The dipole moment change due to CO bond stretching is large

54. The species having the strongest gas phase proton affinity among the following :

- (1) N^{3-} (2) NF_3 (3) NH_3 (4) $N(CH_3)_3$

55. According to Wade's theory, the anion $[B_{12}H_{12}]^{2-}$ adopts :

- (1) Closo structure (2) Arachno structure
- (3) Hypo structure (4) Nido structure

56. When an electron is added to a gaseous atom :

- (1) Its size decreases
- (2) Energy is released
- (3) It changes to positive ion
- (4) Its tendency to accept electron increases

D

57. Aufbau principle is *not* violated in :
- (1) d-block elements (2) s and p-block elements
 (3) Lanthanides (4) Actinides
58. The highest value of n for the elements present in periodic table is :
- (1) 6 (2) 7 (3) 10 (4) 9
59. During the change of NO^+ to NO , the electron is added in a :
- (1) σ -orbital (2) π -orbital (3) σ^* -orbital (4) π^* -orbital
60. Alkali metals dissolve in liquid ammonia to form blue coloured solutions. The blue colour is due to :
- (1) Alkali metals
 (2) Alkali metal ions
 (3) Ammoniated electrons
 (4) Ammoniated alkali metal ions
61. The rotational constant B for the HCl molecule is 10.6 cm^{-1} . The frequency for the pure rotation transition $J = 0 \rightarrow J = 1$ is equal to :
- (1) 10.6 cm^{-1} (2) 5.3 cm^{-1}
 (3) 21.2 cm^{-1} (4) No absorption
62. If the reduced mass of a diatomic molecule is doubled without changing its force constant, the vibrational frequency of the molecule with respect to the original frequency will be :
- (1) Unchanged (2) $\sqrt{2}$ times
 (3) 2 times (4) $\frac{1}{\sqrt{2}}$ times

63. Identify which of the following pairs of molecules exhibit both a pure rotational spectrum and a rotational Raman spectrum ?

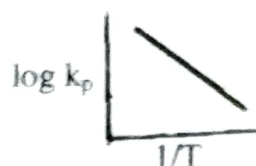
(1) O_2 and H_2O

(2) CO_2 and N_2O

(3) CO and CH_4

(4) NO and $DCCH$

64. The variation of $\log K_p$ with temperature $1/T$ for the equilibrium; $NH_4HS (s) \rightleftharpoons NH_3 (g) + H_2S (g)$; is as shown in the plot. The equilibrium is displaced in the forward direction on :



(1) Increasing the temperature and decreasing the pressure

(2) Increasing the temperature and pressure both

(3) Decreasing the temperature and pressure both

(4) Decreasing the temperature and increasing the pressure

65. The upper critical solution temperature is defined as :

(1) The maximum temperature at which two components will remain immiscible as two distinct liquids

(2) The minimum temperature at which two components will remain immiscible as two distinct liquids

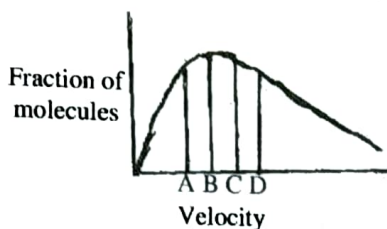
(3) The maximum temperature at which two components remain miscible

(4) The minimum temperature at which two components remain miscible

66. Which of the following is *true* regarding non-ideal solutions with negative deviation ?

- (1) The interactions between the components are lesser than in the pure components
- (2) $\Delta V_{\text{mixing}} = +ve$
- (3) $\Delta H_{\text{mixing}} = +ve$
- (4) They form maximum boiling azeotropes

67. Which out of A, B, C and D corresponds to the most probable speed ?

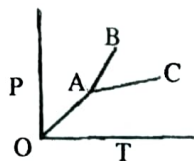


- (1) A
- (2) B
- (3) C
- (4) D

68. 8 distinguishable particles are distributed in two equal sized compartments. The probability of the macro state (4, 4) is equal to :

- (1) $35/128$
- (2) $7/128$
- (3) $7/16$
- (4) $35/256$

69. The slopes of the lines OA, AC and AB are $\tan \pi/4$, $\tan \pi/6$ and $\tan \pi/3$ respectively, if the melting point and ΔH melting are 27°C and 3 kJ mol^{-1} respectively, the change in volume upon melting is :



- (1) $10 \tan \pi/4$
- (2) $10 \cot \pi/3$
- (3) $10 \tan \pi/3$
- (4) $10 \cot \pi/4$

70. Standard enthalpy of vapourisation ΔH_{vap}^0 for water at 100°C is $40.66 \text{ kJ mol}^{-1}$. Assuming water vapour to behave like an ideal gas, the internal energy of vapourisation of water at 100°C (in kJ mol^{-1}) will be equal to :

- (1) $+37.56$
- (2) -40.66
- (3) $+43.76$
- (4) -43.76

71. Freundlich adsorption isotherm can be used to model :

- (1) Monolayer adsorption
- (2) Multilayer adsorption
- (3) Both monolayer and multilayer adsorption
- (4) None of the above

72. Which of the following statements is *not* true ?

- (1) Step-growth polymerization requires a bifunctional monomer
- (2) Nylon 6 is an example of step-growth polymerization
- (3) Chain growth polymerization includes both homo-polymerization and copolymerization
- (4) Chain growth polymerization involves homo-polymerization only

73. Which of the following salts show maximum value of equivalent conductance in their fused state ?

- (1) KCl (2) NaCl (3) CsCl (4) RbCl

74. In terms of energy bands, insulators have :

- (1) Full conduction band
- (2) Very small energy gap
- (3) Full valence band
- (4) Moderate energy gap

75. If the value of the wavelength is doubled, which of the following is *not* true in Bragg's method for crystal structure determination ?

- (1) The d spacings become smaller
- (2) Bragg angles of reflections increase
- (3) The diffraction pattern expands
- (4) Some previously accessible reflections can no longer be measured

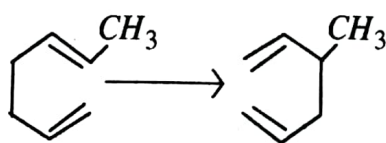
76. A committee has 6 members having weights in (kg) as 45, 50, 65, 72, 63 and 65. What will be the standard deviation ?

- (1) $\sqrt{115}$ (2) $\sqrt{152}$ (3) $\sqrt{88}$ (4) $\sqrt{176}$

77. Most stable carbocation is :

- (1) Tropylium ion
- (2) Benzylcation
- (3) Allylcation
- (4) Vinylcation

78. The given reaction is an example of :



- (1) Cope rearrangement
- (2) The claisen rearrangement
- (3) Diels-Alder reaction
- (4) Cheletropic reaction

79. Which of the following reagents react with phenol at 298K to form salt ?

- (1) NaHCO_3
- (2) Cl_2
- (3) H_2SO_4
- (4) NaOH

80. A single strong absorption near 1800 cm^{-1} in IR spectroscopy indicates the presence of :
- (1) Azo compound (2) Acid halides
(3) Sulphoxide (4) Thioketones
81. In ion-exchange resin method, the order of elution of lanthanides is :
- (1) $\text{Lu}^{+3} > \text{Yb}^{+3} > \text{Ce}^{+3} > \text{La}^{+3}$
(2) $\text{Sm}^{+3} > \text{Eu}^{+3} > \text{Tm}^{+3} > \text{Yb}^{+3}$
(3) $\text{La}^{+3} > \text{Ce}^{+3} > \text{Yb}^{+3} > \text{Lu}^{+3}$
(4) $\text{Yb}^{+3} > \text{Tm}^{+3} > \text{Sm}^{+3} > \text{Eu}^{+3}$
82. Which of the following statements is *false* ?
- (1) Lanthanides have poor tendency to form complexes
(2) Lanthanides closely resemble each other
(3) M^{+} and M^{+2} are less stable than M^{+3} ion in lanthanides
(4) Basic strength of lanthanide oxides increases with increasing atomic number
83. Biological function of Haemocyanin and metal involved in it :
- (1) Oxygen transport and Fe
(2) Oxygen transport and Cu
(3) Electron transport and Fe
(4) Electron transport and Cu

D

84. If an enzyme fixes Nitrogen in plants by evolving H_2 , the number of electrons and protons associated respectively are :
- (1) 6 and 6 (2) 8 and 8 (3) 6 and 8 (4) 8 and 6
85. The half-life of Cobalt-60 is 5.26 years. What will be the remaining percentage activity after 4 years ?
- (1) 76% (2) 32% (3) 59% (4) 18%
86. Radioisotopes of Iodine are used in :
- (1) Tagging leukocytes and labelling of blood platelets
- (2) Diagnosis and treatment of the diseases of thyroid glands
- (3) Diagnosis and treatment of the heart diseases
- (4) Diagnosis and treatment of brain tumours
87. The rate of disintegration of radioactive substances depends only on the and follows the kinetics of order.
- (1) Nature of radioactive substance and first
- (2) Amount of radioactive substance and second
- (3) Temperature and zero
- (4) Half-life of the radioactive substance and first
88. Which of the complex is an active catalyst and a $16 e^-$ species ?
- (1) $[HRh(CO)(PPh_3)_3]$ (2) $[HCo(CO)_3]$
- (3) $[Rh(CO)_2I_4]^-$ (4) $[Pd(PPh_3)_4]$

P. T. O.

94. Green chemistry protects the environment by reducing :

- (1) Forest (2) Temperature
(3) Pollution (4) Weeds

95. Which of the following has the highest bond dissociation energy ?

- (1) Hydrogen bond (2) Covalent bond
(3) Dipole-Dipole interaction (4) Vander Waals forces

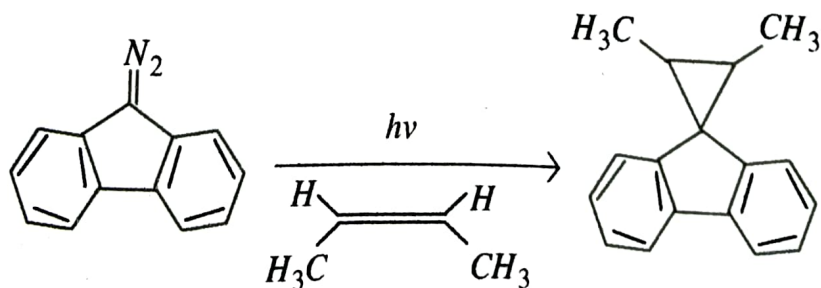
96. The reaction $\text{CH}_3\overset{\text{O}}{\parallel}\text{CCH}_2\text{CH}_3 \xrightarrow[\text{conc. HCl}]{\text{Zn-Hg}} \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ is known as :

- (1) Perkin reaction
(2) Aldol condensation
(3) Clemmensen reduction
(4) Pechmann condensation

97. Which of the following carbonyl give a haloform test ?

- (1) Hexan-2-one (2) Propanal
(3) Pentan-3-one (4) 2-Methyl butanal

98. The intermediate involved in the following reaction is :



- (1) Carbocation (2) Carbene
(3) Nitrene (4) Free radical

99. Spiro compounds are optically active due to :

(1) Chiral axis

(2) Chiral plane

(3) Chiral carbon

(4) Helicity

100. Which one of the following reagent gives *syn* addition with alkene ?

(1) Br_2

(2) Cl_2

(3) Dil $KMnO_4 / OH^-$

(4) DDQ

**Answer Key of Chemistry Ph.D/URS
Entrance Exam 2021-22**

Q. No.	A	B	C	D
1	1	4	3	2
2	4	2	4	4
3	2	1	4	1
4	2	3	1	2
5	3	1	1	1
6	2	1	4	3
7	1	2	2	4
8	2	2	1	3
9	3	2	2	2
10	2	2	1	1
11	2	1	3	4
12	4	4	3	3
13	1	3	4	4
14	2	1	1	1
15	1	1	1	2
16	3	1	2	2
17	4	3	2	4
18	3	4	2	1
19	2	3	4	3
20	1	4	3	1
21	3	1	1	4
22	3	4	4	2
23	4	2	2	1
24	1	3	2	3
25	1	1	3	1
26	2	1	2	1
27	2	2	1	2
28	2	2	2	2
29	4	3	3	2
30	3	2	2	2
31	1	2	2	1
32	4	4	4	4
33	2	1	1	3
34	3	2	3	1
35	1	1	2	1
36	1	3	3	1
37	2	4	1	3
38	2	3	2	4
39	3	2	1	3
40	2	1	3	4
41	3	4	2	1
42	4	3	4	4
43	4	4	3	2
44	1	1	3	3
45	1	2	1	1
46	4	2	3	1
47	2	4	1	2
48	1	1	1	2
49	2	3	4	3
50	1	1	2	2

Pallavi
10/2/2022

SB
doubt