W-9

BOOKLET CODE **A**

Invigilator's Signature

ENTRANCE EXAMINATION – 2020

M. Sc. Chemistry

TIME: 2 HOURS **MAXIMUM MARKS: 100**

HALL TICKET NUMBER:

INSTRUCTIONS

1. Write your **HALL TICKET NUMBER** and the **BOOKLET CODE** in the space provided above and also on the **OMR** ANSWER SHEET given to you.
2. Make sure that pages numbered from **1 - 21** are present (excluding 3 pages assigned for rough work).
3. There are 100 questions in this paper. All questions carry equal marks.
4. **There is negative marking. Each wrong answer carries – 0.33 mark.**
5. Answers are to be marked on the OMR answer sheet following the instructions provided on it.
6. Handover the OMR answer sheet at the end of the examination.
7. In case of a tie, the marks obtained in the first 25 questions (**PART A**) will be used to determine the order of merit.
8. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.
9. Calculators are allowed. **Cell phones are not allowed**.
10. Useful constants are provided at the beginning, before **PART A** in the question paper.
11. Candidate should write and darken the correct Booklet Code in the OMR Answer Sheet, without which the OMR will not be evaluated. The candidates defaulting in marking the Booklet Code in the OMR shall not have any claim on their examination and University shall not be held responsible.

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Useful Constants:

Rydberg constant = 109737 cm^{-1}; Faraday constant = 96500 C; Planck constant = 6.625×10^{-34} J s; Speed of light = 2.998×10^{8} m s^{-1}; Boltzmann constant = 1.380×10^{-23} J K^{-1}; Gas constant = 8.314 J K^{-1} mol^{-1} = 0.082 L atm K^{-1} mol^{-1} = 1.986 cal K^{-1} mol^{-1}; Mass of electron = 9.109×10^{-31} kg; Mass of proton = 1.672×10^{-27} kg; Charge of electron = 1.6×10^{-19} C; 1 D = 3.336×10^{-30} C m; 1 bar = 10^{5} N m^{-2}; RT/F (at 298.15 K) = 0.0257 V; 1 a.m.u. = 1.66×10^{-27} kg

PART – A

1. If a hydrogen atomic orbital has two radial nodes and is non-zero at the origin, its principal (n) and angular momentum (l) quantum numbers, respectively, are

   [A] 1 and 0 [B] 2 and 1

   [C] 3 and 0 [D] 4 and 1

2. The decomposition of nitrogen pentoxide, $N_2O_5(s) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$, is an endothermic process, but spontaneous. It is driven by a

   [A] positive entropy change [B] negative enthalpy change

   [C] positive free energy change [D] negative entropy change

3. At 25 °C, solid $PbCl_2$ is least soluble in

   [A] 0.1 M $CaCl_2$ [B] 0.1 M NaCl

   [C] 0.1 M KNO_3 [D] 0.1 M HCl

4. The splitting of nuclear spin energy levels in a magnetic field is known as

   [A] Stark effect [B] Mössbauer effect

   [C] Zeeman effect [D] Cotton effect

5. The angle between the Miller planes (110) and (100) in a simple cubic lattice is

   [A] 45° [B] 60°

   [C] 90° [D] 120°

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6. The order of electromagnetic radiation with increasing wavelength is

[A] radio wave < microwave < infrared < ultraviolet

[B] ultraviolet < infrared < radio wave < microwave

[C] ultraviolet < infrared < microwave < radio wave

[D] ultraviolet < microwave < infrared < radio wave

7. With increase in ionic strength of the solution, the rate of a chemical reaction between two cationic reactants

[A] decreases [B] increases

[C] does not change [D] becomes zero

8. An even function among the following is

[A] $\sin(x)$ [B] $\frac{\sin(x)}{x}$

[C] $\exp(x)$ [D] $\frac{\exp(x)}{x}$

9. The equation, $xy = 4$, represents

[A] a pair of straight lines [B] an ellipse

[C] a parabola [D] a hyperbola

10. Among the following, the ***incorrect*** expression for $\cos 2\theta$ is

[A] $2\cos^2\theta - 1$ [B] $1 - 2\sin^2\theta$

[C] $\cos^2\theta - \sin^2\theta$ [D] $2\cos^2\theta + 1$

11. Taylor series expansion for $\ln(1 + x)$ is

[A] $1 + x - 2x^2 + 3x^3 - 3x^4 + \cdots$ [B] $x + x^3 + x^5 + x^7 + \cdots$

[C] $x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots$ [D] $x - \frac{x^2}{2!} + \frac{x^3}{3!} - \frac{x^4}{4!} + \cdots$

12. The smallest ion among K^+, Cl^-, H^-, and Ca^{2+} is

[A] K^+ [B] H^-

[C] Cl^- [D] Ca^{2+}

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13. The expected radius ratios (r^+/r^-) for trigonal planar and tetrahedral coordination in ionic compounds, respectively, are in the range

[A] 0.22–0.41 and 0.41–0.73 [B] 0.15–0.22 and 0.22–0.41

[C] 0.15–0.22 and 0.41–0.73 [D] 0.22–0.41 and 0.41–0.73

14. The complex that obeys the 18-electron rule among the following is

[A] $[Cu(NH_3)_6]^{2+}$ [B] $[PtF_6]^-$

[C] $[TiF_6]^{2-}$ [D] $[Ni(PF_3)_4]$

15. If 2.0 g of pure nickel metal (atomic weight = 58.69) is dissolved in nitric acid and then diluted to 500 mL with water, the normality of the resulting $Ni(NO_3)_2$ solution is

[A] 0.136 [B] 0.273

[C] 0.009 [D] 0.068

16. In the reaction, $IO_3^- + a\Gamma^- + bH^+ \rightarrow cI_2 + dH_2O$, the values of the stoichiometric coefficients '*a*', '*b*', '*c*', and '*d*', respectively, are

[A] 3, 4, 2, and 3 [B] 5, 6, 3, and 3

[C] 4, 5, 2, and 3 [D] 3, 4, 2, and 3

17. The species isoelectronic to oxide (O^{2-}) is

[A] N [B] F

[C] S^{2-} [D] Mg^{2+}

18. Based on VSEPR and stereochemically inactive pair of electrons, the possible structure of $[XeF_8]^{2-}$ is

[A] tricapped trigonal prism [B] pentagonal bipyramidal

[C] square antiprism [D] bicapped octahedron

19. The enzyme involved in the fermentation of glucose to alcohol is

[A] amylase [B] dehydrogenase

[C] lipase [D] zymase

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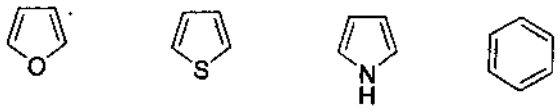
20. Identify the relative reactivities of the following compounds towards aromatic electrophilic reaction



(I) (II) (III) (IV)

[A] (I) < (II) < (III) < (IV)

[B] (I) < (II) < (IV) < (III)

[C] (IV) < (II) < (I) < (III)

[D] (II) < (I) < (III) < (IV)

21. The hybridization of terminal and central carbons of allene, respectively, are

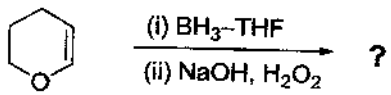
[A] sp and sp^2

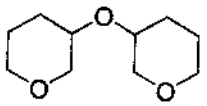
[B] sp^2 and sp

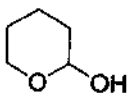
[C] sp^3 and sp

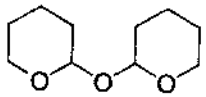
[D] sp and sp^3

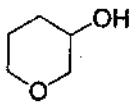
22. The major product formed in the following reaction is



[A] 

[B] 

[C] 

[D] 

23. The most appropriate reagent required for the conversion of cyclohexene to benzene is

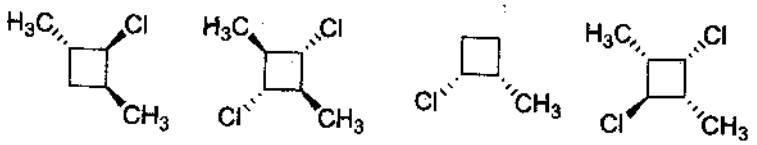
[A] $KMnO_4$

[B] MnO_2

[C] DDQ

[D] CrO_3

24. Identify the optically active compounds among the following



(I) (II) (III) (IV)

[A] (II) and (III)

[B] (I), (II), and (III)

[C] (I), (III), and (IV)

[D] (I) and (III)

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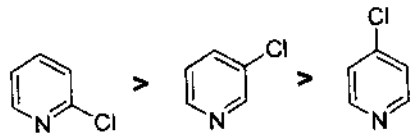
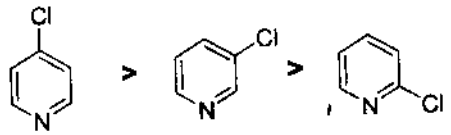
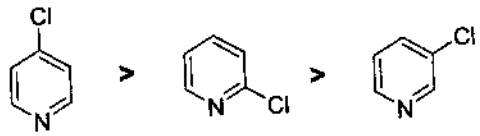
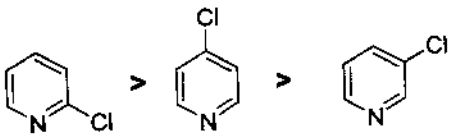
25. Identify the relative reactivities of chloropyridines towards nucleophilic substitution reaction with sodium ethoxide

[A] 

[B] 

[C] 

[D] 

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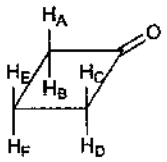
PART - B

26. The topic relations among H_A and H_D, H_E and H_F of cyclobutanone, respectively, are



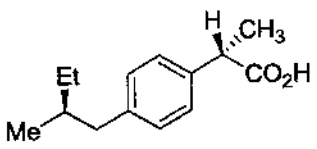
[A] enantiotopic and homotopic

[B] enantiotopic and enantiotopic

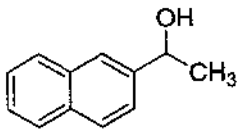
[C] homotopic and enantiotopic

[D] homotopic and homotopic

27. Esterification of acid-I with alcohol-II leads to the formation of a



(S)-acid-I



(±) alcohol-II

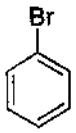
[A] single enantiomer

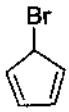
[B] mixture of diastereomers

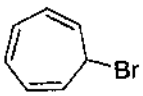
[C] single diastereomer

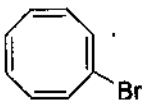
[D] mixture of enantiomers

28. Identify the most water soluble bromo-compound from the following

[A] 

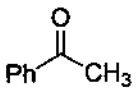
[B] 

[C] 

[D] 

29. The reactions that produce benzoic acid are

(i) $PhBr \xrightarrow[CO_2]{Mg,\ Et_2O}$

(ii)  $\xrightarrow[(b)\ H_2O]{(a)\ Cl_2,\ HCl}$

(iii)  $\xrightarrow[(b)\ H_3O^{\oplus}]{(a)\ KMnO_4,\ HO^{\ominus}}$

(iv) $PhCH_3 \xrightarrow[(b)\ H_3O^{\oplus}]{(a)\ KMnO_4,\ HO^{\ominus}}$

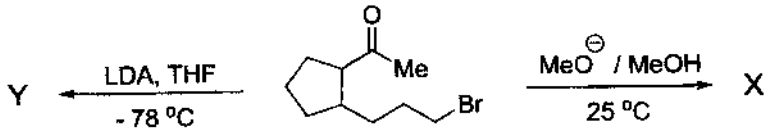
[A] (i), (ii), and (iv)

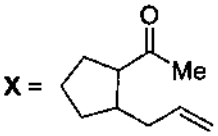
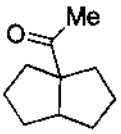
[B] (ii), (iii), and (iv)

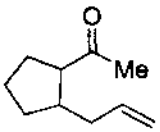
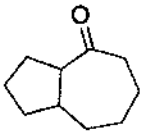
[C] (i), (iii), and (iv)

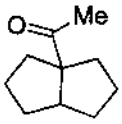
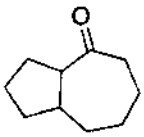
[D] (i) and (iv)

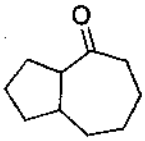
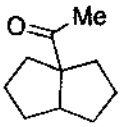
30. Identify the products **X** and **Y** in the following synthetic scheme



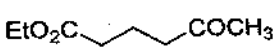
[A] **X** =  **Y** = 

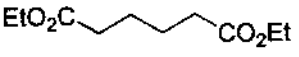
[B] **X** =  **Y** = 

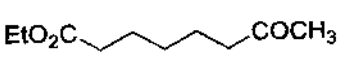
[C] **X** =  **Y** = 

[D] **X** =  **Y** = 

31. The precursor required for obtaining ethyl 2-oxocyclohexanecarboxylate is

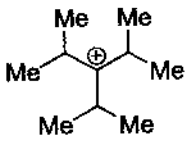
[A] 

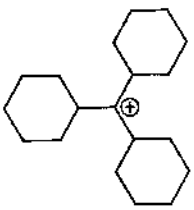
[B] 

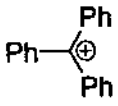
[C] 

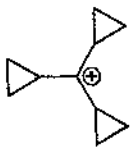
[D] 

32. The carbocation having the longest half-life is

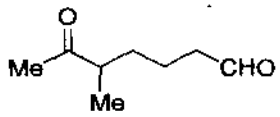
[A] 

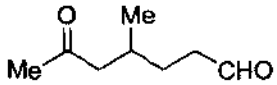
[B] 

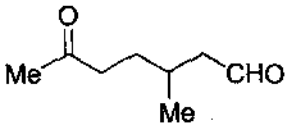
[C] 

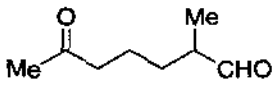
[D] 

33. The major product obtained in the ozonolysis of 1,4-dimethylcyclohexene followed by a reductive workup with Zn and ethanoic acid is

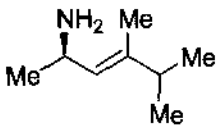
[A] 

[B] 

[C] 

[D] 

34. The IUPAC name of the following compound is



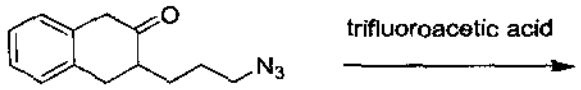
[A] (*R*,*E*)-4,5-dimethylhex-3-en-2-amine

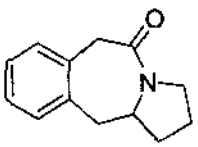
[B] (*S*,*E*)-4,5-dimethylhex-3-en-2-amine

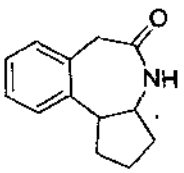
[C] (*R*,*E*)-4-methyl,4-isopropyl-3-en-2-amine

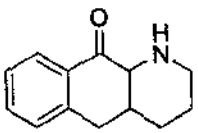
[D] (*S*,*E*)-2,3-dimethylhex-3-en-5-amine

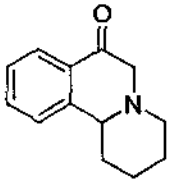
35. The major product formed in the following transformation is



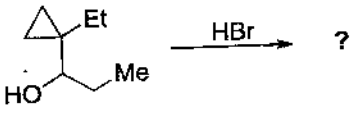
[A] 

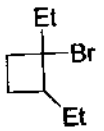
[B] 

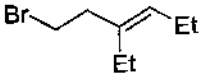
[C] 

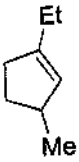
[D] 

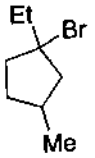
36. Predict the major product in the following transformation



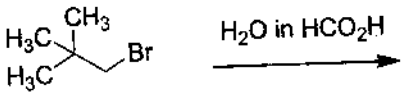
[A] 

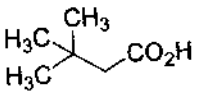
[B] 

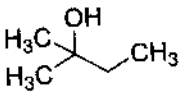
[C] 

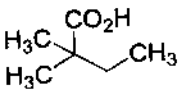
[D] 

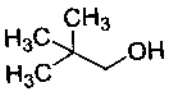
37. Identify the major product in the following reaction



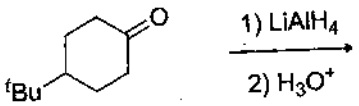
[A] 

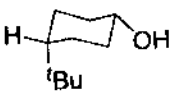
[B] 

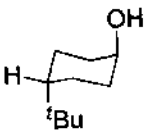
[C] 

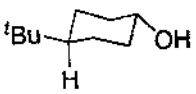
[D] 

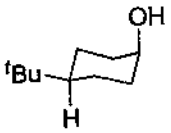
38. The most stable conformation of the major product formed in the following reaction is



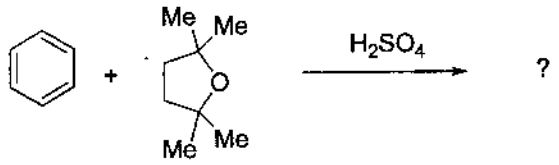
[A] 

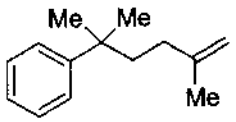
[B] 

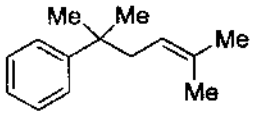
[C] 

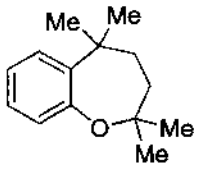
[D] 

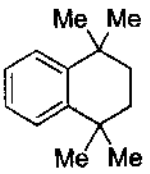
39. Identify the major product in the following transformation



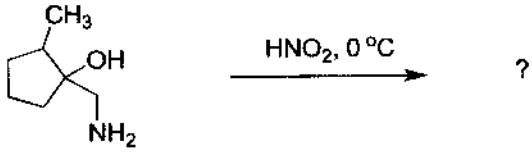
[A] 

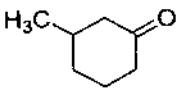
[B] 

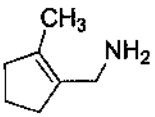
[C] 

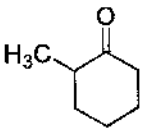
[D] 

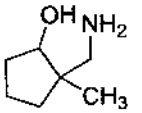
40. Identify the major product in the following reaction



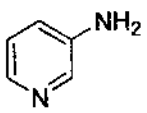
[A] 

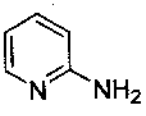
[B] 

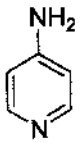
[C] 

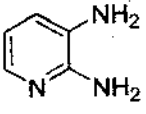
[D] 

41. The major product formed in the Chichibabin reaction of pyridine is

[A] 

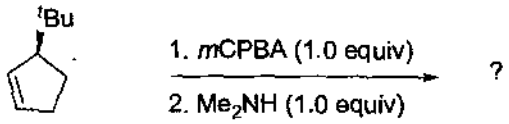
[B] 

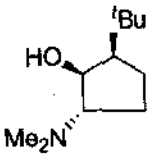
[C] 

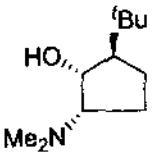
[D] 

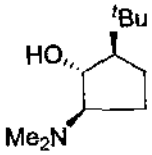
W-9

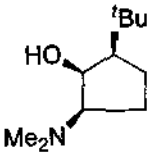
42. The major product formed in the following transformation is



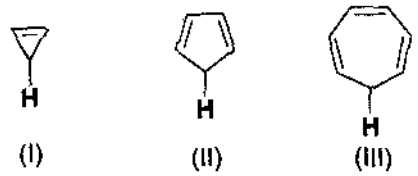
[A] 

[B] 

[C] 

[D] 

43. Arrange the following compounds in the increasing order of pK_a value of the highlighted "**H**"



(I) (II) (III)

[A] (I) < (II) < (III)

[B] (I) < (III) < (II)

[C] (III) < (II) < (I)

[D] (II) < (III) < (I)

44. The $[\alpha]_D^{20}$ of a 90% optically pure (*R*)-2-arylpropanoic acid solution is +135°. On treatment with a base at 20 °C for one hour, $[\alpha]_D^{20}$ changed to +120°. The optical purity of the resulting (*R*)-isomer is

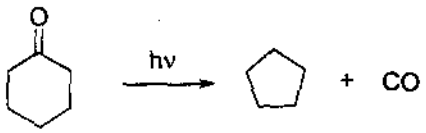
[A] 80%

[B] 70%

[C] 20%

[D] 30%

45. Identify the name of the following reaction



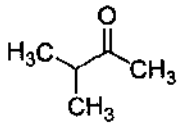
[A] Norrish type-I

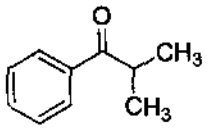
[B] Norrish type-II

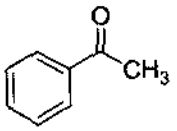
[C] Paterno-Buchi

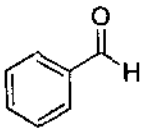
[D] Barton reaction

46. Identify the compound that produces a red/orange colored product when treated with 2,4-dintrophenylhydrazine. The compound does not react with the Schiff's reagent and results negative iodoform test.

[A] 

[B] 

[C] 

[D] 

47. Which of the following compounds will have its absorption maximum at the longest wavelength?

[A] 1,2,5-hexatriene
[B] 1,5-hexadiyne
[C] 1,3-hexadiyne
[D] 1,3,5-hexatriene

48. The ^1H NMR spectrum of H_3C-O-CHCl-CH_2Cl will exhibit

[A] a three-proton doublet, a one-proton singlet, and a two-proton doublet
[B] a three-proton singlet, a one-proton singlet, and a two-proton doublet
[C] a three-proton singlet, a one-proton triplet, and a two-proton doublet
[D] a three-proton triplet, a one-proton triplet, and a two-proton triplet

49. The hormone insulin is a

[A] terpenoid
[B] carbohydrate
[C] steroid
[D] peptide

50. A bacterial cell does not contain

[A] ribosome
[B] DNA
[C] lipid membrane
[D] nucleus

51. Among the following, the electron rich molecular hydride is

[A] CsH
[B] PH_3
[C] B_4H_{10}
[D] SiH_4

52. The value of 'n' for the cyclic ion $[Si_6O_{18}]^{n-}$ is

[A] 6 [B] 10

[C] 12 [D] 8

53. Among the following, the reagents for separation of Group-IV metal ions are

[A] NH_4OH and NH_4Cl [B] HCl and H_2S

[C] NH_4OH, NH_4Cl, and H_2S [D] NH_4OH, NH_4Cl, and $(NH_4)_2CO_3$

54. Among the following thallium compounds, the most stable one above 40 °C is

[A] TlCl [B] $TlCl_3$

[C] $TlCl_2$ [D] Tl_2Cl_6

55. Reaction of AlF_3 with an excess of F^- gives

[A] AlF_4^- [B] AlF_5^{2-}

[C] Al_2F_6 [D] AlF_6^{3-}

56. The total number of tetrahedral voids in the face-centred cubic unit cell is

[A] 6 [B] 8

[C] 4 [D] 12

57. Chlorine in a sample of weight 1.03 g was precipitated as AgCl and the weight of the precipitate was 0.500 g. The percentage of chlorine in the sample is (atomic weight of Cl = 35.45, Ag = 107.87)

[A] 32.86 [B] 12

[C] 48.5 [D] 0.12

58. Match the following

(i)	NMR spectroscopy	p	Electronic transition
(ii)	EPR spectroscopy	q	Vibration of molecules
(iii)	IR Spectroscopy	r	Radio frequency waves
(iv)	UV-Visible spectroscopy	s	Microwave radiation

[A] (i) & q; (ii) & r; (iii) & s; (iv) & p [B] (i) & r; (ii) & s; (iii) & p; (iv) & q

[C] (i) & p; (ii) & r; (iii) & q; (iv) & s [D] (i) & r; (ii) & s; (iii) & q; (iv) & p

59. Among the following, the compound with highest melting point is

[A] AlF_3 [B] SiF_4

[C] PF_5 [D] SF_6

60. The product obtained by the reaction of Me_3As and XeF_2 is

[A] Me_3AsF_2 [B] $(CH_2F)_3XeF_2$

[C] $(CF_3)_3AsXeF_2$ [D] $MeAsF_4$

61. Keeping the mass number unchanged, the nuclear decay process that results in the decrease of atomic number by one unit is

[A] alpha decay [B] gamma decay

[C] beta decay [D] positron emission

62. The number of geometrical and optical isomers of the complexes, $[Co(ethylenediamine)_2Cl_2]^+$ **(I)** and $[Cr(gly)_3]$ **(II)**, respectively, are (gly is $H_2NCH_2COO^-$)

[A] **I:** 2 and 3
II: 2 and 4

[B] **I:** 2 and 2
II: 2 and 4

[C] **I:** 1 and 2
II: 2 and 3

[D] **I:** 2 and 4
II: 2 and 2

63. The metal **M** that cannot form a stable compound with formula $[(\eta^5\text{-}C_5H_5)\mathbf{M}(CO)_4]$ is

[A] Mo [B] Ta

[C] V [D] Nb

64. The protein responsible for O_2 transport in lobsters and crabs is

[A] hemoglobin [B] myoglobin

[C] hemoerthyrin [D] hemocyanin

65. The vitamin that contains metal-carbon bond is

[A] vitamin-A [B] vitamin-B

[C] vitamin-C [D] vitamin-D

66. The hybridizations of Ni in paramagnetic $[NiCl_4]^{2-}$ and diamagnetic $[Ni(CN)_4]^{2-}$, respectively, are

[A] sp^3 and sp^3 [B] dsp^2 and dsp^2

[C] dsp^2 and sp^3 [D] sp^3 and dsp^2

67. Among the following, the d^n configuration not susceptible to Jahn-Teller distortion is

[A] d^2 [B] d^4 (high spin)

[C] d^8 [D] d^6 (high spin)

68. The atomic radii of La, Ce, Eu, and Gd follow the order

[A] Gd < Eu < Ce < La [B] La < Ce < Eu < Gd

[C] Gd < Ce < Eu < La [D] Gd < Ce < La < Eu

69. The inverse of the matrix $\begin{pmatrix} 0 & i \\ -i & 0 \end{pmatrix}$ is

[A] $\begin{pmatrix} 0 & i \\ i & 0 \end{pmatrix}$ [B] $\begin{pmatrix} 0 & i \\ -i & 0 \end{pmatrix}$

[C] $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ [D] $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

70. Value of the determinant of the matrix $\begin{pmatrix} 7 & 2 & 3 \\ 0 & 0 & 6 \\ 0 & 4 & 5 \end{pmatrix}$ is

[A] 0 [B] 24

[C] -168 [D] -42

71. The number of real solutions of the two equations, $x^2 + y^2 = 1$ and $y - x^2 = 0$, is

[A] 0 [B] 1

[C] 2 [D] 3

72. The derivative of the function $(e^{2x} - 1)/(e^{2x} + 1)$ at $x = 0$ is

[A] -1 [B] 0

[C] 2 [D] 1

73. The general solution to the differential equation, $x\frac{dy}{dx} = 2y$, is (c is the constant of integration)

[A] cx [B] $c + x$

[C] $cx^2/2$ [D] $c + x^2/2$

74. The equation of the straight line that is perpendicular to $y = x + 2$, and passing through the origin is

[A] $x + y = 0$ [B] $x + y - 2 = 0$

[C] $x + y + 2 = 0$ [D] $x - y = 0$

75. The complex number that results in a pure imaginary quotient when divided by its own complex conjugate is

[A] $1 + i/2$ [B] $1 + i$

[C] $1 + 2i$ [D] $1 + i\pi$

76. The value of $\lim_{x\to\infty} \sqrt{(x + \sin x)/(x - \cos x)}$ is

[A] 1 [B] 0

[C] -1 [D] ∞

77. $\int e^{x \log a} e^x \, dx =$

[A] $\frac{a^x e^x}{\log a}$ [B] $\frac{e^x}{1 + \log a}$

[C] $(ae)^x$ [D] $\frac{(ae)^x}{\log(ae)}$

78. The solution for the set of equations, $2x - 3y + 4z = 8$, $y - 3z = -7$, and $x + 2y + 2z = 11$, is

[A] $x = 1, y = 2, z = 3$ [B] $x = 3, y = 2, z = 1$

[C] $x = 0, y = 1, z = 2$ [D] $x = 2, y = 1, z = 0$

79. A triangle has sides of length a, b and c and the angles opposite to these sides are A, B, and C, respectively. The correct relation among the following is

[A] $c^2 = a^2 + b^2 - 2ab\cos C$ [B] $c^2 = a^2 - b^2 + 2ab\cos C$

[C] $c^2 = a^2 + b^2 - 2ab\sin C$ [D] $c^2 = a^2 + b^2 - 2ab\cos A\cos B$

80. A coin is tossed 6 times. The probability of getting heads exactly 3 times is

[A] 3/16 [B] 5/16

[C] 1/8 [D] 1/2

81. The root mean square velocity of hydrogen molecule at any given temperature is

[A] 8 times that of oxygen molecule [B] 4 times that of oxygen molecule

[C] 16 times that of oxygen molecule [D] none of the above

82. The term symbol for the ground state of phosphorus is

[A] $^4S_{3/2}$ [B] $^1S_0$

[C] $^4P_{3/2}$ [D] $^1P_0$

83. The solid-liquid boundary in the temperature-pressure phase diagram of water has a negative slope. For melting of ice, the change in enthalpy and volume are

[A] both positive [B] negative and positive, respectively

[C] both negative [D] positive and negative, respectively

84. The enthalpy change in the reaction, $N_2 + 3H_2 \rightarrow 2NH_3$, is −150 kJ at 300 K. Assuming that the gases behave ideally, the corresponding change in internal energy in kJ is

[A] −145 [B] −147

[C] 145 [D] 147

85. The enthalpy of vaporization of benzene at its normal boiling point, 80 °C, is 31 kJ mol^{-1}. The associated entropy (in J K^{-1} mol^{-1}) and internal energy (in kJ mol^{-1}) changes, respectively, are

[A] 88, 28 [B] 388, 28

[C] 88, 34 [D] 388, 34

86. At 298 K, the maximum work (in kJ) derived from the expansion of 1.0 mol of an ideal gas from 100 atm to 1 atm is

[A] 286 [B] 11.4

[C] −286 [D] −143

87. The standard free energy of formation, $\Delta_f G^\circ$, of N_2O_4 (g) and NO_2 (g) are 97.9 kJ mol^{-1} and 51.3 kJ mol^{-1}, respectively. The equilibrium constant for N_2O_4 (g) $\leftrightharpoons$ $2NO_2$ (g) at 300 K is

[A] 6.67 [B] 0.8

[C] 0.15 [D] 0.01

88. The efficiency (in %) of a Carnot engine working between 0 °C and 100 °C is

[A] 12.3 [B] 26.8

[C] 33.3 [D] 45.3

89. The pH of a solution made by mixing 30 mL of 0.1 M HCl and 40 mL of 0.1 M aqueous KOH is

[A] 9.85 [B] 10.15

[C] 12.15 [D] 13.15

90. A 0.1 M solution of a substance taken in a cell of 1.0 cm path length shows an absorbance of 0.45 at 520 nm. The extinction coefficient in cm^2 mol^{-1} is

[A] 45000 [B] 5200

[C] 52000 [D] 4500

91. The dissociative adsorption of a gas (A_2) on a solid surface follows the Langmuir adsorption isotherm. A plot of $1/\theta$ vs $1/\sqrt{P}$ is linear with slope equal to (θ: fractional surface coverage, P: gas pressure at equilibrium, K: equilibrium constant)

[A] K [B] $1/K$

[C] $\sqrt{K}$ [D] $1/\sqrt{K}$

92. The overall rate constant (k) for a three-step chemical reaction is $k_1\sqrt{k_2/k_3}$. The activation energies (in kJ mol^{-1}) corresponding to the three elementary reaction steps are 74, 192, and 10, respectively. The overall activation energy for the reaction is approximately equal to (in kJ mol^{-1})

[A] 276 [B] 175

[C] 165 [D] 128

93. Using the pre-equilibrium approximation, the predicted rate law for the following multistep reaction (k_{eff}: effective rate constant) is

$$A_2 \rightleftharpoons 2A \text{ (fast)}$$
$$A + B \rightarrow P \text{ (slow)}$$

[A] $k_{eff}[A_2][B]$ [B] $k_{eff}[A_2]\sqrt{[B]}$

[C] $k_{eff}\sqrt{[A_2]}[B]$ [D] $k_{eff}[A_2]^2[B]$

94. The slope and X-intercept of the Lineweaver-Burk plot ($1/V$ vs $1/[S]$) of enzyme kinetics are, respectively (V: reaction rate, $[S]$: concentration of substrate, V_{max}: maximum rate, and K_M: Michaelis constant)

[A] $\frac{K_M}{V_{max}}$ and $\frac{1}{V_{max}}$ [B] $\frac{K_M}{V_{max}}$ and $\frac{-1}{K_M}$

[C] $\frac{V_{max}}{K_M}$ and $\frac{1}{K_M}$ [D] $\frac{V_{max}}{K_M}$ and $\frac{-1}{V_{max}}$

95. At 25 °C, the difference in pressure (in Pa), across the surface of a spherical ethanol droplet having radius 220 nm is closest to (the surface tension of ethanol at 25 °C is 22 mN m^{-1})

[A] 2×10^3 [B] 4×10^5

[C] 2×10^5 [D] 3×10^4

96. The ionisation energy of the hydrogen atom is 13.6 eV when the electron is in the 1s orbital. The ionisation energy (in eV) for the electron in the 2p orbital is

[A] 3.4 [B] 6.8

[C] 10.2 [D] 13.6

97. A metal surface is irradiated with light of frequency 2.0×10^{15} Hz. The work-function of the metal is 6 eV. The potential (in V) required to stop the fastest electron ejected from the surface is closest to

[A] 2.28 [B] 4.28

[C] 5.28 [D] 6.28

98. The $^{12}C^{16}O$ molecule strongly absorbs at 6.43×10^{13} Hz. The force constant (in N m^{-1}) of the CO bond is

[A] 1855.6 [B] 1899.6

[C] 1680.6 [D] 1955.6

99. The resistance of 0.1 M KCl solution in a cell is 300 Ω and specific conductance is 1.5 S m^{-1}. If the resistance of 0.05 M NaCl in the same cell is 750 Ω, then the molar conductance (S m^2 mol^{-1}) of NaCl is

[A] 0.032 [B] 0.045

[C] 0.012 [D] 0.055

100. An electrochemical cell involves the cell reaction, $Cd + 2AgCl \rightarrow 2Ag + CdCl_2$. If $E_{cell} = 0.675$ V and $dE_{cell}/dT = -6.5 \times 10^{-4}$ V K^{-1} at 25 °C, then ΔH (in kJ mol^{-1}) for the cell reaction is closest to

[A] −143 [B] −168

[C] −198 [D] −268

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