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1. When ammonium chloride is added to ammonium hydroxide solution, the dissociation of ammonium hydroxide is suppressed due to
(a) hydrolysis
(b) oxidation
(c) reduction
(d) increase in dielectric constant
(e) common ion effect

2. The pKₐ of a weak acid HA and pKₐ of a weak base BOH are 4.60 and 4.80 respectively. The pH of 0.1 M solution of the salt, BA, formed from the acid HA and base BOH is
(a) 7.10  (b) 9.40
(c) 6.90  (d) 0.20
(e) 4.80

3. In which one of the following equilibria will the point of equilibrium shift to left when the pressure of the system is increased?
(a) H₂(g) + I₂(g) ⇌ 2HI(g)
(b) 2NH₃(g) ⇌ N₂(g) + 3H₂(g)
(c) C(s) + O₂(g) ⇌ CO₂(g)
(d) 2H₂(g) + O₂(g) ⇌ 2H₂O(g)
(e) 2H₂(g) + O₂(g) ⇌ H₂O(l)

4. The experimental and calculated elevation in boiling points of an electrolyte AB in its aqueous solution at a given concentration are 0.81 K and 0.54 K respectively. The percentage ionization of the electrolyte at this concentration is
(a) 20  (b) 40
(c) 50  (d) 60
(e) 80

5. Which one of the following binary liquid mixtures exhibits negative deviation from Raoult's law?
(a) n-hexane-n-heptane
(b) Chloroform-acetone
(c) Carbondisulphide-acetone
(d) Bromoethane-chloroethene
(e) Benzene-toluene

6. An electrolyte (AB) is 100 % ionized in 10 % aqueous solution. What is the osmotic pressure (L-atm.) of a 10 % solution of the electrolyte at 300 K if molecular weight of AB is 200 g mol⁻¹?
(R = 0.082 L atm K⁻¹ mol⁻¹)
(a) 200  (b) 100
(c) 246  (d) 24.6
(e) 2.46

7. In the electrolysis of aqueous solution of copper sulphate using copper strips as anode and cathode, the anode reaction is
(a) Cu²⁺ + 2e⁻ → Cu
(b) Cu → Cu²⁺ + 2e⁻
(c) 2HO⁻ → H₂ + ½O₂ + 2e⁻
(d) SO₄²⁻ → SO₄⁻ + 2e⁻
(e) 2HSO₄⁻ → H₂S₂O₈ + 2e⁻

8. 0.001 mole of strong electrolyte Zn(OH)₂ is present in 200 mL of an aqueous solution. The pH of this solution is
(a) 2  (b) 4
(c) 12  (d) 10
(e) 7

9. If the standard potential for Daniel cell is 1.1 V, then the potential of the cell when [Zn²⁺] = 1.0M and [Cu²⁺] = 0.1 M at 298 K is (2.303RT/F value at 298 K = 0.06 V)
(a) 1.1295 V  (b) 0.100 V
(c) 1.07 V  (d) 0.76 V
(e) 1.1 V

10. The t₁/₂ for a zero order reaction at the initial concentration of 6 × 10⁻³ M is one minute at 27°C. The rate constant at 27°C in mol dm⁻³ s⁻¹ is
(a) 3 × 10⁻⁴  (b) 6 × 10⁻⁴
(c) 5 × 10⁻⁵  (d) 5 × 10⁻⁴
(e) 3 × 10⁻⁵

11. The inversion of cane sugar is first order in [sugar] and proceeds with half-life of 600 minutes at pH = 4 for a given concentration of sugar. However, if pH = 5, the half-life changes to 60 minutes. The rate law expression for the sugar inversion can be written as
(a) rate = k[sugar]¹[H⁺]²
(b) rate = k[sugar]¹[H⁺]¹
(c) rate = k[sugar]¹[H⁺]⁴
(d) rate = k[sugar]¹[H⁺]⁰
(e) rate = k[sugar]¹[H⁺]¹

12. In an attempt to compare the half-lives of two radioactive elements A and B, a scientist set aside 400 g of each. After 3 months, the scientist found 25 g of A and 200 g of B. Which one of the following statements is true?
(a) Half-life of B is twice that of A
(b) Half-life of B is four times that of A
(c) Half-life of A is twice that of B
(d) Half-life of A is four times that of B
(e) Half-life of B is eight times that of A

13. When molten magnesium oxide was electrolysed for a certain period, 150 mg of Mg was deposited on the cathode. The volume of oxygen gas in cm³ at STP conditions at the anode during the same period is (atomic mass of Mg = 24 g mol⁻¹)
(a) 140  (b) 280
(c) 70  (d) 120
(e) 240
14. Which one of the following is not explained by adsorption?
   (a) When acetic acid solution is shaken with charcoal the concentration of the acid decreases
   (b) The white precipitate of Mg(OH)₂ attains blue colour when precipitated in the presence of magneson reagent
   (c) The air becomes dry in the presence of silica gel
   (d) An aqueous solution of NaOH attains pink colour with a drop of phenolphthalein
   (e) When animal charcoal is shaken with coloured methylene blue solution, the solution turns colourless

15. The hybridization of central metal ion in K₂[Ni(CN)₄] and K₂[NiCl₄] are respectively
   (a) dsp², sp³  (b) sp³, sp³
   (c) dsp², dsp²  (d) sp³, sp³d²
   (e) sp³d², d²sp³

16. Which of the following compounds show optical isomerism?
   (i) cis-[Co(NH₃)₂Cl₂]+  (ii) trans-[Co(en)$_2$Cl₂]$^+$
   (iii) cis-[Co(en)$_3$]$_2$³⁺  (iv) [Co(en)$_3$]³⁺
   Choose the correct answer codes given below
   (a) i and ii  (b) ii and iii  (c) iii and iv  (d) i, iii and iv
   (e) i, ii, iii and iv

17. Camphor can be purified by
   (a) distillation  (b) vacuum distillation
   (c) sublimation  (d) steam distillation
   (e) fractional crystallization

18. Tropolone is an example of
   (a) benzenoid aromatic compound
   (b) non-benzenoid aromatic compound
   (c) alicyclic compound
   (d) acyclic compound
   (e) heterocyclic aromatic compound

19. Both sp² and sp³ hybrid orbitals are involved in the formation of
   (a) CH₃–CH–C=CH–H  (b) CH₃–CH₂–CH₂–CH₃
   (c) CH₃–CH=CH–C≡N  (d) CH₂=CH₂
   (e) CH₂=CH–CO–CH₃

20. Arrange the following molecules in the correct order of decreasing C–C bond length:
   
   \[
   \begin{align*}
   &C_2H_6, C_2H_4, C_2H_2, C_6H_6 \\
   &C_2H_6 > C_6H_6 > C_2H_4 > C_2H_2
   \end{align*}
   \]
   (a) C₂H₆ > C₆H₆ > C₂H₄ > C₂H₂
   (b) C₂H₆ > C₂H₄ > C₆H₆ > C₂H₂
   (c) C₂H₄ > C₂H₂ > C₆H₆ > C₂H₂
   (d) C₂H₂ > C₆H₆ > C₂H₄ > C₂H₄
   (e) C₆H₆ > C₂H₂ > C₂H₄ > C₂H₂

21. Williamson’s synthesis of preparing dimethyl ether is a/an
   (a) electrophilic substitution
   (b) Sₙ₁ reaction
   (c) electrophilic addition
   (d) Sₙ₂ reaction
   (e) free radical substitution

22. The effect that makes 2,3-dimethyl-2-butene more stable than 2-butene is
   (a) resonance  (b) hyperconjugation
   (c) electromeric effect  (d) inductive effect
   (e) steric effect

23. In which of the following compounds only primary carbon atoms are present?
   (a) CH₃–CH–CH₂–CH₃
   (b) CH₃–CH–CH₃
   (c) CH₃–C–CH₃
   (d) CH₂–CH₂–CH₃
   (e) CH₃–CH₃

24. The organic compound with two asymmetric carbon atoms is
   (a) 3,4-dimethylheptane
   (b) 3-methyl-1-pentene
   (c) 2-chloropentane
   (d) 5-ethyl-2,3-dimethylheptane
   (e) 3-chlorohexane

25. Geometrical isomerism is not possible in
   (a) 2,4-hexadiene
   (b) benzaldehyde
   (c) but-2-ene
   (d) 1,2-dichloroethene
   (e) benzophenone oxime

26. The correct IUPAC name of the organic compound
   \[
   \begin{align*}
   &CH₃–CH–CH–CH–CH₂–OH \\
   &\text{Cl} \quad \text{CH₃} \\
   &\text{Cl} \quad \text{CH₃}
   \end{align*}
   \]
   (a) 4-chloro-2,3-dimethylpentan-1-ol
   (b) 2-chloro-3,4-dimethylpentan-5-ol
   (c) 2,3-dimethyl-4-chloropentan-1-ol
   (d) 2-chloro-3,4-dimethyl n-pentyl alcohol
   (e) 2,3-dimethyl-4-chloro n-pentyl alcohol

27. Carbylation test is not answered by
   (a) C₆H₅NH₂
   (b) (CH₃)$_3$C–CH₂–NH₂
   (c) C₆H₅CH₂NH₂
   (d) (CH₃)$_3$N
   (e) CH₃NH₂

28. Which of the following represents Wurtz-Fittig reaction?
   (a) C₆H₅I + 2Na + CH₃I → C₆H₅CH₃ + 2 NaI
   (b) 2C₆H₅I + 2Na → C₆H₅C₆H₅ + 2 NaI
   (c) 2CH₂CH₂I + 2Na → CH₃CH₂CH₂CH₃ + 2 NaI
   (d) C₂H₅ONa + C₂H₅I → C₂H₅O–C₂H₅ + NaI
   (e) CH₃Br + AgF → CH₃F + AgBr
29. Which of the following organic halogen compounds undergoes hydrolysis with aqueous NaOH predominantly by SN1 mechanism?
(a) ethyl iodide  (b) methyl chloride  (c) isopropyl chloride  (d) chlorobenzene  (e) benzyl chloride

30. The major product formed when 2-bromo-2-methyl butane is refluxed with ethanolic KOH is
(a) 2-methylbut-2-ene  (b) 2-methylbutan-1-ol  (c) 3-methylbutan-2-ol  (d) 2-methylbutan-2-ol  (e) 2-methylbut-l-ene

31. In which of the following reactions new carbon-carbon bond is not formed?
(a) Cannizzaro reaction  (b) Wurtz reaction  (c) Aldol condensation  (d) Friedel-Craft reaction  (e) Kolbe's reaction

32. Which one of the following phenols has the highest pK\textsubscript{a} value?
(a) o-Nitrophenol  (b) Phenol  (c) m-Nitrophenol  (d) Picric acid  (e) p-Cresol

33. The reagent that is used to distinguish between secondary amine and tertiary amine is
(a) p-toluenesulphonyl chloride  (b) Lucas reagent  (c) CHCl\textsubscript{3} and alc. KOH  (d) Borsche's reagent  (e) Bromine water

34. Which one of the following isomeric amines has the highest boiling point?
(a) CH\textsubscript{3}–CH\textsubscript{2}–CH\textsubscript{2}–NH–CH\textsubscript{3}  (b) CH\textsubscript{3}–CH\textsubscript{2}–NH–CH\textsubscript{2}–CH\textsubscript{2}  (c) (CH\textsubscript{3})\textsubscript{2}N–CH\textsubscript{2}–CH\textsubscript{2}  (d) CH\textsubscript{3}–CH\textsubscript{2}–CH\textsubscript{2}–CH\textsubscript{2}–NH\textsubscript{2}  (e) (CH\textsubscript{3})\textsubscript{2}CH–NH–CH\textsubscript{3}

35. Which one of the following reagent will convert acetamide to ethanamine?
(a) Phosphorus pentoxide  (b) Lithium aluminium hydride  (c) Potassium cyanide  (d) Thionyl chloride  (e) Bromine and sodium hydroxide

36. Match the following

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Acetaldehyde and Vinylalcohol  (b) Eclipsed and staggered ethane  (c) (+)-2-Butanol and (-)-2-Butanol  (d) Methyl-n-propylamine and Diethylamine  (e) Phosphorus pentoxide</td>
<td>(i) Enantiomers  (ii) Tautomers  (iii) Chain isomers  (iv) Conformational isomers and Metamers  (v) 45, 46</td>
</tr>
</tbody>
</table>

37. Which one of the following is an example for biodegradable polyester?
(a) PHBV  (b) PET  (c) Nylon 6  (d) Bakelite  (e) Glyptal

38. Which one of the following is an essential amino acid?
(a) Methionine  (b) Tyrosine  (c) Proline  (d) Glycine  (e) Alanine

39. The one letter code for the amino acid tryptophan is
(a) G  (b) V  (c) W  (d) H  (e) A

40. Cheilosis and digestive disorders are due to the deficiency of
(a) Vitamin A  (b) Thiamine  (c) Riboflavin  (d) Ascorbic acid  (e) Pyridoxine

41. Which one of the following is a bacteriostatic drug?
(a) Aminoglycosides  (b) Penicillin-G  (c) Ofloxacin  (d) Ampicillin  (e) Tetracycline

42. Freon-12 is manufactured from tetrachloromethane by
(a) Haloform reaction  (b) Reimer-Tiemann reaction  (c) Wurtz reaction  (d) Swartz reaction  (e) Gattermann reaction

43. The ratio of de Broglie wavelengths of a deuterium atom to that of an alpha particle, with the velocity of the former is five time greater than that of the latter, is
(a) 4  (b) 0.2  (c) 2  (d) 0.4  (e) 5

44. The maximum number of electrons which can be held by sub shell with azimuthal quantum number \( l \) in an atom is given by
(a) \((2l+1)\)  (b) \((2l+2)\)  (c) \( 2(2l+1)\)  (d) \( 2(2l+2)\)  (e) \( 2l \)

45. Which one of the following data has only four significant figures?
(a) 6.023 \times 10^{23}  (b) 285 cm  (c) 0.0025 L  (d) 0.200 g  (e) 1.0 \times 10^{5} mm

46. The uncertainty in the velocity of a particle of mass 6.626 \times 10^{-31} kg is 1 \times 10^{-6} m/s\(^{-1}\). What is the uncertainty in its position (in nm)? (\( h = 6.626 \times 10^{-34} \text{ Js} \))
(a) \((1/2\pi)\)  (b) \((2.5/\pi)\)  (c) \((4/\pi)\)  (d) \((1/4\pi)\)  (e) \((5/\pi)\)
47. The bond orders for \( O_2^+ \) and \( C_2 \) respectively are
(a) 2.5, 2  (b) 3, 2
(c) 2, 2.5  (d) 2, 3
(e) 3, 3

48. The percentage of s-character in the hybridised orbitals of BF\(_3\) is
(a) 25  (b) 50
(c) 75  (d) 33.3
(e) 21.5

49. Which one of the following has the lowest dipole moment?
(a) CH\(_3\)F  (b) CH\(_3\)Cl
(c) CH\(_2\)I  (d) CHCl\(_3\)
(e) CH\(_3\)Br

50. The number of bond pair and lone pair of electrons respectively in NH\(_3\) molecule are
(a) 4 and 0  (b) 3 and 0
(c) 3 and 1  (d) 2 and 2
(e) 5 and 0

51. The partial pressure of nitrogen in air is 0.76 atm. and its Henry's law constant is \( 7.6 \times 10^4 \) atm at 300 K. What is the mole fraction of N\(_2\) in the solution obtained when air is bubbled through water at 300 K?
(a) \( 1 \times 10^{-4} \)  (b) \( 2 \times 10^{-4} \)
(c) \( 1 \times 10^{-5} \)  (d) \( 2 \times 10^{-5} \)
(e) \( 1 \times 10^{-6} \)

52. The type of attractive forces that operate between gaseous HCl and chlorine molecule is
(a) dipole-dipole forces  (b) London forces
(c) induced dipole-induced dipole forces  (d) dipole-induced dipole forces
(e) electrostatic forces

53. Which one of the following statements is incorrect?
(a) Glass is an extremely viscous liquid  (b) Viscosity coefficient of a liquid decreases with increase in temperature
(c) Laminar flow represents regular gradation of velocity in passing from one layer to another in liquids  (d) Liquids rise in capillary due to surface tension  (e) Gases can be liquefied at any temperature by applying sufficient pressure

54. The number of tetrahedral and octahedral voids in a \( ccp \) array of 100 atoms are respectively
(a) 200 and 100  (b) 100 and 200
(c) 200 and 200  (d) 100 and 100
(e) 50 and 50

55. Which of the following pairs contain metalloid elements in the periodic table?
(a) Na and K  (b) F and Cl
(c) Ca and Mg  (d) As and Si
(e) Cu and Ag

56. The atom/ion that has the highest number of unpaired electrons is
(a) Na\(^+\)  (b) F
(c) N  (d) O\(^-2\)
(e) B

57. The inorganic compound obtained by the auto-oxidation of 2-alkylanthaquinol is
(a) H\(_2\)O  (b) H\(_2\)O\(_2\)
(c) H\(_2\)  (d) O\(_2\)
(e) H\(_2\)SO\(_4\)

58. The least stable carbonate of alkali metals is
(a) Cs\(_2\)CO\(_3\)  (b) Na\(_2\)CO\(_3\)
(c) K\(_2\)CO\(_3\)  (d) Rb\(_2\)CO\(_3\)
(e) Li\(_2\)CO\(_3\)

59. Sphalerite is concentrated by
(a) gravity separation  (b) froth floatation
(c) magnetic separation  (d) hydraulic washing
(e) leaching

60. The following set of reactions are used in refining zirconium.
\[ \text{Zr (impure)} + 2\text{I}_2 \xrightarrow{523K} \text{ZrI}_4 \xrightarrow{1800K} \text{Zr (pure)} + 2\text{I}_2 \]
This method is known as
(a) Distillation  (b) Liquation
(c) Hall-Heroult method  (d) Van Arkel method
(e) Mond's process

61. Which one of the following is used as a piezoelectric material?
(a) Silicones  (b) Graphite
(c) Silica gel  (d) Kieselghur
(e) Quartz

62. The gaseous product formed when HOCl reacts with H\(_2\)O\(_2\) in acidic medium is
(a) H\(_2\)  (b) Cl\(_2\)
(c) O\(_2\)  (d) HClO\(_2\)
(e) HClO\(_3\)

63. Three centre two electron bond is present in
(a) NH\(_3\)  (b) B\(_2\)H\(_6\)
(c) BCl\(_3\)  (d) AlCl\(_3\)
(e) BF\(_3\)

64. Which one of the following is used for the production of UF\(_6\) in the enrichment of U\(^{235}\)?
(a) ClF\(_3\)  (b) KF
(c) KHF\(_2\)  (d) HF
(e) PF\(_3\)

65. Zeigler-Natta catalyst is
(a) ZnCl\(_2\)  (b) Et\(_2\)Al + TiCl\(_4\)
(c) Cu/ZnO-Cr\(_2\)O\(_3\)  (d) Pt
(e) V\(_2\)O\(_5\)

66. Among the 3\(d\) series of transition metals the one that has positive M\(^{2+}/M\) standard electrode potential is
(a) Cr  (b) Mn
(c) Zn  (d) Ni
(e) Cu

67. Which one of the following transition metal ions is colourless in aqueous solution?
(a) Ti\(^{4+}\)  (b) V\(^{4+}\)
(c) Mn\(^{2+}\)  (d) Fe\(^{3+}\)
(e) Ni\(^{2+}\)
68. The magnetic moment of Ni$^{2+}$ ion (At. No. of Ni. is 28) in BM unit is
(a) 1.73 (b) 4.81
(c) 5.96 (d) 2.84
(e) 3.86

69. The enthalpy of formation of CH$_4$(g), H$_2$O(l) and CO$_2$(g) are respectively –74.8 mol$^{-1}$, 285.8 kJ mol$^{-1}$, and –393.5 kJ mol$^{-1}$. Then, the standard enthalpy of combustion of CH$_4$(g) is
(a) +8903 kJ mol$^{-1}$ (b) –604.5 kJ mol$^{-1}$
(c) –754.1 kJ mol$^{-1}$ (d) +6045 kJ mol$^{-1}$
(e) –890.3 kJ mol$^{-1}$

70. In the following reaction, 4NO$_2$(g) + O$_2$(g) $\rightarrow$ 2N$_2$O$_5$(g); $\Delta H = –110$ kJ. If N$_2$O$_5$(s) is formed instead of N$_2$O$_5$(g) in the reaction, the enthalpy change (in kJ) would be (enthalpy of sublimation of N$_2$O$_5$(s) is +53 kJ mol$^{-1}$)
(a) –216 (b) –162
(c) +103 (d) +216
(e) +162

71. For the reaction 2A$_3$ $\rightarrow$ 3A$_2$ the equilibrium constant and the $\Delta G^\circ$ values at a certain temperature are respectively $1 \times 10^{30}$ and –172.4 kJ mol$^{-1}$. The equilibrium temperature in °C is about (2.303 R = 19.15 JK$^{-1}$ mol$^{-1}$)
(a) 300 (b) 27
(c) 273 (d) 298
(e) 270

72. The equilibrium constant (K$_C$) for the reaction N$_2$(g) + O$_2$(g) $\rightarrow$ 2NO(g) at 800 K is 0.0625. What is the K$_C$ value for the following reaction at 800 K?
NO(g) $\rightarrow$ 1/2 N$_2$(g) + 1/2 O$_2$(g)
(a) 0.4 (b) 0.375
(c) 4 (d) 40
(e) 0.20

73. A toroid having carries a current of 1 A. The average radius of the toroid is 10 cm. The magnetic field at any point in the open space inside the toroid is
(a) $4 \times 10^{-3}$T (b) zero
(c) $0.5 \times 10^{-3}$T (d) $3 \times 10^{-3}$T
(e) $2 \times 10^{-3}$T

74. Transformer is used to
(a) convert ac to dc voltage
(b) convert dc to ac voltage
(c) obtain desired dc power
(d) obtain desired ac voltage and current
(e) obtain desired dc voltage and current

75. If an LCR series circuit is connected to an ac source, then at resonance the voltage across
(a) R is zero
(b) R equals the applied voltage
(c) C is zero
(d) L equals the applied voltage
(e) L is zero

76. A dynamo converts
(a) mechanical energy into thermal energy
(b) electrical energy into thermal energy
(c) thermal energy into electrical energy
(d) mechanical energy into electrical energy
(e) electrical energy into mechanical energy

77. The electromagnetic waves detected using a thermopile and used in physical therapy are
(a) gamma radiations
(b) X-rays
(c) ultra-violet radiations
(d) infra-red radiations
(e) micro-wave radiations

78. Two lenses of power 15 and –3 dioptre are placed in contact. The focal length of the combination is
(a) 10 cm (b) 15 cm
(c) 12 cm (d) 18 cm
(e) 8.33 cm

79. The speed of light in an isotropic medium depends on
(a) the nature of the source
(b) its wavelength
(c) its direction of propagation
(d) its intensity

80. Astigmatism is corrected using
(a) cylindrical lens
(b) plano-convex lens
(c) plano-concave lens
(d) convex lens
(e) concave lens

81. If the wavelength of incident light falling on a photosensitive material decreases, then
(a) photoelectric current increases
(b) stopping potential decreases
(c) stopping potential remains constant
(d) photoelectric current decreases
(e) stopping potential increases

82. After 300 days, the activity of a radioactive sample is 5000 dps (disintegrations per sec). The activity becomes 2500 dps after another 150 days. The initial activity of the sample in dps is
(a) 20,000 (b) 10,000
(c) 7,000 (d) 25,000
(e) 15,000

83. The control rods used in a nuclear reactor can be made up of
(a) Graphite (b) Cadmium
(c) Uranium (d) Barium
(e) Lead

84. The fusion reaction in the sun is a multi-step process in which the
(a) helium is burned into deuterons
(b) helium is burned into hydrogen
(c) deuteron is burned into hydrogen
(d) hydrogen is burned into helium
(e) helium is burned into neutrons
85. Identify the wrong statement
(a) In conductors, the valence and conduction bands overlap
(b) Substances with energy gap of the order of 10 eV are insulators
(c) The resistivity of semiconductors is lower than metals
(d) The conductivity of metals is high
(e) The resistivity of a semiconductor is lower than that of an insulator

86. Identify the wrong statement with reference to a solar cell
(a) It is a p-n junction diode with no external bias
(b) It uses materials of high optical absorption
(c) It uses materials with band gap of 5 eV
(d) It converts light energy into electrical energy
(e) It uses materials such as GaAs, Si

87. The minimum number of NAND gates used to construct an OR gate is
(a) 4  (b) 6
(c) 5  (d) 3
(e) 2

88. An FM radio station operating at 630 kHz is permitted to broadcast audio frequencies up to 6 kHz. The band pass filter in its modulation circuit can retain the frequencies
(a) 636 kHz, 630 kHz  (b) 12 kHz, 6 kHz
(c) 1260 kHz, 6 kHz  (d) 1260 kHz, 630 kHz
(e) 6 kHz, 630 kHz

89. A transducer, in communication system is a device that
(a) is a part of the antenna
(b) is a combination of a receiver and a transmitter
(c) converts audio signals into video signals
(d) detects the incoming signal
(e) converts physical variable into corresponding variations in the electrical signal

90. The dimensions of mobility are
(a) M⁻²T²A⁻¹  (b) M⁻¹T²A⁻¹
(c) M⁻²T³A⁻¹  (d) M⁻¹T³A⁻¹
(e) M⁻¹T²A⁻¹

91. The acceleration of a moving body is found from the
(a) area under velocity - time graph
(b) area under displacement - time graph
(c) slope of distance - time graph
(d) slope of velocity - time graph
(e) area under acceleration - time graph

92. A ball thrown vertically upwards after reaching a maximum height h, returns to the starting point after a time of 10 s. Its displacement is
(a) h  (b) 2h
(c) 10h  (d) 20h
(e) zero

93. If the angles of projection of a projectile with same initial velocity exceed or fall short of 45° by equal amounts, then the ratio of horizontal ranges is
(a) 1:2  (b) 1:3
(c) 1:4  (d) 1:1
(e) $1: \sqrt{2}$

94. If the length of seconds' hand of a clock is 10 cm, the speed of its tip (in cm s⁻¹) is nearly
(a) 2  (b) 0.5
(c) 1.5  (d) 3
(e) 1

95. The retarding acceleration of 7.35 m s⁻² due to frictional force stops the car of mass 400 kg travelling on a road. The coefficient of friction between the tyre of the car and the road is
(a) 0.55  (b) 0.75
(c) 0.70  (d) 0.65
(e) 0.80

96. A hammer weighing 3 kg strikes the head of a nail with a speed of 2 ms⁻¹ drives it by 1 cm into the wall. The impulse imparted to the wall is
(a) 6Ns  (b) 3Ns
(c) 2Ns  (d) 12Ns
(e) 8Ns

97. If two persons A and B take 2 seconds and 4 seconds respectively to lift an object to the same height h, then the ratio of their powers is
(a) 1:2  (b) 1:1
(c) 2:1  (d) 1:3
(e) 3:1

98. If a machine gun fires n bullets per second each with kinetic energy K, then the power of the machine gun is
(a) $nK^2$  (b) $\frac{K}{n}$
(c) $n^2K$  (d) nK
(e) $\frac{n}{K}$

99. The moment of inertia of the rectangular plate ABCD, (AB = 2 BC) is minimum along the axis
(a) GH  (b) EF
(c) BC  (d) AC
(e) AB

100. The position of centre of mass of a system of particles does not depend upon the
(a) mass of particles
(b) symmetry of the body
(c) position of the particles
(d) relative distance between the particles
(e) nature of particles

101. The relation between escape velocity ($V_e$) from the surface of the earth and the orbital velocity ($V_o$) is
(a) $\sqrt{2}V_e = V_o$  (b) $V_e = \sqrt{2}V_o$
(c) $V_e = 2V_o$  (d) $4V_e = 3V_o$
(e) $V_e = \sqrt{3}V_o$
102. The time period of an earth's satellite revolving at a height of 35,800 km is
(a) 24 hours (b) 100 minutes (c) 12 hours (d) 48 hours (e) 52 hours

103. A solid ball of volume V experiences a viscous force F when falling with a speed v in a liquid. If another ball of volume 8V with the same velocity v is allowed to fall in the same liquid, it experiences a force
(a) F (b) 16F (c) 4F (d) 8F (e) 2F

104. For most of the materials, Young's modulus (Y) and rigidity modulus (G) are related as
(a) G = 3Y (b) G = Y/3 (c) G = 3/2 Y (d) G = Y/8 (e) 10G = 3Y

105. The pressure on an object of bulk modulus B undergoing hydraulic compression due to a stress exerted by surrounding fluid having volume strain \( \left( \frac{\Delta V}{V} \right)^2 \) is
(a) \( B^2 \left( \frac{\Delta V}{V} \right) \) (b) \( B \left( \frac{\Delta V}{V} \right)^2 \) (c) \( \frac{1}{B} \left( \frac{\Delta V}{V} \right) \) (d) \( \frac{1}{B^2} \left( \frac{\Delta V}{V} \right) \) (e) \( B \left( \frac{\Delta V}{V} \right) \)

106. If \( d \) is the average diameter of the molecule, then the mean free path of the molecules between two successive collisions is proportional to
(a) \( d \) (b) \( d^2 \) (c) \( \frac{1}{d} \) (d) \( \frac{1}{d^2} \) (e) \( \frac{1}{d^3} \)

107. Which one of the following is a wrong statement in kinetic theory of gases?
(a) The gas molecules are in random motion (b) The gas molecules are perfect elastic spheres (c) The volume occupied by the molecules of a gas is negligible (d) The force of attraction between the molecules is negligible (e) The collision between molecules are inelastic

108. The change in internal energy of a thermodynamical system which has absorbed 2 kcal of heat and done 400 J of work is (1 cal = 4.2 J)
(a) 2 kJ (b) 8 kJ (c) 3.5 kJ (d) 5.5 kJ (e) 4.2 kJ

109. When the displacement of a particle executing simple harmonic motion is half of its amplitude, the ratio of its kinetic energy to potential energy is
(a) 1:3 (b) 2:1 (c) 3:1 (d) 1:2 (e) 2:3

110. A body oscillates with SHM according to the equation
(in SI units), \( x = 5 \cos \left( 2\pi t - \frac{\pi}{4} \right) \).
Its instantaneous displacement at \( t = 1 \) second is
(a) \( \frac{\sqrt{2}}{5} \) m (b) \( \frac{1}{\sqrt{3}} \) m (c) \( \frac{5}{\sqrt{2}} \) m (d) \( \frac{1}{2} \) m (e) \( \frac{5}{\sqrt{2}} \) m

111. Identify the correct statement
(a) Transverse wave can propagate in gases. (b) Transverse wave consists of compressions and rarefactions. (c) Longitudinal wave can propagate in solids, liquids and gases. (d) In a longitudinal wave, particles of the medium vibrate perpendicular to the direction of propagation. (e) In a longitudinal wave, the higher density corresponds to rarefactions.

112. The speed of sound in air
(a) decreases with temperature (b) increases with pressure (c) increases with humidity (d) decreases with pressure (e) increases with density

113. The bulk modulus of a spherical object is B. If it is subjected to uniform pressure p, the fractional decrease in radius is
(a) \( \frac{p}{B} \) (b) \( \frac{p}{3B} \) (c) \( \frac{3p}{B} \) (d) \( \frac{B}{3p} \) (e) \( \frac{3B}{p} \)
114. An electric dipole of dipole moment $\vec{p}$ is placed in a uniform external electric field $\vec{E}$. Then the
(a) torque experienced by the dipole is $\vec{E} \times \vec{p}$
(b) torque is zero if $\vec{p}$ is perpendicular to $\vec{E}$
(c) torque is maximum if $\vec{p}$ is perpendicular to $\vec{E}$
(d) potential energy is maximum if $\vec{p}$ is parallel to $\vec{E}$
(e) potential energy is maximum if $\vec{p}$ is perpendicular to $\vec{E}$

115. Electric field at a point of distance $r$ from a uniformly charged wire of infinite length having linear charge density $\lambda$ is directly proportional to
(a) $r^{-1}$
(b) $r$
(c) $r^2$
(d) $r^{-2}$
(e) $\sqrt{r}$

116. When 4 ampere current flows for 2 minutes in an electroplating experiment, $m$ gram of silver is deposited. Then the amount (in gram) of silver deposited by 6 ampere current flowing for 40 seconds is
(a) $4m$  
(b) $\frac{m}{2}$
(c) $2m$  
(d) $\frac{m}{4}$
(e) $\frac{3m}{4}$

117. A uniform wire of resistance $9 \Omega$ is joined end-to-end to form a circle. Then the resistance of the circular wire between any two diametrically opposite points is
(a) $6 \Omega$  
(b) $3 \Omega$
(c) $\frac{9}{2} \Omega$  
(d) $\frac{3}{2} \Omega$
(e) $1 \Omega$

118. The temperature coefficient of resistance of an alloy used for making resistors is
(a) small and positive  
(b) small and negative
(c) large and positive  
(d) large and negative
(e) zero

119. The deflection in a moving coil galvanometer is
(a) directly proportional to the torsional constant of the spring
(b) independent of the torsional constant of the spring
(c) inversely proportional to the area of the coil
(d) inversely proportional to the current flowing through it
(e) directly proportional to the number of turns in the coil

120. When a magnetic field is applied on a stationary electron, it
(a) remains stationary  
(b) spins about its own axis
(c) moves in the direction of the field  
(d) moves perpendicular to the direction of the field
(e) moves opposite to the direction of the field

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**Paper-II Biology**

1. Which of the following statements regarding fats is true?
(a) Arachidonic acid has 20 carbons excluding the carboxyl carbon.
(b) Glycerol is a trihydroxy propane.
(c) Palmitic acid has 18 carbons including the carboxyl carbon.
(d) Oils have higher melting points than fats.
(e) Lipids are generally water soluble.

2. Coenzymes NAD and NADP contain the vitamins
(a) Niacin  
(b) Biotin
(c) Thiamine  
(d) Vitamin B₁₂
(e) Vitamin A

3. Which of these is/are wrongly matched?
(1) Alkaloid - Codeine
(2) Lectin - Morphine
(3) Toxin - Abrin
(4) Terpene - Curcumin
(a) (1) and (3) only  
(b) (2) and (3) only
(c) (2) and (4) only  
(d) (3) and (4) only
(e) (1) and (4) only

4. Choose the wrong statement
(a) Cells swell in hypertonic solutions and shrink in hypotonic solutions
(b) Water potential is the kinetic energy of water which helps in the movement of water
(c) The absorption of water by seeds and dry wood takes place by a special type of diffusion called imbibition
(d) Solute potential or PS is always negative
(e) Less than 1% of the water reaching the leaves is used in photosynthesis and plant growth

5. When one element is involved in opening and closing of stomata, the other helps to maintain the ribosome structure. They are
(a) Potassium and calcium
(b) Phosphorus and sulphur
(c) Potassium and magnesium
(d) Iron and magnesium
(e) Calcium and sulphur

6. Which of the following groups of minerals are micronutrients?
(a) Magnesium, Manganese, Copper, Boron and Phosphorus
(b) Manganese, Copper, Magnesium, Zinc and Boron
(c) Nitrogen, Potassium, Manganese, Copper and Iron
(d) Iron, Manganese, Copper, Molybdenum and Zinc
(e) Carbon, Potassium, Phosphorus, Nitrogen and Oxygen
7. Match the mineral in Column I with the enzyme activated in Column II and choose the correct option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Magnesium</td>
<td>(1) Alcohol dehydrogenase</td>
</tr>
<tr>
<td>(B) Molybdenum</td>
<td>(2) Phosphoenolpyruvate carboxylase</td>
</tr>
<tr>
<td>(C) Zinc</td>
<td>(3) Nitrogenase</td>
</tr>
<tr>
<td>(a) A - 2, B - 3, C - 1</td>
<td>(b) A - 1, B - 2, C - 3</td>
</tr>
<tr>
<td>(c) A - 2, B - 1, C - 3</td>
<td>(d) A - 3, B - 2, C - 1</td>
</tr>
<tr>
<td>(e) A - 3, B - 1, C - 2</td>
<td></td>
</tr>
</tbody>
</table>

8. Which of the following statements regarding cyclic flow of electrons during light reactions is false?
   (a) This process takes place in the stromal lamella
   (b) ATP synthesis takes place
   (c) NADPH + H+ is synthesized
   (d) Takes place only when light of wavelength beyond 680 nm is available for excitation
   (e) PS II is not involved in the process

9. In which of the following steps of citric acid cycle, CO₂ is evolved?
   I. Citric acid – Ketoglutaric acid
   II. Succinic acid – Malic acid
   III. Malic acid – Oxaloacetic acid
   IV. α-ketoglutaric acid – Succinyl CoA
   (a) I and II only
   (b) I and IV only
   (c) II and III only
   (d) II and IV only
   (e) III and IV only

10. Find out the mismatched pair
    (a) C₄ plants - Kranz anatomy
    (b) Primary CO₂ fixation product - OAA
    (c) Primary CO₂ acceptor of C₃ - RuBP
    (d) Calvin pathway of C₄ plants - Bundle sheath occur in
    (e) C₃ plants - Maize

11. Which of these is/are not a property of facilitated transport?
    (A) Requires special membrane proteins
    (B) Highly selective
    (C) Uphill transport
    (D) Requires ATP energy
    (a) (A) and (B) only
    (b) (C) and (D) only
    (c) (A) and (C) only
    (d) (B) and (C) only
    (e) (B) and (D) only

12. Oxidative decarboxylation of pyruvic acid results in the formation of
    I. Acetyl CoA
    II. CO₂
    III. ATP
    IV. NADH + H+
    (a) I only
    (b) I and II only
    (c) I, II and III only
    (d) I, II and IV only
    (e) III and IV only

13. Select the correct order of reactions in glycolysis
    (A) Conversion of 3-phosphoglyceraldehyde to 1, 3-bisphosphoglycerate
    (B) Conversion of 3-phosphoglyceric acid to 2- phosphoglycerate
    (C) Conversion of BPGA to 3 phosphoglyceric acid
    (D) Splitting of fructose 1, 6 bisphosphate into dihydroxy acetone phosphate and 3-phosphoglyceraldehyde
    (a) (D), (C), (A), (B)
    (b) (B), (C), (A), (B)
    (c) (B), (D), (C), (A)
    (d) (A), (D), (C), (B)
    (e) (D), (A), (C), (B)

14. Free living nitrogen fixing aerobic bacterium is
    (a) *Rhodospirillum*  (b) *Anabaena*
    (c) *Nostoc*  (d) *Beijernickia*
    (e) *Rhizobium*

15. Which of the following plant growth hormone increases the yield of sugar by increasing the length of stem in sugarcane?
    (a) Cytokinin
    (b) Auxin
    (c) Abscisic acid
    (d) Ethylene
    (e) Gibberellic acid

16. Which of the following feature(s) is/are common to both wind and water pollinated flowers?
    I. Pollen grains are long and ribbon-like
    II. Stigma is large and feathery
    III. The flowers are not colourful
    IV. The flowers do not produce nectar
    (a) III and IV only
    (b) II and III only
    (c) I and II only
    (d) II only
    (e) I only

17. One hormone hastens the maturity period in juvenile conifers, a second hormone controls xylem differentiation while the third increases the tolerance of plants to various stresses and they are respectively
    (a) Auxin, Gibberellin and Cytokinin
    (b) Gibberellin, Auxin and Cytokinin
    (c) Gibberellin, Auxin and Ethylene
    (d) Gibberellin, Auxin and ABA
    (e) Auxin, Gibberellin and ABA

18. Which of the following is NOT an effect of ethylene?
    (a) Promotes senescence and abscission of plant organs
    (b) Breaks seed and bud dormancy
    (c) Brings about horizontal growth of seedlings
    (d) Hastens fruit ripening
    (e) Helps to overcome apical dominance

19. Select the plants pollinated by water
    (A) Water hyacinth  (B) *Zostera*
    (C) *Amorphophallus*  (D) *Vallisneria*
    (E) *Yucca*
    (a) (A), (D) and (E) only
    (b) (B) and (E) only
    (c) (B) and (D) only
    (d) (B), (C) and (D) only
    (e) (A), (B) and (D) only
20. The breakdown of detritus into small particles by detritivores is called
(a) Leaching  (b) Humification
(c) Catabolism  (d) Mineralization
(e) Fragmentation

21. Which of the following statements regarding responses of organisms to abiotic factors is false?
(a) All birds and mammals are capable of thermoregulation
(b) Majority of animals and nearly all plants cannot maintain a constant internal environment
(c) Shivering is a kind of exercise which produces heat and raises body temperature
(d) Very small animals are commonly found in polar regions as they have to spendless energy to generate body heat
(e) Diapause is a stage of suspended development seen in zooplanktons

22. An orchid growing as an epiphyte on a mango tree is an example for
(a) Parasitism  (b) Predation
(c) Commensalism  (d) Mutualism
(e) Competition

23. The ozone hole over Antarctica develops each year between
(a) Late December and early February
(b) Late February and early April
(c) Late April and early June
(d) Late August and early October
(e) Late October and early December

24. In the equation, \( \frac{dN}{dt} = rN\left(\frac{K - N}{K}\right) \) where \( r \) stands for
(a) Intrinsic rate of natural increase
(b) Death rate
(c) Population density at time \( t \)
(d) Carrying capacity
(e) The base of natural logarithms

25. Which of the following statements about Productivity is true?
(a) Primary productivity of all ecosystems is a constant
(b) The annual net primary productivity of the whole of the biosphere is 17 billion tons (dry weight) of organic matter
(c) Net primary productivity is the amount of biomass available for consumption by carnivores
(d) Secondary productivity is defined as the rate of formation of new organic matter by decomposers.
(e) Primary productivity depends on the plant species inhabiting a particular area

26. The first recombinant DNA was constructed by linking an antibiotic resistant gene with the native plasmid of
(a) Escherichia coli  (b) Salmonella typhimurium
(c) Clostridium butylicum  (d) Acetobacter aceti
(e) Bacillus thuringiensis

27. Which of the following statements does not apply to eutrophication?
(a) It is the natural ageing of a lake by nutrient enrichment of its water
(b) In a young lake the water is cold and clear and supports less life
(c) The nutrients such as sulphur and phosphorus encourage the growth of aquatic organisms in the lake
(d) Pollutants released by man radically accelerate the ageing process of a lake
(e) Overgrowth of algae leads to scum that depletes the level of dissolved oxygen in the water

28. According to Robert Constanza, 50% of the total cost for ecosystem services goes to
(a) Recreation  (b) Soil formation
(c) Nutrient cycling  (d) Climate regulation
(e) Habitat for wildlife

29. Which of the following statement(s) regarding energy flow is/are false?
I. The detritus food chain begins with dead organic matter.
II. In aquatic ecosystem, detritus food chain is the major conduit for energy flow.
III. In terrestrial ecosystem a larger fraction of energy flows through grazing food chain.
IV. Producers belong to the first trophic level of the food chain.
(a) II and III only  (b) III and IV only
(c) I and IV only  (d) I and II only
(e) I, II and III only

30. The first recombinant DNA was constructed by linking an antibiotic resistant gene with the native plasmid of V
(a) Escherichia coli  (b) Salmonella typhimurium
(c) Clostridium butylicum  (d) Acetobacter aceti
(e) Bacillus thuringiensis

31. The polymerase chain reaction I (PCR) is a technique that is used for
(a) in vivo replication of specific DNA sequence using thermostable DNA polymerase
(b) in vitro synthesis of mRNA
(c) in vitro replication of specific DNA sequence using thermostable DNA polymerase
(d) in vivo synthesis of mRNA
(e) Separation of DNA fragments according to their size

32. Bioreactors are useful in
(a) Separation and purification of a product
(b) Processing of large volumes of culture
(c) Micro-injection
(d) Isolation of genetic material
(e) Amplification of genes
33. Match Column I with Column II and select the correct option

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ascomycetes</td>
<td>(1) Ustilago</td>
</tr>
<tr>
<td>(B) Phycomycetes</td>
<td>(2) Saccharomyces</td>
</tr>
<tr>
<td>(C) Basidiomycetes</td>
<td>(3) Trichoderma</td>
</tr>
<tr>
<td>(D) Deuteromycetes</td>
<td>(4) Albugo</td>
</tr>
</tbody>
</table>

(a) A-2, B-1, C-4, d-3 (b) A-4, B-3, C-2, D-1  
(c) A-2, B-4, C-1, d-3 (d) A-3, B-4, C-1, D-2  
(e) A-1, B-4, C-2, d-3

34. Which of the following statement(s) about taxonomical aids is/are true?
I. Keys are used to identify plants and animals based on similarities and dissimilarities
II. Flora contains the account of habitat and distribution of plants in a given area
III. Flora provide an index to the plant species found in a particular area
IV. Monographs provide information for identifying the species found in an area
(a) I and II only (b) I, II and III only  
(c) I and IV only (d) I only  
(e) IV only

35. Which one of the following shows the hierarchial arrangement of taxonomic categories of plants in descending order?

(a) Kingdom Kingdom Kingdom Kingdom Kingdom  
(b) Division Division Division Division Division  
(c) Class Order Class Order Class Family  
(d) Order Order Class Order Order  
(e) Family Family Family Family Class

36. Which of the following does not apply to Ascomycetes?
(a) Mycelium is coenocytic and aseptate  
(b) Commonly known as sac fungi  
(c) Asexual spores called conidia are produced exogenously  
(d) Sexual spores called ascospores are produced endogenously  
(e) They are saprophytic, decomposers, parasitic or coprophilous

37. As per Whittaker's classification, an organism possessing eukaryotic cell structure, multicellular organisation, with a cell wall and nuclear membrane showing heterotrophic nutrition can be placed under the kingdom:
(a) Monera  
(b) Protista  
(c) Plantae  
(d) Fungi  
(e) Animalia

38. Which of the following groups of algae belongs to class Rhodophyceae?
(a) Laminaria, Fucus, Porphyra, Volvox  
(b) Gelidium, Porphyra, Dictyota, Fucus  
(c) Gracilaria, Gelidium, Porphyra, Polysiphonia  
(d) Volvox, Spirogyra, Ulothrix, Sargassum  
(e) Sargassum, Laminaria, Fucus, Dictyota

39. Select the correct statement:
(a) Biological names are generally in Greek and written in italics  
(b) Family comprises a group of related species which has more characters in common  
(c) Triticum aestivum comes under the order Sapindales  
(d) An order includes related classes  
(e) Families like Convolvulaceae, Solanaceae are included in the order Polymoniales mainly based on the floral characters

40. Which of the following groups of organisms have a protein rich layer called pellicle?
(a) Chrysophytes  
(b) Euglenoids  
(c) Dinoflagellates  
(d) Slime moulds  
(e) Protozoans

41. Which of the following are heterosporous pteridophytes?
I. Lycopodium  
II. Selaginella  
III. Equisetum  
IV. Salvinia  
(a) I and II only  
(b) II and III only  
(c) II and IV only  
(d) II and IV only  
(e) I and IV only

42. Match the following and choose the correct combination from the options given

<table>
<thead>
<tr>
<th>Column I (Alga type)</th>
<th>Column II (Example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Green alga</td>
<td>(1) Dictyota</td>
</tr>
<tr>
<td>(B) Brown alga</td>
<td>(2) Prophyra</td>
</tr>
<tr>
<td>(C) Red alga</td>
<td>(3) Spirogyra</td>
</tr>
<tr>
<td>(a) A-3, B-2, C-1</td>
<td>(b) A-3, B-1, C-2</td>
</tr>
<tr>
<td>(c) A-2, B-3, C-1</td>
<td>(d) A-1, B-2, C-3</td>
</tr>
<tr>
<td>(e) A-1, B-3, C-2</td>
<td></td>
</tr>
</tbody>
</table>

43. Choose the correct statement.
(a) Bryophytes can live in soil but are dependent on water for sexual reproduction  
(b) The sex organs in bryophytes are unicellular  
(c) In bryophyte the main plant body is a gametophyte which is differentiated into true root, stem and leaves  
(d) Common example of liverwort is Polytrichum  
(e) Common example of moss is Marchantia
44. Read the following statements and identify the correct options given.
   (A) Angiosperms range in size from microscopic Wolfia to tall trees of Eucalyptus
   (B) In angiosperms, the seeds are enclosed by fruits
   (C) Double fertilisation is an event unique to angiosperms
   (D) In angiosperms, each cell of an embryo sac is diploid
   (E) In angiosperms, the zygote develops into an endosperm
   (a) (A), (B) and (D) alone are correct
   (b) (A), (B) and (E) alone are correct
   (c) (A), (B) and (C) alone are correct
   (d) (B), (C) and (D) alone are correct
   (e) (B), (C) and (E) alone are correct

45. Match the plants in Column I with their modification types in Column II and choose the right options given below.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ginger</td>
<td>(1) Flattened stems</td>
</tr>
<tr>
<td>(B) Pumpkin</td>
<td>(2) Thorns</td>
</tr>
<tr>
<td>(C) Bougainvillea</td>
<td>(3) Stem tendrils</td>
</tr>
<tr>
<td>(D) Opuntia</td>
<td>(4) Underground stem</td>
</tr>
<tr>
<td>(a) A-4, B-3, C-2, D-1</td>
<td>(b) A-4, B-1, C-2, D-3</td>
</tr>
<tr>
<td>(c) A-3, B-4, C-1, D-3</td>
<td>(d) A-3, B-4, C-2, D-1</td>
</tr>
<tr>
<td>(e) A-2, B-1, C-4, D-3</td>
<td></td>
</tr>
</tbody>
</table>

46. In one plant adventitious roots are modified for storage and in the other plant a lateral branch with short internodes and each node bearing a rosette of leaves and a tuft of roots is found. They are
   (a) Sweet potato and Pistia
   (b) Eichhornia and jasmine
   (c) Carrot and mint
   (d) Turnip and Chrysanthemum
   (e) Sweet potato and mint

47. The type of placentation seen in Argemone and Primrose are respectively
   (a) Axile and free-central
   (b) Parietal and free-central
   (c) Parietal and basal
   (d) Marginal and free-central
   (e) Basal and parietal

48. Consider the following characters with respect to the gynoecium of Fabaceae and choose the correct options given below.
   (A) Ovary monocarpellary
   (B) Many styles
   (C) Placenta swollen
   (D) Superior ovary
   (E) Axile placentation
   (a) (A), (D) and (E) only
   (b) (D) and (E) only
   (c) (A) and (B) Only
   (d) (A) and (D) only
   (e) (C) and (D) only

49. Which of the following characters are not applicable to the anatomy of dicot stem and choose the correct options given below.
   (A) Collenchymatous hypodermis
   (B) Polyarch xylem
   (C) Presence of casparian strips on the endodermis
   (D) Open vascular bundle
   (E) Presence of medullary rays
   (a) (A), (D) and (E) only
   (b) (B) and (C) only
   (c) (B) and (E) only
   (d) (A), (B) and (C) only
   (e) (C), (D) and (E) only

50. Which of the followings are the characteristic features of Solanaceae?
   (A) Exstipulate leaves
   (B) Persistent calyx
   (C) Racemose inflorescence
   (D) Unilocular ovary
   (E) Fruits are either berry or capsule
   (a) (A), (B) and (E) are correct
   (b) (A), (C) and (D) are correct
   (c) (A) only is correct
   (d) (B) only is correct
   (e) (D) and (E) are correct

51. Pick out the wrong statement
   (a) Gymnosperms lack vessels in their xylem.
   (b) The cell wall of collenchyma is made up of cellulose, hemicellulose and pectin.
   (c) The first formed primary xylem elements are called protoxylem.
   (d) The cell wall of parenchyma is made up of pectin.
   (e) Gymnosperms have albuminous cells and sieve cells in their phloem.

52. Which of these characters does/do not apply to the vascular bundle of monocot stem?
   I. Conjoint
   II. Endarch protoxylem
   III. Open
   IV. Phloem parenchyma is absent
   (a) I and II only
   (b) II and III only
   (c) III and IV only
   (d) III only
   (e) I and IV only

53. When one wood is lighter in colour with a lower density, the other wood is darker with higher density. They are
   (a) Spring wood and autumn wood
   (b) Heart wood and late wood
   (c) Spring wood and early wood
   (d) Sap wood and spring wood
   (e) Autumn wood and spring wood

54. Which of the following part of dicot root is made up of cells with suberin deposition in tangential as well as radial walls?
   (a) Epidermis
   (b) Endodermis
   (c) Cortex
   (d) Pericycle
   (e) Xylem
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55. Choose the matched ones.
(A) Vibrio - Rod like bacteria
(B) Mesosome - Helps in cell wall formation
(C) Smooth endoplasmic reticulum - Synthesis of lipid reticulum
(D) Vacuoles - Rich in hydrolytic enzymes
(a) (B) and (C) only (b) (A) and (D) only
(c) (A), (B) and (C) only (d) (B) and (D) only
(e) (B), (C) and (D) only

56. Which of these organelles does not contain ribosomes?
I. Rough endoplasmic reticulum
II. Chloroplast
III. Golgi apparatus
IV. Mitochondria
(a) I and II only (b) I and IV only
(c) IV only (d) III only
(e) II, III and IV only

57. Match the sub-stage of prophase I of meiosis in Column I and the events in Column II and choose the right option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Leptotene</td>
<td>(1) Terminalization of chiasma</td>
</tr>
<tr>
<td>(B) Zygotene</td>
<td>(2) Crossing over and recombination</td>
</tr>
<tr>
<td>(C) Pachytene</td>
<td>(3) Synapsis</td>
</tr>
<tr>
<td>(D) Diakinesis</td>
<td>(4) Visibility of chromosomes</td>
</tr>
<tr>
<td>(a) A-1, B-2, C-3, D-4</td>
<td>(b) A-1, B-3, C-2, D-4</td>
</tr>
<tr>
<td>(c) A-4, B-3, C-2, D-1</td>
<td>(d) A-4, B-1, C-2, D-3</td>
</tr>
<tr>
<td>(e) A-4, B-2, C-3, D-1</td>
<td></td>
</tr>
</tbody>
</table>

58. Which of the following scientists discovered the triple helical structure of collagen?
(a) G.N. Ramachandran
(b) Anton von Leeuwenhoek
(c) Matthias Schleiden
(d) Theodor Schwann
(e) Rudolf Virchow

59. One type of chromosome has middle centromere whereas the other has a terminal centromere. They are
(a) Metacentric and acrocentric
(b) Metacentric and telocentric
(c) Sub-metacentric and telocentric
(d) Telocentric and acrocentric
(e) Acrocentric and metacentric

60. Match the following and choose the correct combination from the options given.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Chemical compounds)</td>
<td>(Example)</td>
</tr>
<tr>
<td>(A) Nitrogen base</td>
<td>(1) RNA</td>
</tr>
<tr>
<td>(B) Nucleoside</td>
<td>(2) Thymidylic acid</td>
</tr>
<tr>
<td>(C) Nucleotide</td>
<td>(3) Cytidine</td>
</tr>
<tr>
<td>(D) Nucleic acid</td>
<td>(4) Uracil</td>
</tr>
<tr>
<td>(a) A-1, B-2, C-3, D-4</td>
<td>(b) A-1, B-3, C-2, D-4</td>
</tr>
<tr>
<td>(c) A-4, B-3, C-2, D-1</td>
<td>(d) A-4, B-1, C-2, D-3</td>
</tr>
<tr>
<td>(e) A-4, B-2, C-3, D-1</td>
<td></td>
</tr>
</tbody>
</table>

61. In eukaryotic genes, coding sequences are called
(a) introns (b) exons
(c) regulatory sequence (d) repetitive DNA
(e) histones

62. Which site of the tRNA pairs through hydrogen bonding with the triplet codes on mRNA?
(a) Codon (b) 5’ end of tRNA
(c) 3’ end of tRNA (d) Anticodon
(e) Amino acid acceptor end

63. Find the wrongly matched pair
(a) Har Gobind Khorana - synthesized RNA molecules chemically
(b) George Gamow - codon is triplet 'S
(c) Meselson and Stahl - regulation of gene expression
(d) Alec Jeffreys - DNA finger printing
(e) Frederick Sanger - amino acid sequencing

64. If an inheritable mutation is observed in a population at high frequency, it is referred as
(a) DNA polymorphism (b) Expressed sequence tag
(c) Sequence annotation (d) Linkage
(e) Triplet codon

65. In eukaryotes, RNA polymerase II transcribes
(a) hnRNA (b) 18S rRNA
(c) 28S rRNA (d) tRNA
(e) snRNAs

66. Match Column I with Column II and Column III. Choose the correct option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
<th>Column III</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Substrate)</td>
<td>(Enzyme)</td>
<td>(Product)</td>
</tr>
<tr>
<td>(1) Lactose</td>
<td>(A) Lipase</td>
<td>(i) Galactose</td>
</tr>
<tr>
<td>(2) Monoglycerides</td>
<td>(B) Trypsin</td>
<td>(ii) Maltose</td>
</tr>
<tr>
<td>(3) Starch</td>
<td>(C) Lactase</td>
<td>(iii) Fatty acid</td>
</tr>
<tr>
<td>(4) Peptones</td>
<td>(D) Amylase</td>
<td>(iv) Dipeptides</td>
</tr>
<tr>
<td>(a) 1-A-i, 2-C-ii, 3-B-iii, 4-D-iv</td>
<td>(b) 1-D-i, 2-A-ii, 3-B-iii, 4-C-iv</td>
<td></td>
</tr>
<tr>
<td>(c) 1-C-i, 2-A-ii, 3-D-ii, 4-B-iv</td>
<td>(d) 1-C-i, 2-D-ii, 3-C-iii, 4-A-iv</td>
<td></td>
</tr>
</tbody>
</table>

67. Choose the wrong statement among the following
(a) Trypsinogen is activated by entero kinase
(b) The optimum pH for salivary amylase activity is 8.9
(c) Rennin helps in the digestion of milk proteins
(d) Goblet cells secrete mucous 8.9
(e) Submucosal glands of the intestine are also known as Brunner’s glands

68. To generate pressure gradients to facilitate expiration and inspiration, the human body uses the intercostal muscles and
(a) alveolar sacs (b) bronchi
(c) primary, secondary and tertiary bronchioles (d) diaphragm (e) windpipe
69. Choose the wrong statement
(a) Solubility of CO\textsubscript{2} in blood is 20-25 times higher than that of O\textsubscript{2}
(b) The total volume of air accommodated in the lungs at the end of a forced inspiration is called the 'vital capacity'
(c) O\textsubscript{2} can bind with haemoglobin in a reversible manner to form oxyhaemoglobin
(d) Every 100 ml of deoxygenated blood delivers approximately 4 ml of CO\textsubscript{2} to the alveoli
(e) The diffusion membrane is made of three major layers namely the thin squamous epithelium of alveoli, the endothelium of alveolar capillaries and the basement substance in between them.

70. Match Column I with Column II regarding human excretory system. Choose the correct option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Epithelial cells of Bowman's capsule</td>
<td>(A) Juxtamedullary nephron</td>
</tr>
<tr>
<td>(ii) Extension of cortex between the medullary pyramids as renal columns</td>
<td>(B) Vasa recta</td>
</tr>
<tr>
<td>(iii) Nephrons with long loop of Henle running deep into the medulla</td>
<td>(C) Juxtaglomerular Apparatus</td>
</tr>
<tr>
<td>(iv) A fine vessel of the peritubular capillaries running parallel to Henle's loop</td>
<td>(D) Podocytes</td>
</tr>
<tr>
<td>(v) A special sensitive region in the DCT and afferent arteriole at the location of their contact</td>
<td>(E) Columns of Bertin</td>
</tr>
<tr>
<td>(a) i-C, ii-B, iii-A, iv-D, v-E</td>
<td>(b) i-E, ii-A, iii-B, iv-C, v-D</td>
</tr>
<tr>
<td>(c) i-D, ii-C, iii-B, iv-E, v-A</td>
<td>(d) i-D, ii-E, iii-A, iv-B, v-C</td>
</tr>
<tr>
<td>(e) i-B, ii-D, iii-F, iv-A, v-C</td>
<td>(e) Cortical nephron</td>
</tr>
</tbody>
</table>

71. Thrombokinase is associated with
(a) elimination of urea and other excretory products from the body
(b) production of erythrocytes from the bone marrow
(c) pulmonary and systemic circulation
(d) cardiac cycle and its regulation
(e) enzymatic reactions in coagulation of blood

72. What is the pO\textsubscript{2} and pCO\textsubscript{2} in the systemic arteries?
(a) pO\textsubscript{2} 40 mm Hg; pCO\textsubscript{2} 45 mm Hg
(b) pO\textsubscript{2} 95 mm Hg; pCO\textsubscript{2} 104 mm Hg
(c) pO\textsubscript{2} 95 mm Hg; pCO\textsubscript{2} 40 mm Hg
(d) pO\textsubscript{2} 45 mm Hg; pCO\textsubscript{2} 40 mm Hg
(e) pO\textsubscript{2} 104 mm Hg; pCO\textsubscript{2} 159 mm Hg

73. The striated appearance of a myofibril is due to the distribution pattern of
(a) actin and myosin
(b) fascicles
(c) troponin
(d) meromyosin
(e) sarcoplasmic reticulum

74. Label the pans marked in the human skull and select the correct option.

75. The 'U' shaped bone present at the base of the buccal cavity is
(a) Maleus
(b) Ethmoid
(c) Zygomatic
(d) Hyoid
(e) Sphenoid

76. Which of the following statement is wrong regarding conduction of nerve impulse?
(a) In a resting neuron, the axonal membrane is more permeable to K\textsuperscript{+} ions and nearly impermeable to Na\textsuperscript{+} ions
(b) Fluid outside the axon has a high concentration of Na\textsuperscript{+} and low concentration of K\textsuperscript{+}, in a resting neuron
(c) Ionic gradients are maintained by Na-K pumps across the resting membrane, which transport 3 Na\textsuperscript{+} ions outwards for 2K\textsuperscript{+} ions into the cell
(d) Resting potential is the electrical potential difference across the resting membrane
(e) A neuron is polarized only when the outer surface of the axonal membrane possesses a negative charge and its inner surface is positively charged

77. An autoimmune disorder affecting the neuromuscular junction is
(a) Angina
(b) CAD
(c) Emphysema
(d) Gout
(e) Myasthenia gravis

78. Which of the following statement is wrong?
(a) Sella turcica is a bony cavity where the pituitary gland is located
(b) Parathyroid hormone decreases the Ca\textsuperscript{2+} levels in blood
(c) Thymosins play a major role in T cell differentiation
(d) The middle layer of adrenal cortex is zona fasciculata
(e) Insulin stimulates glycogenesis
79. Match the hormones secreted by various endocrine structures and choose the correct option.

   i. Hypothalamus      (A) Melanocyte stimulating hormone
   ii. Pars intermedia  (B) Aldosterone
   iii. Pineal gland    (C) Gonadotrophin releasing hormone
   iv. Adrenal medulla  (D) Melatonin
   v. Adrenal cortex    (E) Catecholamines

(a) i-E, ii-A, iii-D, iv-B, v-C
(b) i-E, ii-D, iii-A, iv-B, v-C
(c) i-B, ii-D, iii-A, iv-C, v-E
(d) i-C, ii-A, iii-D, iv-B, v-E
(e) i-C, ii-A, iii-D, iv-E, v-B

80. Choose the wrongly matched pair

(a) Portion of myofibril – Sarcomere between two 'Z' lines
(b) Isotropic band – Actin
(c) Anisotropic band – Myosin
(d) Central part of I-band – M-line
(e) Central part of A-band – H-zone

81. Chylomicrons are

(a) small fat globules coated with protein
(b) protein molecules coated with fat
(c) small granules found in gastric juice
(d) neural signals that stimulate, intestinal secretions
(e) aerobic microbes

82. When percentage saturation of hemoglobin with O₂ is plotted against pO₂, the curve obtained is

(a) J shaped
(b) Hyperbola
(c) Sigmoid
(d) U shaped
(e) Urn shaped

83. Identify the correct statement regarding cardiac activity

(a) Normal activities of the human heart is regulated intrinsically hence it is neurogenic
(b) A special neural centre in the medulla oblongata can moderate the cardiac function through the CNS
(c) Parasympathetic neural signals increase the rate of heart beat
(d) Adrenal medullary hormones can increase cardiac output
(e) The end of a T-wave marks the end of diastole

84. Identify the correct statement regarding urine formation

(a) Counter current mechanism works around the glomerulus and PCT
(b) To prevent diuresis, ADH facilitates water reabsorption from the latter parts of
(c) Maximum absorption of electrolytes occurs in the Henle's loop
(d) A decrease in blood pressure can increase the glomerular filtration rate
(e) The collecting duct is impermeable to water and thus helps in diluting the urine

85. The yellowish pigmented spot at the posterior pole of the human eye lateral to the blind spot is

(a) crista     (b) sacculle
(c) iris       (d) meatus
(e) macula lutea

86. Which of the following statement is wrong?

(a) The Sertoli cells provide nutrition to the developing male germ cells
(b) Leydig cells synthesize and secrete androgens
(c) Secretions of the acrosome helps the sperm to enter into the cytoplasm of the ovum
(d) Secondary spermatocytes are diploid
(e) The fluid filled cavity in the tertiary follicle is called antrum

87. The inner glandular layer of the uterus is

(a) endometrium     (b) myometrium
(c) fallopian tubes (d) perimetrium
(e) infundibulum

88. The release of sperms from the seminiferous tubules is called

(a) Spermiogenesis      (b) Spermiation
(c) Spermatogenesis     (d) Fertilisation
(e) Gametogenesis

89. Find the wrongly matched pair

(a) Endemism - species confined to one region and not found anywhere else
(b) Hot spots - regions with species richness
(c) Alien species to India - *Clarias gariepinus*
(d) Lungs of the planet - Amazon Rain Forest
(e) *in situ* conservation - IVF D

90. Which one among these is NOT an *ex-situ* conservation strategy?

(a) Seed banks    (b) Botanical gardens
(c) Cryopreservation     (d) Biosphere reserves
(e) Tissue culture

91. The semi dwarf wheat which was instrumental in increasing wheat production was developed by

(a) Alexander von Humboldt
(b) Paul Ehrlich
(c) Dr. Kurien
(d) Edward Jenner
(e) Norman E. Borlaug

92. Ernest Chain and Howard Florey's contribution was

(a) discovery of streptokinase
(b) establishing the potential of penicillin as an effective antibiotic
(c) discovery of the DNA sequencer
(d) isolating the bacterial plasmid
(e) production of genetically engineered insulin

93. Match Column I with Column II and choose the correct option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Totipotency</td>
<td>(A) breeding crops with higher</td>
</tr>
<tr>
<td></td>
<td>levels of nutrients</td>
</tr>
<tr>
<td>(2) Micropropagation</td>
<td>(B) plant grown from hybrid</td>
</tr>
<tr>
<td></td>
<td>protoplast</td>
</tr>
<tr>
<td>(3) Somaclone</td>
<td>(C) producing a large number of</td>
</tr>
<tr>
<td></td>
<td>plants through tissue culture</td>
</tr>
<tr>
<td>(4) Somatic hybrid</td>
<td>(D) capacity to generate a whole</td>
</tr>
<tr>
<td></td>
<td>plant from an explant</td>
</tr>
<tr>
<td>(5) Biofortification</td>
<td>(E) Plants genetically identical</td>
</tr>
<tr>
<td></td>
<td>to the original plant</td>
</tr>
</tbody>
</table>

(a) 1-D, 2-C, 3-E, 4-B, 5-A    (b) 1-A, 2-E, 3-B, 4-D, 5-C
(c) 1-C, 2-B, 3-E, 4-D, 5-A    (d) 1-D, 2-E, 3-A, 4-D, 5-C
(e) 1-D, 2-E, 3-B, 4-A, 5-C    (f) 1-D, 2-E, 3-B, 4-A, 5-C
94. Viruses of the genus *Nucleopolyhedrovirus* are employed as
   (a) Gobar gas producers  
   (b) Biological control agents  
   (c) Anaerobic sludge digesters  
   (d) Antibiotics  
   (e) Atmospheric nitrogen fixing agents

95. Choose the wrong statement
   (a) Louis Pasteur demonstrated that life comes only from pre-existing life  
   (b) S.L. Miller observed that electric discharge in a flask containing CH₄, H₂, NH₃ and water vapour at 800 °C formed amino acids  
   (c) Flippers of penguins and dolphins are examples for homology  
   (d) Homology indicates common ancestry  
   (e) Analogous structures are the result of convergent evolution

96. Match Column I with Column II and choose the right option.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Thomas Malthus</td>
<td>(A) Branching descent</td>
</tr>
<tr>
<td>(2) Hugo de Vries</td>
<td>(B) Studies on populations</td>
</tr>
<tr>
<td>(3) Charles Darwin</td>
<td>(C) Use and disuse theory</td>
</tr>
<tr>
<td>(4) Lamarck</td>
<td>(D) Saltation</td>
</tr>
<tr>
<td>(a) 1-D, 2-A, 3-C,4-B</td>
<td>(b) 1-B, 2-D, 3-A, 4-C</td>
</tr>
<tr>
<td>(c) 1-B, 2-D, 3-C, 4-A</td>
<td>(d) 1-C, 2-B, 3-A, 4-D</td>
</tr>
<tr>
<td>(e) 1-B, 2-A, 3-C, 4-D</td>
<td></td>
</tr>
</tbody>
</table>

97. The hominid fossils discovered in Java in 1891 revealed a stage in the human evolution, which was called
   (a) *Homo erectus*  
   (b) *Dryopithecus*  
   (c) *Australopithecus*  
   (d) *Homo habilis*  
   (e) *Ramapithecus*

98. Functional systems for specific physiological functions are not seen in
   (a) Annelids  
   (b) Molluscs  
   (c) Arthropods  
   (d) Echinoderms  
   (e) Coelenterates

99. Match Column I with Column II and choose the correct answer.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Incomplete digestive system</td>
<td>(A) Sponges</td>
</tr>
<tr>
<td>(ii) Cellular level of organization</td>
<td>(B) Coelenterids</td>
</tr>
<tr>
<td>(iii) Radial symmetry</td>
<td>(C) Annelids</td>
</tr>
<tr>
<td>(iv) Pseudocoelomate</td>
<td>(D) Platyhelminthes</td>
</tr>
<tr>
<td>(v) Metamerism</td>
<td>(E) I Aschelminthes</td>
</tr>
<tr>
<td>(a) i-C, ii-D, iii-A, iv-B, v-E</td>
<td>(b) i-D, ii-E, iii-B, iv-C, v-A</td>
</tr>
<tr>
<td>(c) i-D, ii-A, iii-B, iv-E, v-C</td>
<td>(d) i-A, ii-B, iii-C, iv-D, v-E</td>
</tr>
<tr>
<td>(e) i-B, ii-C, iii-D, iv-A, v-E</td>
<td></td>
</tr>
</tbody>
</table>

100. Which of the following statement/s regarding coelenterates is/are wrong?
   I. Cnidocytes are present on the tentacles and on the body  
   II. Diploblastic with cellular level of organization 
   III. Polyp forms are free swimming  
   IV. Exhibits metagenesis  
   V. Polyps produce medusae sexually and medusae form polyps asexually  
   (a) II and IV only  
   (b) III and V only  
   (c) I, II and III only  
   (d) III only  
   (e) II, III and V only

101. Choose the wrong statement
   (a) Teeth in Chondrichthyes are modified ctenoid scales  
   (b) Air bladder in fishes regulates buoyancy  
   (c) In amphibians, the tympanum represents the ear  
   (d) Long bones in birds are pneumatic  
   (e) Reptiles are poikilotherms

102. Which one of the following is not a sensory structure in cockroach?
   (a) Antennae  
   (b) Eyes  
   (c) Anal cerci  
   (d) Maxillary palp  
   (e) Proventriculus

103. Choose the wrongly matched pair regarding the position of reproductive structures in earthworm
   (A) Testes - 10th and 11th segments  
   (b) Spermathecae - 6th to 9th segments  
   (c) Male genital pore - 9th segment  
   (d) Ovaries - Inter segmental septum of 12th and 13th segments  
   (e) Female genital pore - 14th segment

104. In cockroach, the arthrodial membrane
   (a) forms the hind wings  
   (b) covers the compound eyes  
   (c) forms the hypopharynx  
   (d) forms the tegmina  
   (e) joins the sclerites

105. Choose the wrong statement regarding the circulatory system of frog
   (a) Sinus venosus receives blood through major veins called vena cava  
   (b) The ventricle opens into a sac like conus arteriosus  
   (c) The erythrocytes are nucleated  
   (d) Special venous connection between liver and intestine called renal portal system is present  
   (e) Lymphatic system consists of lymph, lymph channels and lymph nodes

106. Read the following statements and choose the correct answer.
   i. Gap junctions cement adjacent cells together  
   ii. Areolar tissue contains fibroblasts, macrophages and mast cells  
   iii. Tight junctions facilitate the cells to communicate with each other  
   iv. Adhering junctions help to stop substances from leaking across tissues  
   v. Cells of connective tissue except blood secrete fibres of structural proteins called elastin  
   (a) i, ii and iii only are wrong  
   (b) i, iii and iv only are wrong  
   (c) ii and iv only are wrong  
   (d) iii and v only are wrong  
   (e) ii, iv and v only are wrong

107. Tendons, which attach one bone to another bone are made up of
   (a) Dense regular connective tissue  
   (b) Dense irregular connective tissue  
   (c) Areolar tissue  
   (d) Adipose tissue  
   (e) Cuboidal epithelial tissue

108. Multiple allelism is observed in
   (a) flower colour in *Snapdragon*  
   (b) pod colour in *Pisum sativum*
(c) haemophilia in man
(d) sex determination in birds
(e) ABO blood types

109. The graphical representation to calculate the probability of all possible genotypes of offsprings in a genetic cross was developed by
(a) Gregor Mendel (b) Kornberg
(c) Har Gobind Khorana (d) George Gamow
(e) Reginald C. Punnett

110. Choose the wrong statement
(a) Failure of segregation of chromatids during cell division results in aneuploidy
(b) Additional copy of 'X' chromosome in males results in Klinefelter's syndrome
(c) Closely located genes in a chromosome always assert independently resulting in recombinants
(d) According to Mendel, recessive character never blend in heterozygous condition
(e) Failure of cytokines is after DNA replication results in polyploidy

111. A person affected with phenylketonuria, lacks an enzyme that converts the amino acid phenylalanine into
(a) Valine  (b) Proline
(c) Histidine  (d) Tyrosine
(e) Methionine

112. Identify the wrong statement about DNA
(a) The length of DNA is defined as the number of base pairs present in it
(b) Cytosine is common to both DNA and RNA
(c) In a nucleotide, the nitrogenous base is linked to a phosphate group
(d) Thymine is chemically 5-methyl uracil
(e) Nucleoside Deoxythymidine is a nucleoside

113. Choose the wrong statement
(a) In grasshopper, besides autosomes males have only one X-chromosome, whereas females have a pair of X-chromosomes
(b) In XY type of sex determination, both males and females have same number of chromosomes
(c) In Drosophila, males have one X and one Y chromosome, whereas females have a pair of X-chromosome besides autosomes
(d) In birds, females have one Z and one W chromosomes, whereas males have a pair of Z chromosomes besides autosomes
(e) In insects with XO type of sex determination, all sperms bear X-chromosome besides autosomes

114. Which property among these listed below is not a criteria for a molecule to act as a genetic material?
(a) Generate its replica
(b) Chemically and structurally stable
(c) Mutate slowly to facilitate evolution
(d) Express itself in the form of Mendelian characters
(e) Destroy itself after every cell cycle

115. Match Column I with Column II and choose the correct option.

<table>
<thead>
<tr>
<th>Column-I</th>
<th>Column-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Scientists)</td>
<td>(Concept)</td>
</tr>
<tr>
<td>Taylor and colleagues</td>
<td>Lac operon</td>
</tr>
</tbody>
</table>

116. In sickle cell anemia, the sequence of amino acids from the first to the seventh position of the \( \beta \)-chain of haemoglobin S(HbS) is
(a) His, Leu, Thr, Pro, Glu, Val, Val
(b) Val, His, Leu, Thr, Pro, Glu, Glu
(c) Thr, His, Pro, Val, Pro, Val, Glu
(d) Glu, His, Leu, Pro, Val, Glu, Glu
(e) Val, His, Leu, Thr, Pro, Val, Glu

117. Which triplet codon does not have a tRNA associated with it?
(a) UAA  (b) UUA
(b) UUU  (d) AUU
(e) GUU

118. Read the following statements and choose the correct option:
I. RNA polymerase associates transiently with 'Rho' factor to initiate transcription.
II. In bacteria, transcription and translation takes place in the same compartment.
III. RNA polymerase I is responsible for transcription of tRNA.
IV. When hnRNA undergoes capping process, adenlyte residues are added at 3' end in a template independent manner.
V. hnRNA is the precursor of mRNA
(a) II only is correct
(b) II, III and V only are correct
(c) III and IV only are correct
(d) I and IV only are correct
(e) II and V only are correct

119. Choose the correct statement.
(a) Haploid content of human DNA is \( 4.6 \times 10^6 \) bp.
(b) A nitrogenous base is linked to pentose sugar through phosphodiester linkage
(c) X-ray diffraction data of Maurice Wilkins and Rosalind Franklin was the basis of Watson and Crick's DNA model
(d) DNA is an acidic substance was first identified by Watson and Crick
(e) Ratios between adenine, thymine and guanine, cytosine are not constant.

120. Aminocacylation of tRNA is essential for
(a) replication of RNA
(b) formation of peptide bond
(c) splicing
(d) initiation of transcription
(e) termination
1. (e) This is due to common ion effect. According to common ion effect when a solution of strong electrolyte is added to a solution of weak electrolyte which furnishes an ion common to that strong electrolyte, the ionization of weak electrolyte is suppressed. Here \( \text{NH}_4\text{OH} \) is a weak electrolyte and \( \text{NH}_4\text{Cl} \) is a strong electrolyte.

2. (c) For a salt solution formed by weak acid (HA) and weak base (BOH)

\[
pH = \frac{1}{2} \left[ pK_w + pK_a - pK_b \right]
\]

\[= \frac{1}{2} \left[ 14 + 4.60 - 4.80 \right]
\]

\[= 6.90
\]

3. (b) According to Le-chatelier's principle, on increasing pressure equilibrium shifts in the direction where no. of moles decreases.

In the reaction

\[2\text{NH}_3 (g) \rightarrow \text{N}_2 (g) + 3\text{H}_2 (g)
\]

no. of moles of reactants are less than that of products hence on increasing pressure equilibrium will shift towards left.

4. (c) Van't Hoff factor \( (i) = \frac{\text{observed } \Delta T_b}{\text{calculated } \Delta T_b} = \frac{0.81}{0.54} = 1.5
\]

Now

\[\text{AB} \xleftrightarrow{\text{K}} \text{A}^+ + \text{B}^-
\]

at \( t = 0 \)

\[1 \quad 0 \quad 0 \quad 0
\]

at eq. \( 1 - \alpha \quad \alpha \quad \alpha \quad \alpha \)

Total no. of moles at eq. = \( 1 - \alpha + \alpha + \alpha \)

\[= 1 + \alpha
\]

\[\therefore 1 + \alpha = 1.5; \alpha = 0.5 \text{ or } 50
\]

5. (b) Chloroform-acetone solution shows negative deviation.

6. (d) \( \pi = iCRT = \frac{i \cdot n \cdot RT}{V} 
\]

\[= \frac{2 \times 10 \times 0.082 \times 300 \times 1000}{200 \times 100}
\]

\[= 24.6
\]

7. (b) Oxidation occurs at anode i.e.

\[\text{Cu} \rightarrow \text{Cu}^{2+} + 2e^-
\]

8. (d) Molar conc. of \( \text{OH}^- \) in solution = \( 2 \times \frac{0.001}{200} \times 1000 = 10^{-2}
\]

\[\because [\text{OH}^-] = 10^{-2}
\]

\[\therefore \text{pOH} = -\log [\text{OH}^-] = 2
\]

Now since

\[\text{pH} + \text{pOH} = 14
\]

\[\therefore \text{pH} = 14 - 2 = 12
\]

9. (c) According to the Nernst equation

\[E_{\text{cell}} = E^o_{\text{cell}} + \frac{2.303RT}{nF} \log \frac{[\text{Cu}^{2+}]}{[\text{Zn}^{2+}]}
\]

\[= E^o_{\text{cell}} + \frac{0.06}{2} \log \frac{[\text{Cu}^{2+}]}{[\text{Zn}^{2+}]}
\]

\[= 1.1 + \frac{0.06}{2} \log \frac{1}{1} = 1.1 - 0.03
\]

\[= 1.07 \text{V}
\]

10. (c) For a zero order reaction

\[t_{1/2} = \frac{[A]_0}{2k}
\]

or \( k = \frac{[A]_0}{2t_{1/2}} \)

\[k = \frac{6 \times 10^{-3}}{2 \times 1 \times 60} = 5 \times 10^{-5}
\]

11. (d) \( \text{C}_1\text{H}_2\text{O}_{11} + \text{H}_2\text{O} + \text{H}^+ \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + \text{C}_6\text{H}_{12}\text{O}_6 + \text{H}^+
\]

The rate law expression for the sugar inversion can be written as

\[\frac{d[\text{sucrose}]}{dt} = k[\text{Sucrose}]^n [\text{H}^+]^m
\]

Now given

\[[\text{H}^+] = 10^{-5}; t_{1/2} = 60 \text{ minutes}
\]

\[[\text{H}^+] = 10^{-4}; t_{1/2} = 600 \text{ minutes}
\]
For a zero order reaction
\[ t_{1/2} \propto a_0 \]
\[ \therefore \text{Order of reaction with respect to } [H^+] \text{ will be zero} \]
hence the rate law expression will be
\[ \text{rate} = k[\text{Sugar}]^1 [H^+]^0 \]

12. (b) From the formula
\[ \frac{N}{N_0} = \left(\frac{1}{2}\right)^n \]
where \( N_0 \) = initial amount
\( N \) = Final amount
\( n \) = no. of half lives
Substituting the values
For A
\[ \frac{25}{400} = \left(\frac{1}{2}\right)^n \]
\[ \frac{1}{16} = \left(\frac{1}{2}\right)^n \]
\[ \left(\frac{1}{2}\right)^4 = \left(\frac{1}{2}\right)^n \]
\[ \therefore n = 4 \]

now
\[ \therefore \text{Total time} (T) = n \times t_{1/2} \]
\[ \therefore t_{1/2(A)} = \frac{T}{n} = \frac{3}{4} \text{ months} \]

For B
\[ \frac{200}{400} = \left(\frac{1}{2}\right)^n \]
\[ \frac{1}{2} = \left(\frac{1}{2}\right)^n \]
\[ \therefore n = 1 \]
\[ t_{1/2(B)} = 3 \text{ months} \]

now
\[ \frac{t_{1/2(A)}}{t_{1/2(B)}} = \frac{3}{4} \times \frac{1}{3} = \frac{1}{4} \]
\[ \therefore t_{1/2(A)} = \frac{1}{4} \times t_{1/2(B)} \]
or \[ t_{1/2(B)} = 4 \times t_{1/2(B)} \]

13. (c) \[ \frac{\text{wt. of Mg deposited}}{\text{wt. of O}_2 \text{ produced}} = \frac{\text{Eq. wt. of Mg}}{\text{Eq. wt. of O}_2} \]
\[ \frac{0.150}{\text{wt. of O}_2} = \frac{12}{8} \]
wt. of \( \text{O}_2 \) = 0.1 gm

\[ \therefore 32 \text{ g of O}_2 \text{ at STP occupies} = 22400 \text{ ml} \]
\[ \therefore 0.1 \text{ g of O}_2 \text{ at STP occupies} = \frac{22400}{32} \times 0.1 \]
\[ = 70 \text{ cm}^3 \]

14. (d) Colour of the indicator changes due to change in pH and not because of adsorption.

15. (a) \([\text{NiCl}_4]^{2-}\)
\[ \overset{4\,\text{spin}}{\underset{4\,\text{spin}}{\text{sp}^3}} \]

\([\text{Ni(CN)}_4]^{2-}\)
\[ \overset{3\,\text{spin}}{\underset{2\,\text{spin}}{\text{dsp}^2}} \]

16. (c) \([\text{Co(en)}_3]^{3+}\) and \(\text{cis-[Co(en)_2Cl}_2]^+\) show optical isomerism.

17. (c) Camphor can be purified by sublimation as this is a sublime substance

18. (b) Tropolone is classified as non-benzenoid aromatic compound

19. (e) \(\text{CH}_2 = \text{CH} - \text{CO} - \text{CH}_3\)
20. (a) Among aliphatic hydrocarbons, as the no. of Pi bonds increases in carbon–carbon covalent bond, the bond length decreases. In Benzene all the C–C bond lengths are same (139 pm). The C–C bond lengths are greater than a double bond but shorter than a single bond.

\[
\begin{align*}
C_2H_6 & \quad C_2H_4 & \quad C_2H_2 & \quad C_6H_6 \\
154 \text{ pm} & \quad 133 \text{ pm} & \quad 120 \text{ pm} & \quad 139 \text{ pm}
\end{align*}
\]

21. (d) Williamson's synthesis: In this method, an alkyl halide is allowed to react with sodium alkoxide.

\[
R - X + R' - Na \rightarrow R - O - R' + NaX
\]

The reaction involves S_N_2 attack of an alkoxide ion on primary alkyl halide.

22. (b) This is due to hyperconjugation. 2, 3-dimethyl – 2 – butene can have more hyperconjugative structures than 2 – butene.

23. (e) Both carbon atoms in ethane are primary.

24. (a) 3, 4-dimethylheptane

25. (e) Since the compound contains two similar \((-C_6H_5)\) groups on one side of \(\text{C} = \text{N} – \) bond, hence geometrical isomerism is not possible.

26. (d) 4-chloro, 2, 3 dimethyl pentan-1-ol

27. (d) Carbylamine test is performed by only 1° amines. Except \((CH_3)_3N\) all are 1° amines.

28. (c) A mixture of an alkyl halide and aryl halide gives an alkylarene when treated with sodium in dry ether and is called Wurtz-Fitting reaction.

\[
C_6H_5I + 2Na + CH_3I \rightarrow C_6H_5CH_3 + 2NaI
\]

29. (e) Benzyl chloride undergoes hydrolysis by S_N_1 mechanism because of the stability of benzyl carbocation formed as a result of heterolysis.

30. (a) According to Saytzeff's rule "In dehydrohalogenation reactions the preferred product is that alkene which has the greater number of alkyl groups attached to the doubly bonded carbon atoms. Thus 2-methyl but-2-ene will be the major product.

\[
\begin{align*}
\text{CH}_3 - \text{CH}_2 - & \quad \text{C} \quad \text{–CH}_3 + \text{alcohol} + \text{KOH} \\
\text{Br} & \quad \text{CH}_3 \\
\text{CH}_3 - \text{CH} = & \quad \text{C} \quad \text{–CH}_3 + \text{CH}_3 - \text{CH}_2 - \text{C} \quad \text{= CH}_2
\end{align*}
\]

(major)

(minor)

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\text{CH}_3 - \text{CH} = & \quad \text{C} \quad \text{–CH}_3 + \text{CH}_3 - \text{CH}_2 - \text{C} \quad \text{= CH}_2
\end{align*}
\]

(major)

(minor)

31. (a) No new C–C bond formation takes place in Canizzaro's reaction.

32. (e) In substituted phenols the presence of electron withdrawing groups such as nitro group, enhances the acidic strength of phenol. This effect is more pronounced when such a group is present at ortho and para position. It is due to the effective delocalisation of negative charge in phenoxide ion. On the other hand electron releasing groups such as alkyl groups do not favour the formation of phenoxide ion resulting in decrease in acid strength hence p-cresol is least acidic among all and hence have highest pH.

33. (a) p-toluenesulphonyl chloride is used to distinguish between secondary and tertiary amine.

34. (d) The order of boiling points of isomeric amines is as follows:

\[
1° > 2° > 3°
\]

Boiling point of 1° amine is highest due to intermolecular hydrogen bonding.

35. (b) \(\text{CH}_3 - \text{C} \quad \text{–NH}_2 \rightarrow \text{CH}_3 - \text{CH}_2 - \text{NH}_2\)

acetamide

ethanamine
36. (a) a - (v), b - (i), c - (iii), d - (ii)

(a) \( \text{acetaldehyde} \quad \text{vinyl alcohol (Tautomers)} \)

(b) Eclipsed and staggered ethane are example of conformational isomers.

(c) \( (+) - 2 \text{-butanol} \quad (-) - 2 \text{-butanol (enantiomers)} \)

(d) \( \text{Methyl-N-propylamine} \quad \text{Diethyl amine (metamers)} \)

37. (a) PHBV is a biodegradable polymer

38. (a) 39. (c) 40. (c)

41. (e) Tetracycline is a bacteriostatic drug i.e. have inhibitory effect on microbes.

42. (d) Freon - 12 \( (\text{CCl}_2\text{F}_2) \) is one of the most common freons in industrial use. It is manufactured from tetrachloromethane by swarts reaction.

43. (d) De-broglie wavelength \( \lambda = \frac{h}{mv} \)

Consider that the given particle is \( \alpha \)

\[ \lambda_D = \frac{(mv)_\alpha}{(mv)_D} = \frac{4}{5} = 0.4 \]

44. (c) The maximum number of electrons which can be held by subshell with azimuthal quantum number \( (\ell) \) in an atom is \( = 2(2\ell + 1) \)

45. (a)

46. (d) \( \Delta \nu = \frac{h}{4\pi m \cdot \Delta \nu} = \frac{6.626 \times 10^{-34}}{4 \times \pi \times 6.626 \times 10^{-34} \times 1 \times 10^{-6}} \)

\[ = \frac{1}{4\pi} \times 10^{-9} \text{ m} = \frac{1}{4\pi} \text{ nm} \]

47. (a) \( O_2^+ = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\pi 2p_x)^2(\pi 2p_y)^2 \)

\[ (\pi 2p_x^2 \equiv \pi 2p_y^2) (\pi^* 2p_x^1) \]

B.O. = \( \frac{1}{2}[10 - 5] = 2.5 \)

\( C_2 = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\pi 2s)^2 (\pi 2p_x^2 \equiv \pi 2p_y^2) \)

B.O. = \( \frac{1}{2}[8 - 4] = 2 \)

48. (d) B in \( \text{BF}_3 \) is \( sp^2 \) hybridized hence percentage of s-character is 33.3%.

49. (d) Among the given option the dipole moment of \( \text{CHCl}_3 \) is highest.

50. (c) \( \therefore 1 \text{ lone pair and 3 bond pairs} \)

51. (c) According to Henry's law

\[ P = K_H x \text{ where } K_H = \text{Henry's constant} \]

\[ 0.76 = 7.6 \times 10^4 \times x \]

\[ x = \frac{0.76}{7.6 \times 10^4} = 10^{-5} \]

52. (d) It is dipole-induced dipole force that operates between the polar molecules having permanent dipole and the molecule lacking permanent dipole e.g. \( \text{HCl and Cl}_2 \)

53. (e) Gases cannot be liquified above their critical temperature.

54. (a) No. of tetrahedral voids = 2

No. of octahedral voids = \( n \)

55. (a) As and Si are metalloids

56. (c) \( N(7) = 1s^2 2s^2 2p^3 \) i.e. 3 unpaired electrons.

57. (b)

58. (e) \( \text{Li}_2\text{CO}_3 \) is the least stable carbonate and give \( \text{Li}_2\text{O} \) and \( \text{CO}_2 \) on heating to red hot.

59. (c) Sphalerite is \( \text{ZnS} \), the sulphide ore of \( \text{Zn} \). This is concentrated by froth floatation process.

60. (d) Vapour phase refining method is used for the purification of titanium, zirconium etc. and is called Van Arkel method.

61. (e) Quartz is used as a piezoelectric material

62. (c) \( \text{HOCl} + \text{H}_2\text{O} \leftrightarrow \text{H}_3\text{O}^+ + \text{Cl}^- + \text{O}_2 \)

63. (b) In \( \text{B}_2\text{H}_6 \), there are four two-centre two electron bonds and two three centre two electron bonds also called banana bonds

\[ \text{Structure of } \text{B}_2\text{H}_6 \]
64. (a) C\textsubscript{2}F\textsubscript{3} is used for the production of UF\textsubscript{6} in the enrichment of\textsuperscript{235}U
\[ \text{UF}(s) + 3\text{CIF}_3(l) \rightarrow \text{UF}_6(g) + 3\text{CIF}(g) \]

65. (b) Ziegler Natta catalyst is TiCl\textsubscript{4} + (C\textsubscript{2}H\textsubscript{5})\textsubscript{3}Al, used for the polymerization of olefins.

66. (e) The standard reduction potential of copper is +0.34V

67. (a) Ti(Z = 22) \rightarrow [\text{Ar}]3d\textsuperscript{2}4s\textsuperscript{2}
i.e. Ti\textsuperscript{4+} (18) = [\text{Ar}]3d\textsuperscript{0}4s\textsuperscript{0} no unpaired electrons and hence it is colourless in aqueous solution.

68. (d) Ni(Z = 22) \rightarrow [\text{Ar}]3d\textsuperscript{8}4s\textsuperscript{2}
Ni\textsuperscript{2+} = [\text{Ar}]3d\textsuperscript{8}m\textsuperscript{2}=\text{2}(22)\text{2} = \text{2}2\text{5} \text{BM}

69. (e) CH\textsubscript{4} + 2O\textsubscript{2} \rightarrow CO\textsubscript{2} + 2H\textsubscript{2}O
According to Hess's law
\[ \Delta H_f = \Delta H_f(\text{CO}_2) + 2 \times \Delta H_f(\text{H}_2\text{O}) - \Delta H_f(\text{CH}_4) \]
\[ \Delta H = -393.5 + 2 \times -285.8 - (-74.8) = -890.3 \text{ kJ mol}^{-1} \]

70. (a) \Delta H = -110 + 2 \times -53
\[ = -216 \text{ kJ mol}^{-1} \]

71. (b) \Delta G = -2.303 RT \log K
\[ -172.4 = -19.15 \times 10^{-3} \times T \log 10 \]
\[ T = 300 \text{ K} \]

72. (c) N\textsubscript{2}(g) + O\textsubscript{2}(g) \rightleftharpoons 2\text{NO}(g)
\[ K_c = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} \]

\[ \text{NO} \rightleftharpoons \frac{1}{2} \text{N}_2 + \frac{1}{2} \text{O}_2 \]
\[ K_c = \frac{[\text{N}_2]^{\frac{1}{2}}[\text{O}_2]^{\frac{1}{2}}}{[\text{NO}]} \]
\[ \therefore K_c = \frac{1}{K_c} \]
\[ K_c = \sqrt{\frac{1}{0.0625}} \]
\[ = \frac{1}{25 \times 10^{-2}} \]
\[ = 4 \]

73. (b) Magnetic field
\[ B = \frac{\mu_0 NI}{2\pi R} \]
\[ = \frac{4\pi \times 10^{-7} \times 200 \times 1}{2\pi \times 0.1} \]
\[ = 4 \times 10^{-4} \text{ T} \]
This value is inside closed space and, in open space B = zero

74. (c) Transformer is used to obtain desired ac voltage and current

75. (b) In series RLC circuit,
\[ V = \sqrt{V_R^2 + (V_L - V_C)^2} \]
And, at resonance, \( V_L = V_C \)
\[ \text{Hence, } V = V_R \]

76. (d) A dynamo is a device which converts mechanical energy into electrical energy

77. (d) Infrared radiations

78. (e) As we know, equivalent power of lens
\[ P = P_1 + P_2 = 15 + (-3) = 12 \text{ D} \]
And focal length \( F = \frac{1}{P} = \frac{1}{12} \text{ m} = \frac{100}{12} \text{ cm} = 8.33 \text{ cm} \)

79. (b) In an isotropic medium, speed of light depends on its wavelength.

80. (a) Cylindrical lens is used to rectify eye defect astigmatism

81. (e) Stopping potential increases if wavelength of light falling on a photosensitive material decreases.

82. (a) Activity decreases
5000 dps to 2500 dps in 150 days
\[ \therefore \text{Half life period } T_{\frac{1}{2}} = 150 \text{ days} \]
\[ \therefore 300 \text{ days} = 2T_{\frac{1}{2}} \]
Therefore, initial activity = 5000 \times 2T_{\frac{1}{2}} = 5000 \times 2 \times 2
\[ = 20000 \text{ dps} \]

83. (b) Control rods absorb fast moving neutrons in nuclear reaction. They are made of cadmium.

84. (d) In fusion, lighter nuclei combine to form heavier nucleus
\[ \text{i.e., } \frac{2}{3} \text{H} + \frac{2}{3} \text{H} \rightarrow \frac{3}{3} \text{He} + \frac{1}{n} + Q \]

85. (c) Resistivity \( \rho_{\text{insulator}} > \rho_{\text{semiconductor}} > \rho_{\text{metal/conductor}} \)

86. (c) For solar cell, band gap < 3 eV

87. (d) To make an OR gate at least 3 NAND gates are required

88. (a) Low pass filter allows 624 kHz to pass and retains 630 kHz and 636 kHz frequencies.
89. (e) A transducer converts physical variable into corresponding variations in the electrical signal.

90. (b) Mobility $\mu = \frac{\text{drift velocity} \ V_d}{\text{electric field} \ E} = \frac{(\text{ms}^{-1})}{(\text{Vm}^{-1})} = \frac{\text{m}^2 \text{s}^{-3}}{\text{V}}$

\[ \therefore \ \text{Volt} = V = \frac{\text{joule(J)}}{\text{coulomb(C)}} \]

\[ = \frac{\text{m}^2 \text{s}^{-1}\text{C}}{\text{J}} = \frac{\text{m}^2 \text{s}^{-1}\text{As}}{\text{kg} \text{m}^2 \text{s}^{-2}} \] [Coulomb, c = As]

\[ = \text{kg}^{-1} \text{s}^{-2} \text{A} = \text{M}^{-1} \text{T}^2 \text{A} \]

91. (d) Slope $AB = \frac{BC}{AC} = \frac{\Delta V}{\Delta t} = \text{acceleration}$

92. (e) As ball returns to starting point so displacement is zero.

93. (d) For complementary angles of projection $(45^\circ + \alpha)$ and $(45^\circ - \alpha)$ with same initial velocity $u$, range $R$ is same.

\[ \theta_1 + \theta_2 = (45^\circ + \alpha) + (45^\circ - \alpha) = 90^\circ \]

94. (e) Angular speed of tip of seconds hand

\[ \omega = 2 \pi \ \text{radian} \text{ in 60 s} \]

\[ = \frac{\pi}{30} \ \text{rads}^{-1} \]

\[ \therefore \ \text{Linear speed} \ v = R \omega \]

\[ = 10 \times \frac{\pi}{30} \times \frac{\pi}{3} \ \text{cm} \text{ s}^{-1} \] [\( R = 10 \text{ cm} \)]

\[ = 1 \ \text{cm} \text{ s}^{-1} \]

95. (b) As we know, coefficient of friction $\mu = \frac{F}{N}$

\[ \Rightarrow \mu = \frac{ma}{mg} = \frac{a}{g} \] [\( a = 7.35 \text{ m s}^{-2} \text{ given} \)]

\[ \therefore \mu = \frac{7.35}{9.8} = 0.75 \]

96. (a) As we know, $|\text{impulse}| = |\text{change in momentum}|$

\[ = |p_2 - p_1| \]

\[ = |0 - mv_1| \]

\[ = |0 - 3 \times 2| = 6 \text{ Ns} \]

97. (c) Power $= \frac{\text{work done}}{\text{time}}$

Therefore power of A, $P_A = \frac{mgh}{t_A}$

and power of B, $P_B = \frac{mgh}{t_B}$

\[ \therefore \frac{P_A}{P_B} = \frac{t_B}{t_A} = \frac{4}{2} = 2 : 1 \]

98. (d) Power $= \frac{\text{total work done}}{\text{time}}$

\[ = \frac{\frac{1}{2} M v^2}{t} = \frac{1}{2} (mv)^2 n \] [\( M = mn \)]

\[ = kn \] [\( \therefore \text{K.E.} = \frac{1}{2} mv^2 \)]

99. (b) The distribution of mass about axis EF is minimum so radius of gyration is minimum and therefore moment of inertia is minimum about EF.

100. (e) The position of centre of mass of a system depends upon mass, relative distance, position and symmetry of the body.

\[ R_{CM} = \sum m_i \frac{r_i}{\sum m_i} \]

101. (b) Escape velocity $v_e = \sqrt{\frac{2GM}{R}}$

Orbital velocity $v_o = \sqrt{\frac{GM}{R}}$

\[ \therefore \ v_e = \sqrt{2} v_o \]

102. (a) Height of geo-stationary orbit is 35,800 km

The time period of Earth's satellite about its axis is 24 hours.

103. (c) From stoke's law, $F = 6 \pi \eta R_1 v$, and $V = \frac{4}{3} \pi R^3$

\[ F = 6 \pi \eta R_2 v, \left(\text{volume} \ 8 \ V = \frac{4}{3} \pi (2R)^3 \right) \]

\[ = 6 \pi \eta (2R)v \]

\[ = 2F \]
104. (b) As we know, 
\[ Y = 2G(1 + \sigma) \]
\[ \Rightarrow G = \frac{Y}{2(1 + \sigma)} = \frac{Y}{3} \]

105. (e) Bulk modulus \( B = \frac{|\text{dp}|}{\frac{\text{dV}}{V}} \)

\[ \therefore \text{Pressure, dp} = B \left( \frac{\Delta V}{V} \right) \]

106. (d) The mean free path \( \lambda = \frac{1}{n \pi d^2} \)
\[ \Rightarrow \lambda \approx \frac{1}{d^2} \]

Here \( d \) is the average diameter of the gas molecule.

107. (e) According to Kinetic theory of gases the collision between gas molecules are perfectly elastic.

108. (b) According to first law of thermodynamics 
\[ Q = \Delta U + W \]
Given : \( Q = 2 \text{kcal} = 2000 \times 4.2 = 8400 \text{ J} \)
\[ W = 400 \text{ J} \]
\[ \therefore \Delta U = Q - W = 8400 - 400 = 8000 \text{ J} \]

109. (c) Given, \( x = \frac{A}{2} \)
\[ \therefore \text{from } x = A \sin \omega t \]
\[ \Rightarrow \omega t = 30^\circ \]
And, \( \frac{KE}{PE} = \cot^2 \omega t = \left( \sqrt{3} \right)^2 = 3 \]

110. (c) Given \( t = 1 \text{ s} \)
\[ \therefore x = 5 \cos \left( 2\pi + \frac{\pi}{4} \right) \]
\[ = 5 \cos \frac{\pi}{4} = \frac{5}{\sqrt{2}} \text{ m} \]
\[ \Rightarrow \text{i.e., displacement at } t = 1 \text{ s is } \frac{5}{\sqrt{2}} \text{ m} \]

111. (c) Longitudinal waves can propagate in solids, liquids and gases.

112. (c) Speed of sound in air \( v = \sqrt{\frac{P}{\rho}} = \sqrt{\gamma RT} \)
\[ \text{i.e., } v \text{ increases with humidity.} \]

113. (b) Bulk modulus 
\[ B = \frac{\text{dp}}{\Delta V} = \frac{3\text{dp}}{3r} \]
Therefore the fractional decrease in radius
\[ \frac{dr}{r} = \frac{\text{dp}}{3B} = \frac{p}{3B} \]

114. (c) For a dipole placed in a uniform magnetic field, torque is maximum if \( \vec{P} \) is perpendicular to \( \vec{E} \)

115. (a) For a uniformly charged infinite length wire,
\[ E = \frac{\lambda}{2\pi \epsilon_0 r} \]
Where \( \lambda \) is the linear charge density.

116. (b) As we know, mass deposited \( m = ZI \text{t} \)
\[ Z = \text{electrochemical equivalent} \]
when \( I = 4 \text{A current flows for } t = 2 \text{ minutes} = 120 \text{ s} \) then
\[ m = Z \times 4 \times 120 = 480Z \] ...(i)
when \( I = 6 \text{A current flows for } t = 40 \text{ s} \), then
\[ m' = Z \times 6 \times 40 = 240Z \] ...(ii)
From eqn (i) and (ii)
\[ m' = \frac{m}{2} \]

117. (c) As we know, Resistance \( R \propto \text{length} (l) \)

\[ \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{9} + \frac{1}{9} = \frac{2}{9} \]
\[ \therefore R = \frac{9}{4} \Omega \]

118. (a) For an alloy used for making resistor temperature coefficient of resistance is small and positive.

119. (e) Deflection \( \theta = \frac{BINA}{C} \)
\[ \Rightarrow \theta \propto N \]
\[ N = \text{no. of turns in the coil.} \]

120. (a) As we know, \( F = q (\nabla \times \vec{B}) \)
\[ \text{If } v = 0 \Rightarrow F = 0 \]
1. (b) The common name of Niacin or Nicotinic acid is vitamin-PP (Pellagra Preventive). It acts as coenzymes in hydrogen transport as NAD/Coenzyme-I and NADP/Coenzyme-II.

2. (a) Morphine is alkaloid, curcumin is drug.

3. (c) Cells shrink in hypertonic solutions and swell in hypotonic solutions.

4. (d) Micro nutrients are nutrients needed by plant body in relatively small amounts or trace amount (equal or less than 0.1 mg per gram dry matter). They are mostly involved in the functioning of enzymes, cofactors or metal activators. E.g. copper, iron, molybdenum, zinc, boron, chlorine, nickel, manganese etc.

5. (a) NADPH + H⁺ never formed in cyclic reaction.

6. (b) Two decarboxylation reaction take place in citric acid cycle, i.e. Citric acid → ketoglutaric acid. a-ketoglutaric and → Succinyl CoA

7. (c) Maize is C₄ plants.

8. (d) Facilitated transport never requires ATP and never follow uphill transport.

9. (e) Rhizobium is symbiotic bacterium. Rhodospirillum is anaerobic. Nostoc and Anabaena are free living blue-green algae (cyanobacteria).

10. (b) GA increases internode growth in sugar cane.

11. (a) Non-showy and no nectar are the characters of both wind and water pollinated flowers.

12. (d) Bryophytes can live in soil but are dependent on water for very small animals have to spend greater energy.

13. (c) Fungi are achlorophyllous, heterotrophic, gametophytic, haploid, multicellular, eukaryotic nucleated, spore producing thallophytes which are surrounded by cell wall of chitin (fungus cellulose).

14. (c) The common members are Polysiphonia, Porphyra, Gracilaria and Gelidium.

15. (b) Instead of cell wall Euglenoids possess a pellicle layer.

16. (a) Parietal: Single chambered ovary ovules are borne on periphery as in Cruciferae family. Free-Central: The ovary is one-chambered. The placenta arises from the base of the ovary in the form of a swollen central axis. The ovules are borne all over the surface of the placenta, as in Primulaceae, (e.g. Dianthus and Primrose).
48. (d) The gynoecium of fabaceae is monocarpellary, superior ovary unilocular with marginal placentation.
49. (b) Polyarch xylem and casparian strips are seen in dicot roots.
50. (a) Solanaceae shows cymose inflorescence and bilocular ovary.
51. (d) Cell wall of parenchyma is highly cellulosic.
52. (d) Monocots posses closed vascular bundles.
53. (a)
54. (b) Endodermis in dicot root contain suberin deposition.
55. (a) Vibrio – comma shaped bacteria. Lysosome rich in hydrolytic enzyme.
56. (d) Ribosomes are absent in golgi apparatus.
57. (c)
58. (a) G.N. Ramachandran discovered the helical structure of collagen. Collagen is the most abundant protein of animal world.
59. (b) Based on the position of centromere there are four different types of chromosomes metacentric (middle centromere), sub-metacentric (centromere haper to acromcentric (centromere close to end) and telocentric (termirel centromed)
60. (c)
61. (b) In eukaryotes, genes are split genes which contain (expressing coding sequence) called exon and altern with intervening/non coding sequences. Introns do not code for any protein and are removed during RNA processing (splicing).
62. (d) A tRNA has (i) ammino acid (AA) binding (ii) anticodon loop (iii) TPC loop (iv) DHU loop and (v) variable extra arm.
63. (c) Mathew Meselson and Franklin Stahl proved that DNA replication is a semiconservative process. They proved that two strands of DNA duplex separate at time of replication and act as template for synthesis of new complementary strands i.e. semi conservative.
64. (a) 65. (a) 66. (c)
67. (b) They salivary amylase is the starch digesting enzyme and functions at almost neutral pH, that is at 6.8.
68. (d) Diaphragm is present below lung and separates thoracic cavity from abdominal cavity. Its up and down movement helps in expiration and inspiration during breathing.
69. (b) Vital capacity is the maximum volume of air a person can breathe in after a forced expiration or the maximum volume of air a person can breathe out after a forced inspiration. It varies from 3400 mL to 4800 mL.
70. (d)
71. (c) The Thromboplastin or Thrombokinase is released from injured platelets or injured tissue. This converts prothrombin into thrombin in the presence of calcium ions. The thrombin converts fibrinogen into fibrin, the latter forms the clot.
72. (c) The pCO₂ and pO₂ in oxygenated blood i.e. arterial blood is 40 mm Hg and 95 mm Hg respectively.
73. (a) Striated muscle fibres have a large number of myofibrils in their cytoplasm. Each myofibril has dark and light bands, which are made up of actin and myosin proteins and give the myofibril a striated appearance.
74. (c)
75. (d) Hyoid bone is a horseshoe-shaped bone situated in the anterier midline of the neck between the chin and the thyroid cartilage. It serves as a point of attachment for some of the muscles of the tongue and floor of the mouth but does not articulate with any other bone.
76. (c) In a resting nerve fibre, axoplasm contains a high concentration of K⁺ and negatively charged proteins and low concentration of Na⁺. In contrast, the fluid outside axon contains a low concentration of K⁺ and a high concentration of Na⁺ and thus forms a concentration gradient. This ionic gradient is maintained by Na⁺ – K⁺ pump. As a result, the outer surface of axonal membrane possesses a positive charge while its inner surface is negatively charged and therefore is polarised.
77. (c)
78. (b) Parathyroid hormone or parathormone is released by parathyroid glands. This hormone regulates the calcium and phosphate balance between blood and other tissues. It increases calcium reabsorption in nephron, mobilises the release of calcium into blood from bones and hence increases blood calcium level.
79. (c)
80. (d) In a myofibril the dark bands (A bands) and light bands (I bands) are present alternatley. Each I band has at its centre a dark membrane called Z line. The part of myofibril between two successive Z lines is called a sarcomere.
81. (a) Chylomicrons are lipoprotein molecules which consist of small fat globules coated with protein.
82. (c) The relationship between partial pressure of oxygen and percentage saturation of the haemoglobin with oxygen is graphically illustrated by a curve called oxygen haemoglobin dissociation curve. Under normal conditions the oxygen haemoglobin dissociation curve is sigmoid or s-shaped.
83. (d) Hormones of adrenal medulla include noradrenaline and adrenaline. Nor-adrenaline regulates blood pressure and cardiac output under normal conditions.
84. (b) ADH or antidiuretic hormone or vasopressin increases the reabsorption of water in the distal convoluted tubule and collecting ducts of the nephrons of kidney. As a result, water reabsorption from glomerular filtrate is increased and urine becomes concentrated.

85. (e)

86. (d) The additional type spermatogonia grow into larger primary spermatocytes which undergo reduction division to produce two haploid secondary spermatocytes which now undergo second maturation division to form four haploid division to spermatids. Spermatids transform into sperms through spermiogenesis or spermateliosis.

87. (a) The walls of uterus are composed of three layers endometrium, myometrium and perimetrium. Endometrium is inner glandular layer that lines the uterine cavity and undergoes cyclic changes during menstrual cycle.

88. (b)

89. (e) IVF is in vitro fertilization which is a method of assisted reproduction for infertile couples.

90. (d) Biosphere reserves, National Parks and wildlife sanctuaries are in-situ conservation methods i.e. conservation of wildlife in their natural habitat.

91. (e) Norman E. Borlaug is considered the father of 'Green revolution' as the semi dwarf varieties of wheat developed by him increased wheat production manifolds.

92. (b) Pencillin was the first antibiotic to be discovered by Alexander Fleming (1928). The antibiotic was however, commerically extracted by efforts of Chain and Florey and was extensively used in treating wounded soldiers in world war II Fleming, Chain and Florey were awarded Noble Prize in 1945.

93. (a)

94. (b) Baculoviruses mostly of the genus Nucleopolyhedrovirus are useful in controlling many insects and other arthropods. Thus are widely used.

95. (c) Flipper of penguins and dolphins are examples for analogy.

96. (b)

97. (a) Homo erectus had a brain capacity of 900 cc.

98. (e) Coelenterates have tissue level organisation.

99. (c)

100. (e) Polyps produce medusae asexually and medusae form polyps sexually

101. (a)

102. (e) Proventriculus or gizzard is a part of digestive system in cockroach.

103. (c) Male genital pore is present in 18th segment.

104. (e)

105. (d) Venous connection between liver and intestine is called hepatic portal system.

106. (b) Gap junctions are direct cytoplasm to cytoplasm connection. They permit transport of ions and small molecules between cells without leaking into the space or gap between them.

Tight junctions tie the cells firmly and check the movement of materials and thus communication between them.

Adhering junction form a strengthening and interlocking belt encircling the exterior of adjacent cells and contribute to the stability and integrity of the cell layer.

107. (a)

108. (e) Multiple allelism is the condition when more than two alternate forms of a gene are present on the same locus. ABO blood groups are caused due to multiple allelism where three alleles of the gene for blood group i.e. I^A, I^B and I^O are present.

109. (e) Reginald C. Punnett developed Punnett's square where all possible gametes of one parent are placed vertically on the checker board and those of other parent are placed horizontally. Then their combinations are worked out.

110. (c) Mendel gave the law of independent assortment stating that two genes always assort independent of each other. But studies by Morgan proved that genes show linkage. Linkage is the phenomenon or certain closely located genes staying together during inheritance through generations without any change or separation.

Thus, closely located genes generally tend to stay together and do not show recombination.

111. (d) Phenylketonuria (PKU) is an inborn autosomal, recessive metabolic disorder in which the homozygous recessive individual lacks the enzyme phenylalanine hydroxylase needed to change phenylalanine to tyrosine in liver.

112. (c) A deoxyribonucleotide of DNA is formed by cross linkage of three chemicals-phosphoric acid, deoxyribose sugar and nitrogen base. The phosphate group is connected to the 5' carbon of sugar residue of its own nucleotide and 3' carbon of the sugar residue of the next nucleotide by 3' – 5' phosphodiester bond. The sugar is connected with nitrogen base also.
113. (c) XX-XO type of sex determination is found in roundworms and some insects like tree bugs, grasshoppers etc. Here, the females have two sex chromosome XX, while the males have only one sex chromosome X. There is no second sex chromosome. Females show homogamety and produce all X containing eggs while males show heterogamety and produce both X containing sperms and sperms without sex chromosomes.

114. (e) For a biomolecule to act as genetic material it is important that it should be stable so that it can be passed on to progenies as genetic information of the parental traits and traits of the species.

115. (c)

116. (e) Normal haemoglobin has glutamic acid at its 6th position of β chain when it is replaced by valine due to mutation, sickle cell haemoglobin is produced.

117. (a) UAA is the termination codon and thus no tRNA and no amino acid is associated with it.

118. (e)

119. (c) Haploid content of human DNA is $3.3 \times 10^9$ bp. A nitrogenous base is linked to the pentose sugar through a N-glycosidic linkage. DNA is an acidic substance present in nucleus was first identified by Friedrich Meischer in 1869. In DNA, the ratios between Adenine and Thymine, and Guanine and Cytosine are constant.

120. (b) Charging or aminoacylation of tRNA is, the process when tRNA specific for the amino acid forms aminoacyl. The amino acid is linked to 3’ – OH and tRNA through its – COOH group. The tRNA complexed with amino acid is sometimes called charged tRNA. This process is essential for protein synthesis. i.e. polypeptide formation through formation of peptide bonds between amino acids.