BOOKLET CODE | A |

ENTRANCE EXAMINATION – 2015
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 - 18** are present (excluding 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. Hand over 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}; 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} Cm; 1 bar = 10^{5} N m^{-2}; RT/F (at 298.15 K) = 0.0257 V.

PART - A

1. The hybrid orbitals of the underlined atoms that form σ bonds in $\underline{Be}Cl_2$ (vapor), $\underline{C}_2F_4$ and H$\underline{C}$N are respectively:

   [A] sp^2, sp^2 and sp
   [B] sp, sp^2 and sp
   [C] sp^2, sp^3 and sp^2
   [D] sp, sp^3 and sp^2

2. Identify the species with the lowest bond order among the following.

   [A] C_2
   [B] NO
   [C] Cl_2^+
   [D] O_2^+

3. Identify the most appropriate reaction for one carbon homologation.

   [A] Schmidt reaction
   [B] Arndt-Eistert reaction
   [C] Aldol reaction
   [D] Sandmeyer reaction

4. Identify the most appropriate reaction involving HN_3 as the reagent.

   [A] Curtius reaction
   [B] Schmidt reaction
   [C] Hoffman degradation
   [D] Favorskii rearrangement

5. Identify the most appropriate reaction which employs formaldehyde as the key substrate.

   [A] Grignard reaction
   [B] Prins reaction
   [C] Michael reaction
   [D] Friedel-Crafts reaction

6. $e^{x^2/2}\left(\frac{d^2}{dx^2}e^{-x^2/2}\right) =$

   [A] 1
   [B] x^2
   [C] $x^2 - 1$
   [D] $\frac{x^2}{1-x^2}$

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7. If CO_2 is cooled at 1 atm pressure, it changes directly into solid CO_2 (dry ice). Based on this observation, we can say that liquid CO_2:

[A] cannot exist
[B] forms only at low pressure
[C] can form only at high pressure
[D] forms only on slow cooling

8. Given the enthalpy changes:

Cl_2 (g) ⇌ 2Cl (g)	57.9 kcal/mol
I_2 (g) ⇌ 2I (g)	36.1 kcal/mol
ICl (g) ⇌ I (g) + Cl (g)	50.5 kcal/mol
I_2 (s) ⇌ I_2 (g)	15.0 kcal/mol

and that the standard states for iodine and chlorine are I_2(s) and Cl_2(g) at 298 K, the standard heat of formation of ICl(g) at 298 K is:

[A] 58.5 kcal/mol
[B] 4.0 kcal/mol
[C] – 3.5 kcal/mol
[D] – 4.0 kcal/mol

9. The smallest interval in which the function $y = \frac{x^2+3}{x^2+2}$ remains bounded is:

[A] $(0, 1)$
[B] $(1.0, 1.5)$
[C] $(2, 3)$
[D] $(-1.5, 1.5)$

10. The number of points at which the two curves $x^2 - y^2 = 0$ and $x^2 - y^2 = 1$ intersect is:
[A] 0
[B] 1
[C] 2
[D] 4

11. The numbers of σ and π bonds present in the C_3O_2 are, respectively:

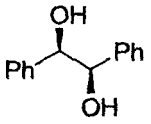
[A] four and four
[B] four and two
[C] three and four
[D] four and three

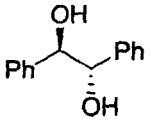
12. Given the numbers, $A = 2.0$, $B = 0.0$ and $C = 1 + \sqrt{3}i$, the angle $\angle CBA$ in the complex plane (in radians) is:

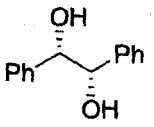
[A] 0
[B] $\frac{\pi}{3}$
[C] $\frac{\pi}{4}$
[D] $\frac{\pi}{2}$

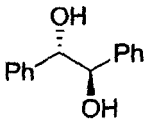
H-10

13. Identify (1*R*, 2*R*)-1,2-diphenylethane-1,2-diol.

[A] 

[B] 

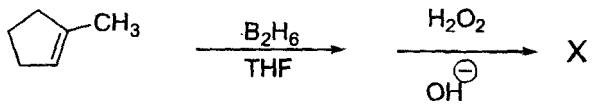
[C] 

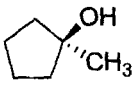
[D] 

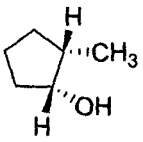
14. $\int_{999}^{1000} \frac{dx}{x^2-1}$ is close to

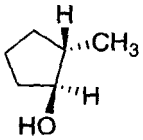
[A] – 1.0
[B] 0
[C] 1.0
[D] ∞

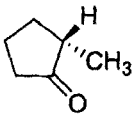
15. Identify the product X in the following reaction sequence.



[A] 

[B] 

[C] 

[D] 

16. In the X-ray diffraction pattern of an *fcc* crystal, the peak due to the (111) plane occurs at $2\theta = 24°$. The peak due to the (222) plane will be observed at $2\theta =$

[A] 12.0°
[B] 28.2°
[C] 48.0°
[D] 49.2°

17. Value of the determinant $\begin{vmatrix} 1 & 1 & 2 \\ 5 & 2 & 1 \\ 3 & 2 & 3 \end{vmatrix}$ is:

[A] 0
[B] 6
[C] 12
[D] 24

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18. Suppose the coldest reservoir we have at hand is at 10 °C. If we want a heat engine that is at least 90% efficient, the minimum temperature required for the hot reservoir is:

[A] 1800 K
[B] 2880 K
[C] 2800 K
[D] 2830 K

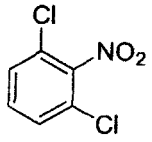
19. Identify the diamagnetic complex among the following.

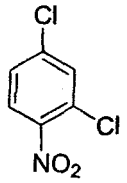
[A] $[Cr(CN)_6]^{3-}$
[B] $[Co(NH_3)_6]^{2+}$
[C] $[Ni(CN)_4]^{2-}$
[D] $[CoF_6]^{3-}$

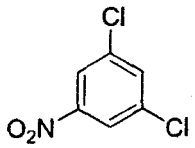
20. The bond angle in the BF_2^- ion is closest to:

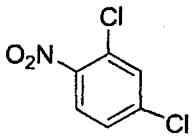
[A] 90°
[B] 100°
[C] 120°
[D] 180°

21. The major isomer obtained in the nitration of 1,3-dicholorobenzene is:

[A] 

[B] 

[C] 

[D] 

22. The ionic strength of a solution that is 0.1 mol/kg in NaCl and 0.2 mol/kg in $CaCl_2$ (assuming complete dissociation) is:

[A] 0.90 mol/kg
[B] 0.70 mol/kg
[C] 1.40 mol/kg
[D] 0.35 mol/kg

23. The osmotic pressure at 25 °C of an aqueous solution of sucrose with a molar concentration of 0.2 mol/L is:

[A] 4.89 atm
[B] 4.30 atm
[C] 4.10 atm
[D] 3.89 atm

A-10

24. What is the concentration of H_3O^+ in a solution at 25°C that has pOH = 5.64?

[A] 2.29×10^{-4}
[B] 2.34×10^{-4}
[C] 4.10×10^{-9}
[D] 4.37×10^{-9}

25. Which one of the following is associated with bacterial cells?

[A] Ribosomes
[B] Lysosomes
[C] Chloroplasts
[D] Nucleus

PART - B

26. Among the following complexes which one does not obey the 18-electron rule?

[A] $[Cr(CO)_6]$
[B] $[V(CO)_6]$
[C] $[Ni(CO)_4]$
[D] $[Fe(CO)_4]^{2-}$

27. The number of unpaired *d* electrons in the coordination complex anion $[CoF_6]^{3-}$ is:

[A] zero
[B] three
[C] five
[D] four

28. The active site of the metalloenzyme, nitrogenase has:

[A] Cu–Zn
[B] V–Ni
[C] Mo–Fe
[D] Co–Zn

29. The paramagnetic species among the following is:

[A] Cu^{+} ion
[B] singlet oxygen
[C] Mo^{6+} ion
[D] triplet oxygen

30. Which of the following statements regarding superacids is incorrect?

[A] Superacids are much stronger than concentrated H_2SO_4
[B] Superacids are aqueous acids
[C] Superacids are non-aqueous acids
[D] Fluorosulfonic acid is a superacid

31. The ion that does not show color in a flame test is:

[A] Ca^{2+}
[B] Cd^{2+}
[C] Zn^{2+}
[D] Pb^{2+}

32. Oxygen has a positive oxidation state in:

[A] O_2F_2
[B] Na_2O_2
[C] Cl_2O_2
[D] H_2O_2

33. Which of the following interhalogen compounds does not exist?

[A] ClF_3
[B] FCl_3
[C] IF_5
[D] BrF_3

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34. The two complexes, $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$ are:

[A] linkage isomers
[B] coordination isomers
[C] optical isomers
[D] polymerization isomers

35. Based on Wade's rules of electron counting, structure of carborane, CB_8H_{14}, is expected to be

[A] closo
[B] nido
[C] arachno
[D] galacto

36. Phenyllithium reacts 10^4 times faster than methyllithium in nucleophilic addition reaction because:

[A] phenyllithium is monomeric in THF solution
[B] phenyllithium exists as a tetramer in solution
[C] phenyllithium exists as a hexamer in solution
[D] methyllithium exists as a hexamer in solution

37. XeF_6 cannot be handled in a quartz vessel, because it reacts with SiO_2 forming:

[A] $XeOF_4$
[B] XeF_4
[C] XeF_2
[D] XeO_4

38. To which class of the following spinels does Fe_3O_4 belong?

[A] normal
[B] inverse
[C] extended
[D] netted

39. Which of the following is responsible for the diphenylamine test in DNA?

[A] nucleobase
[B] 2-deoxy-ribose
[C] D-ribose
[D] adenine

40. The number of S_n axis/axes in tetrahedral SiF_4 is:

[A] one
[B] two
[C] three
[D] four

41. The product in the reaction $[Co(H_2O)_6]^{2+} + xCl^- \rightarrow ? + yH_2O$ is

[A] $[CoCl_6]^{4-}$
[B] $[CoCl_4]^{2-}$
[C] $2CoCl_2$
[D] $[Co(H_2O)_4Cl_2]$

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42. Concentrated hydrochloric acid (molecular weight of HCl = 36.5 g) has a density of 1.19 g/ml and contains 37% HCl by weight. How many millilitres of the concentrated acid should be diluted to 1.00 liter with water to prepare a 0.100 M solution?

[A] 8.3 mL
[B] 3.65 mL
[C] 42.9 mL
[D] 43.4 mL

43. Metallic potassium on treatment with liquid NH_3 in the presence of catalytic amount of Fe_2O_3 provides:

[A] KNH_2
[B] Solvated e^-
[C] KOH
[D] KO_2

44. The second nuclide formed in the following fission reaction is:

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{103}_{42}Mo + 2^{1}_{0}n + ?$$

[A] $^{131}_{51}Sb$
[B] $^{131}_{52}Te$
[C] $^{131}_{49}In$
[D] $^{131}_{50}Sn$

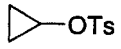
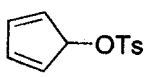
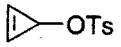
45. In common-ion effect, if a salt MX is added to an aqueous solution containing the solute MY (M is common to both salts), presence of the dissolved M^{n+} ions:

[A] assists the dissolution of MX compared with that in pure water
[B] does not affect the dissolution of MX compared with that in pure water
[C] suppresses the dissolution of MX compared with that in pure water
[D] will increase the solubility products of MX and MY

46. A molecule which can generate a nucleophile upon treatment with *n*-BuLi is:

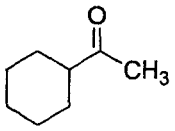
[A] 
[B] 
[C] 
[D] 

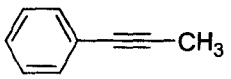
47. Among the following, the compound that undergoes the fastest S_N1 reaction is:

[A] 
[B] 
[C] 
[D] CH_3CH_2-OTs

H-10

48. Among the following, the compound having the most acidic proton is:

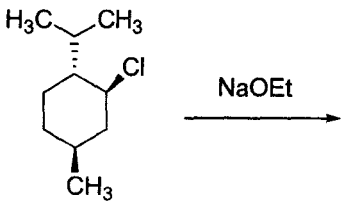
[A] 

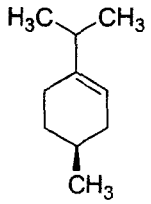
[B] 

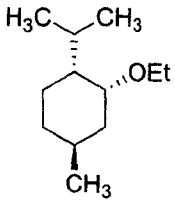
[C] CH_3NO_2

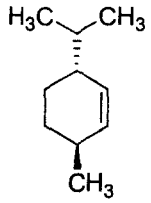
[D] CH_3CN

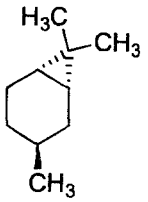
49. The product obtained in the following transformation is:



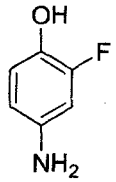
[A] 

[B] 

[C] 

[D] 

50. IUPAC name of the following compound is:



[A] 4-amino-2-fluorohydroxybenzene

[B] 3-fluoro-4-hydroxyaminobenzene

[C] 2-fluoro-4-aminohydroxybenzene

[D] 2-hydroxy-5-aminofluorobenzene

51. Which of the following will not exist in the enol form at all, in $CHCl_3$ solution?

[A] $C_6H_5COCH_2COCH_3$

[B] $CH_3COCH_2COCH_3$

[C] $C_6H_5COC(CH_3)_3$

[D] $CH_3COCH_2CO_2C_2H_5$

52. The reagent used for the qualitative test of carbonyl group is:

[A] NH_2OH [B] NH_2NH_2
[C] $NaHSO_3$ [D] $2,4\text{-}(NO_2)_2C_6H_3NHNH_2$

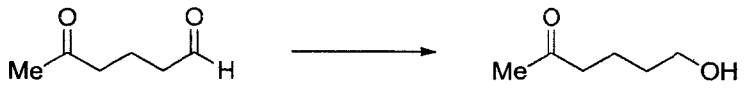
53. The process of conversion of a mixture of carbon monoxide and hydrogen into liquid hydrocarbons is known as:

[A] Ziegler synthesis [B] Frankland synthesis
[C] Fischer-Tropsch synthesis [D] Corey-House synthesis

54. Natural silk is a polymer derived from:

[A] amino acids [B] nucleosides
[C] nucleotides [D] adipic acid

55. The appropriate reducing agent for the following transformation is:

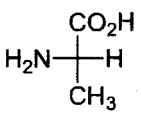


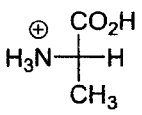
[A] $LiAlH_4$ [B] $NaBH_4$
[C] $Na[BH(OCOCH_3)_3]$ [D] $LiAlH(O^tBu)_3$

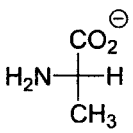
56. Which of the following reagents cannot be used for the halogenation of primary alcohol?

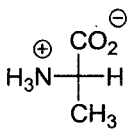
[A] $SOCl_2$ [B] PCl_5
[C] PBr_3 [D] NaI

57. Among the following, the form of alanine at pH = 2 is:

[A] 

[B] 

[C] 

[D] 

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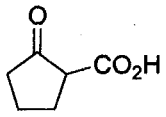
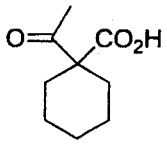
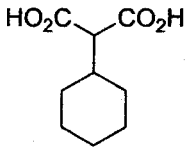
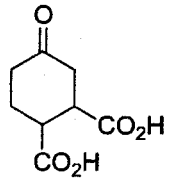
58. The compound which does not undergo decarboxylation upon heating is:

[A] 

[B] 

[C] 

[D] 

59. C–H stretching vibration occurs at 2800 cm^{-1}. The corresponding C–D vibration will occur at:

[A] 3900-4200 cm^{-1}
[B] 2800-3000 cm^{-1}
[C] 3100-3200 cm^{-1}
[D] 1900-2100 cm^{-1}

60. The appropriate substrate for obtaining benzyne is:

[A] nitrobenzene
[B] 1,2-dibromobenzene
[C] benzoyl chloride
[D] 2-aminobenzoic acid

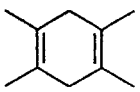
61. DDT is an example of:

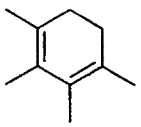
[A] fungicide
[B] herbicide
[C] insecticide
[D] analgesic

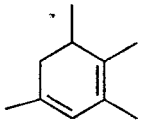
62. Identify the most appropriate reaction from the following, which converts benzaldehyde to benzyl alcohol and benzoic acid.

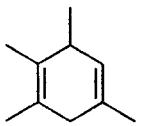
[A] Cannizzaro reaction
[B] Reimer-Tiemann reaction
[C] Perkin reaction
[D] Curtius reaction

63. The compound X ($C_{10}H_{16}$) reacts with two moles of H_2 on catalytic hydrogenation. X gives two diketones Y ($C_6H_{10}O_2$) and Z ($C_4H_6O_2$) on ozonolysis. The structure of X is:

[A] 

[B] 

[C] 

[D] 

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64. The molar enthalpy change of freezing of water is 6.01 kJ/mol. Value of the Cryoscopic constant for water is:

[A] 1.20 K kg/mol
[B] 1.35 K kg/mol
[C] 1.86 K kg/mol
[D] 2.20 K kg/mol

65. On a pressure-temperature phase diagram, the conditions under which a one-component system exists as two phases in equilibrium corresponds to:

[A] a point
[B] a line
[C] an area
[D] the entire diagram

66. State which of the following statements is true for an ideal solution.

[A] The solution and solvent both obey Raoult's law.
[B] The solute obeys Raoult's law and the solvent obeys Henry's law.
[C] The solute obeys Henry's law and the solvent obeys Raoult's law.
[D] The solution and solvent both obey Henry's law.

67. The number of nearest neighbors for an atom in a hexagonal close-packed crystal is:

[A] 6
[B] 12
[C] 18
[D] 24

68. The number of normal modes of vibration in the benzene molecule is:

[A] 6
[B] 30
[C] 12
[D] 36

69. If the equilibrium constant for the reaction A $\rightleftharpoons$ B is 0.5 at a certain temperature, and the initial concentrations of A and B are 20 and 10 mM, respectively, state which of the following statements is true.

[A] The reaction is endothermic.
[B] The reaction will proceed in the reverse direction producing a net increase in the concentration of A if a catalyst is added to the reaction mixture.
[C] The rates of forward and reverse reactions are equal.
[D] The reaction is bimolecular.

70. Which of the following is the condition for $\Delta H^\circ = T\Delta S^\circ$ of a chemical equilibrium?

[A] $\Delta G_P = 0$
[B] $\Delta C_P = \Delta C_V$
[C] $K_{eq} = 0$
[D] $K_{eq} = 1$

71. The amount of $KMnO_4$ required to oxidize 5.0 g of $FeSO_4$ (molecular weights of $KMnO_4$ and $FeSO_4$ are, 158 g and 152 g respectively) is close to:

[A] 1 g
[B] 5 g
[C] 0.5 g
[D] 10 g

72 If the half-life of a reaction doubles as the initial concentration of the reactant is doubled, the order of the reaction is:

[A] Zeroth order
[B] First order
[C] Second order
[D] Pseudo first order

73. Which of the following can be added to maintain the pH of an aqueous solution when CO_2 is dissolved in it?

[A] NH_4Cl
[B] $NaHCO_3$
[C] NaH_2PO_4
[D] CH_3COOH

74. Solutions of the following compounds with the same molality are prepared. The solution of which of the following has the lowest freezing point?

[A] KBr
[B] $Al(NO_3)_3$
[C] $NaNO_2$
[D] $MgCl_2$

75. For which set of $\Delta H°$ and $\Delta S°$ will the reaction be spontaneous only at high temperatures?

[A] $\Delta H° = +70$ kJ; $\Delta S° = +30$ J/K
[B] $\Delta H° = +70$ kJ; $\Delta S° = -30$ J/K
[C] $\Delta H° = -70$ kJ; $\Delta S° = -30$ J/K
[D] $\Delta H° = 0$ kJ; $\Delta S° = -30$ J/K

76. Given the half-cell potentials shown below, the standard cell potential of the cell with spontaneous electrochemical reaction is:

$Hg^{2+} + 2e^- \rightarrow Hg \quad E° = 0.85$ V
$Zn^{2+} + 2e^- \rightarrow Zn \quad E° = -0.76$ V

[A] 0.09 V
[B] 1.61 V
[C] 0.80 V
[D] 0.18 V

77. Given $\Lambda°_m(HCl) = 420$, $\Lambda°_m(NaCl) = 126$, $\Lambda°_m(NaAc) = 91$ S cm^2 mol^{-1}, the equivalent conductance (S cm^2 eqv^{-1}) at infinite dilution of acetic acid (HAc) is:

[A] 385
[B] 637
[C] 455
[D] 203

78. The Miller indices of the face having intercept ($\frac{1}{2}a$, 2b, ∞c; where a, b, c are the unit cell axes) is:

[A] (410)
[B] (220)
[C] (210)
[D] (012)

79. Aqueous solution of a compound with concentration 10^{-3} M, taken in a cell with path length 1 cm, absorbs 10% of the incident light. What concentration will be required to absorb 90% of the light?

[A] 0.022 M
[B] 0.044 M
[C] 0.011M
[D] 0.001 M

80. Given the following reaction at equilibrium at temperature, T:

$$N_2(s) + 3H_2(g) \rightleftharpoons 2NH_3$$

the relationship between K_c and K_p is:

[A] $K_c = K_p(RT)^2$
[B] $K_c = K_pRT$
[C] $K_p = K_cRT^3$
[D] $K_c = K_p(RT)^{-2}$

81. The vapor pressure of water at 20 °C is 17.5 Torr. The vapor pressure of an aqueous solution prepared by dissolving 36.0 g of glucose ($C_6H_{12}O_6$) in 14.4 g of water would be close to

[A] 14.0 Torr
[B] 3.5 Torr
[C] 25.9 Torr
[D] 17.5 Torr

82. For a hypothetical reaction; A + B + C → Products, the rate law is determined to be

$$\text{rate} = k[A][B]^2$$

If the concentration of B is doubled without changing the concentration of A and C, the reaction rate:

[A] doubles.
[B] increases by a factor of four.
[C] increases by a factor of six.
[D] decreases by a factor of eight.

83. Which of the following is not found in prokaryotic cells?

[A] Cell membrane
[B] Membrane bound nucleus
[C] Cytoplasm
[D] Cell wall

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84. The phase of the cell cycle in which the DNA replication takes place is:

[A] M Phase
[B] S phase
[C] G_0 place
[D] G_1 phase

85. The nitrogenous base that is present in DNA but not in RNA is:

[A] Adenine
[B] Guanine
[C] Thymine
[D] Uracil

86. A major difference between plant and animal cells is:

[A] animal cells have mitochondria
[B] plant cells have Golgi complexes
[C] animal cells have endoplasmic reticulam
[D] plant cells have a large vacuole

87. Given that $\frac{dx}{dt} = 2 - x$, with $x(t = 0) = 2$, x at $t = 10$ is:

[A] 0
[B] $2 \ln 10$
[C] $2e^{-10}$
[D] $2e^{10}$

88. Consider a loaded coin that has a probability of 1/3 for the heads and 2/3 for the tails. The number of times the tail is likely to come up when the coin is tossed thirty times is:

[A] 0
[B] 10
[C] 20
[D] 30

89. The sum of the first N odd integers is:

[A] N^2
[B] $\frac{N(N+1)}{4}$
[C] $\frac{N(N-1)}{4}$
[D] $\frac{N^3-N^2}{42}$

90. The integral that is finite among the following is:

[A] $\int_{-\infty}^{\infty} e^{x}\, dx$
[B] $\int_{-\infty}^{\infty} e^{-x}\, dx$
[C] $\int_{-\infty}^{\infty} e^{-x^2}\, dx$
[D] $\int_{-\infty}^{\infty} e^{+x^2}\, dx$

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91. Inverse of the matrix $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ is:

[A] $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ [B] $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$

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

92. The function that is continuous and has a continuous first derivative over the real axis is:

[A] e^{-x} [B] $e^{-|x|}$

[C] $\ln\left(\frac{e^x - e^{-x}}{e^x + e^{-x}}\right)$ [D] $\ln(e^x - e^{-x})$

93. The function with exactly one minimum and one maximum is:

[A] $x^2 e^{-x}$ [B] $x^2 e^{-x^2}$

[C] $x^2 e^{x^2}$ [D] $x^2 \sin x$

94. Ratio of the areas of a circle and the largest square that can be inscribed in it is:

[A] $\sqrt{\frac{3}{2}}$ [B] $\frac{\pi}{2}$

[C] $\sqrt{2}$ [D] $\frac{\pi}{3}$

95. The equation of a straight line that passes through the origin and is perpendicular to the line $y = x + 1$ is:

[A] $y = x - 1$ [B] $y = -x + 1$

[C] $y = -x$ [D] $y = x$

96. The interior angle (the angle between two adjacent sides) in a regular octagon is:

[A] 120° [B] 135°

[C] 144° [D] 150°

97. A vector perpendicular to the two vectors, $(\hat{\imath} + \hat{\jmath} + \hat{k})$ and $(2\hat{\imath} - \hat{\jmath} + 2\hat{k})$ is:

[A] $\hat{\imath} + \hat{k}$ [B] $\hat{\imath} - \hat{k}$

[C] $\hat{\imath} + \hat{\jmath} - \hat{k}$ [D] $(-2\hat{\imath} + \hat{\jmath} - 2\hat{k})$

98. A solution to the equation $\frac{dy}{dx} + 2axy = 0$ is:

[A] $y = e^{-ax^2}$
[B] $y = e^{ax}$
[C] $y = ax^2 + b$
[D] $y = \ln x^2$

99. If a cube and a sphere have the same surface area, ratio of the volume of the cube to the volume of the sphere is:

[A] $\sqrt{\frac{\pi}{6}}$
[B] $\sqrt{\frac{3\pi}{4}}$
[C] $\frac{4}{3\pi}$
[D] $\sqrt{\frac{3}{8\pi}}$

100. Select the correct statement of the cosine rule

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

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