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A

SET-Z

PG-EE-July, 2024

SUBJECT : Chemistry

Sr. No. 10429

Time : 1¼ Hours | Max. Marks : 100 | Total Questions : 100

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

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SEAL

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1. The quantum number of 20th electron of Fe (Z = 26) would be :

(1) 3, 2, –2, – 1/2 (2) 3, 2, 0, 1/2

(3) 4, 0, 0, +1/2 (4) 4, 1, –1, + 1/2

2. The number of orbitals in n = 3 are :

(1) 1 (2) 4 (3) 9 (4) 16

3. Electronegativity of the following elements increases in the order :

(1) O, N, S, P (2) P, S, N, O (3) P, N, S, O (4) S, P, N, O

4. Predict the correct order of repulsion among the following :

(1) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

(2) lone pair – lone pair > bond pair – bond pair > lone pair – bond pair

(3) bond pair – bond pair > lone pair – bond pair > lone pair –lone pair

(4) lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

5. Pick out the incorrect statement :

(1) sp^3d hybridisation involves $dx^2 - y^2$ orbital

(2) Hybridised orbital form sigma-bond when overlaps with other orbitals.

(3) SF_2 molecule is more polar than CS_2.

(4) o-nitrophenol is more volatile than p-nitrophenol.

6. Which of the following order is ***not*** correct ?

(1) $SF_2 > SF_4 > SF_6$ (ionic character)

(2) $AlF_3 < Al_2O_3 < AlN$ (covalent character)

(3) $CaCl_2 < SnCl_2 < CdCl_2$ (covalent character)

(4) $ZnCl_2 < CdCl_2 < HgCl_2$ (ionic character)

7. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

(1) C_2 (2) N_2^- (3) O_2 (4) S_2

8. For which of the following molecule significant $\mu \neq 0$:

(1) 

(2) 

(3) 

(4) 

(1) Only (3) (2) (3) and (4) (3) Only (1) (4) (1) and (2)

9. The geometry with respect to the central atom of the following molecules are $N(SiH_3)_3$, Me_3N, $(SiH_3)_3P$:

(1) planar, pyramidal, planar

(2) planar, pyramidal, pyramidal

(3) pyramidal, pyramidal, pyramidal

(4) pyramidal, planar, pyramidal

10. The IUPAC name of $[Co(NH_3)_5ONO]^{2+}$ ion is :

(1) Pentaamminenitritocobalt (IV) ion

(2) Pentaamminenitrocobalt (IV) ion

(3) Pentaamminenitrocobalt (III) ion

(4) Pentaamminenitritocobalt (III) ion

11. The chemical composition of brown ring produced in the test of NO_2 is :

(1) $[FeNO]SO_4$ (2) $[FeNO]Cl_2$ (3) $[FeSO_4]NO_2$ (4) $[FeCl_2]NO$

12. Under physiological condition, oxygen is binding to deoxy-hemoglobin and deoxy-myoglobin, the binding curve and its pH dependence respectively are :

(1) sigmoidal & pH dependent; hyperbolic and pH independent.

(2) hyperbolic and pH independent; sigmoidal & pH dependent.

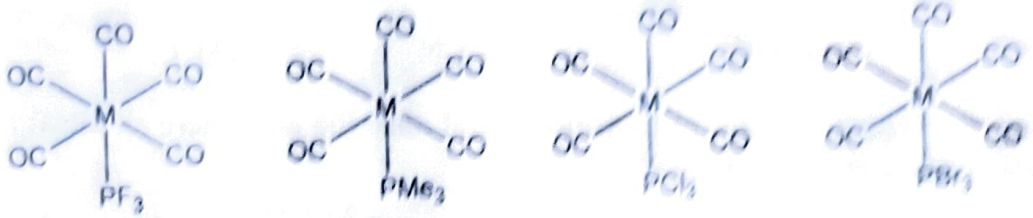
(3) sigmoidal & pH independent; hyperbolic and pH dependent.

(4) hyperbolic and pH independent; sigmoidal & pH dependent.

13. The total number of isomers of $[Co(en)_2Cl_2]$, (en = ethylenediamine) is :

(1) 4 (2) 3 (3) 6 (4) 5

14. Arrange the following in decreasing order of axial C-O bond length and increasing order of axial υ_{M-C} :



(i) (ii) (iii) (iv)

(1) ii > iv > iii > i (2) iv > ii > iii > i

(3) ii > iv > i > iii (4) i > ii > iii > iv

15. Identify the correct statement for the two reactions given below :

$Xe + PtF_6 \xrightarrow{Sl'6} [Xe]^+[PtF_6]$

$XeF_4 + Me_4NF \longrightarrow [Me_4N]^+[XeF_5]$

(1) Xe and XeF_4 both act as acids

(2) Xe and XeF_4 both act as bases

(3) Xe acts as an acid and XeF_4 act as base

(4) Xe acts as a base and XeF_4 act as an acid

16. The separation of lanthanides in the ion-exchange method is based on :

(1) Basicity of hydroxides (2) Size of the hydrated ions

(3) Size of the unhydrated ion (4) The solubility of their nitrates

17. Which one of the following conductometric titration will show a linear increase of the conductance with volume of titrant added upto the break point and almost constant conductance afterwards ?

(1) A strong acid with a strong base (2) A strong acid with a weak base

(3) A weak acid with a strong base (4) A weak acid with a weak base

18. The electronic configuration of chromium is $4s^1 3d^5$. The element tungsten (W) belongs to the same group and has atomic number = 74. The configuration of its valence shell is :

(1) $5s^1 4d^1$ (2) $6s^1 5d^5$ (3) $6s^2 5d^4$ (4) $6s^0 5d^6$

19. The nephelauxetic parameter (β) is highest for :

(1) Br^- (2) Cl^- (3) CN^- (4) F^-

20. Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is :

(1) Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+} (2) Ti^{2+}, V^{2+}, Cr^{3+}, Mn^{4+}

(3) Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+} (4) Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}

21. Coordination number and geometry of $[Ce(NO_3)_6]^{2-}$:

(1) 6, octahedral (2) 12, octahedral (3) 8, octahedral (4) 12, icosaheral

22. If an element has seven electrons in its outermost shell then it is likely to have the ..... atomic size among all the elements in the same period.

(1) largest (2) smallest (3) same (4) both (1) and (2)

23. The tripositive lanthanoid ion which does not show sharp peak in the absorption spectra :

(1) Gd^{3+} (2) Pm^{3+} (3) Ce^{3+} (4) Pr^{3+}

24. C_{60} has :

(1) 14 pentagons and 18 hexagons

(2) 10 pentagons and 20 hexagons

(3) 12 pentagons and 20 hexagons

(4) 12 pentagons and 18 hexagons

25. If Δ_0 is the octahedral splitting energy and P is the pairing energy, then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{2+}$ is :

(1) $-0.8\ \Delta_0 + 2P$ (2) $-0.8\ \Delta_0$ (3) $-1.8\ \Delta_0 + 3P$ (4) $-0.8\ \Delta_0 + P$

26. Consider the following complex ions, P, Q and R, P = $[FeF_6]^{3-}$, Q = $[V(H_2O)_6]^{2+}$ and R = $[Fe(H_2O)_6]^{2+}$: The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is :

(1) Q < P < R (2) R < Q < P (3) R < P < Q (4) Q < R < P

27. Glycerol is more viscous than glycol, the reason is :

(1) Higher molecular wt.

(2) More covalent

(3) More extent of hydrogen bonding

(4) Complex structure

28. In BF_3, the B-F bond length is 1.30 Å, when BF_3 is allowed to be treated with Me_3N, it forms an adduct, $[Me_3N \rightarrow BF_3]$ The bond length of B-F in the adduct is :

(1) Greater than 1.30Å (2) Smaller than 1.30Å

(3) Equal to 1.30Å (4) None of these

29. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared ?

(1) Linear chain silicate (2) Sheet silicate

(3) Pyrosilicate (4) Three dimensional

30. Which of the following represents a set of hard acid and soft base respectively ?

(1) Fe^{3+} and I^- (2) Fe^{3+} and S^{2-} (3) Ag^+ and S^{2-} (4) Ag^+ and F^-

31. Copper has role in :

(1) Hb formation

(2) ATP production by reformation

(3) Formation of fibres elastic

(4) All of the above

32. Which among the following electronic configurations represent the elements with the maximum electron affinity ?

(1) $1s^2 2s^2 2p^6$ (2) $1s^2 2s^2 2p^6 3s^2 3p^5$

(3) $1s^2 2s^2 2p^6 3s^1$ (4) $1s^2 2s^2 2p^5$

33. Which one of the following is most easily reduced ?

(1) $Ni(CO)_4$ (2) $Cr(CO)_6$ (3) $Fe(CO)_5$ (4) $V(CO)_6$

34. The value of d_{111} in a cubic crystal is 325.6 pm. The value of d_{333} is :

(1) 325.6 pm (2) 976.8 pm (3) 108.5 pm (4) 625.6 pm

35. A metal crystallizes in FCC structure with a unit cell side of 500 pm. If the density of the crystal is 1.33 g/cc, the molar mass of the metal is close to :

(1) 23 (2) 24 (3) 25 (4) 26

36. The decomposition of gaseous acetaldehyde at T(K) follows second-order kinetics. The half-life of this reaction is 400 s when the initial pressure is 250 Torr. What will be the rate constant (in $Torr^{-1}s^{-1}$) and half-life (in seconds) respectively, if the initial pressure of the acetaldehyde is 200 Torr at the same temperature ?

(1) 10^5 and 500 seconds (2) 10^{-5} and 400 seconds

(3) 10^{-4} and 400 seconds (4) 10^{-5} and 500 seconds

37. The carbon-14 activity of an old wood sample is found to be 14.2 disintegrations $min^{-1}g^{-1}$. Calculate the age of the old wood sample, if for a fresh wood sample carbon-14 activity is 15.3 disintegrations $min^{-1}g^{-1}$ ($t_{1/2}$ carbon-14 is 5730 years), is :

(1) 5,000 years (2) 4,000 years (3) 877 years (4) 617 years

38. Kohlrausch's law is applicable to a dilute solution of :

(1) Potassium chloride in hexane (2) Acetic acid in water

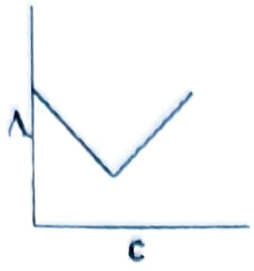
(3) Hydrochloric acid in water (4) Benzoic acid in benzene

39. The concentration of a $MgSO_4$ solution having the same ionic strength as that of a 0.1 M Na_2SO_4 solution is :

(1) 0.05 M (2) 0.067 M (3) 0.075 M (4) 0.133 M

40. The molar conductivity $\wedge$ versus concentration (c) plot of sodium dodecylsufate in water is expected to look like :

(1)



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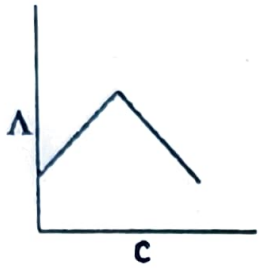

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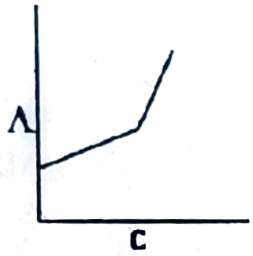

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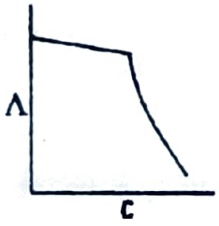


41. Indicate which one of the following relations is ***not*** correct :

(1) $-\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$

(2) $-\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(3) $-\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(4) $-\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

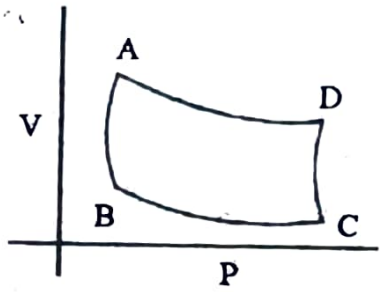
42. When two moles of liquid A are mixed with two moles of liquid B at 300K, the excess molar Gibbs energy of the solution is -1.5 kJ mol^{-1}. The corresponding value of Gibbs energy of mixing (in kJ) is closest to :

(1) -12.9 (2) -6.0 (3) -1.5 (4) -0.9

43. The minimum work required by an engine to transfer 5 J of heat from a reservoir at 100 K to one at 300 K is :

(1) 5 J (2) 10 J (3) 15 J (4) 20 J

44. The figure below describes how a reversible Carnot heat engine works. It starts from the adiabatic compression step denoted by :



(1) AB (2) BC (3) DC (4) AD

45. A thermodynamic equation that relates the chemical potential to the composition of a mixture is known as :

(1) Gibb's-Helmholtz equation

(2) Gibb's-Duhem equation

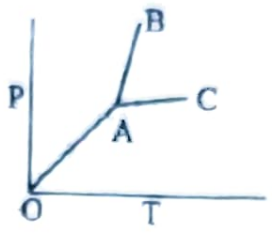
(3) Joule-Thomson equation

(4) Debye-Huckel equation

46. The heat capacity of a species is independent of temperature if it is :

(1) Tetratomic (2) Triatomic (3) Diatomic (4) Monatomic

47. The phase diagram of a compound is shown below :



The slopes of the lines OA, AC and AB are $\tan\frac{\pi}{4}$, $\tan\frac{\pi}{6}$ and $\tan\frac{\pi}{3}$ respectively. If melting point and ΔH of melting are 300K and 3 kJ mol^{-1} respectively, the change in the volume on melting is :

(1) $10\tan\frac{\pi}{3}$ (2) $10\tan\frac{\pi}{4}$ (3) $10\cot\frac{\pi}{3}$ (4) $10\cot\frac{\pi}{4}$

48. The number of phases, components, and degrees of freedom, when Argon is added to an equilibrium mixture of NO, O_2 and NO_2 in the gas phase are, respectively :

(1) 1, 3, 5 (2) 1, 4, 5 (3) 1, 3, 4 (4) 1, 4, 4

49. For a potentiometric titration, in the curve of emf (E) vs volume (V) of the titrant added, the equivalence point is indicated by :

(1) $|dE/dV| = 0$; $|d^2E/d^2V| = 0$

(2) $|dE/dV| = 0$; $|d^2E/d^2V| > 0$

(3) $|dE/dV| > 0$; $|d^2E/d^2V| = 0$

(4) $|dE/dV| > 0$; $|d^2E/d^2V| > 0$

50. The Daniel cell is :

(1) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(2) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Ag^{2+}(aq)|Ag(s)|Pt_{II}$

(3) $Pt_I(s)|Fe(s)|Fe^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(4) $Pt_I(s)|H_2(s)|H_2SO_4(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

51. Electrolysis of an aqueous solution of 1.0 M NaOH results in

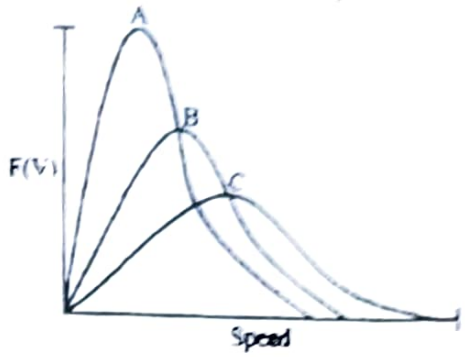
(1) Na at the cathode and O_2 at the anode

(2) H_2 at the cathode and O_2 at the anode

(3) Na and H_2 at the cathode, and O_2 at the anode

(4) O_2 at the cathode and H_2 at the anode

52. Identify the speed distribution functions of Neon, Argon and Krypton gas in the three curves (A or B or C) in the graph given below :



(1) Ne–A, Ar–B, Kr–C

(2) Ne–B, Ar–C, Kr–A

(3) Ne–C, Ar–B, Kr–A

(4) Ne–C, Ar–A, Kr–B

53. The root mean square speed of the molecules of a perfect gas is proportional to :

(1) $1/T^{1/2}$ (2) T (3) $T^{1/2}$ (4) 1/T

54. At room temperature, which molecule has the maximum rotational entropy ?

(1) H_2 (2) O_2 (3) D_2 (4) N_2

55. The rotational constant $^{14}N_2$ is $2\,cm^{-1}$. The wave number of incident radiation in a Raman spectrometer is $20487\,cm^{-1}$. What is the wave number of first scattered Stokes line (in cm^{-1}) of $^{14}N_2$?

(1) 20479 (2) 20475 (3) 20499 (4) 20495

56. For the vibrational Raman spectrum of a homonuclear diatomic molecule, the selection rule under harmonic approximation is :

(1) $\Delta v = 0$ only

(2) $\Delta v = \pm 1$ only

(3) $\Delta v = \pm 2$ only

(4) $\Delta v = 0, \pm 1$

57. The vibrational frequency and anharmonicity constant of an alkali halide are 300 cm^{-1} and 0.0025 respectively. The positions (in cm^{-1}) of its fundamental mode and first overtone are respectively :

(1) 300, 600 (2) 298.5, 595.5 (3) 301.5, 604.5 (4) 290, 580

58. The energy levels for cyclobutadiene are $\alpha + 2\beta$, α, α and $\alpha - 2\beta$. The delocalization energy in this molecule is :

(1) 0 (2) -4β (3) -8β (4) 4α

59. Identify which of the following operators is not Hermitian ? Here i is iota.

(1) $\frac{h}{i2\pi}\frac{\partial}{\partial x}$ (2) $i\frac{\partial^2}{\partial x^2}$ (3) $\frac{\partial^2}{\partial x^2}$ (4) X^2

60. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33 T given that for a free electron, $g_e = 2$ and $\mu_B = 9.273 \times 10^{-24}$ J/T.

(1) 2.3 GHz (2) 9.24 GHz (3) 1.15 GHz (4) 8.36 GHz

61. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon ?

(1) Low extinction coefficients (Lambert-Beer law)

(2) Vertical transitions (Kasha's rule)

(3) High ISC rates (El Sayed rule)

(4) The Franck-Condon principle

62. The vapor pressure of pure benzene at a certain temperature is 640 mmHg. A nonvolatile nonelectrolyte solid weighing 2.175 g is added to 39 g of benzene. The vapor pressure of the solution is 600 mmHg. The molecular weight of the solid substance is :

(1) 42.25 (2) 55.55 (3) 65.25 (4) 72.25

63. What is the molal lowering of the vapor pressure of water is 100°C ?

(1) 17.77 mm (2) 28.28 mm (3) 13.68 mm (4) 24.66 mm

64. Ethylene glycol a major component of permanent antifreeze, effectively depresses the freezing point of water in automobile radiator. What minimum weight of ethylene glycol must be mixed with 6 gallons of water of protect it from freezing at 24°C ?

(Given : 1 Gallon = 3.785 liter and K_f = 1.86)

(1) 22.15 kg (2) 18.15 kg (3) 33.75 kg (4) 62 kg

65. 20.27 g of Benzene containing 0.2965 g of benzoic acid (mol. wt. 122) freezes at 0.137°C below the freezing point of pure benzene. If Benzoic acid exists as a dimer in benzene, find its degree of association. (Given : K_f for Benzene is 5.12°C m^{-1})

(1) 72.34% (2) 86.84% (3) 96.84% (4) 66.34%

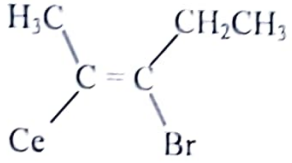
66. The surface tension of water at 21°C is 72.75×10^{-3} N/m. A 33.24% (v/v) solution of ethanol has γ = 33.24×10^{-3} N/m at the same temperature. Given : Density of solution = 0.9614×10^3 kg/m^3, density of water = 0.9982×10^3 kg/m^3 and angle of contact, $\theta = 0°$. How much less will the alcohol solution rise in the same capillary ?

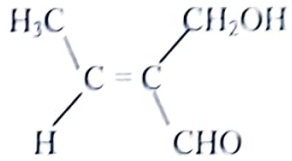
(1) 34.2% (2) 47.4% (3) 54.3% (4) 65.4%

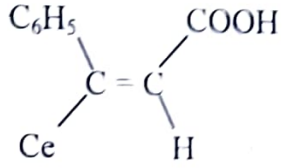
67. Hyperconjugation involves overlap of the following orbitals :

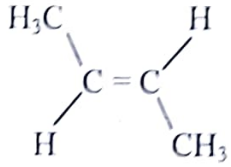
(1) σ-σ (2) σ-ρ (3) ρ-ρ (4) π-π

68. The z-isomer among the following is :

(1) 

(2) 

(3) 

(4) 

69. Out of the following the molecule that exhibits optical isomerism is :

(1) 2-methyl-2-pentene (2) 3-methyl-2-pentene

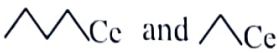
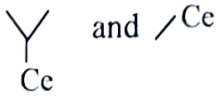
(3) 3-methyl-1-pentene (4) 4-methyl-1-pentene

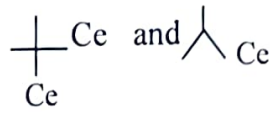
70. The stablest radical among the following is :

(1) $CH_3\dot{C}H_2$ (2) $CH_3\dot{C}HCH_3$

(3) $C_6H_5\dot{C}H_2$ (4) $C_6H_5\dot{C}H_2CH_3$

71. The alkyl halides required to prepare  by Wurtz reaction are :

(1)  (2) 

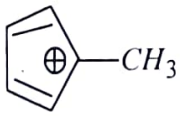
(3)  (4) 

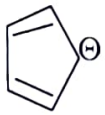
72. Ozonolysis of an alkene produces only one dicarbonyl compound. The structure of the alkene is :

(1) $CH_3-CH=CH-CH_2-CH_3$ (2) 

(3)  (4) All of the above

73. Which one of the following compound is aromatic in nature ?

(1)  (2) 

(3)  (4) 

74. Diels-Alder reaction is :

(1) 4 + 2 cycloaddition

(2) 2 + 2 cycloaddition

(3) Electrophilic addition

(4) Nucleophilic addition

75. Which of the following can be used as the halide component for Friedel-Crafts reaction ?

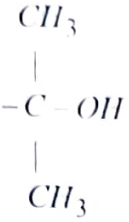
(1) Chlorobenzene

(2) Bromobenzene

(3) Chloroethane

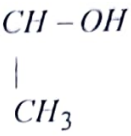
(4) Isopropyl chloride

76. Which of the following alcohol is resistant to oxidation ?

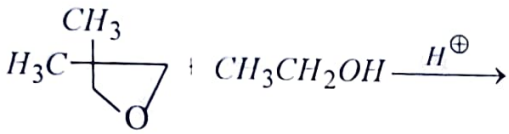
(1) 

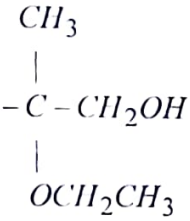
(2) 

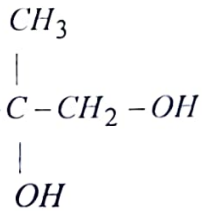
(3) CH_3-OH

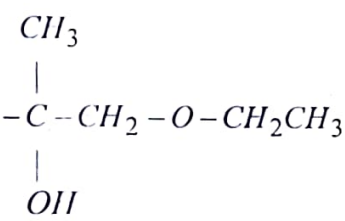
(4) 

77. The product of the following reaction is :



(1) 

(2) 

(3) 

(4) None of these

78. Phenol reacts with bromine in CS_2 to give :

(1) o-bromophenol

(2) m- bromophenol

(3) o- and p-bromophenol

(4) 2, 4, 6-tribromophenol

79. The carboxylic acid that does not undergo Hell-Volhard-Zelinsky reaction is :

(1) CH_3COOH

(2) $(CH_3)_2CHCOOH$

(3) $CH_3CH_2CH_2COOH$

(4) $(CH_3)_3CCOOH$

80. Which one of the following is a reagent in Gabriel amine synthesis ?

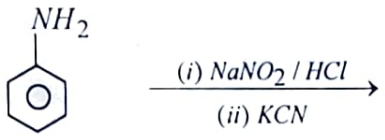
(1) an acyl or arylhalide

(2) phthalimide

(3) hydroxylamine

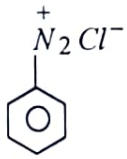
(4) sodium azide

81. The product of the following reaction is :



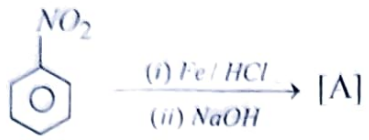
(1) 

(2) 

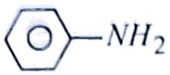
(3) 

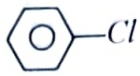
(4) 

82. The product [A] of the following reaction is :



(1) 

(2) 

(3) 

(4) 

83. The most suitable reagent for the conversion of $RCH_2OH \rightarrow RCHO$ is :

(1) CrO_3 / H_2SO_4

(2) $KMnO_4 / KOH$

(3) PCC

(4) $K_2Cr_2O_7 / H_2SO_4$

84. Which of the following combination of aldehydes give cross Cannizzaro reaction ?

(1) CH_3CHO , $HCHO$

(2) C_6H_5CHO, CH_3CHO

(3) C_6H_5CHO, $HCHO$

(4) All of these

85. Which of the following compound used alone will undergo an aldol reaction ?

(1) CH_2O

(2) CH_3COCH_3

(3) $C_6H_5COC_6H_5$

(4) $CH_2 = CHCHO$

86. The diasaccharide sucrose is composed of monosaccharides :

(1) D-glucose + D-glucose

(2) D-fructose + D-fructose

(3) D-glucose + D-galactose

(4) D-glucose + D-fructose

87. Which of the following statements about anomers is ***true*** ?

(1) Anomers are diastereoisomers

(2) Anomers are enantiomers

(3) Anomers are constitutional isomer

(4) All of these

88. The reaction of CH_3CH_2MgBr with water yield :

(1) CH_3CH_3

(2) $CH_2 = CH_2$

(3) CH_3CH_2OH

(4) $\begin{matrix} CH_2 - CH_2 \\ | \quad\quad | \\ OH \quad OH \end{matrix}$

89. Pyrrole is less basic than pyridine because the lone-pair of electrons on N-atom in pyrrole :

(1) reside in *sp* hybrid orbital

(2) reside in sp^2 hybrid orbital

(3) is not part of the delocalized π molecular orbital

(4) is part of the delocalized π molecular orbital

90. Quinoline undergo nucleophilic substitution on heating with $NaNH_2$ to give :

(1) 6-Aminoquinoline

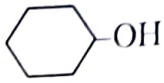
(2) 2-Aminoquinoline

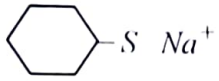
(3) 3-Aminoquinoline

(4) 4-Aminoquinoline

91. Complete the following reaction [A] is :

(1) 

(2) 

(3) 

(4) None of these

92. Base-catalyzed condensation of two ester molecules to form an alcohol and β-keto ester is called :

(1) Claisen condensation

(2) Corey-House reaction

(3) Aldol condensation

(4) Kolbe's reaction

93. What is used to initiate a tree-radical polymerization ?

(1) Benzoyl peroxide

(2) Benzoic acid

(3) Benzyl alcohol

(4) Benzil

94. The α-Helix is common form of :

(1) Primary structure of protein

(2) Secondary structure of protein

(3) Tertiary structure of protein

(4) None of these

95. An auxochrome is one which is :

(1) colour enhancing

(2) a group or atom with lone pairs of electron

(3) extended conjugation

(4) all of these

96. The energy required for various transition follow the order :

(1) $\pi \rightarrow \pi^* > n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^*$

(2) $n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^*$

(3) $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

(4) $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

97. In infra-red spectroscopy, the pair of isomers, which cannot be distinguished :

(1) Cis-trans isomers

(2) Functional isomers

(3) Enantiomers

(4) Position isomers

98. The cycloalkanones, the frequency of absorption for carbonyl group is :

(1) 1000-1100 cm^{-1} (2) 1280-1300 cm^{-1}

(3) 1580-1600 cm^{-1} (4) 1705-1725 cm^{-1}

99. The signal(s) for a compound like $A-CH_2-CH_2-B$ will be :

(1) Two singlets (2) Two triplet (3) One singlet (4) One triplet

100. How many ^1H NMR signal in case of benzene ?

(1) Zero (2) One (3) Three (4) Six

Total No. of Printed Pages : 21

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

B

SET-Z

PG-EE-July, 2024

SUBJECT : Chemistry

10426

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

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

Name _____ Date of Birth_____

Father's Name _____ Mother's Name _____

Date of Examination _____

_____ _____

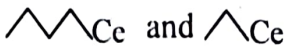
(Signature of the Candidate) (Signature of the Invigilator)

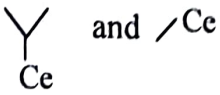
CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

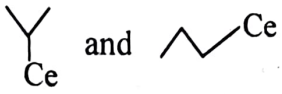
1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to 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 shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. 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.*

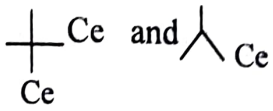
SEAL

1. The alkyl halides required to prepare  by Wurtz reaction are :

(1) 

(2) 

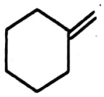
(3) 

(4) 

2. Ozonolysis of an alkene produces only one dicarbonyl compound. The structure of the alkene is :

(1) $CH_3 - CH = CH - CH_2 - CH_3$

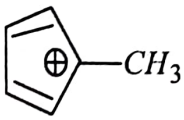
(2) 

(3) 

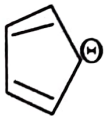
(4) All of the above

3. Which one of the following compound is aromatic in nature ?

(1) 

(2) 

(3) 

(4) 

4. Diels-Alder reaction is :

(1) 4 + 2 cycloaddition

(2) 2 + 2 cycloaddition

(3) Electrophilic addition

(4) Nucleophilic addition

5. Which of the following can be used as the halide component for Friedel-Crafts reaction ?

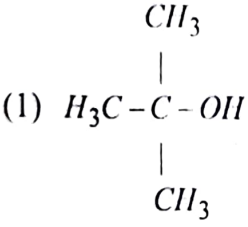
(1) Chlorobenzene

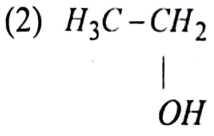
(2) Bromobenzene

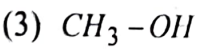
(3) Chloroethane

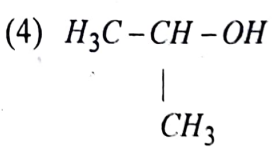
(4) Isopropyl chloride

6. Which of the following alcohol is resistant to oxidation ?

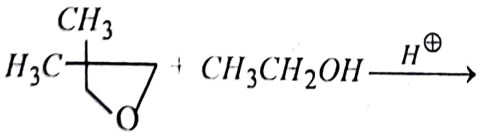
(1) 

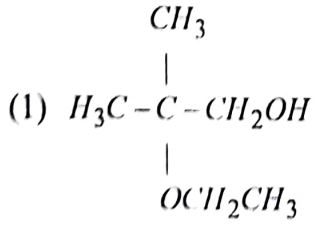
(2) 

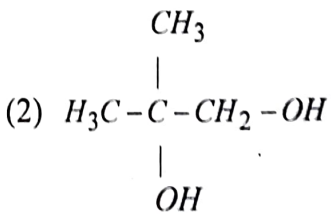
(3) 

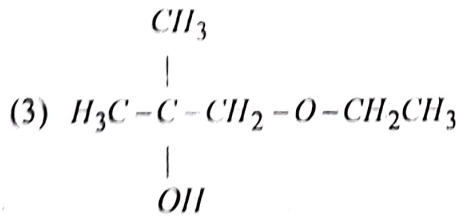
(4) 

7. The product of the following reaction is :



(1) 

(2) 

(3) 

(4) None of these

8. Phenol reacts with bromine in CS_2 to give :

(1) o-bromophenol

(2) m- bromophenol

(3) o- and p-bromophenol

(4) 2, 4, 6-tribromophenol

9. The carboxylic acid that does not undergo Hell-Volhard-Zelinsky reaction is :

(1) CH_3COOH

(2) $(CH_3)_2CHCOOH$

(3) $CH_3CH_2CH_2COOH$

(4) $(CH_3)_3CCOOH$

10. Which one of the following is a reagent in Gabriel amine synthesis ?

(1) an acyl or arylhalide

(2) phthalimide

(3) hydroxylamine

(4) sodium azide

11. Electrolysis of an aqueous solution of 1.0 M NaOH results in :

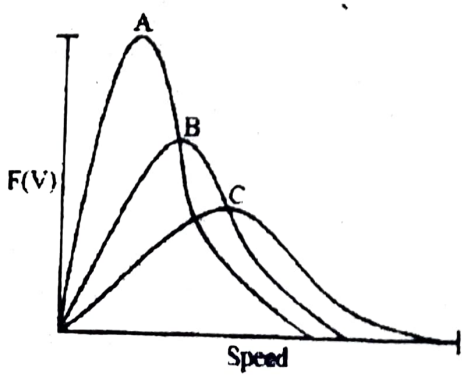
(1) Na at the cathode and O_2 at the anode

(2) H_2 at the cathode and O_2 at the anode

(3) Na and H_2 at the cathode, and O_2 at the anode

(4) O_2 at the cathode and H_2 at the anode

12. Identify the speed distribution functions of Neon, Argon and Krypton gas in the three curves (A or B or C) in the graph given below :



(1) Ne–A, Ar–B, Kr–C

(2) Ne–B, Ar–C, Kr–A

(3) Ne–C, Ar–B, Kr–A

(4) Ne–C, Ar–A, Kr–B

13. The root mean square speed of the molecules of a perfect gas is proportional to :

(1) $1/T^{1/2}$ (2) T (3) $T^{1/2}$ (4) 1/T

14. At room temperature, which molecule has the maximum rotational entropy ?

(1) H_2 (2) O_2 (3) D_2 (4) N_2

15. The rotational constant $^{14}N_2$ is $2\,cm^{-1}$. The wave number of incident radiation in a Raman spectrometer is $20487\,cm^{-1}$. What is the wave number of first scattered Stokes line (in cm^{-1}) of $^{14}N_2$?

(1) 20479 (2) 20475 (3) 20499 (4) 20495

16. For the vibrational Raman spectrum of a homonuclear diatomic molecule, the selection rule under harmonic approximation is :

(1) $\Delta v = 0$ only (2) $\Delta v = \pm 1$ only

(3) $\Delta v = \pm 2$ only (4) $\Delta v = 0, \pm 1$

17. The vibrational frequency and anharmonicity constant of an alkali halide are 300 cm^{-1} and 0.0025 respectively. The positions (in cm^{-1}) of its fundamental mode and first overtone are respectively :

(1) 300, 600 (2) 298.5, 595.5

(3) 301.5, 604.5 (4) 290, 580

18. The energy levels for cyclobutadiene are $\alpha + 2\beta$, α, α and $\alpha - 2\beta$. The delocalization energy in this molecule is :

(1) 0 (2) -4β (3) -8β (4) 4α

19. Identify which of the following operators is not Hermitian ? Here i is iota.

(1) $\frac{h}{i2\pi}\frac{\partial}{\partial x}$ (2) $i\frac{\partial^2}{\partial x^2}$ (3) $\frac{\partial^2}{\partial x^2}$ (4) X^2

20. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33 T given that for a free electron, $g_e = 2$ and $\mu_B = 9.273 \times 10^{-24}$ J/T.

(1) 2.3 GHz (2) 9.24 GHz

(3) 1.15 GHz (4) 8.36 GHz

21. Copper has role in :

(1) Hb formation
(2) ATP production by reformation
(3) Formation of fibres elastic
(4) All of the above

22. Which among the following electronic configurations represent the elements with the maximum electron affinity ?

(1) $1s^2 2s^2 2p^6$
(2) $1s^2 2s^2 2p^6 3s^2 3p^5$
(3) $1s^2 2s^2 2p^6 3s^1$
(4) $1s^2 2s^2 2p^5$

23. Which one of the following is most easily reduced ?

(1) $Ni(CO)_4$ (2) $Cr(CO)_6$ (3) $Fe(CO)_5$ (4) $V(CO)_6$

24. The value of d_{111} in a cubic crystal is 325.6 pm. The value of d_{333} is :

(1) 325.6 pm (2) 976.8 pm (3) 108.5 pm (4) 625.6 pm

25. A metal crystallizes in FCC structure with a unit cell side of 500 pm. If the density of the crystal is 1.33 g/cc, the molar mass of the metal is close to :

(1) 23 (2) 24 (3) 25 (4) 26

26. The decomposition of gaseous acetaldehyde at T(K) follows second-order kinetics. The half-life of this reaction is 400 s when the initial pressure is 250 Torr. What will be the rate constant (in $Torr^{-1}s^{-1}$) and half-life (in seconds) respectively, if the initial pressure of the acetaldehyde is 200 Torr at the same temperature ?

(1) 10^5 and 500 seconds
(2) 10^{-5} and 400 seconds
(3) 10^{-4} and 400 seconds
(4) 10^{-5} and 500 seconds

27. The carbon-14 activity of an old wood sample is found to be 14.2 disintegrations $min^{-1}g^{-1}$. Calculate the age of the old wood sample, if for a fresh wood sample carbon-14 activity is 15.3 disintegrations $min^{-1}g^{-1}$ ($t_{1/2}$ carbon-14 is 5730 years), is :

(1) 5,000 years (2) 4,000 years (3) 877 years (4) 617 years

28. Kohlrausch's law is applicable to a dilute solution of :

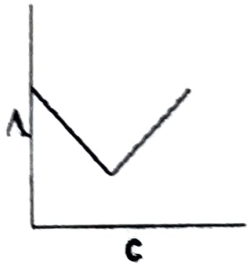
(1) Potassium chloride in hexane
(2) Acetic acid in water
(3) Hydrochloric acid in water
(4) Benzoic acid in benzene

29. The concentration of a $MgSO_4$ solution having the same ionic strength as that of a 0.1 M Na_2SO_4 solution is :

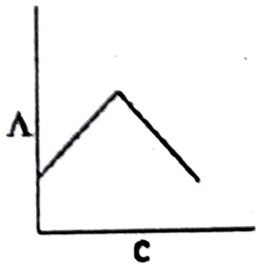
(1) 0.05 M (2) 0.067 M (3) 0.075 M (4) 0.133 M

30. The molar conductivity $\wedge$ versus concentration (c) plot of sodium dodecylsufate in water is expected to look like :

(1)



(2)



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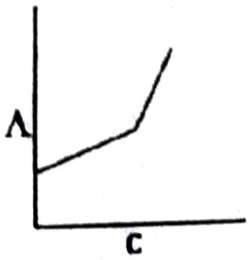

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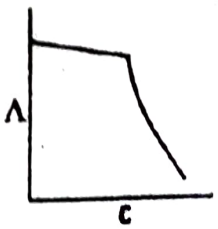


31. The chemical composition of brown ring produced in the test of NO_2^- is :

(1) $[FeNO]SO_4$ (2) $[FeNO]Cl_2$ (3) $[FeSO_4]NO_2$ (4) $[FeCl_2]NO$

32. Under physiological condition, oxygen is binding to deoxy-hemoglobin and deoxy-myoglobin, the binding curve and its pH dependence respectively are :

(1) sigmoidal & pH dependent; hyperbolic and pH independent.

(2) hyperbolic and pH independent; sigmoidal & pH dependent.

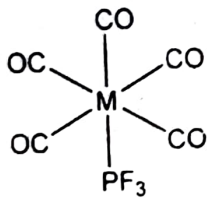
(3) sigmoidal & pH independent; hyperbolic and pH dependent.

(4) hyperbolic and pH independent; sigmoidal & pH dependent.

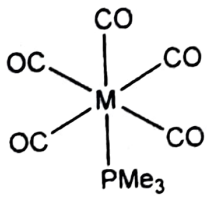
33. The total number of isomers of $[Co(en)_2Cl_2]$, (en = ethylenediamine) is :

(1) 4 (2) 3 (3) 6 (4) 5

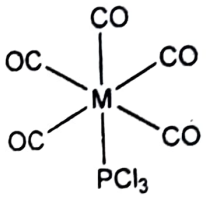
34. Arrange the following in decreasing order of axial C-O bond length and increasing order of axial $\upsilon_{M\text{-}C}$:



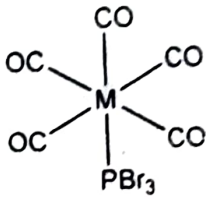
(i)



(ii)



(iii)



(iv)

(1) ii > iv > iii > i (2) iv > ii > iii > i

(3) ii > iv > i > iii (4) i > ii > iii > iv

35. Identify the correct statement for the two reactions given below :

$Xe + PtF_6 \xrightarrow{SF_6} [Xe]^+[PtF_6]^-$

$XeF_4 + Me_4NF \longrightarrow [Me_4N]^+[XeF_5]^-$

(1) Xe and XeF_4 both act as acids

(2) Xe and XeF_4 both act as bases

(3) Xe acts as an acid and XeF_4 act as base

(4) Xe acts as a base and XeF_4 act as an acid

36. The separation of lanthanides in the ion-exchange method is based on :
(1) Basicity of hydroxides
(2) Size of the hydrated ions
(3) Size of the unhydrated ion
(4) The solubility of their nitrates

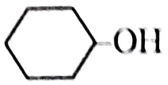
37. Which one of the following conductometric titration will show a linear increase of the conductance with volume of titrant added upto the break point and almost constant conductance afterwards ?
(1) A strong acid with a strong base
(2) A strong acid with a weak base
(3) A weak acid with a strong base
(4) A weak acid with a weak base

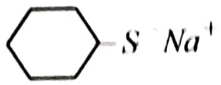
38. The electronic configuration of chromium is $4s^1 3d^5$. The element tungsten (W) belongs to the same group and has atomic number = 74. The configuration of its valence shell is :
(1) $5s^1 4d^1$
(2) $6s^1 5d^5$
(3) $6s^2 5d^4$
(4) $6s^0 5d^6$

39. The nephelauxetic parameter (β) is highest for :
(1) Br^-
(2) Cl^-
(3) CN^-
(4) F^-

40. Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is :
(1) $Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+}$
(2) $Ti^{2+}, V^{2+}, Cr^{3+}, Mn^{4+}$
(3) $Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+}$
(4) $Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}$

41. Complete the following reaction [A] is :

(1) 
(2) 

(3) 

(4) None of these

42. Base-catalyzed condensation of two ester molecules to form an alcohol and β-keto ester is called :
(1) Claisen condensation
(2) Corey-House reaction
(3) Aldol condensation
(4) Kolbe's reaction

43. What is used to initiate a tree-radical polymerization ?

(1) Benzoyl peroxide
(2) Benzoic acid
(3) Benzyl alcohol
(4) Benzil

44. The α-Helix is common form of :

(1) Primary structure of protein
(2) Secondary structure of protein
(3) Tertiary structure of protein
(4) None of these

45. An auxochrome is one which is :

(1) colour enhancing
(2) a group or atom with lone pairs of electron
(3) extended conjugation
(4) all of these

46. The energy required for various transition follow the order :

(1) $\pi \rightarrow \pi^* > n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^*$

(2) $n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^*$

(3) $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

(4) $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

47. In infra-red spectroscopy, the pair of isomers, which cannot be distinguished :

(1) Cis-trans isomers
(2) Functional isomers
(3) Enantiomers
(4) Position isomers

48. The cycloalkanones, the frequency of absorption for carbonyl group is :

(1) 1000-1100 cm^{-1} (2) 1280-1300 cm^{-1}

(3) 1580-1600 cm^{-1} (4) 1705-1725 cm^{-1}

49. The signal(s) for a compound like $A-CH_2-CH_2-B$ will be :

(1) Two singlets (2) Two triplet (3) One singlet (4) One triplet

50. How many ^1H NMR signal in case of benzene ?

(1) Zero (2) One (3) Three (4) Six

51. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon ?

(1) Low extinction coefficients (Lambert-Beer law)

(2) Vertical transitions (Kasha's rule)

(3) High ISC rates (El Sayed rule)

(4) The Franck-Condon principle

52. The vapor pressure of pure benzene at a certain temperature is 640 mmHg. A nonvolatile nonelectrolyte solid weighing 2.175 g is added to 39 g of benzene. The vapor pressure of the solution is 600 mmHg. The molecular weight of the solid substance is :

(1) 42.25 (2) 55.55 (3) 65.25 (4) 72.25

53. What is the molal lowering of the vapor pressure of water is 100°C ?

(1) 17.77 mm (2) 28.28 mm (3) 13.68 mm (4) 24.66 mm

54. Ethylene glycol a major component of permanent antifreeze, effectively depresses the freezing point of water in automobile radiator. What minimum weight of ethylene glycol must be mixed with 6 gallons of water of protect it from freezing at –24°C ?

(Given : 1 Gallon = 3.785 liter and $K_f = 186$)

(1) 22.15 kg (2) 18.15 kg (3) 33.75 kg (4) 62 kg

55. 20.27 g of Benzene containing 0.2965 g of benzoic acid (mol. wt. 122) freezes at 0.137°C below the freezing point of pure benzene. If Benzoic acid exists as a dimer in benzene, find its degree of association. (Given : K_f for Benzene is 5.12°C.m^{-1})

(1) 72.34% (2) 86.84% (3) 96.84% (4) 66.34%

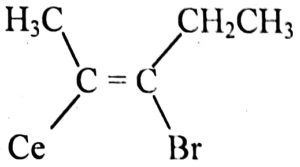
56. The surface tension of water at 21°C is 72.75×10^{-3} N/m. A 33.24% (v/v) solution of ethanol has γ 33.24×10^{-3} N/m at the same temperature. Given : Density of solution $= 0.9614 \times 10^3$ kg/m^3, density of water $= 0.9982 \times 10^3$ kg/m^3 and angle of contact, $\theta = 0°$. How much less will the alcohol solution rise in the same capillary ?

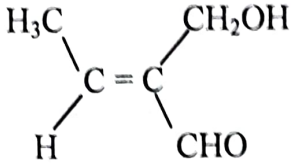
(1) 34.2% (2) 47.4% (3) 54.3% (4) 65.4%

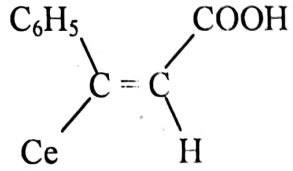
57. Hyperconjugation involves overlap of the following orbitals :

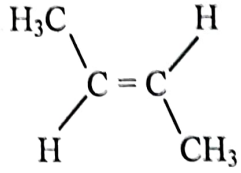
(1) σ-σ (2) σ-ρ (3) ρ-ρ (4) π-π

58. The z-isomer among the following is :

(1) 

(2) 

(3) 

(4) 

59. Out of the following the molecule that exhibits optical isomerism is :

(1) 2-methyl-2-pentene (2) 3-methyl-2-pentene

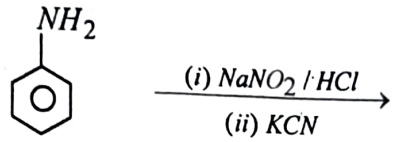
(3) 3-methyl-1-pentene (4) 4-methyl-1-pentene

60. The stablest radical among the following is :

(1) $CH_3CH_2\dot{C}H_2$ (2) $CH_3\dot{C}HCH_3$

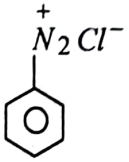
(3) $C_6H_5CH_2\dot{C}H_2$ (4) $C_6H_5\dot{C}H_2CH_3$

61. The product of the following reaction is :



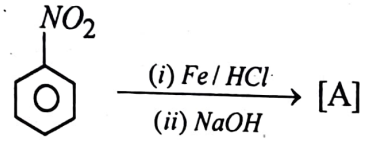
(1) 

(2) 

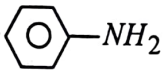
(3) 

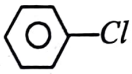
(4) 

62. The product [A] of the following reaction is :



(1) 

(2) 

(3) 

(4) 

63. The most suitable reagent for the conversion of $RCH_2OH \rightarrow RCHO$ is :

(1) CrO_3 / H_2SO_4

(2) $KMnO_4 / KOH$

(3) PCC

(4) $K_2Cr_2O_7 / H_2SO_4$

64. Which of the following combination of aldehydes give cross Cannizzaro reaction ?

(1) CH_3CHO , $HCHO$

(2) C_6H_5CHO, CH_3CHO

(3) $C_6H_5CHO, HCHO$

(4) All of these

65. Which of the following compound used alone will undergo an aldol reaction ?

(1) CH_2O (2) CH_3COCH_3

(3) $C_6H_5COC_6H_5$ (4) $CH_2=CHCHO$

66. The diasaccharide sucrose is composed of monosaccharides :

(1) D-glucose + D-glucose

(2) D-fructose + D-fructose

(3) D-glucose + D-galactose

(4) D-glucose + D-fructose

67. Which of the following statements about anomers is ***true*** ?

(1) Anomers are diastereoisomers

(2) Anomers are enantiomers

(3) Anomers are constitutional isomer

(4) All of these

68. The reaction of CH_3CH_2MgBr with water yield :

(1) CH_3CH_3 (2) $CH_2=CH_2$

(3) CH_3CH_2OH (4) $\begin{matrix} CH_2-CH_2 \\ | \quad\quad | \\ OH \quad OH \end{matrix}$

69. Pyrrole is less basic than pyridine because the lone-pair of electrons on N-atom in pyrrole :

(1) reside in *sp* hybrid orbital

(2) reside in sp^2 hybrid orbital

(3) is not part of the delocalized π molecular orbital

(4) is part of the delocalized π molecular orbital

70. Quinoline undergo nucleophilic substitution on heating with $NaNH_2$ to give :

(1) 6-Aminoquinoline (2) 2-Aminoquinoline

(3) 3-Aminoquinoline (4) 4-Aminoquinoline

71. Indicate which one of the following relations is ***not*** correct :

(1) $-\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$ (2) $-\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(3) $-\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (4) $-\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

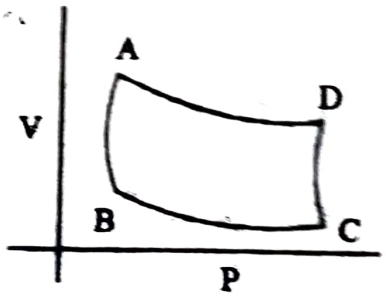
72. When two moles of liquid A are mixed with two moles of liquid B at 300K, the excess molar Gibbs energy of the solution is -1.5 kJ mol^{-1}. The corresponding value of Gibbs energy of mixing (in kJ) is closest to :

(1) -12.9 (2) -6.0 (3) -1.5 (4) -0.9

73. The minimum work required by an engine to transfer 5 J of heat from a reservoir at 100 K to one at 300 K is :

(1) 5 J (2) 10 J (3) 15 J (4) 20 J

74. The figure below describes how a reversible Carnot heat engine works. It starts from the adiabatic compression step denoted by :



(1) AB (2) BC (3) DC (4) AD

75. A thermodynamic equation that relates the chemical potential to the composition of a mixture is known as :

(1) Gibb's-Helmholtz equation

(2) Gibb's-Duhem equation

(3) Joule-Thomson equation

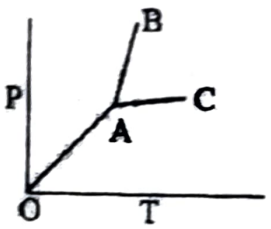
(4) Debye-Huckel equation

76. The heat capacity of a species is independent of temperature if it is :

(1) Tetratomic (2) Triatomic

(3) Diatomic (4) Monatomic

77. The phase diagram of a compound is shown below :



The slopes of the lines OA, AC and AB are $\tan\frac{\pi}{4}$, $\tan\frac{\pi}{6}$ and $\tan\frac{\pi}{3}$ respectively. If melting point and ΔH of melting are 300K and 3 kJ mol^{-1} respectively, the change in the volume on melting is :

(1) $10\tan\frac{\pi}{3}$ (2) $10\tan\frac{\pi}{4}$

(3) $10\cot\frac{\pi}{3}$ (4) $10\cot\frac{\pi}{4}$

78. The number of phases, components, and degrees of freedom, when Argon is added to an equilibrium mixture of NO, O_2 and NO_2 in the gas phase are, respectively :

(1) 1, 3, 5 (2) 1, 4, 5

(3) 1, 3, 4 (4) 1, 4, 4

79. For a potentiometric titration, in the curve of emf (E) vs volume (V) of the titrant added, the equivalence point is indicated by :

(1) $|dE/dV| = 0 ; |d^2E/d^2V| = 0$ (2) $|dE/dV| = 0 ; |d^2E/d^2V| > 0$

(3) $|dE/dV| > 0 ; |d^2E/d^2V| = 0$ (4) $|dE/dV| > 0 ; |d^2E/d^2V| > 0$

80. The Daniel cell is :

(1) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(2) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Ag^{2+}(aq)|Ag(s)|Pt_{II}$

(3) $Pt_I(s)|Fe(s)|Fe^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(4) $Pt_I(s)|H_2(s)|H_2SO_4(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

81. Coordination number and geometry of $[Ce(NO_3)_6]^{2-}$:

(1) 6, octahedral (2) 12, octahedral

(3) 8, octahedral (4) 12, icosaheral

82. If an element has seven electrons in its outermost shell then it is likely to have the ..... atomic size among all the elements in the same period.

(1) largest (2) smallest

(3) same (4) both (1) and (2)

83. The tripositive lanthanoid ion which does not show sharp peak in the absorption spectra :

(1) Gd^{3+} (2) Pm^{3+} (3) Ce^{3+} (4) Pr^{3+}

84. C_{60} has :

(1) 14 pentagons and 18 hexagons

(2) 10 pentagons and 20 hexagons

(3) 12 pentagons and 20 hexagons

(4) 12 pentagons and 18 hexagons

85. If Δ_0 is the octahedral splitting energy and P is the pairing energy, then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{2+}$ is :

(1) $-0.8\ \Delta_0 + 2P$ (2) $-0.8\ \Delta_0$ (3) $-1.8\ \Delta_0 + 3P$ (4) $-0.8\ \Delta_0 + P$

86. Consider the following complex ions, P, Q and R, $P = [FeF_6]^{3-}$, $Q = [V(H_2O)_6]^{2+}$ and $R = [Fe(H_2O)_6]^{2+}$; The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is :

(1) $Q < P < R$ (2) $R < Q < P$

(3) $R < P < Q$ (4) $Q < R < P$

87. Glycerol is more viscous than glycol, the reason is :

(1) Higher molecular wt.

(2) More covalent

(3) More extent of hydrogen bonding

(4) Complex structure

88. In BF_3, the B-F bond length is 1.30 Å, when BF_3 is allowed to be treated with Me_3N, it forms an adduct, $[Me_3N \rightarrow BF_3]$ The bond length of B-F in the adduct is :

(1) Greater than 1.30Å

(2) Smaller than 1.30Å

(3) Equal to 1.30Å

(4) None of these

89. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared ?

(1) Linear chain silicate

(2) Sheet silicate

(3) Pyrosilicate

(4) Three dimensional

90. Which of the following represents a set of hard acid and soft base respectively ?

(1) Fe^{3+} and I^-

(2) Fe^{3+} and S^{2-}

(3) Ag^+ and S^{2-}

(4) Ag^+ and F^-

91. The quantum number of 20th electron of Fe (Z = 26) would be :

(1) 3, 2, –2, – 1/2

(2) 3, 2, 0, 1/2

(3) 4, 0, 0, +1/2

(4) 4, 1, –1, + 1/2

92. The number of orbitals in n = 3 are :

(1) 1 (2) 4 (3) 9 (4) 16

93. Electronegativity of the following elements increases in the order :

(1) O, N, S, P

(2) P, S, N, O

(3) P, N, S, O

(4) S, P, N, O

94. Predict the correct order of repulsion among the following :

(1) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

(2) lone pair – lone pair > bond pair – bond pair > lone pair – bond pair

(3) bond pair – bond pair > lone pair – bond pair > lone pair –lone pair

(4) lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

95. Pick out the incorrect statement :

(1) sp^3d hybridisation involves $dx^2 - y^2$ orbital

(2) Hybridised orbital form sigma-bond when overlaps with other orbitals.

(3) SF_2 molecule is more polar than CS_2.

(4) o-nitrophenol is more volatile than p-nitrophenol.

96. Which of the following order is ***not*** correct ?

(1) $SF_2 > SF_4 > SF_6$ (ionic character)

(2) $AlF_3 < Al_2O_3 < AlN$ (covalent character)

(3) $CaCl_2 < SnCl_2 < CdCl_2$ (covalent character)

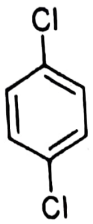
(4) $ZnCl_2 < CdCl_2 < HgCl_2$ (ionic character)

97. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

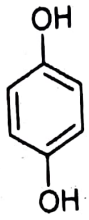
(1) C_2 (2) N_2^-

(3) O_2 (4) S_2

98. For which of the following molecule significant $\mu \neq 0$:

(1) 

(2) 

(3) 

(4) 

(1) Only (3) (2) (3) and (4)

(3) Only (1) (4) (1) and (2)

99. The geometry with respect to the central atom of the following molecules are $N(SiH_3)_3$, Me_3N, $(SiH_3)_3P$:

(1) planar, pyramidal, planar

(2) planar, pyramidal, pyramidal

(3) pyramidal, pyramidal, pyramidal

(4) pyramidal, planar, pyramidal

100. The IUPAC name of $[Co(NH_3)_5ONO]^{2-}$ ion is :

(1) Pentaamminenitritocobalt (IV) ion

(2) Pentaamminenitrocobalt (IV) ion

(3) Pentaamminenitrocobalt (III) ion

(4) Pentaamminenitritocobalt (III) ion

Total No. of Printed Pages : 21

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C

SET-Z

PG-EE-July, 2024

SUBJECT : Chemistry

Sr. No. 10427

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

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

Name _____ Date of Birth_____

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 shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. 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.*

SEAL

1. Indicate which one of the following relations is ***not*** correct :

(1) $-\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$ (2) $-\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(3) $-\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (4) $-\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

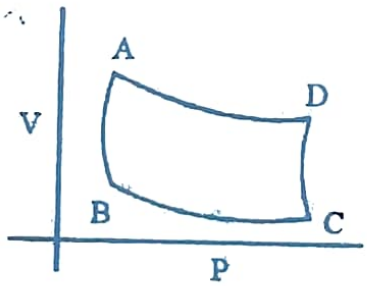
2. When two moles of liquid A are mixed with two moles of liquid B at 300K, the excess molar Gibbs energy of the solution is -1.5 kJ mol^{-1}. The corresponding value of Gibbs energy of mixing (in kJ) is closest to :

(1) -12.9 (2) -6.0 (3) -1.5 (4) -0.9

3. The minimum work required by an engine to transfer 5 J of heat from a reservoir at 100 K to one at 300 K is :

(1) 5 J (2) 10 J (3) 15 J (4) 20 J

4. The figure below describes how a reversible Carnot heat engine works. It starts from the adiabatic compression step denoted by :



(1) AB (2) BC (3) DC (4) AD

5. A thermodynamic equation that relates the chemical potential to the composition of a mixture is known as :

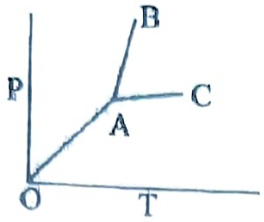
(1) Gibb's-Helmholtz equation (2) Gibb's-Duhem equation

(3) Joule-Thomson equation (4) Debye-Huckel equation

6. The heat capacity of a species is independent of temperature if it is :

(1) Tetratomic (2) Triatomic (3) Diatomic (4) Monatomic

7. The phase diagram of a compound is shown below :



The slopes of the lines OA, AC and AB are $\tan\frac{\pi}{4}$, $\tan\frac{\pi}{6}$ and $\tan\frac{\pi}{3}$ respectively. If melting point and ΔH of melting are 300K and 3 kJ mol^{-1} respectively, the change in the volume on melting is :

(1) $10\tan\frac{\pi}{3}$ (2) $10\tan\frac{\pi}{4}$ (3) $10\cot\frac{\pi}{3}$ (4) $10\cot\frac{\pi}{4}$

8. The number of phases, components, and degrees of freedom, when Argon is added to an equilibrium mixture of NO, O_2 and NO_2 in the gas phase are, respectively :

(1) 1, 3, 5 (2) 1, 4, 5 (3) 1, 3, 4 (4) 1, 4, 4

9. For a potentiometric titration, in the curve of emf (E) vs volume (V) of the titrant added, the equivalence point is indicated by :

(1) $|dE/dV| = 0$; $|d^2E/d^2V| = 0$ (2) $|dE/dV| = 0$; $|d^2E/d^2V| > 0$

(3) $|dE/dV| > 0$; $|d^2E/d^2V| = 0$ (4) $|dE/dV| > 0$; $|d^2E/d^2V| > 0$

10. The Daniel cell is :

(1) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(2) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Ag^{2+}(aq)|Ag(s)|Pt_{II}$

(3) $Pt_I(s)|Fe(s)|Fe^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(4) $Pt_I(s)|H_2(s)|H_2SO_4(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

11. Coordination number and geometry of $[Ce(NO_3)_6]^{2-}$:

(1) 6, octahedral (2) 12, octahedral (3) 8, octahedral (4) 12, icosaheral

12. If an element has seven electrons in its outermost shell then it is likely to have the ..... atomic size among all the elements in the same period.

(1) largest (2) smallest (3) same (4) both (1) and (2)

13. The tripositive lanthanoid ion which does not show sharp peak in the absorption spectra :

(1) Gd^{3+} (2) Pm^{3+} (3) Ce^{3+} (4) Pr^{3+}

14. C_{60} has :

(1) 14 pentagons and 18 hexagons

(2) 10 pentagons and 20 hexagons

(3) 12 pentagons and 20 hexagons

(4) 12 pentagons and 18 hexagons

15. If Δ_0 is the octahedral splitting energy and P is the pairing energy, then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{2+}$ is :

(1) $-0.8\ \Delta_0 + 2P$ (2) $-0.8\ \Delta_0$ (3) $-1.8\ \Delta_0 + 3P$ (4) $-0.8\ \Delta_0 + P$

16. Consider the following complex ions, P, Q and R, $P = [FeF_6]^{3-}$, $Q = [V(H_2O)_6]^{2+}$ and $R = [Fe(H_2O)_6]^{2+}$; The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is :

(1) $Q < P < R$ (2) $R < Q < P$ (3) $R < P < Q$ (4) $Q < R < P$

17. Glycerol is more viscous than glycol, the reason is :

(1) Higher molecular wt.

(2) More covalent

(3) More extent of hydrogen bonding

(4) Complex structure

18. In BF_3, the B-F bond length is 1.30 Å, when BF_3 is allowed to be treated with Me_3N, it forms an adduct, $[Me_3N \rightarrow BF_3]$ The bond length of B-F in the adduct is :

(1) Greater than 1.30Å (2) Smaller than 1.30Å

(3) Equal to 1.30Å (4) None of these

19. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared ?

(1) Linear chain silicate (2) Sheet silicate

(3) Pyrosilicate (4) Three dimensional

20. Which of the following represents a set of hard acid and soft base respectively ?

(1) Fe^{3+} and F^- (2) Fe^{3+} and S^{2-} (3) Ag^+ and S^{2-} (4) Ag^+ and F^-

21. The quantum number of 20th electron of Fe (Z = 26) would be :

(1) 3, 2, –2, – 1/2 (2) 3, 2, 0, 1/2

(3) 4, 0, 0, +1/2 (4) 4, 1, –1, + 1/2

22. The number of orbitals in n = 3 are :

(1) 1 (2) 4 (3) 9 (4) 16

23. Electronegativity of the following elements increases in the order :

(1) O, N, S, P (2) P, S, N, O (3) P, N, S, O (4) S, P, N, O

24. Predict the correct order of repulsion among the following :

(1) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

(2) lone pair – lone pair > bond pair – bond pair > lone pair – bond pair

(3) bond pair – bond pair > lone pair – bond pair > lone pair –lone pair

(4) lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

25. Pick out the incorrect statement :

(1) sp^3d hybridisation involves $dx^2 - y^2$ orbital

(2) Hybridised orbital form sigma-bond when overlaps with other orbitals.

(3) SF_2 molecule is more polar than CS_2.

(4) o-nitrophenol is more volatile than p-nitrophenol.

26. Which of the following order is ***not*** correct ?

(1) $SF_2 > SF_4 > SF_6$ (ionic character)

(2) $AlF_3 < Al_2O_3 < AlN$ (covalent character)

(3) $CaCl_2 < SnCl_2 < CdCl_2$ (covalent character)

(4) $ZnCl_2 < CdCl_2 < HgCl_2$ (ionic character)

27. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

(1) C_2 (2) N_2^- (3) O_2 (4) S_2

28. For which of the following molecule significant $\mu \neq 0$:

(1) 

(2) 

(3) 

(4) 

(1) Only (3) (2) (3) and (4)

(3) Only (1) (4) (1) and (2)

29. The geometry with respect to the central atom of the following molecules are $N(SiH_3)_3$, Me_3N, $(SiH_3)_3P$:

(1) planar, pyramidal, planar

(2) planar, pyramidal, pyramidal

(3) pyramidal, pyramidal, pyramidal

(4) pyramidal, planar, pyramidal

30. The IUPAC name of $[Co(NH_3)_5ONO]^{2-}$ ion is :

(1) Pentaammincnitritocobalt (IV) ion

(2) Pentaammincnitrocobalt (IV) ion

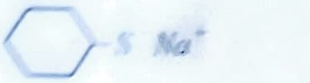
(3) Pentaammincnitrocobalt (III) ion

(4) Pentaammincnitritocobalt (III) ion

31. Complete the following reaction [A] is :

(1) 

(2) 

(3) 

(4) None of these

32. Base-catalyzed condensation of two ester molecules to form an alcohol and β-keto ester is called :

(1) Claisen condensation

(2) Corey-House reaction

(3) Aldol condensation

(4) Kolbe's reaction

33. What is used to initiate a tree-radical polymerization ?

(1) Benzoyl peroxide

(2) Benzoic acid

(3) Benzyl alcohol

(4) Benzil

34. The α-Helix is common form of :

(1) Primary structure of protein

(2) Secondary structure of protein

(3) Tertiary structure of protein

(4) None of these

35. An auxochrome is one which is :

(1) colour enhancing

(2) a group or atom with lone pairs of electron

(3) extended conjugation

(4) all of these

36. The energy required for various transition follow the order :

(1) $\pi \rightarrow \pi^* > n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^*$

(2) $n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^*$

(3) $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

(4) $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

37. In infra-red spectroscopy, the pair of isomers, which cannot be distinguished :

(1) Cis-trans isomers

(2) Functional isomers

(3) Enantiomers

(4) Position isomers

38. The cycloalkanones, the frequency of absorption for carbonyl group is :

(1) 1000-1100 cm^{-1}

(2) 1280-1300 cm^{-1}

(3) 1580-1600 cm^{-1}

(4) 1705-1725 cm^{-1}

39. The signal(s) for a compound like $A-CH_2-CH_2-B$ will be :

(1) Two singlets (2) Two triplet (3) One singlet (4) One triplet

40. How many ^{1}H NMR signal in case of benzene ?

(1) Zero (2) One (3) Three (4) Six

41. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon ?

(1) Low extinction coefficients (Lambert-Beer law)

(2) Vertical transitions (Kasha's rule)

(3) High ISC rates (El Sayed rule)

(4) The Franck-Condon principle

42. The vapor pressure of pure benzene at a certain temperature is 640 mmHg. A nonvolatile nonelectrolyte solid weighing 2.175 g is added to 39 g of benzene. The vapor pressure of the solution is 600 mmHg. The molecular weight of the solid substance is :

(1) 42.25 (2) 55.55 (3) 65.25 (4) 72.25

43. What is the molal lowering of the vapor pressure of water is 100°C ?

(1) 17.77 mm (2) 28.28 mm

(3) 13.68 mm (4) 24.66 mm

44. Ethylene glycol a major component of permanent antifreeze, effectively depresses the freezing point of water in automobile radiator. What minimum weight of ethylene glycol must be mixed with 6 gallons of water of protect it from freezing at –24°C ?

(Given : 1 Gallon = 3.785 liter and $K_f = 186$)

(1) 22.15 kg (2) 18.15 kg (3) 33.75 kg (4) 62 kg

45. 20.27 g of Benzene containing 0.2965 g of benzoic acid (mol. wt. 122) freezes at 0.137°C below the freezing point of pure benzene. If Benzoic acid exists as a dimer in benzene, find its degree of association. (Given : K_f for Benzene is $5.12°C.m^{-1}$)

(1) 72.34% (2) 86.84%

(3) 96.84% (4) 66.34%

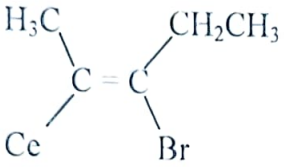
46. The surface tension of water at 21°C is 72.75×10^{-3} N/m. A 33.24% (v/v) solution of ethanol has γ 33.24×10^{-3} N/m at the same temperature. Given : Density of solution $= 0.9614 \times 10^{3}$ kg/m^3, density of water $= 0.9982 \times 10^{3}$ kg/m^3 and angle of contact, $\theta = 0°$. How much less will the alcohol solution rise in the same capillary ?

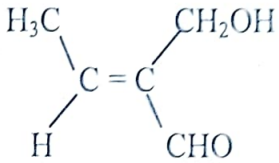
(1) 34.2% (2) 47.4% (3) 54.3% (4) 65.4%

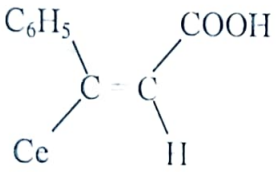
47. Hyperconjugation involves overlap of the following orbitals :

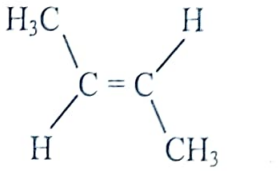
(1) σ-σ (2) σ-ρ (3) ρ-ρ (4) π-π

48. The z-isomer among the following is :

(1) 

(2) 

(3) 

(4) 

49. Out of the following the molecule that exhibits optical isomerism is :

(1) 2-methyl-2-pentene (2) 3-methyl-2-pentene

(3) 3-methyl-1-pentene (4) 4-methyl-1-pentene

50. The stablest radical among the following is :

(1) $CH_3CH_2\dot{C}H_2$ (2) $CH_3\dot{C}HCH_3$

(3) $C_6H_5CH_2\dot{C}H_2$ (4) $C_6H_5\dot{C}H_2CH_3$

51. Copper has role in :

(1) Hb formation

(2) ATP production by reformation

(3) Formation of fibres elastic

(4) All of the above

52. Which among the following electronic configurations represent the elements with the maximum electron affinity ?

(1) $1s^2 2s^2 2p^6$

(2) $1s^2 2s^2 2p^6 3s^2 3p^5$

(3) $1s^2 2s^2 2p^6 3s^1$

(4) $1s^2 2s^2 2p^5$

53. Which one of the following is most easily reduced ?

(1) $Ni(CO)_4$ (2) $Cr(CO)_6$ (3) $Fe(CO)_5$ (4) $V(CO)_6$

54. The value of d_{111} in a cubic crystal is 325.6 pm. The value of d_{333} is :

(1) 325.6 pm (2) 976.8 pm (3) 108.5 pm (4) 625.6 pm

55. A metal crystallizes in FCC structure with a unit cell side of 500 pm. If the density of the crystal is 1.33 g/cc, the molar mass of the metal is close to :

(1) 23 (2) 24 (3) 25 (4) 26

56. The decomposition of gaseous acetaldehyde at T(K) follows second-order kinetics. The half-life of this reaction is 400 s when the initial pressure is 250 Torr. What will be the rate constant (in $Torr^{-1}s^{-1}$) and half-life (in seconds) respectively, if the initial pressure of the acetaldehyde is 200 Torr at the same temperature ?

(1) 10^5 and 500 seconds

(2) 10^{-5} and 400 seconds

(3) 10^{-4} and 400 seconds

(4) 10^{-5} and 500 seconds

57. The carbon-14 activity of an old wood sample is found to be 14.2 disintegrations $min^{-1}g^{-1}$. Calculate the age of the old wood sample, if for a fresh wood sample carbon-14 activity is 15.3 disintegrations $min^{-1}g^{-1}$ ($t_{1/2}$ carbon-14 is 5730 years), is :

(1) 5,000 years (2) 4,000 years (3) 877 years (4) 617 years

58. Kohlrausch's law is applicable to a dilute solution of :

(1) Potassium chloride in hexane

(2) Acetic acid in water

(3) Hydrochloric acid in water

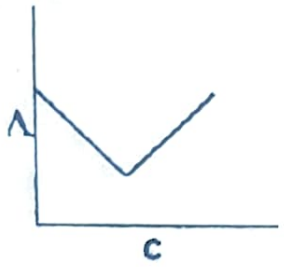
(4) Benzoic acid in benzene

59. The concentration of a $MgSO_4$ solution having the same ionic strength as that of a 0.1 M Na_2SO_4 solution is :

(1) 0.05 M
(2) 0.067 M
(3) 0.075 M
(4) 0.133 M

60. The molar conductivity $\wedge$ versus concentration (c) plot of sodium dodecylsufate in water is expected to look like :

(1)



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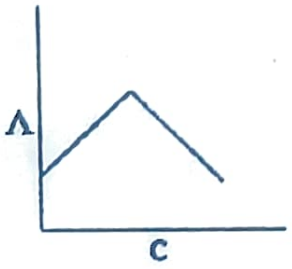

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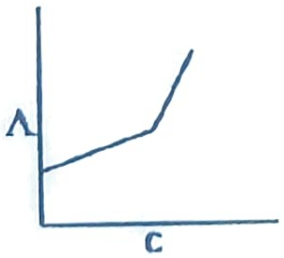

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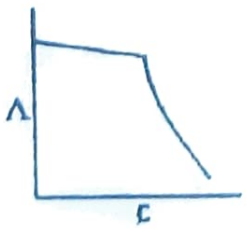
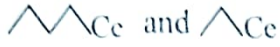
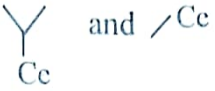
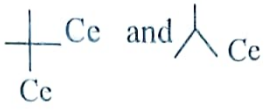


61. The alkyl halides required to prepare  by Wurtz reaction are :

(1) 

(2) 

(3) 

(4) 

62. Ozonolysis of an alkene produces only one dicarbonyl compound. The structure of the alkene is :

(1) $CH_3-CH=CH-CH_2-CH_3$

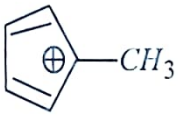
(2) 

(3) 

(4) All of the above

63. Which one of the following compound is aromatic in nature ?

(1) 

(2) 

(3) 

(4) 

64. Diels-Alder reaction is :

(1) 4 + 2 cycloaddition

(2) 2 + 2 cycloaddition

(3) Electrophilic addition

(4) Nucleophilic addition

65. Which of the following can be used as the halide component for Friedel-Crafts reaction ?

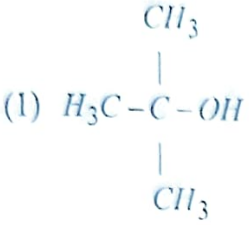
(1) Chlorobenzene

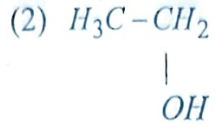
(2) Bromobenzene

(3) Chloroethane

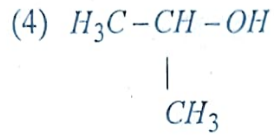
(4) Isopropyl chloride

66. Which of the following alcohol is resistant to oxidation ?

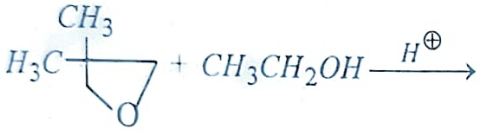
(1) 

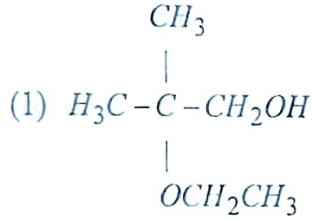
(2) 

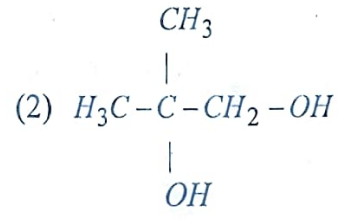
(3) CH_3-OH

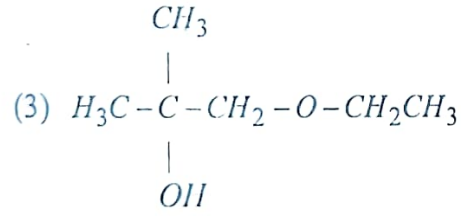
(4) 

67. The product of the following reaction is :



(1) 

(2) 

(3) 

(4) None of these

68. Phenol reacts with bromine in CS_2 to give :

(1) o-bromophenol

(2) m- bromophenol

(3) o- and p-bromophenol

(4) 2, 4, 6-tribromophenol

69. The carboxylic acid that does not undergo Hell-Volhard-Zelinsky reaction is :

(1) CH_3COOH

(2) $(CH_3)_2CHCOOH$

(3) $CH_3CH_2CH_2COOH$

(4) $(CH_3)_3CCOOH$

70. Which one of the following is a reagent in Gabriel amine synthesis ?

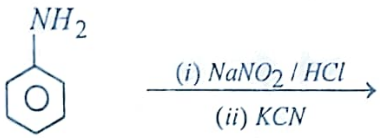
(1) an acyl or arylhalide

(2) phthalimide

(3) hydroxylamine

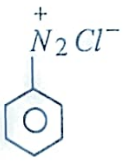
(4) sodium azide

71. The product of the following reaction is :



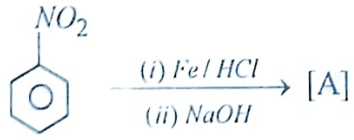
(1) 

(2) 

(3) 

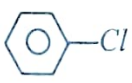
(4) 

72. The product [A] of the following reaction is :



(1) 

(2) 

(3) 

(4) 

73. The most suitable reagent for the conversion of $RCH_2OH \rightarrow RCHO$ is :

(1) CrO_3 / H_2SO_4

(2) $KMnO_4 / KOH$

(3) PCC

(4) $K_2Cr_2O_7 / H_2SO_4$

74. Which of the following combination of aldehydes give cross Cannizzaro reaction ?

(1) CH_3CHO , $HCHO$

(2) C_6H_5CHO, CH_3CHO

(3) C_6H_5CHO, $HCHO$

(4) All of these

75. Which of the following compound used alone will undergo an aldol reaction ?

(1) CH_2O

(2) CH_3COCH_3

(3) $C_6H_5COC_6H_5$

(4) $CH_2 = CHCHO$

76. The diasaccharide sucrose is composed of monosaccharides :

(1) D-glucose + D-glucose

(2) D-fructose + D-fructose

(3) D-glucose + D-galactose

(4) D-glucose + D-fructose

77. Which of the following statements about anomers is ***true*** ?

(1) Anomers are diastereoisomers

(2) Anomers are enantiomers

(3) Anomers are constitutional isomer

(4) All of these

78. The reaction of CH_3CH_2MgBr with water yield :

(1) CH_3CH_3

(2) $CH_2 = CH_2$

(3) CH_3CH_2OH

(4) $\begin{matrix} CH_2 - CH_2 \\ | \quad\quad | \\ OH \quad OH \end{matrix}$

79. Pyrrole is less basic than pyridine because the lone-pair of electrons on N-atom in pyrrole :

(1) reside in sp hybrid orbital

(2) reside in sp^2 hybrid orbital

(3) is not part of the delocalized π molecular orbital

(4) is part of the delocalized π molecular orbital

80. Quinoline undergo nucleophilic substitution on heating with $NaNH_2$ to give :

(1) 6-Aminoquinoline

(2) 2-Aminoquinoline

(3) 3-Aminoquinoline

(4) 4-Aminoquinoline

81. The chemical composition of brown ring produced in the test of NO_2 is :

(1) $[FeNO]SO_4$ (2) $[FeNO]Cl_2$ (3) $[FeSO_4]NO_2$ (4) $[FeCl_2]NO$

82. Under physiological condition, oxygen is binding to deoxy-hemoglobin and deoxy-myoglobin, the binding curve and its pH dependence respectively are :

(1) sigmoidal & pH dependent; hyperbolic and pH independent.

(2) hyperbolic and pH independent; sigmoidal & pH dependent.

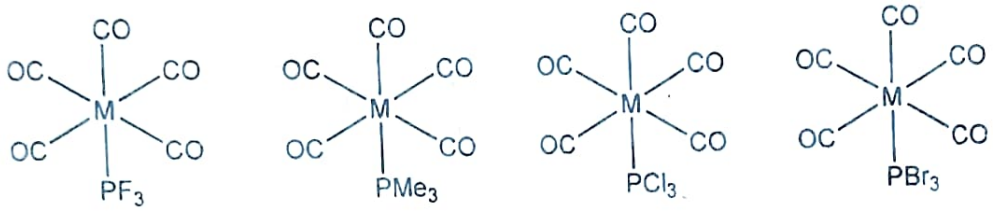
(3) sigmoidal & pH independent; hyperbolic and pH dependent.

(4) hyperbolic and pH independent; sigmoidal & pH dependent.

83. The total number of isomers of $[Co(en)_2Cl_2]$, (en = ethylenediamine) is :

(1) 4 (2) 3 (3) 6 (4) 5

84. Arrange the following in decreasing order of axial C-O bond length and increasing order of axial υ_{M-C} :



(i) (ii) (iii) (iv)

(1) ii > iv > iii > i (2) iv > ii > iii > i

(3) ii > iv > i > iii (4) i > ii > iii > iv

85. Identify the correct statement for the two reactions given below :

$Xe + PtF_6 \xrightarrow{SF_6} [Xe]^+[PtF_6]^-$

$XeF_4 + Me_4NF \longrightarrow [Me_4N]^+[XeF_5]^-$

(1) Xe and XeF_4 both act as acids

(2) Xe and XeF_4 both act as bases

(3) Xe acts as an acid and XeF_4 act as base

(4) Xe acts as a base and XeF_4 act as an acid

86. The separation of lanthanides in the ion-exchange method is based on :

(1) Basicity of hydroxides

(2) Size of the hydrated ions

(3) Size of the unhydrated ion

(4) The solubility of their nitrates

87. Which one of the following conductometric titration will show a linear increase of the conductance with volume of titrant added upto the break point and almost constant conductance afterwards ?

(1) A strong acid with a strong base (2) A strong acid with a weak base

(3) A weak acid with a strong base (4) A weak acid with a weak base

88. The electronic configuration of chromium is $4s^1 3d^5$. The element tungsten (W) belongs to the same group and has atomic number = 74. The configuration of its valence shell is :

(1) $5s^1 4d^1$ (2) $6s^1 5d^5$ (3) $6s^2 5d^4$ (4) $6s^0 5d^6$

89. The nephelauxetic parameter (β) is highest for :

(1) Br^- (2) Cl^- (3) CN^- (4) F^-

90. Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is :

(1) Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+} (2) Ti^{2+}, V^{2+}, Cr^{3+}, Mn^{4+}

(3) Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+} (4) Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}

91. Electrolysis of an aqueous solution of 1.0 M NaOH results in :

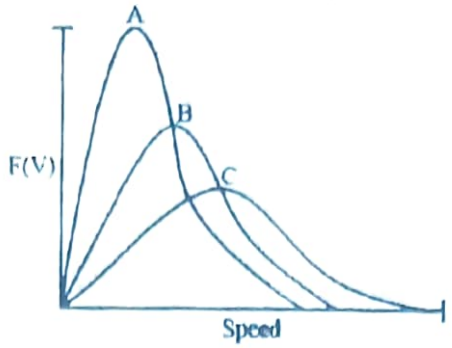
(1) Na at the cathode and O_2 at the anode

(2) H_2 at the cathode and O_2 at the anode

(3) Na and H_2 at the cathode, and O_2 at the anode

(4) O_2 at the cathode and H_2 at the anode

92. Identify the speed distribution functions of Neon, Argon and Krypton gas in the three curves (A or B or C) in the graph given below :



(1) Ne–A, Ar–B, Kr–C (2) Ne–B, Ar–C, Kr–A

(3) Ne–C, Ar–B, Kr–A (4) Ne–C, Ar–A, Kr–B

93. The root mean square speed of the molecules of a perfect gas is proportional to :

(1) $1/T^{1/2}$ (2) T (3) $T^{1/2}$ (4) 1/T

94. At room temperature, which molecule has the maximum rotational entropy ?

(1) H_2 (2) O_2 (3) D_2 (4) N_2

95. The rotational constant $^{14}N_2$ is $2\,cm^{-1}$. The wave number of incident radiation in a Raman spectrometer is $20487\,cm^{-1}$. What is the wave number of first scattered Stokes line (in cm^{-1}) of $^{14}N_2$?

(1) 20479 (2) 20475 (3) 20499 (4) 20495

96. For the vibrational Raman spectrum of a homonuclear diatomic molecule, the selection rule under harmonic approximation is :

(1) $\Delta v = 0$ only (2) $\Delta v = \pm 1$ only

(3) $\Delta v = \pm 2$ only (4) $\Delta v = 0, \pm 1$

97. The vibrational frequency and anharmonicity constant of an alkali halide are 300 cm^{-1} and 0.0025 respectively. The positions (in cm^{-1}) of its fundamental mode and first overtone are respectively :

(1) 300, 600 (2) 298.5, 595.5 (3) 301.5, 604.5 (4) 290, 580

98. The energy levels for cyclobutadiene are $\alpha + 2\beta$, α, α and $\alpha - 2\beta$. The delocalization energy in this molecule is :

(1) 0 (2) -4β (3) -8β (4) 4α

99. Identify which of the following operators is not Hermitian ? Here i is iota.

(1) $\frac{h}{i2\pi}\frac{\partial}{\partial x}$ (2) $i\frac{\partial^2}{\partial x^2}$ (3) $\frac{\partial^2}{\partial x^2}$ (4) X^2

100. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33 T given that for a free electron, $g_e = 2$ and $\mu_B = 9.273 \times 10^{-24}$ J/T.

(1) 2.3 GHz (2) 9.24 GHz (3) 1.15 GHz (4) 8.36 GHz

Total No. of Printed Pages : 21

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D

SET-Z

PG-EE-July, 2024

SUBJECT : Chemistry

10428

Sr. No.

Time : 1¼ Hours | Max. Marks : 100 | Total Questions : 100

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

Name _____ Date of Birth _____

Father's Name _____ Mother's Name _____

Date of Examination _____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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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 shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University Website. The complaint be sent by the students to the Controller of Examinations by hand or through email. 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.*

1. The chemical composition of brown ring produced in the test of NO_3^- is :

(1) $[Fe(NO)(SO_4)_2]$ (2) $[Fe(NO)]Cl_3$ (3) $[Fe(NO)_4][NO]_2$ (4) $[FeCl_2][NO]$

2. Under physiological condition, oxygen is binding to deoxy-hemoglobin and deoxy-myoglobin, the binding curve and its pH dependence respectively are :

(1) sigmoidal & pH dependent; hyperbolic and pH independent

(2) hyperbolic and pH independent; sigmoidal & pH dependent

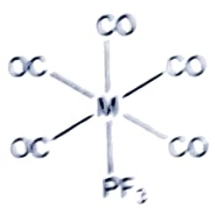
(3) sigmoidal & pH independent; hyperbolic and pH dependent.

(4) hyperbolic and pH independent; sigmoidal & pH dependent.

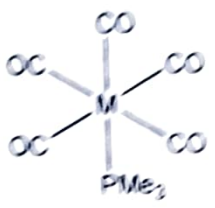
3. The total number of isomers of $[Co(en)_2Cl_2]$, (en = ethylenediamine) is :

(1) 4 (2) 3 (3) 6 (4) 5

4. Arrange the following in decreasing order of axial C-O bond length and increasing order of axial bond :

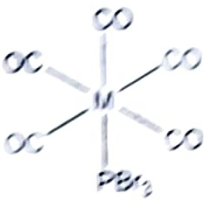


(i)



(ii)

(iii)



(iv)

(1) ii > iv > iii > i (2) iv > ii > iii > i

(3) ii > iv > i > iii (4) i > ii > iii > iv

5. Identify the correct statement for the two reactions given below :

$$Xe + PtF_6 \xrightarrow{SF_6} [Xe]^+[PtF_6]^-$$

$$XeF_4 + Me_4NF \longrightarrow [Me_4N]^+[XeF_5]^-$$

(1) Xe and XeF_4 both act as acids

(2) Xe and XeF_4 both act as bases

(3) Xe acts as an acid and XeF_4 act as base

(4) Xe acts as a base and XeF_4 act as an acid

6. The separation of lanthanides in the ion-exchange method is based on :

(1) Basicity of hydroxides
(2) Size of the hydrated ions
(3) Size of the unhydrated ion
(4) The solubility of their nitrates

7. Which one of the following conductometric titration will show a linear increase of the conductance with volume of titrant added upto the break point and almost constant conductance afterwards ?

(1) A strong acid with a strong base
(2) A strong acid with a weak base
(3) A weak acid with a strong base
(4) A weak acid with a weak base

8. The electronic configuration of chromium is $4s^1 3d^5$. The element tungsten (W) belongs to the same group and has atomic number = 74. The configuration of its valence shell is :

(1) $5s^1 4d^1$
(2) $6s^1 5d^5$
(3) $6s^2 5d^4$
(4) $6s^0 5d^6$

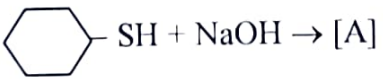
9. The nephelauxetic parameter (β) is highest for :

(1) Br^-
(2) Cl^-
(3) CN^-
(4) F^-

10. Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is :

(1) Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+}
(2) Ti^{2+}, V^{2+}, Cr^{3+}, Mn^{4+}
(3) Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+}
(4) Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}

11. Complete the following reaction [A] is :



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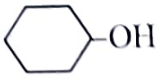
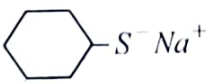
(2) 

(3) 

(4) None of these

12. Base-catalyzed condensation of two ester molecules to form an alcohol and β-keto ester is called :

(1) Claisen condensation

(2) Corey-House reaction

(3) Aldol condensation

(4) Kolbe's reaction

13. What is used to initiate a tree-radical polymerization ?

(1) Benzoyl peroxide

(2) Benzoic acid

(3) Benzyl alcohol

(4) Benzil

14. The α-Helix is common form of :

(1) Primary structure of protein

(2) Secondary structure of protein

(3) Tertiary structure of protein

(4) None of these

15. An auxochrome is one which is :

(1) colour enhancing

(2) a group or atom with lone pairs of electron

(3) extended conjugation

(4) all of these

16. The energy required for various transition follow the order :

(1) $\pi \rightarrow \pi^* > n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^*$

(2) $n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^*$

(3) $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

(4) $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

17. In infra-red spectroscopy, the pair of isomers, which cannot be distinguished :

(1) Cis-trans isomers

(2) Functional isomers

(3) Enantiomers

(4) Position isomers

18. The cycloalkanones, the frequency of absorption for carbonyl group is :

(1) 1000-1100 cm^{-1} (2) 1280-1300 cm^{-1}

(3) 1580-1600 cm^{-1} (4) 1705-1725 cm^{-1}

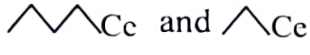
19. The signal(s) for a compound like $A-CH_2-CH_2-B$ will be :

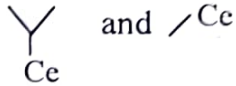
(1) Two singlets (2) Two triplet (3) One singlet (4) One triplet

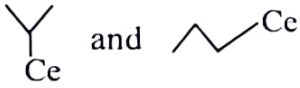
20. How many ^1H NMR signal in case of benzene ?

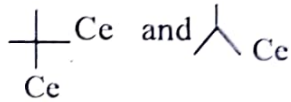
(1) Zero (2) One (3) Three (4) Six

21. The alkyl halides required to prepare  by Wurtz reaction are :

(1) 

(2) 

(3) 

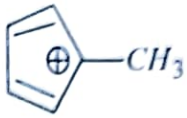
(4) 

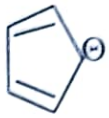
22. Ozonolysis of an alkene produces only one dicarbonyl compound. The structure of the alkene is :

(1) $CH_3-CH=CH-CH_2-CH_3$ (2) 

(3)  (4) All of the above

23. Which one of the following compound is aromatic in nature ?

(1)  (2) 

(3)  (4) 

24. Diels-Alder reaction is :

(1) 4 + 2 cycloaddition (2) 2 + 2 cycloaddition

(3) Electrophilic addition (4) Nucleophilic addition

25. Which of the following can be used as the halide component for Friedel-Crafts reaction ?

(1) Chlorobenzene (2) Bromobenzene

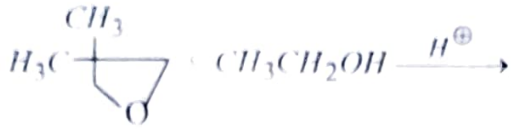
(3) Chloroethane (4) Isopropyl chloride

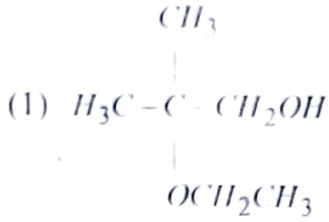
26. Which of the following alcohol is resistant to oxidation ?

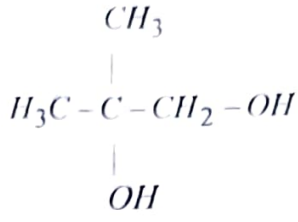
(1) $H_3C-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}-OH$ (2) $H_3C-\underset{\displaystyle OH}{\overset{\displaystyle CH_2}{\overset{|}{\underset{|}{}}}}$

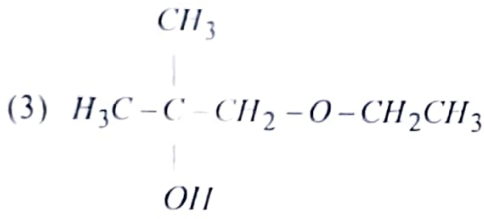
(3) CH_3-OH (4) $H_3C-\underset{\displaystyle CH_3}{\overset{\displaystyle OH}{\overset{|}{\underset{|}{CH}}}}$

27. The product of the following reaction is :



(1) 

(2) 

(3) 

(4) None of these

28. Phenol reacts with bromine in CS_2 to give :

(1) o-bromophenol

(2) m- bromophenol

(3) o- and p-bromophenol

(4) 2, 4, 6-tribromophenol

29. The carboxylic acid that does not undergo Hell-Volhard-Zelinsky reaction is :

(1) CH_3COOH

(2) $(CH_3)_2CHCOOH$

(3) $CH_3CH_2CH_2COOH$

(4) $(CH_3)_3CCOOH$

30. Which one of the following is a reagent in Gabriel amine synthesis ?

(1) an acyl or arylhalide (2) phthalimide

(3) hydroxylamine (4) sodium azide

31. Electrolysis of an aqueous solution of 1.0 M NaOH results in :

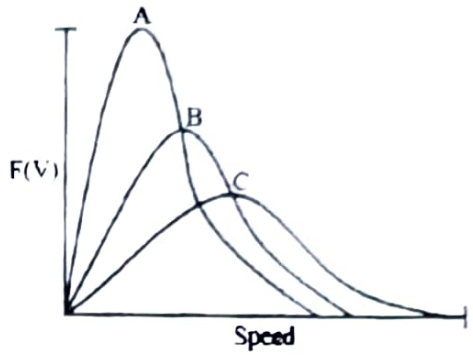
(1) Na at the cathode and O_2 at the anode

(2) H_2 at the cathode and O_2 at the anode

(3) Na and H_2 at the cathode, and O_2 at the anode

(4) O_2 at the cathode and H_2 at the anode

32. Identify the speed distribution functions of Neon, Argon and Krypton gas in the three curves (A or B or C) in the graph given below :



(1) Ne–A, Ar–B, Kr–C (2) Ne–B, Ar–C, Kr–A

(3) Ne–C, Ar–B, Kr–A (4) Ne–C, Ar–A, Kr–B

33. The root mean square speed of the molecules of a perfect gas is proportional to :

(1) $1/T^{1/2}$ (2) T (3) $T^{1/2}$ (4) 1/T

34. At room temperature, which molecule has the maximum rotational entropy ?

(1) H_2 (2) O_2 (3) D_2 (4) N_2

35. The rotational constant $^{14}N_2$ is $2\,cm^{-1}$. The wave number of incident radiation in a Raman spectrometer is $20487\,cm^{-1}$. What is the wave number of first scattered Stokes line (in cm^{-1}) of $^{14}N_2$?

(1) 20479 (2) 20475 (3) 20499 (4) 20495

36. For the vibrational Raman spectrum of a homonuclear diatomic molecule, the selection rule under harmonic approximation is :

(1) $\Delta v = 0$ only

(2) $\Delta v = \pm 1$ only

(3) $\Delta v = \pm 2$ only

(4) $\Delta v = 0, \pm 1$

37. The vibrational frequency and anharmonicity constant of an alkali halide are 300 cm^{-1} and 0.0025 respectively. The positions (in cm^{-1}) of its fundamental mode and first overtone are respectively :

(1) 300, 600 (2) 298.5, 595.5 (3) 301.5, 604.5 (4) 290, 580

38. The energy levels for cyclobutadiene are $\alpha + 2\beta$, α, α and $\alpha - 2\beta$. The delocalization energy in this molecule is :

(1) 0 (2) -4β (3) -8β (4) 4α

39. Identify which of the following operators is not Hermitian ? Here i is iota.

(1) $\frac{h}{i2\pi}\frac{\partial}{\partial x}$ (2) $i\frac{\partial^2}{\partial x^2}$ (3) $\frac{\partial^2}{\partial x^2}$ (4) X^2

40. Calculate the ESR frequency of an unpaired electron in a magnetic field of 0.33 T given that for a free electron, $g_e = 2$ and $\mu_B = 9.273 \times 10^{-24}$ J/T.

(1) 2.3 GHz (2) 9.24 GHz (3) 1.15 GHz (4) 8.36 GHz

41. Copper has role in :

(1) Hb formation

(2) ATP production by reformation

(3) Formation of fibres elastic

(4) All of the above

42. Which among the following electronic configurations represent the elements with the maximum electron affinity ?

(1) $1s^2 2s^2 2p^6$

(2) $1s^2 2s^2 2p^6 3s^2 3p^5$

(3) $1s^2 2s^2 2p^6 3s^1$

(4) $1s^2 2s^2 2p^5$

43. Which one of the following is most easily reduced ?

(1) $Ni(CO)_4$ (2) $Cr(CO)_6$ (3) $Fe(CO)_5$ (4) $V(CO)_6$

44. The value of d_{111} in a cubic crystal is 325.6 pm. The value of d_{333} is :

(1) 325.6 pm (2) 976.8 pm (3) 108.5 pm (4) 625.6 pm

45. A metal crystallizes in FCC structure with a unit cell side of 500 pm. If the density of the crystal is 1.33 g/cc, the molar mass of the metal is close to :

(1) 23 (2) 24 (3) 25 (4) 26

46. The decomposition of gaseous acetaldehyde at T(K) follows second-order kinetics. The half-life of this reaction is 400 s when the initial pressure is 250 Torr. What will be the rate constant (in $Torr^{-1}s^{-1}$) and half-life (in seconds) respectively, if the initial pressure of the acetaldehyde is 200 Torr at the same temperature ?

(1) 10^5 and 500 seconds (2) 10^{-5} and 400 seconds

(3) 10^{-4} and 400 seconds (4) 10^{-5} and 500 seconds

47. The carbon-14 activity of an old wood sample is found to be 14.2 disintegrations $min^{-1}g^{-1}$. Calculate the age of the old wood sample, if for a fresh wood sample carbon-14 activity is 15.3 disintegrations $min^{-1}g^{-1}$ ($t_{1/2}$ carbon-14 is 5730 years), is :

(1) 5,000 years (2) 4,000 years (3) 877 years (4) 617 years

48. Kohlrausch's law is applicable to a dilute solution of :

(1) Potassium chloride in hexane

(2) Acetic acid in water

(3) Hydrochloric acid in water

(4) Benzoic acid in benzene

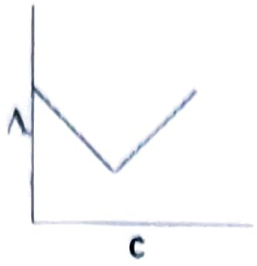
49. The concentration of a $MgSO_4$ solution having the same ionic strength as that of a 0.1 M Na_2SO_4 solution is :

(1) 0.05 M (2) 0.067 M

(3) 0.075 M (4) 0.133 M

50. The molar conductivity $\wedge$ versus concentration (c) plot of sodium dodecylsufate in water is expected to look like :

(1)



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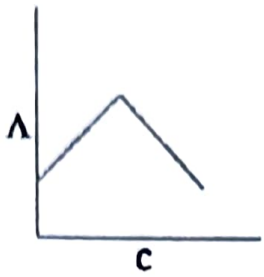

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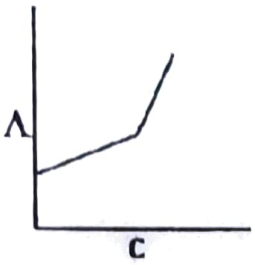


(4)

51. Coordination number and geometry of $[Ce(NO_3)_6]^{2-}$:

(1) 6, octahedral

(2) 12, octahedral

(3) 8, octahedral

(4) 12, icosaheral

52. If an element has seven electrons in its outermost shell then it is likely to have the ..... atomic size among all the elements in the same period.

(1) largest (2) smallest (3) same (4) both (1) and (2)

53. The tripositive lanthanoid ion which does not show sharp peak in the absorption spectra :

(1) Gd^{3+} (2) Pm^{3+} (3) Ce^{3+} (4) Pr^{3+}

54. C_{60} has :

(1) 14 pentagons and 18 hexagons

(2) 10 pentagons and 20 hexagons

(3) 12 pentagons and 20 hexagons

(4) 12 pentagons and 18 hexagons

55. If Δ_0 is the octahedral splitting energy and P is the pairing energy, then the crystal field stabilization energy (CFSE) of $[Co(NH_3)_6]^{2+}$ is :

(1) $-0.8\ \Delta_0 + 2P$ (2) $-0.8\ \Delta_0$ (3) $-1.8\ \Delta_0 + 3P$ (4) $-0.8\ \Delta_0 + P$

56. Consider the following complex ions, P, Q and R, $P = [FeF_6]^{3-}$, $Q = [V(H_2O)_6]^{2+}$ and $R = [Fe(H_2O)_6]^{2+}$; The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is :

(1) $Q < P < R$ (2) $R < Q < P$

(3) $R < P < Q$ (4) $Q < R < P$

57. Glycerol is more viscous than glycol, the reason is :

(1) Higher molecular wt.

(2) More covalent

(3) More extent of hydrogen bonding

(4) Complex structure

58. In BF_3, the B-F bond length is 1.30 Å, when BF_3 is allowed to be treated with Me_3N, it forms an adduct, $[Me_3N \rightarrow BF_3]$ The bond length of B-F in the adduct is :

(1) Greater than 1.30Å (2) Smaller than 1.30Å

(3) Equal to 1.30Å (4) None of these

59. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared ?

(1) Linear chain silicate

(2) Sheet silicate

(3) Pyrosilicate

(4) Three dimensional

60. Which of the following represents a set of hard acid and soft base respectively ?

(1) Fe^{3+} and F^- (2) Fe^{3+} and S^{2-} (3) Ag^+ and S^{2-} (4) Ag^+ and F^-

61. Indicate which one of the following relations is ***not*** correct :

(1) $-\left(\frac{\partial T}{\partial V}\right)_S = \left(\frac{\partial P}{\partial S}\right)_V$ (2) $-\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(3) $-\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (4) $-\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$

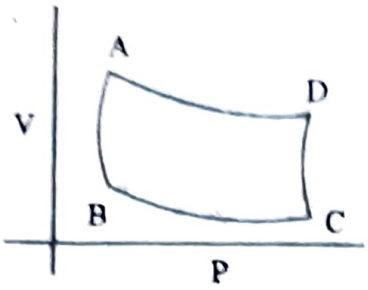
62. When two moles of liquid A are mixed with two moles of liquid B at 300K, the excess molar Gibbs energy of the solution is -1.5 kJ mol^{-1}. The corresponding value of Gibbs energy of mixing (in kJ) is closest to :

(1) -12.9 (2) -6.0 (3) -1.5 (4) -0.9

63. The minimum work required by an engine to transfer 5 J of heat from a reservoir at 100 K to one at 300 K is :

(1) 5 J (2) 10 J (3) 15 J (4) 20 J

64. The figure below describes how a reversible Carnot heat engine works. It starts from the adiabatic compression step denoted by :



(1) AB (2) BC (3) DC (4) AD

65. A thermodynamic equation that relates the chemical potential to the composition of a mixture is known as :

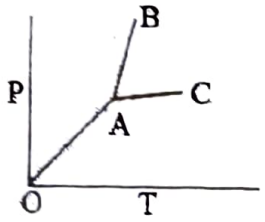
(1) Gibb's-Helmholtz equation (2) Gibb's-Duhem equation

(3) Joule-Thomson equation (4) Debye-Huckel equation

66. The heat capacity of a species is independent of temperature if it is :

(1) Tetratomic (2) Triatomic (3) Diatomic (4) Monatomic

67. The phase diagram of a compound is shown below :



The slopes of the lines OA, AC and AB are $\tan \frac{\pi}{4}$, $\tan \frac{\pi}{6}$ and $\tan \frac{\pi}{3}$ respectively. If melting point and ΔH of melting are 300K and 3 kJ mol^{-1} respectively, the change in the volume on melting is :

(1) $10 \tan \frac{\pi}{3}$ (2) $10 \tan \frac{\pi}{4}$ (3) $10 \cot \frac{\pi}{3}$ (4) $10 \cot \frac{\pi}{4}$

68. The number of phases, components, and degrees of freedom, when Argon is added to an equilibrium mixture of NO, O_2 and NO_2 in the gas phase are, respectively :

(1) 1, 3, 5 (2) 1, 4, 5 (3) 1, 3, 4 (4) 1, 4, 4

69. For a potentiometric titration, in the curve of emf (E) vs volume (V) of the titrant added, the equivalence point is indicated by :

(1) $|dE/dV| = 0 : |d^2E/d^2V| = 0$

(2) $|dE/dV| = 0 : |d^2E/d^2V| > 0$

(3) $|dE/dV| > 0 : |d^2E/d^2V| = 0$

(4) $|dE/dV| > 0 : |d^2E/d^2V| > 0$

70. The Daniel cell is :

(1) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(2) $Pt_I(s)|Zn(s)|Zn^{2+}(aq)||Ag^{2+}(aq)|Ag(s)|Pt_{II}$

(3) $Pt_I(s)|Fe(s)|Fe^{2+}(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

(4) $Pt_I(s)|H_2(s)|H_2SO_4(aq)||Cu^{2+}(aq)|Cu(s)|Pt_{II}$

71. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon ?

(1) Low extinction coefficients (Lambert-Beer law)

(2) Vertical transitions (Kasha's rule)

(3) High ISC rates (El Sayed rule)

(4) The Franck-Condon principle

72. The vapor pressure of pure benzene at a certain temperature is 640 mmHg. A nonvolatile nonelectrolyte solid weighing 2.175 g is added to 39 g of benzene. The vapor pressure of the solution is 600 mmHg. The molecular weight of the solid substance is :

(1) 42.25 (2) 55.55 (3) 65.25 (4) 72.25

73. What is the molal lowering of the vapor pressure of water is [illegible] ?

(1) 17.77 mm (2) 28.28 mm (3) 13.68 mm (4) 24.66 mm

74. Ethylene glycol a major component of permanent antifreeze, effectively depresses the freezing point of water in automobile radiator. What minimum weight of ethylene glycol must be mixed with 6 gallons of water of protect it from freezing at 26°C ?

(Given : 1 Gallon = 3.785 liter and K_f = 1.86)

(1) 22.15 kg (2) 18.15 kg (3) 33.75 kg (4) 62 kg

75. 20.27 g of Benzene containing 0.2965 g of benzoic acid (mol. wt. 122) freezes at 0.137°C below the freezing point of pure benzene. If Benzoic acid exists as a dimer in benzene, find its degree of association. (Given : K_f for Benzene is 5.12°C, m =)

(1) 72.34% (2) 86.84% (3) 96.84% (4) 66.34%

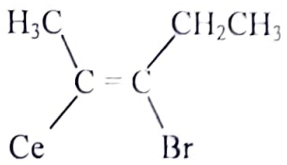
76. The surface tension of water at 21°C is 72.75×10^{-3} N/m. A 33.24% (v/v) solution of ethanol has $\gamma = 33.24 \times 10^{-3}$ N/m at the same temperature. Given : Density of solution $= 0.9614 \times 10^3$ kg/m^3, density of water $= 0.9982 \times 10^3$ kg/m^3 and angle of contact $\theta = 0°$. How much less will the alcohol solution rise in the same capillary ?

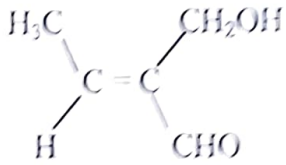
(1) 34.2% (2) 47.4% (3) 54.3% (4) 65.4%

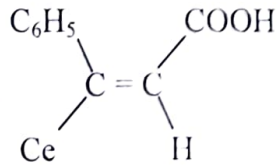
77. Hyperconjugation involves overlap of the following orbitals :

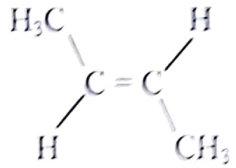
(1) σ-σ (2) σ-ρ (3) ρ-ρ (4) π-π

78. The z-isomer among the following is :

(1) 

(2) 

(3) 

(4) 

79. Out of the following the molecule that exhibits optical isomerism is :

(1) 2-methyl-2-pentene (2) 3-methyl-2-pentene

(3) 3-methyl-1-pentene (4) 4-methyl-1-pentene

80. The stablest radical among the following is :

(1) $CH_3CH_2\dot{C}H_2$ (2) $CH_3\dot{C}HCH_3$

(3) $C_6H_5CH_2\dot{C}H_2$ (4) $C_6H_5\dot{C}H_2CH_3$

81. The quantum number of 20th electron of Fe ($Z = 26$) would be :

(1) 3, 2, –2, – 1/2 (2) 3, 2, 0, 1/2

(3) 4, 0, 0, +1/2 (4) 4, 1, –1, + 1/2

82. The number of orbitals in n = 3 are :

(1) 1 (2) 4 (3) 9 (4) 16

83. Electronegativity of the following elements increases in the order :

(1) O, N, S, P (2) P, S, N, O (3) P, N, S, O (4) S, P, N, O

84. Predict the correct order of repulsion among the following :

(1) lone pair – lone pair > lone pair – bond pair > bond pair – bond pair

(2) lone pair – lone pair > bond pair – bond pair > lone pair – bond pair

(3) bond pair – bond pair > lone pair – bond pair > lone pair –lone pair

(4) lone pair – bond pair > bond pair – bond pair > lone pair – lone pair

85. Pick out the incorrect statement :

(1) sp^3d hybridisation involves $dx^2 - y^2$ orbital

(2) Hybridised orbital form sigma-bond when overlaps with other orbitals.

(3) SF_2 molecule is more polar than CS_2.

(4) o-nitrophenol is more volatile than p-nitrophenol.

D

86. Which of the following order is ***not*** correct ?

(1) $SF_2 > SF_4 > SF_6$ (ionic character)

(2) $AlF_3 < Al_2O_3 < AlN$ (covalent character)

(3) $CaCl_2 < SnCl_2 < CdCl_2$ (covalent character)

(4) $ZnCl_2 < CdCl_2 < HgCl_2$ (ionic character)

87. Which one of the following molecules is expected to exhibit diamagnetic behaviour ?

(1) C_2 (2) N_2 (3) O_2 (4) S_2

88. For which of the following molecule significant $\mu \neq 0$:

(1) 

(2) 

(3) 

(4) 

(1) Only (3) (2) (3) and (4) (3) Only (1) (4) (1) and (2)

89. The geometry with respect to the central atom of the following molecules are $N(SiH_3)_3$, Me_3N, $(SiH_3)_3P$:

(1) planar, pyramidal, planar

(2) planar, pyramidal, pyramidal

(3) pyramidal, pyramidal, pyramidal

(4) pyramidal, planar, pyramidal

90. The IUPAC name of $[Co(NH_3)_5ONO]^{2-}$ ion is :

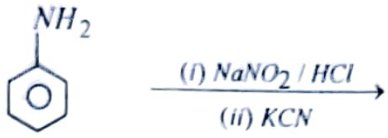
(1) Pentaamminenitritocobalt (IV) ion

(2) Pentaamminenitrocobalt (IV) ion

(3) Pentaamminenitrocobalt (III) ion

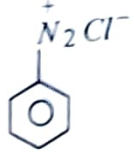
(4) Pentaamminenitritocobalt (III) ion

91. The product of the following reaction is :



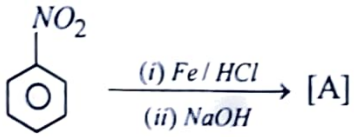
(1) 

(2) 

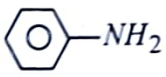
(3) 

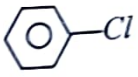
(4) 

92. The product [A] of the following reaction is :



(1) 

(2) 

(3) 

(4) 

93. The most suitable reagent for the conversion of $RCH_2OH \rightarrow RCHO$ is :

(1) CrO_3 / H_2SO_4

(2) $KMnO_4 / KOH$

(3) PCC

(4) $K_2Cr_2O_7 / H_2SO_4$

94. Which of the following combination of aldehydes give cross Cannizzaro reaction ?

(1) CH_3CHO , $HCHO$

(2) C_6H_5CHO, CH_3CHO

(3) C_6H_5CHO, $HCHO$

(4) All of these

95. Which of the following compound used alone will undergo an aldol reaction ?

(1) CH_2O

(2) CH_3COCH_3

(3) $C_6H_5COC_6H_5$

(4) $CH_2=CHCHO$

96. The diasaccharide sucrose is composed of monosaccharides :

(1) D-glucose + D-glucose

(2) D-fructose + D-fructose

(3) D-glucose + D-galactose

(4) D-glucose + D-fructose

97. Which of the following statements about anomers is ***true*** ?

(1) Anomers are diastereoisomers

(2) Anomers are enantiomers

(3) Anomers are constitutional isomer

(4) All of these

98. The reaction of CH_3CH_2MgBr with water yield :

(1) CH_3CH_3

(2) $CH_2=CH_2$

(3) CH_3CH_2OH

(4) $\begin{matrix} CH_2-CH_2 \\ | \quad\quad | \\ OH \quad OH \end{matrix}$

99. Pyrrole is less basic than pyridine because the lone-pair of electrons on N-atom in pyrrole :

(1) reside in sp hybrid orbital

(2) reside in sp^2 hybrid orbital

(3) is not part of the delocalized π molecular orbital

(4) is part of the delocalized π molecular orbital

100. Quinoline undergo nucleophilic substitution on heating with $NaNH_2$ to give :

(1) 6-Aminoquinoline

(2) 2-Aminoquinoline

(3) 3-Aminoquinoline

(4) 4-Aminoquinoline

Answer keys of M.Sc. (Chemistry) entrance exam dated 15.07.2024				
Q. NO.	A	B	C	D
1	3	3	2	1
2	3	2	1	1
3	2	4	2	2
4	1	1	2	1
5	1	4	2	4
6	4	1	4	4
7	1	1	3	4
8	2	3	3	3
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15/07/2024

Answer keys of M.Sc. (Chemistry) entrance exam dated 15.07.2024				
Q. NO.	A	B	C	D
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99	2	2	2	4
100	2	4	2	2

15/07/2024