SOLVED PAPER
AIIMS - 2011*

Time : 3½ Hours   Max. Marks : 200

PHYSICS

1. What is the dimensions of magnetic field B in terms of C (= coulomb), M, L, T?
   (a) $[M^1L^1T^{-2}C]$
   (b) $[M^1L^0T^{-1}C^{-1}]$
   (c) $[M^1L^0T^{-2}C]$
   (d) $[M^1L^0T^{-1}C]$

2. What is the mechanical equivalent of spring constant k in LC oscillating circuit?
   (a) $\dfrac{1}{L}$
   (b) $\dfrac{1}{C}$
   (c) $\dfrac{L}{C}$
   (d) $\dfrac{1}{LC}$

3. What is the moment of inertia for a solid sphere w.r.t. a tangent touching to its surface?
   (a) $\dfrac{2}{5}MR^2$
   (b) $\dfrac{7}{5}MR^2$
   (c) $\dfrac{2}{3}MR^2$
   (d) $\dfrac{5}{3}MR^2$

4. Water is flowing with velocity 4 m s^{-1} in a cylinder of diameter 8 cm, it is connected to a pipe with it end tip of diameter 2 cm, calculate the velocity of water at this free end.
   (a) 4 m s^{-1}
   (b) 8 m s^{-1}
   (c) 32 m s^{-1}
   (d) 64 m s^{-1}

5. A cylindrical wire is twisted with an angle θ, what is torsion produced in it?
   (a) $\dfrac{C}{\theta}$
   (b) $C\theta$
   (c) $\dfrac{C}{\theta^2}$
   (d) $C\theta^{3/2}$

6. Given, $\vec{\omega} = 2\hat{k}$ and $\vec{r} = 2\hat{i} + 2\hat{j}$. Find the linear velocity.
   (a) $4\hat{i} + 4\hat{j}$
   (b) $4\hat{i} + 4\hat{k}$
   (c) $-4\hat{i} + 4\hat{j}$
   (d) $-4\hat{i} - 4\hat{j}$

7. If maximum speed of a particle in SHM is given by V_m, what is its average speed?

   (a) $\dfrac{\pi}{2}V_m$
   (b) $\dfrac{2}{\pi}V_m$
   (c) $\dfrac{\pi}{4}V_m$
   (d) $\dfrac{V_m}{\sqrt{2}}$

8. Which of the following equation does not represent a SHM?
   (a) $\cos\omega t + \sin\omega t$
   (b) $\sin\omega t - \cos\omega t$
   (c) $1 - \sin 2\omega t$
   (d) $\sin\omega t + \cos(\omega t + \alpha)$

9. In simple harmonic motion, loss of kinetic energy is proportional to
   (a) e^x
   (b) x^3
   (c) $\log x$
   (d) x^2

10. Emissive and absorptive power of a material at 2000 K is 8 and 10 respectively, calculate the emissivity of IBB (Ideal black body)
    (a) 0.2
    (b) 0.4
    (c) 0.6
    (d) 0.8

11. Energy stored in between the plates of parallel plate capacitor of area A, separated by distance d is
    (a) $\dfrac{1}{2}\varepsilon_0 E^2 Ad$
    (b) $\dfrac{1}{2}\varepsilon_0 E^2 \dfrac{A}{d}$
    (c) $\dfrac{1}{2}\varepsilon_0 \dfrac{d}{E^2 A}$
    (d) $\dfrac{1}{2}\dfrac{Ad}{\varepsilon_0 E^2}$

12. Magnetic energy per unit volume is represented by
    (a) $\dfrac{B^2}{2\mu_0}$
    (b) $\dfrac{B^2}{2\mu_0^2}$
    (c) $\dfrac{2B^2}{\mu_0}$
    (d) $\dfrac{B^2}{\mu_0}$

13. Mutual inductance M between two concentric coils of radii 1 m and 2 m is
    (a) $\dfrac{\mu_0\pi}{2}$
    (b) $\dfrac{\mu_0\pi}{4}$

(c) $\dfrac{\mu_0 \pi}{8}$

(d) $\dfrac{\mu_0 \pi}{10}$

14. In an interference, the intensity of two interfering waves are I and $4I$ respectively. They produce intensity at two points A and B with phase angle of $\pi/2$ and π respectively. Then difference in between them is
    (a) I
    (b) $2I$
    (c) $4I$
    (d) $5I$

15. In a single slit diffraction with $\lambda = 500$ nm and a lens of diameter 0.1 mm then width of central maxima, obtain on screen at a distance of 1 m will be
    (a) 5 mm
    (b) 1 mm
    (c) 10 mm
    (d) 2.5 mm

16. Voltage of modulating wave of 5 V with 10 MHz frequency was superimposed on carrier wave of frequency 20 MHz and voltage 20 V then the modulation index is
    (a) 0.25
    (b) 1.25
    (c) 2.43
    (d) 64.0

17. The area covered by a transmitting antenna of height 50 m is
    (a) 320π km^2
    (b) 1440 km^2
    (c) 640π km^2
    (d) 120π km^2

18. If we assume kinetic energy of a proton is equal to energy of the photon, the ratio of de Broglie wavelength of proton to photon is proportional to
    (a) E
    (b) $E^{-1/2}$
    (c) $E^{1/2}$
    (d) $E^{3/2}$

19. The ratio of the masses of the elements having their nuclear radii 2 fermi and 1 fermi is
    (a) 8
    (b) 2
    (c) 3
    (d) 4

20. A proton travels few distance in an electric field, then it enters a crossed magnetic field of 1 T and radius 0.2 m, find the velocity of proton.
    (a) 0.2×10^8 m s^{-1}
    (b) 0.2×10^7 m s^{-1}
    (c) 0.2×10^6 m s^{-1}
    (d) 2×10^7 m s^{-1}

21. Two lens of focal lengths −20 cm and +10 cm are put in combination, find the power of the combination.
    (a) − 1 D
    (b) − 2 D
    (c) + 5 D
    (d) + 2 D

22. A far sighted person has his near point 50 cm, find the power of lens he should use to see at 25 cm, clearly.
    (a) + 1 D
    (b) + 2 D
    (c) − 2 D
    (d) − 1 D

23. For a nuclear reactor to run in critical condition the reproduction factor k should be
    (a) $= 1$
    (b) > 1
    (c) < 1
    (d) $>>> 1$

24. Which of the following substances magnetic susceptibility χ_m is negative?
    (a) Diamagnetic
    (b) Paramagnetic
    (c) Ferromagnetic
    (d) All of these

25. When orientation of dipoles parallel and antiparallel to magnetic field is distributed unequally, then the material is
    (a) paramagnetic
    (b) ferromagnetic
    (c) ferrimagnetic
    (d) antiferromagnetic

26. S^{32} absorbs energy and decays into which element after two α-emissions?
    (a) Carbon
    (b) Aluminium
    (c) Oxygen
    (d) Magnesium

27. Lenz law is consistent with conservation of
    (a) energy
    (b) mass
    (c) charge
    (d) momentum

28. In series LCR circuit, the phase difference between applied voltage and current is
    (a) positive when $X_L > X_C$
    (b) positive when $X_C > X_L$
    (c) $90°$
    (d) $0°$

29. Direction of electric field in P-N junction diode is
    (a) from P-side to N-side
    (b) from N-side to P-side
    (c) randomly oriented
    (d) electric field does not exist

30. What is your observation when two sources are emitting sound with frequency 499 Hz and 501 Hz?
    (a) Frequency of 500 Hz is heard with change in intensity take place twice.
    (b) Frequency of 500 Hz is heard with change in intensity take place once.
    (c) Frequency of 2 Hz is heard with change in intensity take place once.
    (d) Frequency of 2 Hz is heard with change in intensity take place twice.

31. A 0.2 kg object at rest is subjected to a force $(0.3\hat{i} - 0.4\hat{j})$ N. What is the velocity after 6 s?
    (a) $(9\hat{i} - 12\hat{j})$
    (b) $(8\hat{i} - 16\hat{j})$
    (c) $(12\hat{i} - 9\hat{j})$
    (d) $(16\hat{i} - 8\hat{j})$

32. If man were standing unsymmetrically between parallel cliffs, claps his hands and starts hearing a series of echoes at intervals of 1 s. If speed of sound in air is 340 m s⁻¹, the distance between two cliffs would be
    (a) 340 m
    (b) 510 m
    (c) 170 m
    (d) 680 m

33. Half life of a radioactive material is 5 years, then the percentage of it remained after 25 years will be
    (a) 3.125%
    (b) 6.25%
    (c) 1.25%
    (d) 25%

34. For an adiabatic process
    (a) $\Delta S = 0$
    (b) $\Delta U = 0$
    (c) $Q = 0$
    (d) $W = 0$

35. For cyclic process which of the following quantity is zero?
    (a) ΔV
    (b) ΔU
    (c) W
    (d) ΔQ

36. Magnetic field at a distance a from long current carrying wire is proportional to
    (a) $\dfrac{1}{a}$
    (b) $\dfrac{1}{a^2}$
    (c) $\dfrac{1}{\sqrt{a}}$
    (d) $\dfrac{1}{a^{3/2}}$

37. When a positively charged particle enters into a uniform magnetic field with uniform velocity, its trajectory can be
    (i) a straight line
    (ii) a circle
    (iii) a helix
    (a) (i) only
    (b) (i) or (ii)
    (c) (i) or (iii)
    (d) any one of (i), (ii) and (iii)

38. Among the following which is used to control the rate of reaction in nuclear fission reactions?
    (a) Water
    (b) Heavy water
    (c) Cadmium
    (d) Graphite

39. The series corresponding to minimum wavelength transition in H-atom
    (a) Balmer series
    (b) Lyman series
    (c) Paschen series
    (d) Brackett series

40. Pressure head in Bernoulli's equation is
    (a) $\dfrac{P\rho}{g}$
    (b) $\dfrac{P}{\rho g}$
    (c) ρg
    (d) $P\rho g$

Directions : In the following questions (41-60), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :
(a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

41. **Assertion** : Transverse sound wave does not occurs in gases.
    Reason : Gases cannot sustain shearing strain.

42. **Assertion** : When white light fall on the compact disc, multicolours are seen after reflection.
    Reason : CD disc behaves like a prism.

43. **Assertion** : Total energy is conserved in moving a satellite to higher orbit.
    Reason : Sum of change in PE and KE is same in magnitude and opposite in nature.

44. **Assertion** : KE is conserved at every instant of (elastic) collision.
    Reason : No deformation of matter occurs in elastic collision.

45. **Assertion** : C_P is always greater than C_V in gases.
    Reason : Work done at constant pressure is more than at constant volume.

46. **Assertion** : During rapid pumping of air in tyres, air inside the tyre is hotter than atmospheric air.
    Reason : Adiabatic process occurs at very high rate.

47. **Assertion** : For nuclear reactor, it is desirable to have $k = 1$.
    Reason : Sustained chain reaction occur at this critical condition.

48. Assertion : Gauss's law can't be used to calculate electric field near an electric dipole.

Reason : Electric dipole don't have symmetrical charge distribution.

49. Assertion : Photodiode and photovoltaic cell are based on the same principle.

Reason : Both use same method of operations to work.

50. Assertion : Transistor can be used as a switch.

Reason : Both linear and non-linear voltage bias dependance occurs in it.

51. Assertion : When a white light is passed through a lens, violet light is more refracted than red light.

Reason : Focal length for red light is greater than violet.

52. Assertion : Microscope magnifies the image.

Reason : Angular magnification for image is more than object in microscope.

53. Assertion : Mass defect in nuclear reactions is less than 1%

Reason : In nuclear reaction, change in BE/N is generally less than 1%.

54. Assertion : It is very easy to detect neutrino in nature.

Reason : It has high affinity to interact with matter.

55. Assertion : In the transmission of long distance radio signals, short wave band is used.

Reason : In shorter wavelength, attenuation is very less.

56. Assertion : There is a physical significance of matter waves.

Reason : Both interference and diffraction occurs in it.

57. Assertion : It is desirable to slow down fast moving neutrons to sustain controlled chain reactions.

Reason : Slow moving neutrons efficiently collides with U^{235}.

58. Assertion : Magnetic field lines are continuous and closed.

Reason : Magnetic monopole does not exist.

59. Assertion : Magnification of a convex mirror is always positive, but that of a concave mirror may be both positive or negative.

Reason : It depends on the sign convention chosen.

60. Assertion : Magnetic force between two short magnets, when they are co-axial follows inverse square law of distance.

Reason : The magnetic forces between two poles do not follow inverse square law of distance.

CHEMISTRY

61. The compound which does not exist as hydrate form
    (a) ferrous sulphate (b) copper sulphate
    (c) magnesium sulphate
    (d) sodium chloride

62. Iodine oxidises sodium borohydride to give
    (a) B_2H_6 (b) sodium hydride
    (c) HI (d) I_3^-

63. The wrong statement about fullerene is
    (a) it has 5-membered carbon ring
    (b) it has 6-membered carbon ring
    (c) it has sp^2 hybridization
    (d) it has 5-membered rings more than 6-membered rings

64. The wavelength of light absorbed is highest in
    (a) $[Co(NH_3)_5Cl]^{2+}$ (b) $[Co(NH_3)_5H_2O]^{3+}$
    (c) $[Co(NH_3)_6]^{3+}$ (d) $[Co(en)_3]^{3+}$

65. PCl_3 on hydrolysis gives fumes of
    (a) $H_3PO_3 + HCl$ (b) $H_3PO_4 + HCl$
    (c) H_3PO_2 and H_3PO_3 (d) $H_3PO_2 + HCl$

66. In solid ice, oxygen atom is surrounded
    (a) tetrahedrally by 4 hydrogen atoms
    (b) octahedrally by 2 oxygen and 4 hydrogen atoms
    (c) tetrahedrally by 2 hydrogen and 2 oxygen atoms
    (d) octahedrally by 6 hydrogen atoms

67. Predict the product of reaction of I_2 with H_2O_2 in basic medium.

(a) I^- (b) I_2O_3
(c) IO_3^- (d) I_3^-

68. First compound of Xe synthesized was
    (a) $[XeF]^+ [XePtF_5]^-$ (b) $[XeO_2]$
    (c) $Xe[PtF_6]$ (d) $O_2[XeF_6]$

69. Which of the following is diamagnetic ?
    (a) $[Cu(NH_3)_4]^{2+}$ (b) $[NiCl_4]^{2-}$
    (c) $[PtCl_4]^{2-}$ (d) $[Cu(H_2O)_4]^{2+}$

70. Which of the following is not hygroscopic?
    (a) $CsCl$ (b) $MgCl_2$
    (c) $CaCl_2$ (d) $LiCl$

71. Decreasing order of bond angle is
    (a) $BeCl_2 > NO_2 > SO_2$ (b) $BeCl_2 > SO_2 > NO_2$
    (c) $SO_2 > BeCl_2 > NO_2$ (d) $SO_2 > NO_2 > BeCl_2$

72. The enthalpy of formation of $CO_{(g)}$, $CO_{2(g)}$, $N_2O_{(g)}$ and $N_2O_{4(g)}$ is -110, -393, $+811$ and 10 kJ/mol respectively. For the reaction,
    $N_2O_{4(g)} + 3CO_{(g)} \rightarrow N_2O_{(g)} + 3CO_{2(g)}$. ΔH_r (kJ/mol) is
    (a) -212 (b) $+212$
    (c) $+48$ (d) -48

73. When $KMnO_4$ reacts with KBr in alkaline medium gives bromate ion. Then oxidation state of Mn changes from $+7$ to
    (a) $+6$ (b) $+4$
    (c) $+3$ (d) $+2$

74. How much amount of $CuSO_4 \cdot 5H_2O$ is required for liberation of 2.54 g of I_2 when titrated with KI?
    (a) 2.5 g   (b) 4.99 g
    (c) 2.4 g   (d) 1.2 g

75. Which of the following is incorrect for physisorption?
    (a) Reversible
    (b) Increases with increase in temperature.
    (c) Low heat of adsorption.
    (d) Increases with increase in surface area.

76. Smallest wavelength occurs for
    (a) Lyman series   (b) Balmer series
    (c) Paschen series   (d) Brackett series

77. K_{sp} of $CaSO_4 \cdot 5H_2O$ is 9×10^{-6}, find the volume for 1 g of $CaSO_4$ (M.wt. = 136).
    (a) 2.45 litre   (b) 5.1 litre
    (c) 4.52 litre   (d) 3.2 litre

78. Which of the following is not a characteristic of equilibrium?
    (a) Rate is equal in both directions.
    (b) Measurable quantities are constant at equilibrium.
    (c) Equilibrium occurs in reversible condition.
    (d) Equilibrium occurs only in open vessel at constant temperature.

79. Which of the following is wrong for Bohr model?
    (a) It establishes stability of atom.
    (b) It is inconsistent with Heisenberg uncertainty principle.
    (c) It explains the concept of spectral lines for hydrogen like species.
    (d) Electrons behave as particle and wave.

80. In the van der Waals equation, 'a' signifies
    (a) intermolecular attraction
    (b) intramolecular attraction
    (c) attraction between molecules and wall of container
    (d) volume of molecules

81. For adiabatic process, which is correct?
    (a) $\Delta T = 0$ (b) $\Delta S = 0$
    (c) $q = 0$ (d) $q_p = 0$

82. 25 mL, 0.2 M $Ca(OH)_2$ is neutralised by 10 mL of 1 M HCl. Then pH of resulting solution is
    (a) 1.37   (b) 9
    (c) 12   (d) 7

83. Schottky defect is
    (a) vacancy of ions
    (b) delocalization of ions
    (c) interstitial vacancy of ions
    (d) vacancy of only cations

84. Which material is used as a neutron moderator?
    (a) Graphite   (b) Cadmium
    (c) Boron   (d) Uranium

85. Which of the following is not a thermodynamic function?
    (a) Internal energy   (b) Work done
    (c) Enthalpy   (d) Entropy

86. Which of the following is intensive property?
    (a) Enthalpy   (b) Entropy
    (c) Specific heat   (d) Volume

87. For a first order gas phase reaction–
$$A_{(g)} \rightarrow 2B_{(g)} + C_{(g)}$$
P_0 be initial pressure of A and P_t the total pressure at time 't'. Integrated rate equation is
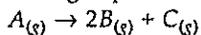
(a) $\dfrac{2.303}{t}\log\left(\dfrac{P_0}{P_0 - P_t}\right)$

(b) $\dfrac{2.303}{t}\log\left(\dfrac{2P_0}{3P_0 - P_t}\right)$

(c) $\dfrac{2.303}{t}\log\left(\dfrac{P_0}{2P_0 - P_t}\right)$

(d) $\dfrac{2.303}{t}\log\left(\dfrac{2P_0}{2P_0 - P_t}\right)$

88. Decreasing order of nucleophilicity is

(a) $OH^- > NH_2^- > CH_3O^- > RNH_2$

(b) $NH_2^- > OH^- > CH_3O^- > RNH_2$

(c) $NH_2^- > CH_3O^- > OH^- > RNH_2$

(d) $CH_3O^- > NH_2^- > OH^- > RNH_2$
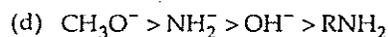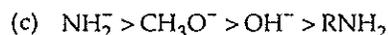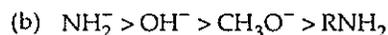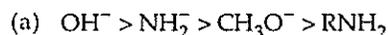
89. Find the number of stereoisomers of 1,2-dihydroxy cyclopentane.
(a) 1   (b) 2
(c) 3   (d) 4

90. Find the hydrolysis product when a phosphodiester bond of nucleotide breaks.
(a) 3-OH-deoxyribose-5-PO_4^{3-}
(b) 5-OH-deoxyribose-3-PO_4^{3-}
(c) 2-OH-deoxyribose-2-PO_4^{3-}
(d) 4-OH-deoxyribose-2-PO_4^{3-}
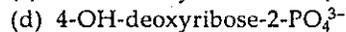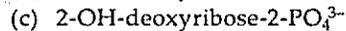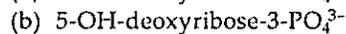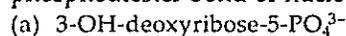
91. Find the hydrolysis product of maltose.
(a) α-D-glucose + α-D-glucose
(b) α-D-glucose + α-D-fructose
(c) α-D-glucose + α-D-galactose
(d) α-D-fructose + α-D-galactose

92. Isoprene is
(a) 3-methyl-1,2-butadiene
(b) 2-methyl-1,3-butadiene
(c) 3-chloro-1,2-butadiene
(d) 2-chloro-1,3-butadiene

93. Find the product for
$CH_3CH_2-O-CH_2-CH_2-O-CH_2-C_6H_5 + HI$
(excess)
(a) $HO-CH_2CH_2OH, C_6H_5CH_2-I, CH_3CH_2-I$
(b) $C_6H_5CH_2-OH, CH_3CH_2-I, I-CH_2CH_2-OH$

(c) $I-CH_2CH_2-I, C_6H_5CH_2-I, CH_3CH_2-OH$
(d) $HO-CH_2CH_2-OH, C_6H_5CH_2-I, CH_3CH_2-OH$
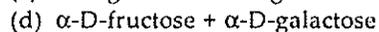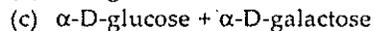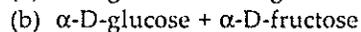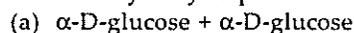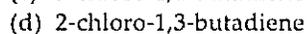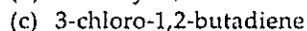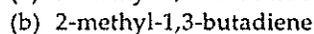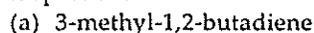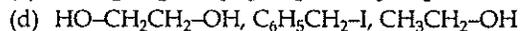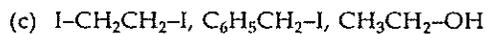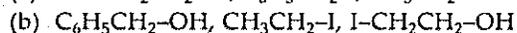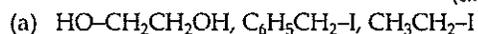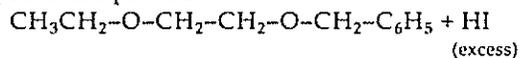
94. Best method to form aromatic iodide is
(a) $ArN_2^+ + HI \longrightarrow$ (b) $RNH_2 + I_2 \longrightarrow$
(c) $ArN_2^+ + KI \longrightarrow$ (d) $ArN_2^+ + PI_3 \longrightarrow$

95. Maximum decarboxylation occurs in
(a) CH_3COOH (b) C_6H_5COOH
(c) $C_6H_5CH_2COOH$ (d) CH_3COCH_2COOH
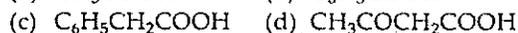
96. The correct increasing order of reactivity for the following molecules towards electrophilic aromatic substitution is
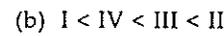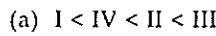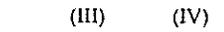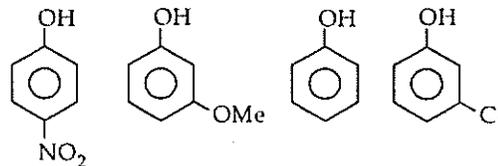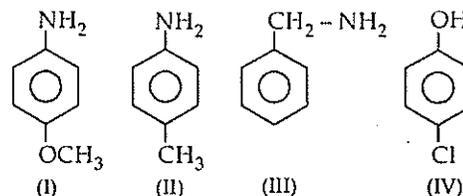
(a) $I < IV < II < III$ (b) $I < IV < III < II$
(c) $I < III < II < IV$ (d) $I < III < IV < II$

97.

The correct decreasing order of pK_b is
(a) $I > II > III > IV$ (b) $III > IV > II > I$
(c) $II > III > IV > I$ (d) $IV > II > I > III$

98. The correct decreasing order of pK_a is

(a) $II > IV > I > III$ (b) $IV > II > III > I$
(c) $III > II > IV > I$ (d) $IV > I > II > III$
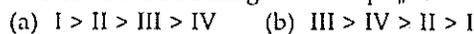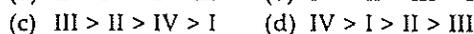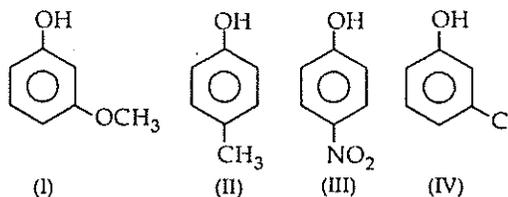
99. S_N2 reaction readily occurs in
(a) $CH_3CH_2 - O - CH_3$

(b) $CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - O - CH_3$
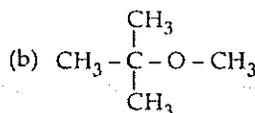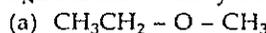
(c) $CH_2=CH - CH_2 - O - CH_3$
(d) $Ph - CH_2 - O - CH_2 - CH_3$

100. The number of σ- and π-bonds present in pent-4-ene-1-yne is
(a) 10, 3   (b) 4, 9
(c) 3, 10   (d) 9, 4

Directions : In the following questions (101-120), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :
(a)   If both assertion and reason are true and reason is the correct explanation of assertion
(b)   If both assertion and reason are true but reason is not the correct explanation of assertion
(c)   If assertion is true but reason is false
(d)   If both assertion and reason are false.

101. Assertion : H_2S is less acidic than H_2Te.
     Reason   : Te has larger radius than S.

102. Assertion : $R_3P=O$ exists but $R_3N=O$ does not exist.
     Reason   : P is more electronegative than N.

103. Assertion : AgCl is more soluble in NH_3 than in water.
     Reason   : Ammonia is more polar than water.

104. Assertion : BCC and HCP has same packing efficiency.
     Reason   : Both have same number of atoms per unit cell and same arrangement.

105. Assertion : Reduction potential of Mn (+3 to +2) is more positive than Fe (+3 to +2).
     Reason   : Ionisation potential of Mn is more than that of Fe.

106. Assertion : Helium is used in diving apparatus.
     Reason   : Solubility of helium is less in blood.

107. Assertion : A reaction is spontaneous if E_{cell} = +ve.
     Reason   : For E_{cell} = +ve, ΔG is always –ve.

108. Assertion : Sulphur is oxidised by H_2O_2 in presence of Fe (III).
     Reason   : Fe (III) oxidises sulphur to sulphate.

109. Assertion : Chlorine undergoes disproportionation reaction in alkaline medium.

Reason   : Cl_2 is an oxidising agent.

110. Assertion : Entropy is always constant for a closed system.
     Reason   : Closed system is always reversible.

111. Assertion : Two different reactions can never have same rate of reaction.
     Reason   : Rate of reaction always depends only on frequency of collision and Arrhenius factor.

112. Assertion : The formal oxidation no. of sulphur in $Na_2S_4O_6$ is 2.5.
     Reason   : Two S-atoms are not directly linked with O-atoms.

113. Assertion : A non volatile solute is mixed in a solution then elevation in boiling point and depression in freezing point both are 2 K.
     Reason   : Elevation in boiling point and depression in freezing point both depend on melting point of non-volatile solute.

114. Assertion : Rate of reaction of alkyl halide in Williamson's synthesis reaction is $1°RX > 2°RX > 3°RX$.
     Reason   : It is a type of bimolecular substitution reaction (S_N2).

115. Assertion : Dehydration of alcohols always takes place in basic medium.
     Reason   : OH^- is a better leaving group.

116. Assertion : Toluene in presence of UV rays forms benzaldehyde.
     Reason   : Dichlorotoluene is formed as an intermediate.

117. Assertion :
$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - Br + NaOH \longrightarrow$$
$$CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$$

Reason   : It follows with formation of more stable carbocation.

118. Assertion : β- pleated sheet structure of protein shows maximum extension.

Reason   : Intermolecular hydrogen bonding is present in them.

119. Assertion : Fructose is a reducing sugar.
     Reason   : It has a ketonic group.

120. Assertion : *p*-Nitrophenol gives more electrophilic substituted compound than *m*-methoxyphenol.
     Reason   : Methoxy group shows only negative *I*-effect.

BIOLOGY

121. What is the source of *Eco* R I?
    (a) *Escherichia coli* R I
    (b) *Escherichia coli* R I 13
    (c) *Escherichia coli* R Y 13
    (d) *Escherichia coli* R X 13

122. First clinical gene therapy was given in 1992 to a 4 years old girl for
    (a) adenine deficiency
    (b) growth deficiency
    (c) adenosine deaminase deficiency
    (d) adenosine deficiency

123. Bacteria, fungi, lower plants survive in adverse conditions by
    (a) diapause   (b) suspended growth
    (c) migration
    (d) formation of thick walled spores

124. What are labelled phases A, B and C in given sigmoidal growth curve?
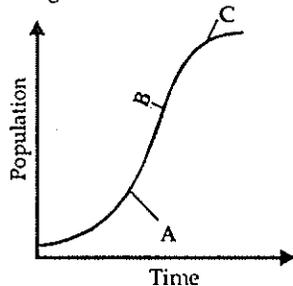
	A	B	C
(a)	Stationary	Log	Lag
(b)	Lag	Stationary	Log
(c)	Log	Lag	Stationary
(d)	Lag	Log	Stationary

125. Monarch butterfly escapes from predators by
    (a) foul smell   (b) bitter taste

    (c) colour combination
    (d) rough skin

126. What is the characteristic of tapetum ?
    (a) It does not store food
    (b) It is multi-nucleated
    (c) It is multi-layered structure
    (d) It nourishes the megaspore

127. In vehicles, catalytic converters are used
    (a) to increase mileage of vehicles
    (b) to convert CO_2 into carbonates
    (c) to increase the efficiency of lead mixed petrol
    (d) to convert CO to CO_2.

128. Cell theory was proposed by
    (a) a botanist
    (b) a zoologist
    (c) a botanist and a zoologist
    (d) a psychologist

129. Identify the given figures A, B, C, D and E.
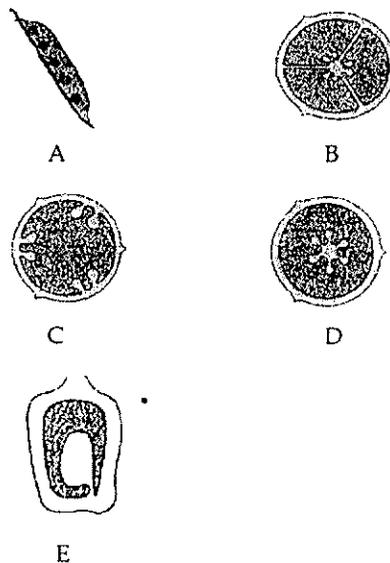
	A	B	C	D	E
(a)	Marginal	Axile	Free central	Parietal	Basal
(b)	Marginal	Parietal	Free central	Axile	Basal
(c)	Marginal	Axile	Parietal	Free central	Basal
(d)	Marginal	Axile	Parietal	Basal	Free central

130. Given figure shows

- Epidermis
- Complementary cells
- Cork cambium
- Secondary cortex
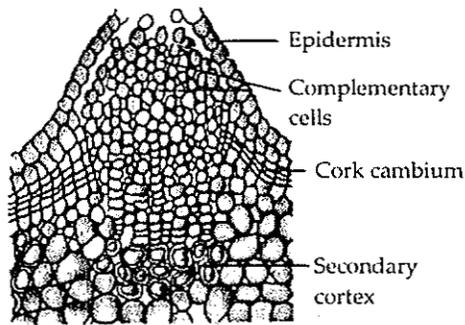
(a) structure of lenticel
(b) hydathode showing gaseous vapour exchange
(c) fungus reproducing by spore formation
(d) algae reproducing by spore formation.

131. In the given diagram A and B represent
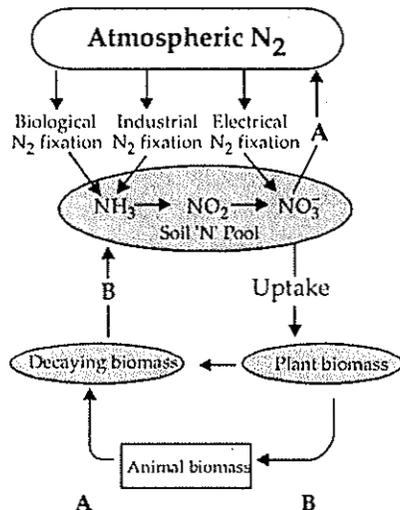
	A	B
(a)	Mineralisation	Demineralisation
(b)	Ammonification	Denitrification
(c)	Denitrification	Ammonification
(d)	Denitrification	Mineralisation

132. In active transport, carrier proteins are used, which use energy in the form of ATP, to
(a) transport molecules against concentration gradient of cell wall.
(b) transport molecules along concentration gradient of cell membrane.
(c) transport molecules against concentration gradient of cell membrane.

(d) transport molecules along concentration gradient of cell wall.

133. In a 50 gm living tissue, what would be the amount of water?
(a) 15 - 25 gm   (b) 25 - 30 gm
(c) 35 - 45 gm   (d) 70 - 90 gm

134. PS-II occurs only in
(a) stroma   (b) granal thylakoids
(c) stromal lamella   (d) matrix

135. After glycolysis, fate of glucose in mitochondrial matrix is
(a) oxidation   (b) reduction
(c) oxidative decarboxylation
(d) hydrolysis

136. Cleistogamy is leading over anthesis because
(a) pollination agent is not required
(b) it assures heterozygosity
(c) it favours insect pollination
(d) it allows xenogamy.

137. Which of the following statements is correct?
(a) Photorespiration is useful process.
(b) C_4 plants are more efficient than C_3 plants.
(c) C_3 plants are more efficient than C_4 plants.
(d) Photorespiration is absent in C_3 plants but present in C_4 plants.

138. Which of the following statements is incorrect regarding fermentation ?
(a) *Propionibacterium* is used to ferment the cheese.
(b) The puffed-up appearance of dough is due to the production of CO_2 gas.
(c) Fermentation in muscle produces ethanol.
(d) Toddy is made by fermenting sap from palms.

139. Which of the following statements is correct ?
(a) *Aspergillus niger* is used for producing cyclosporin A.
(b) Activated sludge is digested by aerobic bacteria to produce marsh gas.
(c) Fleming, Chain & Florey were awarded with Nobel Prize for discovering penicillin.
(d) BOD is amount of oxygen produced by bacteria on decomposition.

140. Which of the following elements is present in very less quantity in the body ?
(a) K   (b) Ca
(c) Mg   (d) Cu

141. Which of the following is best method of germplasm conservation ?
(a) herbarium   (b) botanical garden
(c) seed bank   (d) zoological park

142. Which one of the following options is a correct match of phenomenon and its explanation ?
(a) Reverse Transcription PCR – Many copies of a DNA sequence.
(b) Central dogma – RNA → DNA → Protein → RNA.
(c) RNA silencing – Use of ds-RNA to stop the expression of ss-RNA.
(d) Transcription – Process of formation of RNA & proteins.

143. Which of the following is not a characteristic of meiosis?
(a) It involves two stages of DNA replication one before meiosis-I and another before meiosis-II
(b) It involves recombination and crossing over
(c) Sister chromatids separate during anaphase-II
(d) Nuclear membrane disappears during prophase.

144. Which of the following is correct ?
(a) Henking discovered the small Y-chromosome
(b) *Drosophila* also shows XX-XY sex determination like human
(c) Birds have ZZ-ZW sex determination, where females are ZZ & males are ZW
(d) Grasshoppers show XX-XY sex determination.

145. Which statement is correct regarding mosses ?
(a) They have dominant and independent sporophyte.
(b) Their antherozoids require water for fertilization.
(c) Their archegonia produce many eggs.
(d) Their antherozoids are multiflagellated.

146. Which of the following statements is correct ?
(a) Catalytic converter can separate particulate matter of diameter less than 2.5 micrometers.
(b) Histones are acidic in nature that forms core for DNA packaging.
(c) *Lactobacillus* is not present in dough used in idli formation.

(d) Template with polarity 5' → 3' has continuous DNA replication.

147. Which of the following statements is correct ?
1. Common cold – Droplet Infection.
2. Typhoid – Contaminated food & water.
3. AIDS – Shaking hands.
4. Ringworm – Using infected towels.
(a) 1 and 2   (b) 3 and 4
(c) 1 and 3   (d) 1,2 and 4

148. Which of the following statements is correct ?
(a) Lion and leopard show convergent evolution.
(b) Cryptic camouflage is seen in *Biston betularia*.
(c) Natural selection is responsible for extinction of dinosaurs.
(d) *Homo habilis* and *Homo erectus* are closely related.

149. Tendon and ligament are example of
(a) dense regular connective tissue
(b) dense irregular connective tissue
(c) loose connective tissue
(d) specialised connective tissue

150. Kingdom Animalia is characterised by
(a) direct dependence on autotrophs
(b) indirect dependence on autotrophs
(c) absence of chlorophyll
(d) absence of cell wall.

151. If medulla oblongata is destroyed then which of the following functions will be effected ?
(a) No thermoregulation
(b) No vision
(c) No memory
(d) No response when pricked with needle

152. Which of the following statements is correct?
(a) Monkey, apes and humans exhibit estrous cycle.
(b) Urine is pale yellow and slightly alkaline.
(c) Lots of enzymes are present in bile juice.
(d) Ovulation in humans is spontaneous.

153. Which of the following evidences does not favour the Lamarckian concept of inheritance of acquired characters?
(a) absence of limbs in snakes
(b) melanization in peppered moth
(c) presence of webbed toes in aquatic birds
(d) lack of pigment in cave-dwelling animals

154. Which of the following is a correct match?
    (a) Frog – External ears
    (b) Earthworm – Muscular gizzard, typhlosole.
    (c) Human – Fat globule, 10 pairs of cranial nerves.
    (d) Cockroach – Chilopoda

155. Which of the following is an incorrect statement?
    (a) Blood group 'O' person have A and B antigens on RBCs.
    (b) Eosinophils resist infections and are associated with allergic infection.
    (c) RBC's contain carbonic anhydrase.
    (d) T wave of normal ECG represent of depolarization of ventricle.

156. Which one of the following is correct regarding the excretion ?
    (a) Large amount of water from renal filtrate is reabsorbed in DCT and a less amount is reabsorbed by PCT
    (b) The descending limb of loop of Henle is completely impermeable to salts.
    (c) Malpighian corpuscle is found in medulla region of kidney.
    (d) The colour of urine is pale yellow and is slightly alkaline in nature.

157. In assisted reproductive technology where gametes have been fertilized *in vitro*, which of the following is practicable for embryo transplantation in Fallopian tube?
    (a) only embryo up to 8 blastomeres if zygote is not transplanted.
    (b) only zygote is transplanted not embryo
    (c) either embryo or zygote with 8 blastomere phase transplanted.
    (d) morulla with 8-24 celled stage is transplanted in Fallopian tube.

158. Which of the following features can be said to be a true defining feature of living beings without any exception ?
    (a) they can digest their food.
    (b) all of them can reproduce.
    (c) they can regenerate.
    (d) they can respond to external stimuli

159. The opening between the right atrium and the right ventricle is guarded by the valve named
    (a) bicuspid valve   (b) tricuspid valve
    (c) mitral valve   (d) semilunar valve

160. Skeletal muscles appear striated due to presence of two characteristic proteins in alternating dark and light bands. Which of the following is a correct match of the protein with its light refractive property and colour?

	Protein	Colour	Property
(a)	Myosin	Light	Anisotropic
(b)	Actin	Dark	Anisotropic
(c)	Myosin	Dark	Isotropic
(d)	Actin	Light	Isotropic

Directions : In the following questions (161-180), a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as :
(a)   If both assertion and reason are true and reason is the correct explanation of assertion
(b)   If both assertion and reason are true but reason is not the correct explanation of assertion
(c)   If assertion is true but reason is false
(d)   If both assertion and reason are false.

161. Assertion   : Enzymes lower down the activation energy of the reactant molecule to make its transition into product easier.
    Reason   : Enzymes are highly substrate specific catalysts.

162. Assertion   : Water that enters into a plant cell through diffusion makes it turgid.
    Reason   : Entry of water into the cell through diffusion develops wall pressure inside the cell.

163. Assertion   : Movement of materials inside phloem is bidirectional *i.e.* it can be both upwards or downwards.
    Reason   : Movement of molecules inside xylem is unidirectional *i.e.* always upwards.

164. Assertion   : Protons or hydrogen ions produced by photolysis of water accumulate in the lumen of thylakoids.
    Reason   : Photolysis of water takes place in inner membrane of thylakoid.

165. Assertion   : Plant growth as a whole is indefinite.
    Reason   : Plants retain the capacity of continuous growth throughout their life.

166. Assertion : Amount of organic biodegradable compounds present in water is measured by the BOD of that water.

Reason : During biodegradation of biodegradable organic compounds, oxygen is released by bacteria.

167. Assertion : In angiosperms, transport of food and water is more efficient than gymnosperms and pteridophytes.

Reason : In angiosperms longitudinally arranged sieve elements and vessels with perforated end walls are present.

168. Assertion : In some species of asteraceae and poaceae seeds are formed without fertilization.

Reason : Formation of fruit without fertilization is called parthenocarpy.

169. Assertion : Algal blooms are formed in nutrient-less water.

Reason : Algal blooms in water turn it unfit for human consumption, but cause enormous growth of fish.

170. Assertion : A mangrove tree growing in marshy place has pneumatophores.

Reason : Pneumatophores help in better anchorage to marshy soil.

171. Assertion : A geneticist crossed two plants, he got 50% tall and 50% dwarf progenies.

Reason : It follows Mendelian law as one of the parent plant might be heterozygous.

172. Assertion : Now-a-days amniocentesis is banned.

Reason : Amniocentesis gives the information of any abnormality in the foetus and many other complications regarding pregnancy can be detected.

173. Assertion : A gene from *Bacillus thuringiensis* is incorporated in plant genome to increase their yield.

Reason : *Bacillus thuringiensis* has Bt toxin producing gene, which kills the larva of insects.

174. Assertion : Glycerides are important nutrients for body.

Reason : Glycerides are hydrolysed into glycerol and fatty acids which are further absorbed in intestine by the formation of chylomicron.

175. Assertion : Blood in cockroach is colourless haemolymph with no respiratory pigment.

Reason : Respiration in cockroach occurs through diffusion in haemolymph.

176. Assertion : Blood group 'O' have anti-A & anti-B antibodies.

Reason : It does not have any antigens.

177. Assertion : S.A. node induces excitatory impulses in heart.

Reason : S.A. node is self excitatory.

178. Assertion : Organ of Corti rests on tectorial membrane.

Reason : It helps to maintain equilibrium of body.

179. Assertion : Corpus luteum is produced by Graafian follicle after ovulation.

Reason : It secretes estrogen which is necessary to maintain pregnancy.

180. Assertion : Sporozoites of malarial parasite enter in the human body due to biting of freshly born female *Anopheles* mosquito, whose mother was a carrier of malarial parasite.

Reason : Male and female gametocytes of malarial parasites are formed in the human intestine.

GENERAL KNOWLEDGE

181. Which river derives its name from Sanskrit word "Lavanavari"?
(a) Luni (b) Kosi
(c) Sabarmati (d) Kaveri

182. Which river's name means "containing reed"?
(a) Gangad (b) Betwa
(c) Narmada (d) Luni

183. First Indian woman grandmaster in chess is
(a) Saheli Dhar
(b) Bhagyashree Thipse

(c) Vijaylakshmi Pandit
(d) Amrit Kaur

184. Two letters printed on first postal stamp of India are
 (a) Jai hind
 (b) Jai kisan
 (c) Jai bharat
 (d) Vande matram

185. Which of the following is called 'Floating sanctuary of India'?
 (a) Keibul Lamjao
 (b) Manas
 (c) Kaziranga
 (d) Bharatpur

186. "India wins freedom" this book was written by
 (a) Jawahar Lal Nehru
 (b) Maulana Azad
 (c) Sardar Patel
 (d) Rajendra Prasad

187. Which fruit is often called "love apple"?
 (a) Pineapple
 (b) Orange
 (c) Tomato
 (d) Papaya

188. Which country was first to adopt family planning programme?
 (a) India
 (b) China
 (c) USA
 (d) Indonesia

189. After whom the atomic energy programme is commissioned in India?
 (a) S.N. Bose
 (b) C.V. Raman
 (c) H.G. Khurana
 (d) H.J. Bhabha

190. After the death of which prime minister did Guljarilal Nanda joined as acting PM for second time?
 (a) Indira Gandhi
 (b) Jawahar Lal Nehru
 (c) Lal Bahadur Shastri
 (d) Charan Singh

191. Whom did Jawahar Lal Nehru called father of Indian revolution?
 (a) Bal Gangadhar Tilak
 (b) Vipin Chandra Pal
 (c) Dhondo Keshave Karve
 (d) Maulana Abdul Kalam Azad

192. Among these, who had been the last governor general of India?

(a) Dr. Radhakrishnan
(b) R. Gopalachari
(c) Sardar Patel
(d) Dr. Bhim Rao Ambedkar

193. With which of the following religions, "Karamappa" is related?
 (a) Jainism
 (b) Buddhism
 (c) Hinduism
 (d) Christinism

194. Which of the following authors is not born in India?
 (a) Rudyard Kipling
 (b) Ruskin Bond
 (c) Gorge Orwell
 (d) V.S. Naipal

195. Which of the following actress won the best actress award 3 times consecutively?
 (a) Rekha
 (b) Jaya Bachchan
 (c) Smita Patil
 (d) Shabana Azmi

196. Which woman won the Sahitya Kala Academy award first time?
 (a) Amrita Pritam
 (b) Sarojini Naidu
 (c) Kamla Mehta
 (d) Geeta Das

197. To which gharana " Kishori Amonkar "' belongs to?
 (a) Kirana
 (b) Jaipur-Attrivi
 (c) Lucknow
 (d) Gwalior

198. Who is the author of the book "Siddhant Shiromani"?
 (a) Bhaskaracharya - II
 (b) Bhaskaracharya - I
 (c) Aryabhatt
 (d) Ramanujan

199. Which of the following has introduced transcendental meditation?
 (a) Rajneesh Osho
 (b) Swami Chinmiyanand
 (c) Vivekanand
 (d) Maharishi Mahesh Yogi

200. Which of the following animal's body secretion is oily red, commonly known as "Sweat blood"?
 (a) Rhinoceros
 (b) Hippopotamus
 (c) Cow
 (d) Tiger

SOLUTIONS

PHYSICS

1. **(b)** : $B = \dfrac{F}{qv} = \dfrac{[MLT^{-2}]}{[AT][LT^{-1}]} = [ML^0T^{-2}A^{-1}]$

   But $[A] = [C\,T^{-1}]$

   $\therefore\ [B] = [ML^0T^{-1}C^{-1}]$

2. **(b)** : The mechanical equivalent of spring constant in LC oscillating circuit is, $k = \dfrac{1}{C}$.

3. **(b)** :
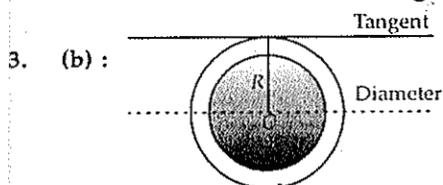
   The moment of inertia for a solid sphere along its diameter is

   $I_{diameter} = \dfrac{2}{5}MR^2$

   Moment of inertia about a tangent touching to its surface,

   $I_{tangent} = I_{diameter} + MR^2$

   (using theorem of parallel axes)

   $= \dfrac{2}{5}MR^2 + MR^2 = \dfrac{7}{5}MR^2$

4. **(d)** : Here, $v_1 = 4$ m s^{-1}, $A_1 = \pi r_1^2 = 16\pi \times 10^{-4}$ m^2

   $A_2 = \pi r_2^2 = \pi \times 10^{-4}$ m^2

   Using, $A_1v_1 = A_2v_2$

   $\therefore\ v_2 = \dfrac{A_1v_1}{A_2} = \dfrac{16\pi \times 10^{-4} \times 4}{\pi \times 10^{-4}} = 64\,\text{m s}^{-1}$

   Velocity of water at free end, $v_2 = 64$ m s^{-1}

5. **(b)** : The torsion produced in wire is directly proportional to the twist

   $i.e,\ \tau \propto \theta$

   or $\tau = C\theta$, where C is restoring couple per unit twist.

6. **(c)** : Here, $\omega = 2\hat{k}$

   $\vec{r} = 2\hat{i} + 2\hat{j}$

   Linear velocity, $\vec{v} = \vec{\omega} \times \vec{r}$

   $= 2\hat{k} \times (2\hat{i} + 2\hat{j})$

   $= -4\hat{i} + 4\hat{j}$

7. **(b)** : The average velocity in simple harmonic motion is given by

   $V_{av} = \dfrac{2}{\pi}V_m$

8. **(c)** : (a) $(\cos\omega t + \sin\omega t)$ is a periodic function. It can also be written as

   $= \dfrac{\sqrt{2}}{\sqrt{2}}\sin\omega t + \dfrac{\sqrt{2}}{\sqrt{2}}\cos\omega t$

   $= \sqrt{2}\left(\cos\dfrac{\pi}{4}\sin\omega t + \sin\dfrac{\pi}{4}\cos\omega t\right)$

   $= \sqrt{2}\sin\left(\omega t + \dfrac{\pi}{4}\right) = \sqrt{2}\sin\left(\omega t + \dfrac{\pi}{4} + 2\pi\right)$

   $= \sqrt{2}\sin\left[\omega\left(t + \dfrac{2\pi}{\omega}\right) + \dfrac{\pi}{4}\right]$

   This represent a simple harmonic function with period $\dfrac{2\pi}{\omega}$ and phase $\dfrac{\pi}{4}$.

   (b) $\sin\omega t - \cos\omega t$ is a periodic function. It can be written as

   $= \sqrt{2}\left[\sin\omega t\cos\dfrac{\pi}{4} - \cos\omega t\sin\dfrac{\pi}{4}\right]$

   $= \sqrt{2}\sin\left(\omega t - \dfrac{\pi}{4}\right) = \sqrt{2}\sin\left[\omega\left(t + \dfrac{2\pi}{\omega}\right) - \dfrac{\pi}{4}\right]$

   This represent a simple harmonic function with period $\dfrac{2\pi}{\omega}$.

   (c) $F(t) = 1 - \sin 2\omega t$

   This is a non periodic function.

   (d) $F(t) = \sin\omega t + \cos(\omega t + \alpha)$

   also represent a simple harmonic function.

9. **(d)** : In simple harmonic motion, loss of kinetic energy is proportional to the square of amplitude of oscillation.

   $i.e.$, loss of kinetic energy $\propto x^2$

10. **(d)** : The ratio of emissive power to absorptive power is the same for all surfaces at the same temperature and is equal to the emissivity for a perfectly black body at that temperature.

    $i.e,\ \dfrac{e}{a} = \varepsilon$

    Here, $e = 8$, $a = 10$

    $\therefore\ \varepsilon = \dfrac{e}{a} = \dfrac{8}{10} = 0.8$

11. **(a)** : Energy stored in capacitor of capacitance C with voltage V is, $U = \frac{1}{2}CV^2$

but $C = \frac{\varepsilon_0 A}{d}$, $V = Ed$

where A is the area of capacitor plate and d is the distance of separation and E is the electric field.

$\therefore \quad U = \frac{1}{2}\frac{\varepsilon_0 A}{d}E^2 d^2 = \frac{1}{2}\varepsilon_0 E^2 A d$

12. **(a)**

13. **(b)** : Here, $r_1 = 1$ m, $r_2 = 2$ m

Mutual inductance, $M = \frac{\mu_0 \pi r_1^2}{2r_2}$

$= \frac{\mu_0 \pi \times 1}{2 \times 2} = \frac{\mu_0 \pi}{4}$

14. **(c)** : Resultant intensity,

$I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

Here, $I_1 = I, I_2 = 4I, \phi_1 = \frac{\pi}{2}$ and $\phi_2 = \pi$

At A intensity,

$I_A = I + 4I + 2\sqrt{4I^2}\cos\frac{\pi}{2} = 5I$

At B intensity,

$I_B = I + 4I + 2\sqrt{4I^2}\cos\pi = 5I - 4I = I$

Therefore, difference between intensities is

$I_A - I_B = 5I - I = 4I$

15. **(c)**

16. **(a)** : Given, $A_m = 5$ V, $A_c = 20$ V

$\therefore$ Modulation index, $\mu = \frac{A_m}{A_c} = \frac{5}{20} = 0.25$

17. **(c)** : Here, $h = 50$ m

Area covered $= \pi d^2 = \pi \times 2hR$ $(\because d^2 = 2hR)$

where $R = 6.4 \times 10^6$ m (radius of earth)

$\therefore$ area covered $= \pi \times 2hR = \pi \times 2 \times 50 \times 6.4 \times 10^6$

$= 640\pi \times 10^6$ m^2 $= 640\pi$ km^2

18. **(c)** : For photon, $\lambda_p = \frac{hc}{E}$

Here, E is energy of photon.

For proton, $\lambda_p = \frac{h}{\sqrt{2mK}}$

Here, m and K be mass and kinetic energy of proton respectively.

$\therefore \quad \frac{\lambda_p}{\lambda_p} = \frac{E}{c}\sqrt{2mK} \propto E^{1/2}$ $(\because E = K$ Given$)$

19. **(a)** : Here $R_1 = 2$ fm, $R_2 = 1$ fm

The radius of nucleus is, $R \propto A^{1/3}$

$\therefore \quad \frac{A_1}{A_2} = \left(\frac{R_1}{R_2}\right)^3 = \left(\frac{2}{1}\right)^2 = 8$

20. **(a)** : Given, $B = 1$ T, $r = 0.2$ m

$r = \frac{mv}{qB}$

i.e, $v = \frac{0.2 \times 1.6 \times 10^{-19} \times 1}{1.6 \times 10^{-27}} = 0.2 \times 10^8$ m s^{-1}

21. **(c)** : Here $f_1 = -20$ cm, $f_2 = +10$ cm

Focal length of combination is,

$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{-20} + \frac{1}{10}$

$\frac{1}{F} = \frac{1}{20} \quad \Rightarrow \quad F = 20$ cm

Power of the combination,

$P = \frac{100}{F} = \frac{100}{20} = +5$ D

22. **(b)** : Here $u = -25$ cm, $v = -50$ cm

We have $\frac{1}{f} = \frac{1}{-u} + \frac{1}{v}$

i.e, $\frac{1}{f} = \frac{1}{25} - \frac{1}{50}$ or $f = 50$ cm

Power of lens he should use,

$P = \frac{100}{f} = \frac{100}{50} = +2$ D

23. **(a)** : At $k = 1$, the chain reaction will be steady or sustained and the size of the fissionable material used is said to be the critical size.

24. **(a)** : Susceptibility χ_m is small and negative for diamagnetic substances.

25. **(c)** : The orientation of dipoles parallel and antiparallel to magnetic field is distributed unequally in ferrimagnetic materials.

26. **(d)** : The α-emission of S^{32} is as follows :

$_{16}S^{32} \rightarrow \, _{14}Si^{28} + \, _2He^4$

$_{14}Si^{28} \rightarrow \, _{12}Mg^{24} + \, _2He^4$

So after the emission of two α-particle $_{12}Mg^{24}$ is formed.

27. **(a)** : Lenz's law is accordance with the principle of conservation of energy.

28. **(a)** : In series LCR circuit, the phase angle ϕ is given by

$$\tan\phi = \frac{X_L - X_C}{R}$$

When $X_L > X_C$, $\tan\phi$ is positive. Therefore the phase difference is positive.

29. **(b)** : The direction of electric field is from N-side to P-side in PN junction diode.

30. **(a)** : Here, $v_1 = 499$ Hz, $v_2 = 501$ Hz

Frequency heard $= \dfrac{v_1 + v_2}{2} = \dfrac{499 + 501}{2}$

$= 500$ Hz

Since the difference in intensity is 2, change in intensity take place twice.

31. **(a)** : Here, $m = 0.2$ kg, $u = 0$

$$\vec{F} = (0.3\,\hat{i} - 0.4\,\hat{j})$$

$$\vec{v} = ?, t = 6\text{ s}$$

$$\vec{a} = \frac{\vec{F}}{m} = \frac{(0.3\,\hat{i} - 0.4\,\hat{j})}{0.2} = \left(\frac{3}{2}\,\hat{i} - 2\,\hat{j}\right)$$

From $\vec{v} = \vec{u} + \vec{a}t$

$$\vec{v} = 0 + \left(\frac{3}{2}\,\hat{i} - 2\,\hat{j}\right) \times 6 = 9\,\hat{i} - 12\,\hat{j}$$

32. **(b)** : Let x be distance of person from one cliff and y be distance of person from 2nd cliff. Let $y > x$.

$\therefore \quad x + x = v \times t_1 = 340 \times 1 = 340$

$x = 170$ m

$y + y = v \times t_2 = 340 \times 2 = 680$

$y = 340$ m.

Distance between two cliffs

$= x + y = 170 + 340 = 510$ m

33. **(a)** : Here, $t = 25$ years, $T_{1/2} = 5$ years

Number of half lives, $n = \dfrac{t}{T_{1/2}} = \dfrac{25}{5} = 5$

Percentage of radio active material remained after

25 years is $= \left(\dfrac{1}{2}\right)^n \times 100$

$= \left(\dfrac{1}{2}\right)^5 \times 100 = 3.125\%$

34. **(a)** : For an adiabatic process, change in entropy of the system is zero,

i.e, $\Delta S = 0$

35. **(b)** : As internal energy is a state variable and final state coincides with the initial state in cyclic process, $\therefore \Delta U = 0$

36. **(a)** : The expression for magnetic field is case of a long current carrying wire is $B = \dfrac{\mu_0 I}{2\pi a}$

i.e, $B \propto \dfrac{1}{a}$

37. **(d)**

38. **(c)** : In nuclear reactor, to control the chain reaction from becoming violent, rods of boron or cadmium called control rods are inserted in the holes of reactor core.

39. **(b)** : Lyman series is obtained when an electron jumps to the first orbit ($n_1 = 1$) from any outer orbit ($n_2 = 2, 3, 4...$)

$$\frac{1}{\lambda} = RZ\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

For H, $Z = 1$ and R is the Rydberg's constant $R = 1.097 \times 10^7$ m^{-1}. In this series, the shortest wavelength or the limit of this series (For $n_1 = 1$ and $n_2 = \infty$) is nearly $= 911$Å

40. **(b)** : Bernoulli's equation is

$$P + \rho gh + \frac{1}{2}\rho v^2 = \text{a constant,}$$

or $\dfrac{P}{\rho g} + h + \dfrac{1}{2}\dfrac{v^2}{g} = \text{constant,}$

Here, $\dfrac{P}{\rho g}$ is called pressure head.

41. **(b)** : In gases, sound waves are always longitudinal because, gases cannot sustain shearing strain.

42. **(a)** : The CD acts like a prism because the narrow grooves are so close to each other that you cannot see the separation. But, white light fall on the CD will be separated by multicolours by grooves.

43. **(c)** : Total energy is given by

$$E = -\frac{GMm}{2R}$$

where R is the radius of orbit.

44. **(d)** : Kinetic energy is not conserved at every instant of elastic collision because there will be friction and deformation losses of energy.

45. **(a)** : When we heat the gas at constant volume, the heat is supplied to raise the temperature of gas only. When we heat the gas at constant pressure, the volume of the gas apart from temperature of the gas rises. When the gas

expands, it does some external work for increasing the volume. So in this case, the heat is supplied.
(a) to raise the temperature of the gas.
(b) to do the mechanical work for expansion. As a result more amount of heat is required to increase the temperature of the gas through the same amount when the pressure is kept constant. Hence C_P is always greater than the value of C_V.

46. **(a)**

47. **(a)** : Multiplication factor (k) is a measure of the growth rate of neutrons in the reactor. For $k = 1$; the operation of the reaction is said to be critical condition at which sustained chain reaction occurs. If k becomes greater than the reaction rate and reactor power increases exponentially.

48. **(a)** : Gauss's law is applicable for any closed surface. Gauss's law is most useful in situation where the charge distribution has spherical or cylindrical symmetry or is distributed uniformly over the plane. Whereas electric dipole is a system of two equal and opposite point charges separated by a very small and finite distance.

49. **(a)**

50. **(b)** : The transistor can be used as a switch, amplifier and oscillator.

51. **(a)** : When white light is passed through a lens, violet light is more refracted than red light because wavelength of violet is less than red light and therefore focal length for red light is greater than violet.

52. **(a)** : Microscope is an optical instrument which forms a magnified image of a small nearby object and thus, increases the visual angle subtended by the image at the eye so that the object is seen to be bigger and distinct. Therefore angular magnification for image is more than object.

53. **(a)**

54. **(d)**

55. **(a)** : The sky waves are the radio waves used for very long distance radio communication at medium and high frequencies (*i.e.*, shortwave band). In shorter wavelength, attenuation is very less.

56. **(a)**

57. **(c)** : The average energy of a neutron produced in fission of U^{235} is 2 MeV. These neutrons unless slowed down will escape from the reactor without interacting with uranium nuclei, unless a large amount of fissionable material is used for sustaining the chain reaction. What we needs to do is to slow down the fast neutrons by elastic scattering with light nuclei. Chadwick's experiment showed that in an elastic collision with hydrogen neutron almost come to rest.

58. **(a)**

59. **(b)** : The sign of magnification depend on the sign convention chosen. According to the new Cartesian sign conventions, magnification for a convex mirror is positive because image formed by a convex mirror is always virtual and erect. A concave mirror can form virtual or erect images and also real, inverted images. In the latter case, its magnification becomes negative. The reason though correct does not explain the assertion properly.

60. **(d)** : It does not follow inverse square law of distance. The assertion is false. The reason is also false.

CHEMISTRY

61. **(d)** : Ferrous sulphate $\rightarrow$ $FeSO_4 \cdot 7H_2O$
Copper sulphate $\rightarrow$ $CuSO_4 \cdot 5H_2O$
Magnesium sulphate $\rightarrow$ $MgSO_4 \cdot 7H_2O$
Sodium chloride $\rightarrow$ $NaCl$

62. **(a)** : The oxidation of sodium borohydride with iodine in diglyme gives diborane.
$$2NaBH_4 + I_2 \xrightarrow{\text{Diglyme}} B_2H_6 + 2NaI + H_2$$
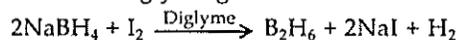
63. **(d)** : Fullerene consists of 12 five-membered rings and 20 six-membered rings. So it has five membered rings less than six membered rings.

64. **(a)** : As in complex $[Co(NH_3)_5Cl]^{2+}$ unpaired electrons are present, so it requires less energy for excitation. Thus, the wavelength of light absorbed will be highest (*i.e.*, $E \propto 1/\lambda$).

65. **(a)** : Phosphorus trichloride reacts violently with water forming phosphorous acid.
$$PCl_3 + 3HOH \longrightarrow H_3PO_3 + 3HCl$$
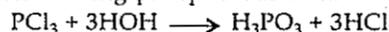
66. **(a)** : X-ray studies have shown that in ice, four hydrogen atoms tetrahedrally surround each oxygen atoms.
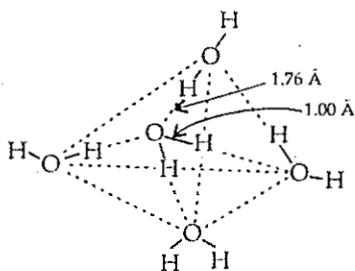
Tetrahedral arrangement of water

67. **(a)** : $I_{2(s)} + H_2O_{2(aq)} + 2OH^-_{(aq)} \longrightarrow$
$$2I^-_{(aq)} + 2H_2O_{(l)} + O_{2(g)}$$

68. **(c)** : $XePtF_6$ was first real compound of any of the noble gases.

69. **(c)** : $[Cu(NH_3)_4]^{2+}$

$$dsp^2$$
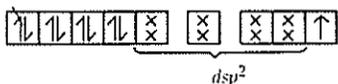
No. of unpaired electrons = 1
So, $[Cu(NH_3)_4]^{2+}$ is paramagnetic.

$[NiCl_4]^{2-}$:

$$sp^3$$
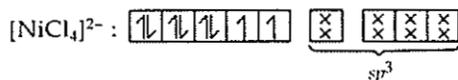
No. of unpaired electrons = 2
So, $[NiCl_4]^{2-}$ is paramagnetic.

$[PtCl_4]^{2-}$:

$$dsp^2$$

No. of unpaired electrons = 0
So, $[PtCl_4]^{2-}$ is diamagnetic.

$[Cu(H_2O)_4]^{2+}$:

$$sp^3$$
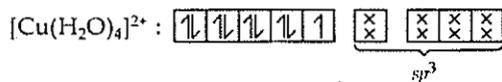
No. of unpaired electrons = 1
So, $[Cu(H_2O)_4]^{2+}$ is paramagnetic.

70. **(a)** : CsCl is not hygroscopic in nature while $MgCl_2$, $CaCl_2$ and LiCl are hygroscopic in nature.

71. **(a)** : Compound : $BeCl_2 > NO_2 > SO_2$
Angle : $180° > 132° > 119.5°$

72. **(d)** : $N_2O_{4(g)} + 3CO_{(g)} \longrightarrow N_2O_{(g)} + 3CO_{2(g)}$

$\Delta H_{reaction} = \Sigma_{Heat\ of\ formation\ of\ products}$
$$- \Sigma_{Heat\ of\ formation\ of\ reactants}$$
$\Delta H_{reaction} = [\Delta H_f N_2O + 3 \times \Delta H_f CO_2] -$
$$[\Delta H_f N_2O_4 + 3 \times \Delta H_f CO]$$
$\Delta H_r = [+811 + 3(-393)] - [10 + 3(-110)]$
$= [811 - 1179] - [-320] = -368 + 320$
$= -48$ kJ/mol

73. **(b)** : $2\overset{+7}{Mn}O_4^- + Br^- + H_2O \longrightarrow$
$$2\overset{+4}{Mn}O_2 + BrO_3^- + 2OH^-$$

74. **(b)** : $2CuSO_4 \cdot 5H_2O + 4KI \longrightarrow$
$$\underset{254\ g}{Cu_2I_2 + 2K_2SO_4 + I_2 + 10H_2O}$$
Molecular weight of $2CuSO_4 \cdot 5H_2O$
$[2(63.5 + 32 + 64) + 10(18)]$ g = 499 g
254 g of I_2 is liberated by 499 g $CuSO_4 \cdot 5H_2O$
2.54 g of I_2 will be liberated by x g $CuSO_4 \cdot 5H_2O$
$$x = \frac{499}{254} \times 2.54 = 4.99\ g$$

75. **(b)** : Since, the adsorption process is exothermic, the physical adsorption occurs readily at low temperature and decreases with increase in temperature (Le-Chatelier's principle).

76. **(a)** : Series $\rightarrow$ Lyman, Balmer, Paschen, Brackett, Pfund

$$\xrightarrow{\text{Increasing wavelength}}$$

77. **(a)** : $CaSO_{4\ (s)} \rightleftharpoons \underset{S}{Ca^{2+}_{(aq)}} + \underset{S}{SO_4^{2-}_{(aq)}}$

$K_{sp} = S^2 = 9 \times 10^{-6}$
$S = 3 \times 10^{-3}$ mol L^{-1}
Solubility in g litre^{-1} = molecular mass $\times S$
$= 136 \times 3 \times 10^{-3} = 408 \times 10^{-3}$ g L^{-1}
408×10^{-3} g of $CaSO_4$ present in 1 litre

1 g of $CaSO_4$ present is $\dfrac{1}{408 \times 10^{-3}} = 2.45$ litre.

78. **(d)** : Equilibrium state can only be achieved if a reversible reaction is carried out in a closed space.

79. **(d)** : (a) It successfully explained the stability of atoms.
(b) It is not in agreement with Heisenberg's uncertainty principle.
(c) It does not explain the spectra of multi-electron atoms.
(d) It does not explain de Broglie concept of the dual character of matter.

80. **(a)** : In van der Waal's equation, a signifies the intermolecular force of attraction.

81. **(c)** : For adiabatic process, no exchange of heat takes place between the system and surroundings. *i.e.* $q = 0$.

82. **(d)** : Number of millimoles of base (*i.e.*, $Ca(OH)_2$)
$= N_1V_1 = 2 \times M_1 \times V_1 = 2 \times 0.2 \times 25 = 10$

Number of millimoles of acid (*i.e.*, HCl) = $N_2 V_2$
$$= 10 \times 1 = 10$$
As, no. of millimoles of acid = no. of millimoles of base

∴ Acid is completely neutralised by base forming a neutral solution.

∴ pH of the resulting solution = 7.

83. **(a)** : In Schottky defect, some of the lattice points are unoccupied (vacancies or holes). The number of missing cations and anions is the same, thus crystal remains neutral.

84. **(a)** : Neutron moderators slow down the speed of neutrons by collisions. They do not absorb neutrons. *e.g.* water and graphite.

85. **(b)** : Thermodynamic functions are : Internal energy, enthalpy, entropy, pressure, volume, temperature, free energy, number of moles.

86. **(c)** : Intensive property : Specific heat
Extensive property : Enthalpy, entropy, volume.

87. **(b)** :
$$A_{(g)} \longrightarrow 2B_{(g)} + C_{(g)}$$
Initial : P_0 0   0
         $P_0 - P$ $2P$ P

Total pressure at time (t) = $P_0 - P + 2P + P = P_t$
$$\Rightarrow \quad P_t = P_0 + 2P$$

$$P_t - P_0 = 2P \quad \Rightarrow \quad P = \frac{P_t - P_0}{2}$$

$$k = \frac{2.303}{t} \log\left[\frac{P_0}{P_0 - P}\right] = \frac{2.303}{t} \log\left[\frac{P_0}{P_0 - \left(\frac{P_t - P_0}{2}\right)}\right]$$

$$= \frac{2.303}{t} \log\left(\frac{2P_0}{2P_0 - P_t + P_0}\right) = \frac{2.303}{t} \log\left(\frac{2P_0}{3P_0 - P_t}\right)$$

88. **(c)** : If the nucleophilic atoms are in the same row of the periodic table, nucleophilicity is approximately in order of basicity. So, the order is $NH_2^- > CH_3O^- > OH^- > RNH_2$.

89. **(c)** : Symmetrical molecule

Number of chiral carbon atoms = 2 (even)

Number of stereoisomers = $2^{n-1} + 2^{\frac{n}{2}-1}$

$$= 2^{2-1} + 2^{\frac{2}{2}-1} = 2^1 - 2^0 = 2 + 1 = 3$$

90. **(a)**

91. **(a)** : $C_{12}H_{22}O_{11} + H_2O \xrightarrow[\text{or}]{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$
    Maltose   maltase   Glucose   Glucose

92. **(b)** : Isoprene is a monomer of natural rubber.
$$H_2C{=}C{-}CH{=}CH_2$$
$$\quad\quad\quad | $$
$$\quad\quad\quad CH_3$$
2-methyl-1,3-butadiene

93. **(a)** : Presence of excess of HI favours $S_N 1$ mechanism.
So, formation of products is controlled by the stability of the carbocation resulting in the cleavage of C – O bond in protonated ether.
Thus the product for given equation are $C_6H_5CH_2I$, CH_3CH_2I, $HOCH_2 - CH_2OH$.

94. **(c)**

95. **(d)** : CH_3COCH_2COOH is a β-keto acid. Thus decarboxylation is maximum in a carboxylic acid containing an electron withdrawing group such as $>CO$ or $-COOH$ at the β-carbon atom with respect to the – COOH group.

96. **(b)** : Greater is the electron density on aromatic ring, greater is the reactivity towards electrophilic aromatic substitution.

97. **(d)** : Substituent with strong +R effect, +I effect and weaker –I effect increases the basicity. Hence pK_b decreases. Also, alkylamines are stronger bases than arylamines. So, the order is (d).

98. **(a)** : Weaker acids have higher pK_a. – OCH_3 at *meta*-position exerts only –I effect, hence increases the acidity.
–I effect order : $- NO_2 > - OCH_3 > - Cl$.
– CH_3 has +I effect.
So order is (a).

99. **(a)**

100. **(a)** : Pent-4-ene-1-yne
   1   2   3   4   5
$$CH \equiv C - CH_2 - CH = CH_2$$
No. of σ-bonds – 4 (C – C) + 6 (C – H) = 10
No. of π-bonds – 1 (C=C) + 2 (C≡C) = 3

101. **(b)** : As the size of the atom M in H_2M increases, the strength of the H – M bond decreases.

102. **(c)** : The electronegativity of N (3.0) is much higher than P (2.1).

103. (c) : Solubility of AgCl (at 25°C) in H_2O
$$= 0.0020 \text{ g AgCl per litre of } H_2O$$
Solubility of AgCl in NH_3 (at 25°C)
$$= 14.00 \text{ g AgCl dissolved per kg of } NH_3$$
Ammonia is less polar than water, as oxygen is more electronegative than nitrogen.

104. (d) : BCC has 68% and HCP has 74% packing efficiency.
BCC - 2 atoms per unit cell, HCP - 4 atoms per unit cell
In BCC, particles are present at corners and one particle is present at the centre within the body of the unit cell. In HCP, the packing gives a hexagonal pattern.

105. (c) : $Mn^{2+} = [Ar] 3d^5$, $Mn^{3+} = [Ar] 3d^4$
$Fe^{2+} = [Ar] 3d^6$, $Fe^{3+} = [Ar] 3d^5$

Thus, Mn^{2+} has more stable configuration than Mn^{3+} while Fe^{3+} has more stable configuration than Fe^{2+}. Hence, reduction potential for Mn^{3+}/Mn^{2+} couple is more positive than Fe^{3+}/Fe^{2+}.

106. (a) : A mixture of 2% O_2 and 98% He is used in diving apparatus which gives the same partial pressure of O_2 as in normal air at 1 atm. Due to high partial pressure and greater solubility, N_2 gets dissolved in blood and form bubbles (bends or decompression sickness). Hence, N_2 is replaced by helium which is much less soluble in biological fluids.

107. (a) : For a redox reaction to be spontaneous, the EMF of the cell must be positive.
As, $-\Delta G = nFE_{cell}$
Therefore, for E_{cell} = +ve, ΔG is always negative.

108. (a) : H_2O_2 oxidises sulphur to sulphate in presence of Fe^{3+} ions.

109. (b) : $Cl_2 + 2NaOH \text{ (dil.)} \xrightarrow{\text{cold}}$
$$NaCl + NaOCl + H_2O$$
$3Cl_2 + 6NaOH \text{ (conc.)} \xrightarrow{\text{heat}}$
$$5NaCl + NaClO_3 + 3H_2O$$
Chlorine undergoes the simultaneous oxidation-reduction. Chlorine is simultaneously reduced to chloride ion (Cl^-) and is oxidised to either ClO^- or ClO_3^- ion. Halogens (*e.g.* Cl) have a strong tendency to accept electrons, so they act as strong oxidising agents.
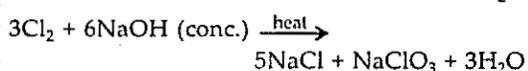
110. (d) : For a closed system, the entropy can increase, decrease or remain constant.
Closed system can be reversible or irreversible.

111. (d) : Two different reactions can have same rate of reaction. Rate of reaction depends upon many factors like nature and concentration of reactants, temperature, catalyst, energy factors, orientation factor, etc.

112. (a) :
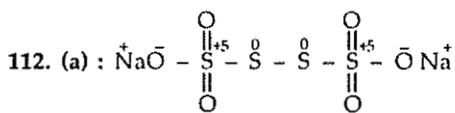
Formal oxidation number of sulphur
$$= \frac{2 \times 5 + 2 \times 0}{4} = 2.5$$

**113. (d) :** Elevation in boiling point $(\Delta T_b) = K_b \times m$
Depression in freezing point $(\Delta T_f) = K_f \times m$.
Elevation in boiling point and depression in freezing point are colligative properties *i.e.*, they depend only on the number of particles of the solute. Value of K_b and K_f are different, so ΔT_b and ΔT_f are also different.

114. (a) : Williamson's synthesis occurs by S_N2 mechanism and primary alkyl halides are most reactive in S_N2 reactions.

115. (d) : Dehydration of alcohols can be carried out either with protonic acids such as conc. H_2SO_4, H_3PO_4 or catalysts such as anhydrous zinc chloride or alumina.

116. (d) : Oxidation of toluene using CrO_3 in acetic anhydride or CrO_2Cl_2 in CCl_4 or CS_2 and then hydrolysis gives benzaldehyde. No such intermediate is formed.

117. (a) :
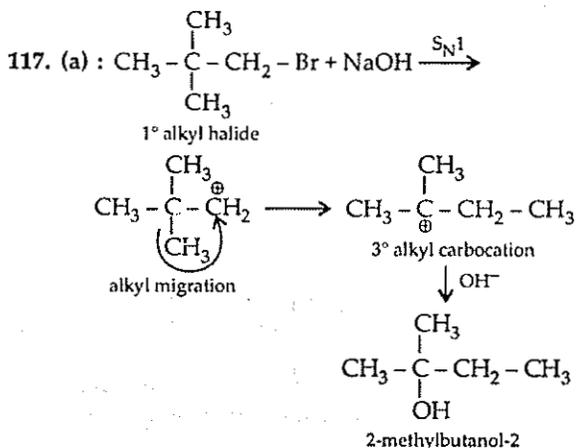
Neopentyl bromide being primary alkyl halide does not undergo S_N2 reaction but proceeds via S_N1 path because of steric hindrance caused by the bulky nature of tertiary butyl group.

118. (b) : In β-pleated sheet structure, the polypeptide chains are held together by intermolecular H-bonds. Extension and contraction of β-pleated sheet structure of protein depends on the size of *R*.

119. (b) : All those carbohydrates which contain aldehydic or ketonic group in the hemiacetal or hemiketal form and reduce Tollen's or Fehling's solutions are reducing sugars. All monosaccharides are reducing sugars (whether aldoses or ketoses).
Fructose is a monosaccharide with keto group.

120. (d) : In *p*-nitrophenol, – NO_2 group has –*I* effect, as a result of which electron density decreases on the benzene ring, hence reactivity towards electrophilic substitution decreases. Methoxy group shows both +*R* (due to lone pair of electrons on O) and –*I* effect (due to greater electronegativity of O).
– OCH_3 at *meta*-position shows only –*I* effect but lesser than –*I* effect of – NO_2 group.

BIOLOGY

121. (c) : *Eco* R I is type II restriction endonuclease enzyme extracted from *Eco* R Y 13 bacteria. It can recognize and cleave 5'-GAATTC-3' palindromic sequence and is widely used in biotechnology experiments.

122. (c) : Gene therapy is a procedure of introducing copies of a healthy gene to replace defective gene responsible for disease development. The first clinical gene transfer took place on 22nd May 1992 for correction of adenosine deaminase (ADA) enzyme deficiency.

123. (d) : Bacteria, fungi and lower plants survive in adverse conditions through formation of thick walled spores. Algae form resting spore or akinetes which are thick walled spores and store food material. In fungi, thick walled perennating spores called chlamydospores are formed. Bacteria form endospores which is probably the most resistant living thing known. They may remain alive in boiling water for more than 2 hours.

124. (d) : When a graph is plotted taking into consideration time on one hand and growth rate on the other hand, a 'S' shaped curve is obtained. It is called "grand period of growth". This total growth period is divided into three stages.
(1) Initial lag phase
(2) Middie log phase
(3) Final stationary phase.

125. (b) : Monarch butterfly escapes from predators because of its bitter taste. Viceroy butterfly (*Basilarchia archippus*) mimics monarch butterfly to escape from predators.

126. (b) : Tapetum is the innermost one cell thick layer of microsporangium wall. The cells of this layer are radially enlarged and store food. The cells are multinucleated and provide nourishment to developing microspores or pollen grains.

127. (d) : Catalytic converters have platinum-palladium and rhodium metals as catalyst. It converts more harmful carbon monoxide and unburnt hydrocarbons into less harmful carbon dioxide and water.

128. (c) : Cell theory was proposed by a German botanist M.J. Schleiden and another German, a zoologist T.S. Schwann in 1839.

129. (c) : These are different arrangements of ovule attachment to inner surface of ovary wall. (A) represents marginal, (B) represents axile, (C) represents parietal, (D) represents free central, (E) represents basal placentation.

130. (a) : The figure shows structure of lenticel which facilitates gaseous exchange and transpiration These are aerating pores in the bark of woody trees. These are surrounded by loosely arranged thin walled complementary cells enclosing intercellular spaces for gaseous exchange

131. (c) : In given diagram (A) represents denitrification and (B) represents ammonification. Denitrification is conversion of nitrates into nitrogen gas by some microorganisms *e.g.*, *Pseudomonas denitrificans,* *Thiobacillus denitrificans, Micrococcus denitrificans.* Ammonification is conversion of dead remains of living organisms into ammonia with the help of microorganisms like *Bacillus ramosus, B. vulgaris, B. mesentericus* etc.

132. (c) : In active transport, carrier proteins which are located at membrane, use energy in the form of ATP to transport molecules against concentration gradient of cell membrane. Transportation rate

reaches maximum when all carrier proteins are being used or are saturated. These proteins are very specific to certain substances and are sensitive to inhibitors.

133. (c) : Water is the most abundant chemical compound in living organism. In a cell, water occupies 70–90% of the cellular mass. So, in 50 gm of living tissue 35–45 gm of water would be present.

134. (b) : Photosystem II mostly occurs in the appressed regions of granal thylakoids.

135. (a) : After glycolysis, pyruvate forms acetyl Co-A which undergoes oxidation to form CO_2 and H_2O through Krebs' cycle in mitochondrial matrix.

136. (a) : Cleistogamous flowers do not open at all. In such flowers, the anthers and stigma lie close to each other. Anthers when dehisce in the flower buds, pollen grains come in contact with the stigma to effect pollination Thus, cleistogamous flowers are autogamous as there is no chance of cross-pollination. So, no pollination agent is required in these flowers.

137. (b) : C_4 plants are more efficient than C_3 plants because they have little photorespiration while in C_3 plants more than half of photosynthetic carbon get lost in photorespiration. C_4 plants are more efficient in picking up CO_2, even in low CO_2 concentration because of high affinity of CO_2 with PEP (phosphoenol pyruvic acid).

138. (c) : Fermentation in muscle produces lactic acid. In our bodies certain muscle cells, called fast twitch muscles, have less capability for storing and using oxygen than other muscles. When we run, these muscles run short of oxygen, the fast twitch muscles begin using lactic acid fermentation. This allows the muscle to continue to function by producing ATP by glycolysis.

139. (c) : *Aspergillus niger* is used for commercial and industrial production of certain chemicals like citric acid. Activated sludge is digested by anaerobic bacteria to produce marsh gas. BOD is amount of oxygen required by bacteria for decomposition.

140. (d) : Trace elements or microelements (*e.g.* iron, iodine, zinc, manganese, cobalt, copper,

molybdenum, etc.) are required in very small amounts to our body.

141 (c) : Endangered plants may be preserved in part through seed bank or germplasm bank. The term seed bank sometimes refers to a cryogenic laboratory facility in which the seeds of certain species can be preserved for up to a century or more without losing their fertility. It can also be used to refer to a special type of arboretum where seeds are harvested and the crop is rotated. For plants that cannot be preserved in seed banks, the only other option for preserving germplasm is *in vitro* storage, where cuttings of plants are kept under strict conditions in glass tubes and vessels.

142. (a) Reverse Transcription Polymerase Chain Reaction (RT-PCR) is a variant of Polymerase Chain Reaction (PCR), a laboratory technique commonly used in molecular biology to generate many copies of a DNA sequence, a process termed "amplification". In RT-PCR, however, an RNA strand is first reverse transcribed into its DNA complement (complementary DNA, or *c*DNA) using the enzyme reverse transcriptase, and the resulting *c*DNA is amplified using traditional PCR or Real-Time PCR. Reverse transcription PCR (RT-PCR)is not to be confused with Real-Time Polymerase Chain Reaction (Q-PCR/qRT-PCR),RNA silencing (also called as post-transcriptional gene silencing PTGS) refers to a family of gene silencing effects by which the expression of one or more genes is down regulated or entirely suppressed by the introduction of an antisense (single stranded) RNA molecule. Transcription is the process of creating a complementary RNA copy of a sequence of DNA.

143. (a) : Chromosome replication occurs once but meiosis has two M-phases each with its own karyokinesis and cytokinesis. As a result chromosome number is halved. The transition period between M-phase I (meiosis I) and M-phase II (meiosis II) is short and without DNA replication. It is called interkinesis.

144. (b) : Hermann Henking discovered the X chromosome while studying insects in the early 1890s. The sex chromosomes in birds are opposite of that in humans. Human males are

heterogametic (XY), females are homogametic (XX), in birds males are homogametic (ZZ) and females are heterogametic (ZW). The "W" is the sex determining chromosome just as the Y in humans. A bird with a W is always a female. In grasshoppers, there is no Y chromosome, so a grasshopper with one X chromosome (symbolized as XO) is normally a male, while a grasshopper with two X chromosomes (XX) is normally a female.

145. (b) : In mosses the sporophytes (*i.e.* the diploid body) are short-lived and dependent on the gametophyte. In the presence of water, sperms from the antheridia swim to the archegonia and fertilization occurs, leading to the production of a diploid sporophyte. The sperm of mosses is biflagellate, *i.e.* they have two flagella that aid in propulsion. Since the sperms must swim to the archegonium, fertilization cannot occur without water.

146. (a) : According to Central Pollution Control Board (CPCB), particulate size 2.5 micrometers or less in diameter (PM 2.5) are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, such as irritation, inflammations and damage to the lungs and premature deaths.

147. (d) : Common cold can take place from one person to other as it is a communicable in nature. A healthy person can get infected by being in close vicinity of infected person when he/she sneezes, coughs, as the droplets generated by sneeze and cough contain infecting agents. Typhoid occurs by the intake of contaminated water & food. While ringworm is one of the skin disease which can transfer from one person to other by the use of infected towel & handkerchief. AIDS (Acquired Immuno deficiency) does not occur or transfer by shaking hands.

148. (b) : The peppered moth (*Biston betularia*) is a temperate species of night-flying moth. Peppered moth evolution is often used by educators as an example of natural selection. Peppered moths are cryptically camouflaged against their backgrounds when they rest on the tree trunk.

149. (a) : Fibres and fibroblasts are compactly packed in the dense connective tissues. Orientation of fibres show a regular or irregular pattern and are called dense regular and dense irregular tissues. In the dense regular connective tissues, the collagen fibres are present in rows between many parallel bundles of fibres. Tendons, which attach skeletal muscles to bones and ligaments which attach one bone to another are examples of this tissue.

150. (d) : The main criteria for classification used by Whittaker includes cell structure, thallus organization, mode of nutrition, reproduction and phylogenetic relationships. So, the absence of cell wall is one of the main characteristics of animal kingdom.

151. (d) : Medulla oblongata is part of the vertebrate brain stem, derived from the hindbrain, that is continuous with the spinal cord. Its function is to regulate the reflex responses controlling respiration, heart beat, blood pressure, and other involuntary processes. It gives rise to many of the cranial nerves.

152. (d) : Great apes, humans goes through a menstrual cycle while monkey goes through estrous cycle. Urine is light yellow colored watery fluid which is slightly acidic. Bile juice does not contain any digestive enzymes.

153. (b) : Industrial melanism is an adaptation where the moths living in the industrial areas developed melanin pigments to match their body to the soot-covered surroundings. The phenomenon provides an excellent example of operation of selection in natural conditions.
Industrial melanism, therefore, presents an excellent example of natural selection (proposed by Darwin), but it is not the example of acquired characters proposed by Lamarck.
In caves, due to absence of light, the body of the animal lacks pigmentation. *e.g. Proteus anguinus.* In pythons and related snakes rudimentary pelvic girdle and traces of hind limb are present. They form small clawed projections externally, but internally there are vestiges of an ilium, femur, tibia and a claw. In aquatic birds and flying frog, the feet are webbed which sustain it in the prolonged leaps to which it is adapted.

154. (b) : Frogs do not have external ears. Instead, they have an eardrum of sorts, called a tympanum, which is just behind each eye. Typhlosole are

internal folds of the intestine or intestinal inner wall. Typhlosole occurs in bivalve mollusks, lampreys and some annelids and echinoderms. The gizzard, also referred to as the ventriculus, gastric mill, and gigerium, is an organ found in the digestive tract of some animals, including birds, reptiles, earthworms and some fish. This specialized organ constructed of thick, muscular walls is used for grinding up food; often rocks are instrumental in this process. In certain insects and mollusks, the gizzard features chitinous plates or teeth. Humans have 12 pairs of cranial nerves. Cockroach belongs to class insecta of phylum arthropoda.

155. **(d)** : The T wave represents the repolarization (or recovery) of the ventricles. The end of the T-wave marks the end of systole. The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria. The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction.

156. **(b)** : In descending limb of loop of Henle, the water is reabsorbed from filtrate flowing in it due to increasing osmolarity of interstitial fluid. Sodium and other solutes are not reabsorbed here. The filtrate becomes hypertonic to blood plasma. All nephrons have their renal Malphigian corpuscles in the cortex. Cortical nephrons have their loop of Henle in the renal medulla near its junction with the renal cortex, while the loop of Henle of juxtamedullary nephrons is located deep in the renal medulla; they are called juxtamedullary because their renal corpuscle is located near the medulla (but still in the cortex).

157. **(a)** : In *in vitro* fertilization (IVF-fertilization outside the body in almost similar conditions as that in the body) followed by embryo transfer (ET), ova from the wife/donor (female) and sperms from the husband/donor (male) are collected and are induced to form zygote under simulated conditions in the laboratory. The zygote or early embryos (with upto 8 blastomeres) could then be transferred into the Fallopian tube (ZIFT-Zygote Intra Fallopian Transfer) and embryos with more than 8 blastomeres, into the uterus (IUT-Intra Uterine Transfer), to complete its further development.

158. **(d)** : The most obvious and technically complicated feature of all living organisms is their ability to sense their surroundings or environment and respond to these environmental stimuli which could be physical, chemical or biological. All organisms, from the prokaryotes to the most complex eukaryotes can sense and respond to environmental cues *eg*. Photoperiod affects reproduction in seasonal breeders, both plants and animals. Consciousness therefore, becomes the defining property of living organisms. There are many organisms which do not reproduce *e.g.* mule. Thus, reproduction cannot be an all-inclusive defining characteristic of living organisms. However no non-living object is capable of reproducing or replicating by itself.

159. **(b)** : The opening between the right atrium and right ventricle is guarded by a valve formed of three muscular flaps or cusps, the tricuspid valve.

160. **(d)** : Each actin (thin) filament is a polymerised protein made up of two 'F' (fibrous) actin strands helically wound to each other. Each 'F' actin is a polymer of monomeric 'G' (globular) actins. It is light in colour & shows isotropic property.

161. **(b)** : Enzymes are highly substrate specific *i.e.* they catalyze the reaction of a particular substrate only. They facilitate occurrence of a reaction and transition of reactant into product. A chemical reaction $S \rightarrow P$ (where S is the substrate and P the product or products) will take place when a certain number of S molecules at any given instant possess enough energy to attain an activated condition called the 'transition state'. The enzyme combines transiently with the substrate to produce a transient state having a lower energy of activation than that of substrate alone. This results in acceleration of the reaction. Once the products are formed, the enzyme (or catalyst) is free or regenerated to combine with another molecule of the substrate and repeat the process.

162. **(c)** : Cell's turgidity is due to turgor pressure. Turgor pressure is the pressure which develops in the confined part of an osmotic system due to osmotic entry of water into it. It is also called hydrostatic pressure or pressure potential. The force exerted by the cell wall over the protoplast is called wall pressure. Normally wall pressure

is equal and opposite to turgor pressure except when the cell becomes flaccid.

163. (b) : Long distance bulk movement of substances that occurs through conducting or vascular tissues of plants is called translocation. There are two vascular tissues, xylem and phloem. Xylem translocation is mainly from roots to aerial parts. It passes water with mineral salts, some organic nitrogen and hormones *i.e.* unidirectional. Phloem translocates organic substances and inorganic solutes first from leaves to all other parts of the plant and storage organs. Storage organs re-export organic nutrients to those parts which require the same as newly formed leaves and fruits *i.e.* it is bidirectional.

164. (b) : The first step in photosynthesis is the light-driven oxidation (splitting or photolysis) of water. It provides the electrons for the photosynthetic electron transport chains as well as protons for the establishment of a proton gradient. It occurs on the lumenal side of the thylakoid membrane. During photolysis, water is oxidised to oxygen, protons and electrons. Protons accumulate in the lumen.

165. (a) : Unlike animals, plants do not stop growing after reaching maturity. They continue to grow and bear new roots, leaves, branches, flowers, etc. While roots, stems and their branches have indefinite growth, other organs like leaves, flowers and fruits show limited or definite growth. They appear and fall off periodically and sometimes repeatedly. In lower plants, growth is diffused as every cell can divide and enlarge. Higher plants possess specific areas which take part in the formation of new cells. These areas are called meristems. Meristems are of three types– apical, intercalary and lateral. Cells of the meristematic region have the capacity to divide and self perpetuate. They produce cells which lose the capacity to divide and enter G_0 phase for undergoing differentiation to form particular tissues and organs. The meristem which is consumed in the formation of an organ is called determinate meristem. The meristem which continues its activity throughout life of the plant is called indeterminate meristem. It is the reason behind indefinite growth of plants.

166. (c) : Organic biodegradable (*i.e.* they can be

degraded by decomposers) pollutants in water are measured by BOD. BOD(biological oxygen demand) is the oxygen demanded or required by bacteria and other decomposers to oxidise pollutants.

167. (a) : Vessels are much elongated tubes which are closed at either end and are formed by the union of several short, wide and thickened cells called vessel elements. The end walls of vessel elements are transverse or oblique. They are often completely dissolved. The condition is called simple perforation plate. In a few cases the end walls remain intact and possess several pores in reticulate, scalariform or forminate forms. Such an end wall is called multiple perforation plate. Sieve tubes are elongated tubular conducting channels of phloem formed of several cells called sieve tube elements or members or sieve tube cells. Sieve tube members are placed end to end. The end walls are generally bulged out. They may be transverse or oblique. They have many small pores or sieve pits. Due to the presence of sieve pits the end walls are commonly called sieve plates. In some cases the end walls of sieve elements possess more than one porous area. Such an end wall is called compound sieve plate. Gymnosperms & pteridophytes lack these two vascular structures *i.e.* vessels and sieve elements. In angiosperms presence of vessels & sieve elements in addition to all other vascular tissues make their food & water transport more efficient.

168. (b) : Formation of seeds without fertilization is called apomixis. It leads to clonal reproduction in which all offsprings are by and large genetically identical to the parent. The egg contains a full complement of genes and does not need to fuse with a sperm to produce a zygote. Apomixis provides for the perpetuation of traits favourable to individual survival but eliminates the longer-term evolutionary advantage of biparental inheritance. In asteraceae, various genera and individual species of the order asterales are known to reproduce by apomixis (the setting of seeds without fertilization), either completely or in addition to normal sexual means. In poaceae about 35 genera produce seeds without fertilization. On the other hand, parthenocarpy is development of fruits without fertilization. The

fruit resembles a normally produced fruit but is seedless, *e.g.* pineapple, banana, cucumber, grape, orange, grapefruit etc.

169. **(d)** : Algal blooms are a result of eutrophication. Eutrophication involves change in biological productivity and nutrient content of a water body. Eutrophication literally means 'well nourished or enriched'. Eutrophication become excessive, when abnormally high amount of nutrients from sewage, fertilizers, animal wastage and detergent, enter streams and lakes causing excessive growth or blooms of microorganisms. They are harmful for both humans and aquatic organisms. Eutrophication results in higher BOD and reduced dissolved oxygen in water body. It causes death of fish and other aquatic animals.

170. **(c)** : Mangroves which form shallow littoral forests near sea shores areas are halophytes. Mangrove grow in physiologically dry environment (water is available in plenty but in the form of strong salt solution). These plants develop shallow rootings due to water logged environment where oxygen scarcity prevails. To ensure proper aeration in root system, plants produce respiratory roots or pneumatophores which are negatively geotropic peg-like projections above ground with numerous pores or lenticels for gaseous exchange.

171. **(a)** : It can be explained as follows

or 50% tall, 50% dwarf progeny.
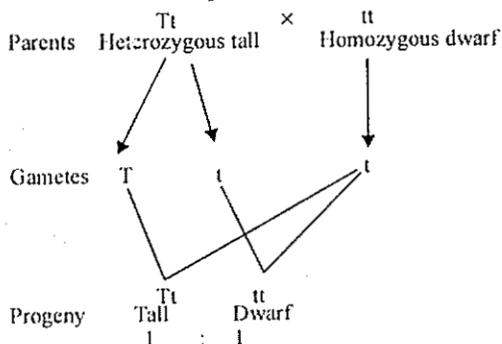
172. **(b)** : Amniocentesis is a foetal sex determination and disorder test based on the chromosomal pattern in the amniotic fluid surrounding the developing embryo. The amniotic fluid contains cells from foetus skin and respiratory tract. These cells are cultured and are used to determine chromosomal abnormalities (Down's syndrome, Klinefelter's syndrome, etc.) and metabolic disorders (phenylketonuria, sickle cell anaemia, etc.) of the foetus. But now-a-days instead of positive uses of amniocentesis it is being used for female foeticide. Sex of the foetus is determined using amniocentesis and then if it turns out to been a female one, foetus is aborted. That is why amniocentesis has been banned in India.

173. **(a)** : *Bacillus thuringiensis* is a bacterium found in soil worldwide. Several strains can infect and kill insects. Due to this property, through genetic engineering, gene coding for insecticide is incorporated into plant genome. Plant having this gene are insect resistant thus high yielding *e.g.* Bt cotton is usually resistant to bollworm disease of cotton. It is the first genetically modified crop of India. This produces its own insecticide, as it contain a gene from soil bacterium *Bacillus thuringiensis*.

174. **(c)** : Glycerides, mainly triglycerides are a principle form of fats present in our food. During digestion, fats are digested to form monoglycerides and free fatty acids. They first become dissolved in the central lipid portions of bile micelles which are soluble in chyme. In this form, the monoglycerides and free fatty acids are carried to the surfaces of the microvilli of the intestinal cell brush border and then penetrate into the interior of the epithelial cells, which is possible because the lipids are also soluble in the epithelial cell membrane. This leaves the bile micelles still in the chyme, where they function again and to help absorb still more monoglycerides and fatty acids.

After entering the epithelial cell, the fatty acids and monoglycerides are taken up by the cell's smooth endoplasmic reticulum; here they are mainly used to form new triglycerides that are subsequently released in the form of chylomicrons through the base of the epithelial cell, to flow upward through the thoracic lymph duct and empty into the circulating blood. Thus, chylomicrons help in transport of glycerides through blood circulation to various body parts.

175 **(c)** : The colourless blood or haemolymph of cockroach has a clear plasma and numerous white corpuscles called haemocytes. Being devoid of any respiratory pigment, it does not serve for gaseous exchange. Its plasma contains

about 70% water. Rest of it is composed of amino acids, uric acid, proteins, sugars, fats, and salts of sodium, potassium, calcium and magnesium. Transportation of these materials between different parts of body is the main function of haemolymph. In all terrestrial insects, like cockroach, every tissue of body is in direct contact with atmospheric air for gaseous exchange. A complicated system of numerous shiny, transparent and branched air tubes or tracheae is found for this purpose in the haemocoel cavity. Atmospheric air enters into and escapes out from this system through ten pairs of slit-like apertures called stigmata or spiracles, located on lateral sides of body.

176. **(b)** : ABO blood groups are determined by the gene I (isoagglutinin). There are three alleles, I^A, I^B and I^O of this gene. Proteins produced by the I^A and I^B alleles are called A antigen and B antigen. People with blood group A have the A antigen on the surface of their RBCs, and antibodies against antigen B in their plasma. Persons with blood group B have B antigen on their RBCs, and antibodies against A antigen in their plasma. Individuals with AB blood group have both antigen A and antigen B on their RBCs, and no antibodies for either of the antigens in their plasma. Type O individuals are without A and B antigens on their RBCs, but have antibodies for both these antigens in their plasma.

177. **(b)** : Sinu-auricular node or S-A node is located in the wall of the right auricle below the opening of the superior vena cava. The S-A node has unique property of self excitation, which enables it to act the "pacemaker" of the heart. It spontaneously initiates a wave of contraction which spreads over both the auricles more or less simultaneously along the muscle fibres that fan out from the pacemaker.

178. **(d)** : The organ of Corti lies on the basilar membrane. It contains a series of electromechanically sensitive cells *i.e.* hair cells. They are the receptive end organs that generate nerve impulses in response to sound vibrations. Thus, organ of Corti is actually the organ that perceives sound. Minute hairs project upward from hair cell and they are embedded in the tectorial membrane. Equilibrium of body is maintained with the help of semicircular canals, utricle and saccule of internal ear.

179. **(b)** : After ovulation, the empty Graafian follicle contains a blood clot which is called corpus haemorrhagic. Its granulosa cells continue to proliferate, develop yellow carotene pigment or lutein and get converted into lutein cells. This converts the ruptured follicle into yellow body called corpus luteum. It becomes a temporary endocrine gland secreting progesterone with small quantity of estrogen. in absence of fertilization, after few days, corpus luteum ultimately stops activity, loses yellow colour, begins to degenerate, then it is called corpus albicans. If fertilization occurs and foetus is implanted in the endometrium, the trophoblast cells of the developing placenta secrete a hormone human chorionic gonadotrophin (hCG). This hormone, like LH, maintains the corpus luteum and the secretion of progesterone and estradiol by it. These two hormones check the breakdown of the endometrium of the uterus. Thus corpus luteum helps to maintain pregnancy.

180. **(b)** : A healthy person acquires infection when a female *Anopheles* mosquito, containing infective stages of parasite (sporozoites) in its salivary glands, bites him for sucking his blood. The mosquito punctures the host's skin by its proboscis and first introduces some saliva into blood stream. Along with saliva, thousands of sporozoites contained therein are also inoculated. Sporozoites represent the infective forms of parasite. These are small spindle-shaped, slightly curved or sickle-shaped, and uninucleate organisms, measuring 11-12µm in length and 0.5-1µm in width. After infection sporozoites enter liver cells here after a few divisions, micrometacryptomerozoites are formed that enter RBC's and gametocytes are formed here in RBC's.

GENERAL KNOWLEDGE

181. (a)	182. (b)	183. (c)	184. (a)	185. (a)
186. (b)	187. (c)	188. (a)	189. (d)	190. (c)
191. (a)	192. (b)	193. (b)	194. (d)	195. (d)
196. (a)	197. (b)	198. (a)	199. (d)	200. (b)

☺☺☺

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AIIMS paper and refer to these
questions when you are practising MCQs chapterwise.

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