SOLUTIONS

PHYSICS

1. **(a) :** A space wave travels in a straight line from transmitting antenna to the receiving antenna. Space waves are used for line of sight communication as well as satellite communication.

2. **(d) :** In nuclear fission or fusion both energy and mass are conserved.

3. **(b) :** Number of fission per second

$$= \frac{\text{total power}}{\text{energy/fission}}.$$

Here, total power = 100 W

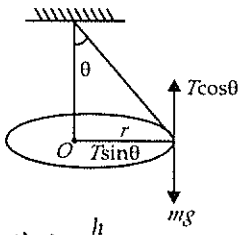
energy/fission = 200 MeV = $200 \times 10^6 \times 1.6 \times 10^{-19}$ J

$= 3.2 \times 10^{-11}$ J.

$$\therefore \quad \text{fission rate} = \frac{100}{3.2 \times 10^{-11}} = 3.1 \times 10^{12}\ \text{s}^{-1}$$

4. **(c) :** From figure,

$$\therefore \quad T\sin\theta = \frac{mv^2}{r}$$



5. **(d)**

6. **(a) :** de brogile wavelength, $\lambda = \frac{h}{p}$

or $\lambda = \frac{h}{mv}$

$$\therefore \quad \frac{\lambda_p}{\lambda_e} = \frac{m_e v_e}{m_p v_p}$$

$$\Rightarrow \quad m_p = \frac{m_e v_e}{v_p} \times \frac{\lambda_e}{\lambda_p}$$

Here, $m_e = 9.1 \times 10^{-31}$ kg, $v_p = 3v_e$

and $\frac{\lambda_p}{\lambda_e} = 1.814 \times 10^{-4}$

$$\therefore \quad m_p = \frac{9.1 \times 10^{-31}}{1.814 \times 10^{-4} \times 3} = 1.672 \times 10^{-27}\ \text{kg}$$

Thus, the particle is neutron.

7. **(d)**

8. **(a) :** Angular momentum = moment of inertia × angular velocity

$= [ML^2] \times [T^{-1}] = [ML^2T^{-1}]$.

9. **(a) :** Magnetic moment,

$$M = IA = I(\pi r^2) = \frac{q}{T} \times \pi r^2 \qquad (\because\ q = It).$$

As $\omega = \frac{2\pi}{T}$

$$\therefore \quad M = \frac{q\omega r^2}{2}$$

or $M \propto \omega$

10. **(c)**

11. **(b) :** If a point mass m is placed at a height h from surface of earth, the potential energy is

$$U_h = -\frac{GMm}{(R+h)} = \frac{-gR^2m}{R\left(1+\frac{h}{R}\right)} = \frac{-gR^2m}{R}\left(1+\frac{h}{R}\right)^{-1}$$

$$\left(\because\ g = \frac{GM}{R^2}\right)$$

$$U_h = \frac{-gR^2m(R-h)}{R^2}$$

$$= -gm(R-h)$$

$$\therefore \quad V = \frac{U_h}{m} = \frac{-gm(R-h)}{m} = -g(R-h)$$

12. **(a) :** To reduce the eddy currents in the metal armature of motors the wire is wrapped around a number of thin metal sheets called lamination.

13. **(c)** **14. (d)**

15. **(b) :** For mixture of gases,

$$C_V = \frac{\frac{3}{2}R + \frac{5}{2}R}{1+1} = 2R$$

$$C_p = 2R + R = 3R$$

$$\therefore \quad \frac{C_p}{C_V} = \frac{3}{2}\frac{R}{R} = 1.5$$

16. (d)

17. (c) : According to first law of thermodynamics

$$\Delta Q = \Delta U + P\Delta V$$

If ΔQ is absorbed at constant volume, $\Delta V = 0$

$$C_V = \left(\frac{\Delta Q}{\Delta T}\right)_V = \left(\frac{\Delta U}{\Delta T}\right)_V = \frac{\Delta U}{\Delta T}$$

for an ideal monoatomic gas

$$\frac{\Delta U}{\Delta T} = \frac{3}{2}R;\ C_V = \frac{3}{2}R$$

18. (a) : Torque, $\vec{\tau} = \vec{r} \times \vec{F}$

$$= (\hat{i} + \hat{j} - \hat{k}) \times (5\hat{i} + 7\hat{j} - 3\hat{k})$$

$$= \hat{i}(-3+7) - \hat{j}(-3+5) + \hat{k}(7-5)$$

$$\vec{\tau} = 4\hat{i} - 2\hat{j} + 2\hat{k}$$

19. (a) : In physics (namely astrophysics), redshift happens when light or other electromagnetic radiation from an object moving away from the observer is increased in wavelength or shifted to the red end of the spectrum.

20. (b) : Sky waves are of practical importance of large distance communication.

21. (d)

22. (b) : Restoring force is produced by inductor as it acts as a source of energy.

23. (a) : Polaroid glass is used in sun glasses because it reduces the light intensity to half on account of polarisation.

24. (c) : A free neutron is unstable ($n \rightarrow p + \bar{e} + \bar{\nu}$). But a simlar free proton decay is not possible, since a proton is (slightly) lighter than a neutron.

25. (d) : From Gauss's law, E is independent of r.

26. (a) : Using, $\sigma = n_e e \mu_e$

Here, $\sigma = 500$ mho/m

$e = 1.6 \times 10^{-19}$ C

$\mu_e = 0.4\ m^2\ V^{-1}\ s^{-1}$

$$\therefore \quad n_e = \frac{500}{1.6 \times 10^{-19} \times 0.4}$$

$$= 7.8 \times 10^{21} \simeq 8 \times 10^{21}\ m^{-3}$$

27. (b) **28. (b)**

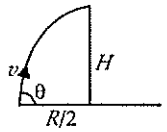
29. (c) : As simple pendulum performs simple harmonic motion.

$\therefore$ velocity, $v = \omega\sqrt{a^2 - x^2}$

At, $x = \frac{a}{2}$

$$v = \frac{2\pi}{T}\sqrt{a^2 - \left(\frac{a}{2}\right)^2} = \frac{2\pi}{T}\frac{\sqrt{3a^2}}{2} = \frac{\pi a\sqrt{3}}{T}$$

30. (c) : From figure,



average velocity,

$$v_{av} = \frac{\sqrt{H^2 + R^2/4}}{T/2} \quad ...(i)$$

Here, $H = \frac{u^2 \sin^2\theta}{2g}$

$$R = \frac{u^2 \sin 2\theta}{g} \text{ and } T = \frac{2u\sin\theta}{g}$$

Putting these value in (i), we get

$$v_{av} = \frac{v}{2}\sqrt{1 + 3\cos^2\theta}$$

31. (b) : Using, $\mu = \frac{c}{v}$

Here, $c = 3 \times 10^8$ m s^{-1}

$v = \upsilon\lambda = 2 \times 10^{14}$ Hz $\times\ 5000 \times 10^{-10}$ m

$= 1 \times 10^8$ m s^{-1}

$$\therefore \quad \mu = \frac{3 \times 10^8\ m\ s^{-1}}{1 \times 10^8\ m\ s^{-1}} = 3$$

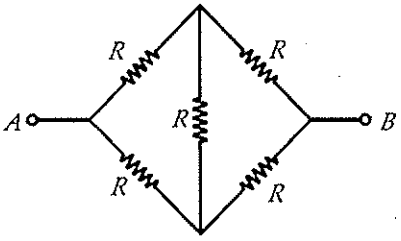
32. (a) : For solenoids, self inductance is given by,

$$L = \frac{\mu_0 N^2 A}{l}$$

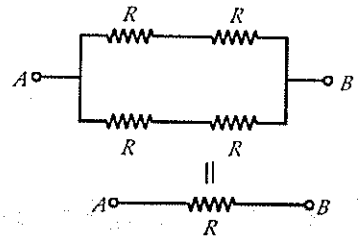
$$\therefore \quad \frac{L_1}{L_2} = \frac{\left(\frac{\pi r_1^2}{l_1}\right)}{\left(\frac{\pi r_2^2}{l_2}\right)} = \frac{\left(\frac{r_1^2}{l_1}\right)}{\left(\frac{r_2^2}{l_1}\right)}$$

or $\quad \frac{L_1}{L_2} = \frac{1}{2} \qquad \left(\because \ \frac{r_1^2}{l_1} \Big/ \frac{r_2^2}{l_2} = 1/2\right)$

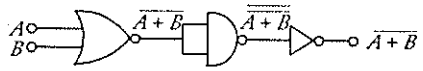
33. (b) :



Equivalent circuit,



34. (a) : From circuit diagram,



Output, $Y = \overline{A+B}$

Thus, circuit behave like NOR gate.

35. (c) : Using, $\eta = 1 - \frac{T_2}{T_1}$

or $\frac{T_2}{T_1} = 1 - \eta$

According to first case

$$\frac{T_2}{T_1} = 1 - \frac{1}{6} = \frac{5}{6} \quad ...(i)$$

According to second case

$$\frac{T_2 - 62}{T_1} = 1 - 2 \times \frac{1}{6} = \frac{2}{3} \quad ...(ii)$$

$$\frac{T_2}{T_1} - \frac{62}{T_1} = \frac{2}{3}$$

From equations (i) and (ii), we get

$$\frac{5}{6} - \frac{62}{T_1} = \frac{2}{3} \Rightarrow \frac{5}{6} - \frac{2}{3} = \frac{62}{T_1}$$

$$\Rightarrow \quad \frac{1}{6} = \frac{62}{T_1}$$

$T_1 = 372$ K or $T_1 = 372 - 273$

$T_1 = 99°C$

36. (b) : For perpendicular vectors.

$\vec{A} \cdot \vec{B} = 0$

$$\therefore \quad (2\hat{i} + 3\hat{j} + 8\hat{k}) \cdot (4\hat{i} - 4\hat{j} + \alpha\hat{k}) = 0$$

$8 - 12 + 8\alpha = 0$

$-4 + 8\alpha = 0$

$\alpha = \frac{1}{2}$.

37. (c) : Heat required to melt 1 g of ice at 0°C to water at 0°C = 1 × 80 cal.

Heat required to raise temperature of 1 g of water from 0°C to 100°C = 1 × 1 × 100 = 100 cal.

Total heat required for maximum temperature of 100°C = 80 + 100 = 180 cal.

As one gram of steam gives 540 cal of heat when it is converted to water at 100°C, therefore, temperature of the mixture = 100°C.

38. (c) : The transition equation for Lyman series is given by

$$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{n^2}\right)$$

for largest wavelength, $n = 2$.

$$\therefore \quad \frac{1}{\lambda_{max}} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

The transition equation for Balmer series is given by

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

for largest wavelength, $n = 3$

$$\therefore \quad \frac{1}{\lambda_{max}} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

Therefore, $\frac{\lambda_{L_{max}}}{\lambda_{B_{max}}} = \frac{\left(\frac{1}{2^2} - \frac{1}{3^2}\right)}{\left(\frac{1}{1^2} - \frac{1}{2^2}\right)} = \frac{\frac{5}{36}}{\frac{3}{4}} = \frac{5}{27}$

39. (d) : Using,

$C_P - C_V = R$

$$\Rightarrow \quad C_V\left(\frac{C_P}{C_V} - 1\right) = R$$

$$(\gamma - 1) = \frac{R}{C_V} \quad \left(\because \quad \frac{C_P}{C_V} = \gamma\right)$$

or $C_V = \frac{R}{(\gamma - 1)}$

40. (d)

41. (a) : The modulation index in practice, is kept ≤ 1 to avoid distortion.

42. (a) : Optical density and mass density are not related to each other mass density is mass per unit volume. It is not possible that mass density of an optically denser medium may be less than that of an optically rarer medium (optical density is the ratio of the speed of light in two media). *e.g.*, turpentine and water. Mass

density of turpentine is less than that of water but its optical density is higher.

43. **(d)**

44. **(b) :** When a conductor is charged the excess charge can reside only on the surface. The electric field inside conductor is zero.

45. **(c) :** Since the escape velocity on the surface of the moon is much less than that on earth, so the water molecules get evaporated faster.

46. **(d) :** The moment of inertia is not a fixed quantity but depends on the orientation and position of the axis of rotation with respect to the body as a whole.

47. **(c) :** The magnetic field lines form closed loops unlike electrostatic field lines which originate from the charge and end at charge. Mono-magnetic pole does not exist in nature.

48. **(a)**

49. **(c) :** The emission of γ rays by a $^{60}_{27}Co$ nucleus is subsequent to beta decay.

50. **(d) :** Light reflected (in the rarer medium) is completely polarised. The intensity of light does not change in polarisation.

51. **(c) :** A laser is a highly monochromatic and near-perfect parallel beam of light, due to which the beam can be focussed by a converging lens to a very small spot. As the intensity of the beam is too high, it can drill holes through a metal sheet even if the power is 0.2 W. But even a torch-light of 1000 W power cannot drill holes in such a metal sheet, because the light is less intense and the beam is not parallel.

52. **(b) :** Electromagnetic wave transport energy, momentum and information. Electromagnetic waves exert radiation pressure on surface.

53. **(c)**

54. **(a) :** The sum of all the currents directed towards a point in circuit is equal to the sum of all the currents directed away from that point. It is based on conservation of electrical energy.

55. **(a) :** This is because refraction through the different layers of atmosphere.

56. **(d) :** Centre of mass of a body is a point that moves when external forces are applied on the body as though all the mass concentrated at that point and when external forces were applied there.

57. **(a)**

58. **(c) :** An undamped spring-mass system is the simplest free vibration system. It has one degree of freedom

59. **(a)** **60. (d)**

CHEMISTRY

61. **(b) :** A straight line plot of $[A]$ *vs* t with negative slope is for a reaction of zero-order.

62. **(d) :** Cu has lowest melting point because it has lowest enthalpy of atomisation (*i.e.*, heat required to break the metal lattice to get free atoms) among the elements.

	Ni	> Fe	> Cr	> Cu
Enthalpy of atomisation : (in kJ mol^{-1})	430	416	397	339

63. **(a) :**

		No. of unpaired electrons
Gd^{3+} : $[Xe]4f^7$	↑ ↑ ↑ ↑ ↑ ↑ ↑	7
Yb^{2+} : $[Xe]4f^{14}$	↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓	0
Tb^{2+} : $[Xe]4f^9$	↑↓ ↑↓ ↑ ↑ ↑ ↑ ↑	5
Pm^{3+} : $[Xe]4f^4$	↑ ↑ ↑ ↑	4

64. **(c) :** Na, Mg, Al and Si are in period 3 and as we move across the period, the atomic size decreases and hence ionisation enthalpy increases. So, the order is Na < Mg < Al < Si Hence, *IE* of Al is greater than that of Mg (737 kJ/mol) and lower than that of Si (776 kJ/mol).

65. **(c) :**

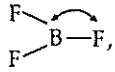
$$Hg_2Cl_2 + 2NH_4OH \longrightarrow \underset{\text{Black}}{\underset{Cl}{\overset{NH_2}{Hg}}} + Hg + NH_4Cl + 2H_2O$$

(Calomel)

66. **(a) :** O_2 $(\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\sigma 2p_z)^2(\pi 2p_x^2 = \pi 2p_y^2)$ $(\pi^* 2p_x^1 = \pi^* 2p_y^1)$

Thus, there are total 6 electrons in antibonding orbitals.

67. **(a) :** In BF_3, there is back bonding in between fluorine and boron due to presence of p-orbital in boron.



, back bonding imparts double bond characteristics.

As BF_3 forms adduct the back bonding is no longer present and thus double bond characteristic disappears. Hence, bond becomes a bit longer than earlier (1.30 Å).

68. **(b) :** Oxidation state of iron in haemoglobin is +2.

69. **(c) :** Hydrolysis of XeF_6 is not a redox reaction. XeF_6 reacts violently with water, but slow hydrolysis by atmospheric moisture gives highly explosive solid, XeO_3.

$$XeF_{6(s)} + 3H_2O_{(l)} \longrightarrow XeO_{3(s)} + 6HF_{(aq)}$$

Partial hydrolysis of XeF_6 yields $XeOF_4$ and XeO_2F_2.

$$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$$
$$XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$$

70. **(c) :** $La(OH)_3$ is the most basic as it has the largest atomic size. $Al(OH)_3$ is amphoteric in nature.

71. **(d) :** Bleaching powder is a mixture of calcium hypochlorite, $Ca(OCl)_2$ and the basic chloride $CaCl_2$, H_2O with some slaked lime, $Ca(OH)_2$.

72. **(a) :** Except Ag(I), all ions form stable complexes with CN^-.

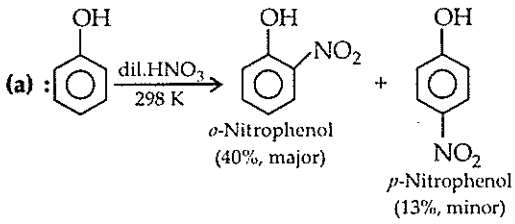
73. **(a) :** $[CuI_4]^{2-}$ does not exist because I^- being a stronger reducing agent reduces Cu^{2+} to Cu^+.

$$2CuI_2 \longrightarrow 2CuI + I_2$$

74. **(b) :** $Cr_2O^{2-}_7 + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

75. **(a) :** Carbon dioxide, methane, water vapour, nitrous oxide, CFCs and ozone are green house gases.

76. **(a) :**



o-Nitrophenol (40%, major)

p-Nitrophenol (13%, minor)

77. **(a) :** All the monosaccharides (aldoses and ketoses) and disaccharides except sucrose reduce Fehling's solution or Tollens' reagent and hence are reducing sugars.

78. **(a) :** Two electron releasing alkyl groups in ketones make the carbon less electron deficient in comparison to aldehydes. Therefore ketones are less reactive than aldehydes towards nucleophilic addition reactions.

Aromatic aldehydes and ketones are less reactive than corresponding aliphatic aldehydes and ketones due to +*R* effect of benzene ring.

Aromatic aldehydes are more reactive than alkyl aryl ketones which in turn are more reactive than diaryl ketones.

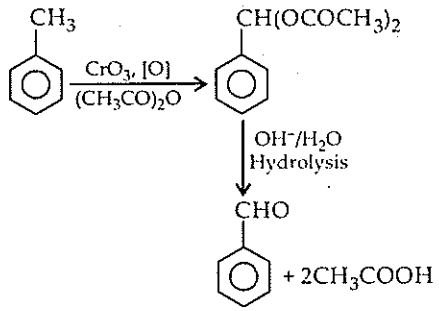
Since –Cl is more electronegative than carbon, it increases the reactivity.

So, the order is

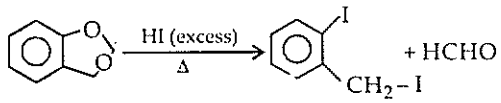
$Cl - CH_2 - CHO > C_6H_5CHO > CH_3COC_2H_5 >$ (II) $C_6H_5COCH_3$ (I)

(IV) (III)

79. **(d) :**



80. **(b) :**



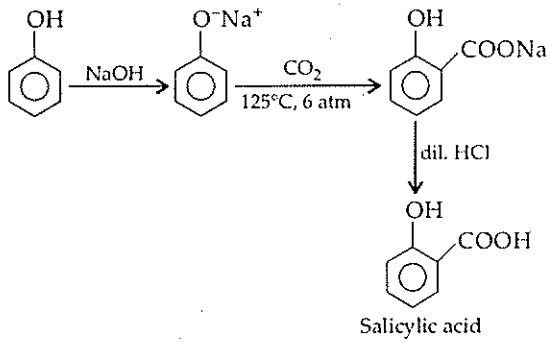
Ethers are readily cleaved by action of HI to form alcohol and alkyl halide.

$R - O - R + HX \longrightarrow RX + R - OH$

If excess of halogen acid is used, then alcohol formed reacts further with halogen acid to produce alkyl halide.

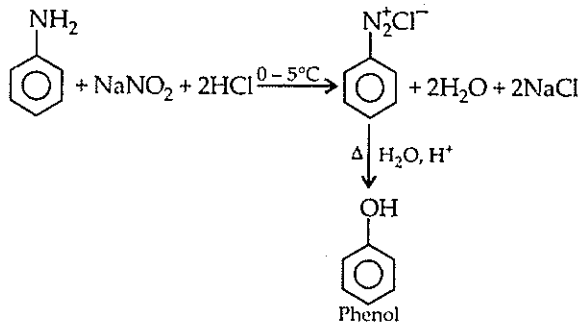
81. **(c) :**

82. **(a) :**



Salicylic acid

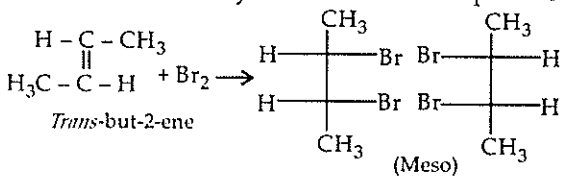
83. **(b) :** $NaNO_2 + HCl \longrightarrow NaCl + HNO_2$



84. **(a) :** Only primary amines will give carbylamine test.

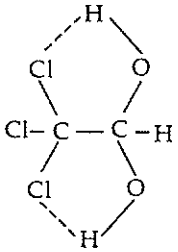
$$CH_3NH_2 + CHCl_3 + 3KOH \longrightarrow CH_3N \equiv C \text{ (offensive smell)} + 3KCl + 3H_2O$$

85. **(d) :** With *trans*-but-2-ene, the product of Br_2 addition is optically inactive due to the formation of symmetric meso-compounds.



86. **(a) :** Tertiary amines are not oxidised by $KMnO_4$.

87. **(c) :** Chloral hydrate is stable due to hydrogen bonding.



88. **(a) :** For an ideal solution, $\Delta H_{mix} = 0$ and $\Delta V_{mix} = 0$.

89. **(a) :** $T_b^\circ = 353.23$ K, $W_B = 1.8$ g, $W_A = 90$ g, $T_b = 354.11$ K, $K_b = 2.53$ kg mol^{-1}

$\Delta T_b = T_b - T_b^\circ = 354.11 - 353.23 = 0.88$ K

$$M_B = \frac{W_B \times K_b \times 1000}{\Delta T_b \times W_A} = \frac{1.8 \times 2.53 \times 1000}{0.88 \times 90}$$

$= 57.5 \approx 58$ g mol^{-1}

90. **(a) :** Suppose number of M atoms $= n$

Then number of tetrahedral sites $= 2n$

Number of N atoms $= \frac{1}{3}(2n)$

Ratio $M : N = n : \frac{2}{3}n = 3 : 2$,

i.e., formula is M_3N_2

91. **(b) :** Hair cream is an emulsion in which both dispersed phase and dispersion medium are liquids.

92. **(a) :** Given : $\frac{\lambda_{particle}}{\lambda_{electron}} = 1.8 \times 10^{-4}$

and $\frac{v_{particle}}{v_{electron}} = 3$

According to de-Broglie equation,

$$\lambda = \frac{h}{mv}$$

$$\frac{\lambda_{particle}}{\lambda_{electron}} = \frac{h}{m_{particle} \times v_{particle}} \times \frac{m_{electron} \times v_{electron}}{h}$$

$$= \frac{m_{electron}}{m_{particle}} \times \frac{v_{electron}}{v_{particle}}$$

$$\Rightarrow 1.8 \times 10^{-4} = \frac{9.1 \times 10^{-31} \text{ kg}}{m_{particle}} \times \frac{1}{3}$$

$$m_{particle} = \frac{9.1 \times 10^{-31}}{1.8 \times 10^{-4} \times 3}$$

$= 1.6852 \times 10^{-27}$ kg

Actual mass of neutron is 1.67493×10^{-27} kg. Hence, the particle is neutron.

93. **(c) :** Given : $E_{H^+/H_2} = 18 \times 10^{-3}$ V, $[H^+] = ?$

Applying Nernst equation,

$$E_{H^+/H_2} = E^\circ_{H^+/H_2} - \frac{0.0591}{1} \log \frac{1}{[H^+]}$$

18×10^{-3} V $= 0 + 0.0591 \log [H^+]$

18×10^{-3} V $= 0.0591 \log [H^+]$

$\log [H^+] = 0.3046$

$\therefore$ $[H^+] = \text{antilog } (0.3046) = 2.02 = 2.0$

94. **(a) :** $AX_3 \rightleftharpoons \underset{S}{A^{3+}} + \underset{3S}{3X^-}$

$K_{sp} = [A^{3+}]\,[X^-]^3$

$= (S) \cdot (3S)^3 = 27S^4$

95. **(d) :** H and U are state functions but W and q are not state functions.

From the equation, $\Delta H = \Delta U + \Delta PV$

At constant pressure, $\Delta H = \Delta U + P\Delta V$

At constant volume, $\Delta H = \Delta U + V\Delta P$

At constant pressure, $\Delta P = 0$, $\Delta H = q_p$

so, it is a state function.

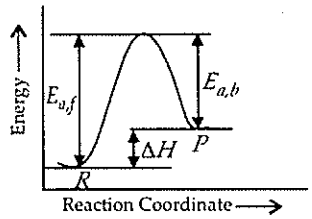
At constant volume, $\Delta V = 0$, $\Delta U = q_v$
so, it is a state function.
Work done in any adiabatic process is state function.
$\Delta U = q - W$ $(\because q = 0)$
$\Delta U = -W$
Work done in isothermal process is not a state function.
$W = -q$ $(\because \Delta T = 0, q \neq 0)$

96. **(d) :** Greater the valency of the flocculating ion, greater is its flocculating power.

97. **(c) :** Volume strength $= \dfrac{5.6 \times \text{Strength in g L}^{-1}}{\text{Eq. wt. of } H_2O_2}$

$= \dfrac{5.6 \times 15.18}{12} = 5$ volumes

98. **(a) :**



For endothermic reaction,
$E_{a,b} = E_{a,f} - \Delta H°$
$= 50$ kJ $- 20$ kJ $= 30$ kJ

99. **(a)**

100. **(d) :** $n CF_2=CF_2 \longrightarrow \underset{\text{Teflon}}{+CF_2-CF_2+_n}$

Teflon is used for non-sticking cookwares.

101. **(d) :** Bond dissociation energy is $F_2 < Cl_2$ because of relatively large electron-electron repulsion among the lone pairs in F_2 molecule where they are much closer to each other than in Cl_2.

102. **(a) :** As in solid state, PCl_5 exists as an ionic solid $[PCl_4]^+[PCl_6]^-$ in which the cation, $[PCl_4]^+$ is tetrahedral and the anion, $[PCl_6]^-$ is octahedral. PCl_5 in gaseous state has trigonal bipyramidal structure in which three equatorial bonds are equivalent, while the two axial bonds are longer than equatorial bonds due to more bond pair repulsion.

103. **(b) :** EDTA is a hexadentate ligand. It forms complex with central metal in the ratio 1 : 1 in which it binds through two nitrogen atoms and four oxygen atoms.

104. **(a) :** $Cd^{2+} + 2CN^- \longrightarrow Cd(CN)_2\downarrow$

$Cd(CN)_2\downarrow + 2CN^- \longrightarrow [Cd(CN)_4]^{2-}$

$[Cd(CN)_4]^{2-}$ is colourless compound and not too stable. When hydrogen sulphide gas is added, cadmium sulphide is precipitated.

$[Cd(CN)_4]^{2-} + H_2S \longrightarrow CdS\downarrow + 2H^+ + 4CN^-$

But in case of Cu^{2+},

$Cu^{2+} + 2CN^- \longrightarrow Cu(CN)_2\downarrow$

$2Cu(CN)_2\downarrow \xrightarrow[\text{decomposes}]{\text{Quickly}} 2CuCN\downarrow + (CN)_2\uparrow$

$CuCN\downarrow + 3CN^- \longrightarrow [Cu(CN)_4]^{3-}$

This complex is so stable (*i.e.*, $[Cu^+]$ is too low) that H_2S cannot precipitate Cu(I) sulphide (Cu_2S).

105. **(a) :**

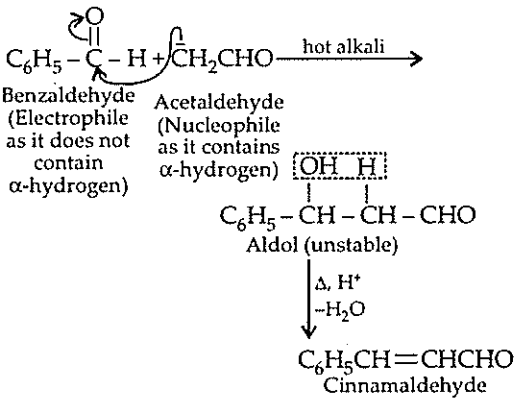
$$\underset{\text{Pink}}{[Co(H_2O)_6]^{2+}} + 4Cl^- \rightleftharpoons \underset{\text{Blue}}{[CoCl_4]^{2-}} + 6H_2O$$

According to Le Chatelier's principle, on adding conc. HCl, the equilibrium shifts in forward direction giving blue colour. And when this blue colour is diluted, equilibrium shifts in backward direction leading to pink colour.

106. **(d) :**

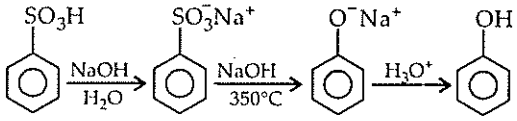
$$\underset{\text{Acetamide}}{CH_3-\overset{\overset{O}{\|}}{C}-NH_2} + Br_2 + 4KOH \longrightarrow \underset{\text{Methanamine}}{CH_3NH_2} + K_2CO_3 + 2KBr + 2H_2O$$

107. **(a) :** This is a Claisen-Schmidt reaction.



108. **(b) :** Assertion is true because usually, for acrylic systems *trans*-isomers are more stable than *cis*-isomers. This is due to increased unfavourable steric interaction of the substituents in *cis*-isomer. Reason is also true because generally the dipole moment of *trans*-form is zero (or less) depending whether the substituents on both sides of double bond are same or not while *cis*-forms are polar in nature with certain value of dipole moment.

109. (c) :



This is nucleophilic aromatic substitution reaction and occurs *via* the addition-elimination mechanism with SO_3^{2-} as the leaving group.

110. (d) : All enzymes are made up of proteins and all proteins do not have 3-dimensional structures as proteins are classified into primary, secondary, tertiary and quaternary structures and only tertiary has 3-dimensional structure. The sequence in which the amino acids are arranged in a protein is called primary structure of protein.

111. (b) : When an atom or an ion is missing from its normal lattice site, a lattice vacancy or defect is created, which is called Schottky defect. Due to missing density of crystal will be lowered.

112. (b) : For an isolated system,

$W = q = 0$

$\Delta U = q + W$

Hence, $\Delta U = 0$

$W = P\Delta V$

as $W = 0$ so, $\Delta V = 0$

113. (c) : Temperature at which the real gas exhibit ideal behaviour for considerable range of pressure is known as Boyle's temperature.

$T_b = \frac{a}{bR}$ a, and b are van der Waal's constant. Critical temperature is the temperature above which the gas cannot be liquefied, how so ever high pressure may be applied : $T_c = \frac{8a}{27Rb}$.

114. (a) : ΔS is +ve and ΔH is –ve for a spontaneous reaction at all temperatures.

115. (d) : Catalyst have no effects on Gibb's free energy of system and pre-exponential factor of a chemical reaction.

116. (c) : It may involve increase or decrease in temperature of the system. Systems in which such process occur, are thermally insulated from the surroundings.

117. (c) : For $3p$-orbital, number of radial nodes $= n - l - 1 = 3 - 1 - 1 = 3 - 2 = 1$

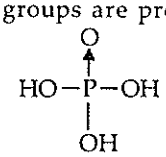
Number of angular nodes = $l = 1$

Number of radial and angular nodes depend on both n and l.

118. (d) : $E°$ of Cu^{2+}/Cu is + 0.34 V and positive $E°$ means that the redox couple is a weaker reducing agent than the H^+/H_2 couple.

119. (c) : NaCl and $CaCl_2$ are added to provide conductivity to the electrolyte and also to lower the fusion temperature of anhydrous $MgCl_2$.

120. (a) : Phosphoric acid is a tribasic acid, *i.e*,. 3 hydroxyl groups are present.



BIOLOGY

121. (c) : Stinging cells (cnidocytes or cnidoblasts or nematoblasts) are used for offence and defence. These have nematocysts (the stinging organs), composed of capsule, shaft and thread tube. The thread tube coils around the prey or attaches to it or injects a toxin, called hypnotoxin which paralyzes the victim. They are found in cnidarians- sea pen (*Pennatula*), sea fan (*Gorgonia*), etc.

122. (b) : The DNA used as a carrier for transferring a fragment of foreign DNA into a suitable host is called vehicle DNA or cloning vector or gene carrier. The *Ti* plasmid (tumour inducing plasmid) is present in *Agrobacterium tumefaciens*, a Gram negative soil bacterium that infects a wide range of plants and causes tumorous growth specially at the root /stem junction (crown gall). The *Ti* plasmid comprises the gene responsible for the tumorous growth, gets incorporated into the genome of infected plant cells. This property is of interest for genetic engineering as *Ti* plasmid can be used as DNA vector by replacing the tumour inducing genes with the gene of interest and a marker gene to enable selection of transformed cells. The *Ti* plasmid, is widely used in plant genetic engineering as a vector, novel plant genes being spliced into the plasmid sequence by gene manipulation and thus carried into the host plant cells. This provides the opportunity to develop new and better species.

123. (d) : The total number of species estimated is about 1.74 million. Out of these, the number of known species in India is 1,42,000 or roughly 8.1% of the total though India has only 2.4% land area. India with about 45000 species of plants and twice as many species of animals is one of the 12 megadiversity countries of the world.

124. (b) : Non-native or alien species are often introduced inadvertently for their economic and other uses. They often become invasive and drive away the local species. These species are considered to be second major cause of extinction of species (the first being habitat destruction). *Lantana camara* has replaced many species in forests of Central India. *Parthenium hystero-phorus* has pushed out several herbs and shrubs from open places in the plains. Water hyacinth (*Eichhornia crassipes*) was introduced in Indian waters to reduce pollution. It clogged water bodies including wetlands at many places resulting in death of several aquatic plants and animals. *Nelumbo* (lotus) is not an invasive species.

125. (a) : Cardiac muscle fibres are found in the wall of heart. They have dark intercalated discs at intervals. These are specialized regions of cell membranes of two adjacent fibres. They permit the wave of muscle contraction to be transmitted from one cardiac fibre to another.

126. (c) : When fertilization occurs outside the body of the organism, this type of gametic fusion is called external fertilization or external syngamy. The external medium such as water is required for this type of fertilization. Thus, in most aquatic organisms such as a majority of algae, fishes and amphibians, external fertilization occurs.

127. (d) : Seminal vesicles produce an alkaline secretion which forms 60% of the volume of semen. The secretion of the seminal vesicles contains fructose, prostaglandins, citrate, inositol, and clotting proteins. Prostate gland produces a milky and slightly alkaline secretion which forms 25% of the volume of semen. It possesses calcium, phosphate, bicarbonate, enzymes prefibrolysin, clotting enzymes, and prostaglandins. Bulbourethral glands or Cowper's glands also secrete an alkaline fluid which neutralizes acids from urine in the urethera. Their secretion contributes the least to semen but is very important.

128. (a) : All the options are examples of intra-uterine contraceptive devices (IUCDs). These are plastic or metal objects which are inserted by doctors in the uterus through vagina. Lippe's loop is non-medicated IUCD. CuT and Multiload are copper releasing IUCDs, which suppress motility and fertilizing capacity of sperms. Progestasert is a hormone releasing IUCD which makes the uterus unsuitable for implantation and cervix hostile to the sperms.

129. (a)

130. (b) : Inside the red blood cells, oval-shaped merozoites stop proceeding with erythrocytic cycle to increase in size and become rounded gametocytes. Male gametocytes or microgametocytes are smaller and contain a large diffused nucleus. Female gametocytes (or mega gametocytes) are larger with a small compact peripheral nucleus. These do not divide but remain as intracellular parasites within their host's blood corpuscles, until they either die or are ingested by the vectors. They give rise to gametes in insects.

131. (c) : Endosperm is the food laden tissue which is meant for nourishing the embryo in seed plants. In gymnosperms, it represents the female gametophyte and thus is haploid(n). In angiosperms, the endosperm is a special tissue which is formed as a result of fusion of a male gamete with diploid secondary nucleus of the central cell (vegetative fertilization or triple fusion). The fusion product is primary endosperm cell having a triploid (3n) endosperm nucleus.

132. (d) : Secondary metabolites are derivatives of primary metabolites which have no direct function in growth and development of plants. These compounds are accessory rather than central to the functioning, *e.g.*, arbrin, cellulose, gums, diterpenes, carotenoids, curcumin, rubber etc. Arginine, tyrosine, glycine, serine and phenylalanine are amino acids, which are primary metabolites.

133. (d) : S-phase is known as synthetic phase. In this stage replication of DNA takes place on the template of the existing DNA and thus the amount of DNA per cell doubles. If the initial amount of DNA is denoted as 2C, then

it increases to 4C.

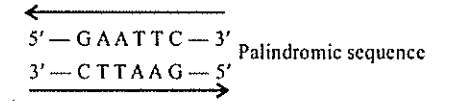
134. (d) : The outer layer of pollen grain is called exine. It is thick and smooth and culticularised. The cutin is called sporopollenin. It is not degraded by any enzyme. It is not affected by high temperature, strong acid or strong alkali. Thus, it is resistant to chemical and biological decomposition. Because of sporopollenin, pollen grains are well preserved as microfossils.

135. (a) : Pollen viability is the period for which pollen grains retain the ability to germinate. Pollen viability is little in flowers which are pollinated in bud condition. It is 30 minutes in rice and wheat. It depends upon environmental conditions of temperature and humidity.

136. (b) : Double fertilization is the fusion of two male gametes brought about by a pollen tube fusing to two different cells of the same female gametophyte in order to produce two different structures. It is found only in angiosperms. In angiosperms, the pollen tube bursts open in one of the two synergids to release the two male gametes. One male gamete fuses with the egg or oosphere to form a diploid zygote or oospore. It is called generative fertilization. The second male gamete descends down and fuses with the diploid secondary nucleus of the central cell to form a triploid primary endosperm cell. It is known as vegetative fertilization. Thus, after double fertilization, a mature angiospermous ovule contains one diploid cell (zygote) and one triploid cell (endosperm). The haploid cells of the ovule such as antipodals and synergids degenerate after fertilization.

137. (a) : Transgenic plants or genetically modified (GM) crops are those plants in which a foreign gene has been introduced and integrated into the host DNA *via* recombinant DNA technology. The transfer or introduction of a foreign gene results in the production of desirable traits like disease resistance, insect resistance, herbicide resistance, etc.

138. (c) : The palindromes in DNA are base pair sequences that are the same when read forward (left to right) or backward (right to left) from a central axis of symmetry. The following sequence reads the same on the two strands in 5′ → 3′ direction. This is also true when we read in the 3′ → 5′ direction.



Restriction endonuclease enzymes recognize palindromic sequences in DNA and cut them.

139. (c) : Presence of photorespiration is considered as a wasteful and energy consuming process in crop plants which ultimately leads to reduction in final yield of crops. It is estimated that during C_3 photosynthesis, upto 50% of the CO_2 fixed may have to pass through photorespiratory process, thereby resulting in considerable decrease in photosynthetic productivity. In C_3 plants, there is little loss of photosynthetic activity on account of photorespiration which is absent in C_4 plants and hence they have better productivity.

140. (c) : Oxytocin is released by posterior pituitary. Vasopressin decreases the amount of urine by increasing reabsorption of water from DCT and collecting tubules. It also stimulates the contraction of walls of blood vessels, thereby raising the blood pressure. Glucagon stimulates liver to convert stored glycogen into glucose and thus raises the blood sugar level. Thymus releases thymosin which aids in proliferation of T-lymphocytes.

141. (d) : *Aspergillus niger* carries out fermentation to form citric acid. Fungus *Trichoderma polysporum* produces cyclosporin through fermentative activity. Cyclosporin-A has antifungal, anti-inflammatory and immuno-suppressive properties. *Saccharomyces cerevisiae* (baker's yeast/brewer's yeast) is used in production of bread/alcohol. Methanogenic bacteria carry out microbial decomposition of organic matter and aids in gobar gas production.

142. (a)

143. (a) : Parietal cells (or oxyntic cells) secrete hydrochloric acid (HCl) and Castle's intrinsic factor. Chief cells (or peptic cells) secrete gastric digestive enzymes as proenzymes — pepsinogen and prorennin. HCl helps in converting pepsinogen to pepsin. Goblet cells secrete mucus which helps to neutralise acid in stomach and protects stomach wall against HCl action.

144. (d) : In family A, if both the parents are

homozygous recessive, then both should be diseased and should have 100% diseased progeny. In family B, if both parents are homozygous dominant, they would not have got the recessive disease in first place. In family B, if both are heterozygous recessive, then also they would not have got the disease, neither 80% of progeny would be diseased.

145. **(c)** : Glucose and amino acids are reabsorbed in PCT by secondary active transport. Water, sodium and chloride ions are reabsorbed in DCT. It is permeable to water. Maximum reabsorption takes place within the PCT. Humans are ureotelic and excrete out 25-30 gm of urea per day.

146. **(b)**: Inbreeding leads to increase in homozygosity. This, in recessive alleles, may cause expression of harmful effects. Also, inbreeding depression may lead to loss of fitness in progenies, thus decreasing productivity in some cases.

147. **(c)** : The given floral diagram is of family Fabaceae. Flower – zygomorphic, bisexual. Sepals - five, fused. Petals - five, polypetalous, papillionaceous corolla. Androecium - ten, diadelphous. Gynoecium - ovary superior, monocarpellary, unilocular, marginal placentation, with many ovules.

148. **(d)** : A - Fovea centralis : Sharpest vision occurs here.
B - Blindspot : No image is formed here.
C - Ciliary body: It helps to hold the lens in position.
D - Iris : Visible coloured portion of eye.

149. **(a)** :A - Z line : located at centre of I-band.
B - Thin filament : occurs in both I-band and A-band.
C - Thick filament : occurs in A-band.
D - H-zone - present at the centre of A-band.

150. **(a)** : All plant families end with –ae suffix. However, it differs for division, class and genus.

151. **(b)** : RBCs contain haemoglobin. It has four polypeptide chains and four haem groups attached to it or 4 atoms of iron in ferrous form (Fe^{2+}), thus it can react with 4 molecules of oxygen to form oxyhaemoglobin.

152. **(c)** : *Nereis* is classified under Phylum Annelida. It is a unisexual annelid and its reproductive phase is called *Heteronereis*. It is usually called clam worm or sand worm or rag worm which is found on the sea shore in the tubular burrows. Except the peristomium (first segment) and last anal segment, each segment bears laterally one pair of fleshy projections, the parapodia, used in swimming.

153. **(d)** : The yearly growth of secondary xylem is distinct in the area which experiences two seasons, one favourable (spring or rainy season) and the other unfavourable (autumn, winter and dry summer). The wood formed in a single year consists of two types of wood, spring wood and autumn wood. The spring or early wood is much wider than the autumn or late wood. It is lighter in colour and of lower density. Spring wood consists of larger and wider xylem elements. The autumn or late wood is dark coloured and of higher density. It contains compactly arranged smaller and narrower elements which have comparatively thicker walls. In autumn wood, tracheids and fibres are more abundant than those found in the spring wood.

154. **(a)** : Both mitochondria and chloroplast are semi-autonomous organelles as they possess their own DNA, RNA and 70S ribosomes to have sufficient functional independence from cellular machinery. Chloroplasts DNA is bigger than mitochondrial DNA. However, genetic information contained in these DNAs is limited. DNA is naked (without histone proteins) in both.

155. **(a)** : Blood is the medium of transport of O_2 and CO_2. Nearly 20-25% of CO_2 is transported by RBCs as carbaminohaemoglobin whereas 70% of it is carried as bicarbonate through plasma. About 7% of CO_2 is carried in dissolved state through plasma. The largest fraction of CO_2 is converted to bicarbonate ions (HCO^-_3) and transported in plasma. When CO_2 diffuses into the RBCs, it combines with H_2O, forming carbonic acid (H_2CO_3). H_2CO_3 is unstable and quickly dissociates into hydrogen ions and bicarbonate ions.

156. **(b)** : Options (a), (b), (c) and (d) show neutrophil, basophil, eosinophil and monocyte respectively. Neutrophils are the most abundant cells (60-65%) of the total WBCs and basophils are the least (0.5 - 1%) among them. Neutrophils and

monocytes (6 - 8%) are phagocytic cells. Which destroy foreign organisms entering the body. Basophils secrete histamine, serotonin, heparin, etc. and are involved in inflammatory reactions. Eosinophils (2 - 3%) resist infections and are also associated with allergic reactions.

157. (c) : Nucleus contains nucleoli and chromatin network. Chromatin contains DNA and some basic proteins called histones, some non-histone proteins and also RNA.

158. (b) :When sewage, having biodegradable organic matter is released in water body, micro-organisms involved in biodegradation of organic matter in the receiving water body consume a lot of oxygen to decompose the sewage and as a result there would be a sharp decline in dissolved oxygen downstream from the point of sewage discharge, and biological oxygen demand (BOD) would increase. Presence of large amount of nutrients in water causes excessive growth of planktonic (free-floating) algae, called algal bloom. Algal bloom causes deterioration of water quality and fish mortality.

159. (b): Auxins promote root initiation at a concentration which otherwise is inhibitory for growth of intact root. Auxins are often employed for inducing flowering in litchi and pineapple. Application of auxins to unpollinated pistils make them develop into seedless fruits or parthenocarps.

160.(c): Secondary air pollutants are photochemically produced from primary pollutants and are thus called photochemical oxidants. Ozone, peroxyacyl nitrates, aldehydes and phenols are produced due to photochemical reactions between nitrogen oxides and unsaturated hydrocarbons.

161. (b): The earthworms are bisexual or hermaphrodite or monoecious and protandrous. The self-fertilization is not possible in the earthworm because of the relative position of openings of male and female reproductive organs, hence cross fertilization takes place.

During mating, two worms attach themselves with their ventral surfaces and become opposed to each other in opposite direction to exchange packets of sperms called spermatophores.

Mature sperm and egg cells and nutritive fluid are deposited in cocoons, produced by the gland cells of clitellum. The ova (eggs) are fertilized by the sperm cells within the cocoon which then slips off the worm and is deposited in or on the soil. The cocoon holds the worm embryos. After about 3 weeks, each cocoon produces two to twenty baby worms with an average of four.

162. (a): In arithmetic growth, following mitotic cell division, only one daughter cell continues to divide while the other differentiates and matures. The simplest expression of arithmetic growth is exemplified by a root elongating at a constant rate. On plotting the length of the organ against time, a linear curve is obtained.

163. (c): Absorption of substances takes place in different parts of the alimentary canal, like mouth, stomach, small intestine and large intestine. However, maximum absorption occurs in the small intestine. Hence, small intestine is the principal organ for absorption of nutrients. The digestion is completed here and the final products of digestion such as glucose, fructose, fatty acids, glycerol and amino acids are absorbed through the mucosa into the blood stream and lymph. Absorption of water, single sugars and alcohol, etc. takes place in stomach. In larger intestine, absorption of water, some minerals and drugs takes place.

164. (b): Pulse is the rhythmic contraction and relaxation in the aorta and its main arteries. It is a regular jerk of an artery. The pulse rate is exactly the same as the heart rate because an artery pulses every time the heart beats. Pulse is usually taken on the radial artery in the wrist but it can be taken on any artery that flows near enough to the surface of the body to be felt. The heart beat originates from the sinoatrial node (SA Node) - pacemaker, which lies in the wall of the right atrium near the opening of the superior vena cava. The SA node is a mass of neuromuscular tissue. Another mass of neuromuscular tissue, the atrioventricular node (AV node) is situated in the wall of the right atrium. The AV node picks up the wave of contraction propagated by SA node. A mass of specialized fibres, the bundle of His, originates from the AV node. The bundle of His divides into two branches, one going to each ventricle. Within the

myocardium of the ventricles, the branches of bundle of His divides into a network of fine fibres called the Purkinje fibres. The bundle of His and the Purkinje fibres convey impulse of contraction from the AV node to the myocardium of the ventricles.

165. (a): One of the hormones released by the placenta is human chorionic gonadotropin (hCG). This hormone is secreted by the trophoblast cells even before they become the chorion, and is the hormone assayed in the pregnancy test. Because its action is almost identical to that of luteinizing hormone (LH), hCG maintains the mother's corpus luteum. The corpus luteum, in turn, continues to secrete oestrogens and progesterone, thereby preventing menstruation and further ovulations. At around 10th week, the secretion of human chorionic gonadotropin (hCG) by placenta declines, and the corpus luteum regresses as a result. However, menstruation does not occur because placenta itself secretes oestrogens and progesterone. In fact, the amounts of these two hormones secreted by the placenta far exceed the amounts that are ever secreted by the ovaries. The high levels of oestrogens and progesterone in the blood during pregnancy continue to inhibit the release of FSH and LH, thereby preventing ovulation. They also help maintain the uterus and eventually prepare it for labor and delivery, and they stimulate the development of the mammary glands in the preparation for lactation after delivery.

166. (c): Alexander Fleming while working on *Staphylococci* bacteria, once observed a mould growing in one of his unwashed culture plates around which *Staphylococci* could not grow. He found out that it was due to a chemical produced by the mould and he named it Penicillin after the mould *Penicillium notatum*. However, its full potential as an effective antibiotic was established much later by Ernest Chain and Howard Florey.

167. (d): Yeast (*Saccharomyces cerevisiae*) is used for commercial production of ethanol. A bioactive molecule, cyclosporin A which is used as an immunosuppressive agent in organ-transplant patients, is produced by the fungus *Trichoderma polysporum*.

168. (c): Protostele is the simplest and considered to be the most primitive type of stele. It consists of a solid core of xylem surrounded by the cylinder of phloem, enclosing no pith. All other types of steles have evolved from it in the course of evolutionary specialization. Protosteles may be found in *Selaginella, Lycopodium, Gleichenia* and *Lygodium* among present day forms.

169. (b): The human digestive system carries about trillions of microorganisms colonising the gut making an amazing ecosystem that live together in harmony. In this context human intestine is said to be rich in flora and fauna. The microorganisms perform a host of useful functions, such as fermenting unused energy substrates, training the immune system, preventing growth of harmful, pathogenic bacteria, regulating the development of the gut, producing vitamins for the host (such as biotin and vitamin K), and producing hormones to direct the host to store fats.

Fish culture is sometimes done in combination with a rice crop, so that fish are grown in the water in the paddy field. Thus, a rice field is an example of ecosystem inhabiting both plants and animals.

170. (c) : *Refer answer 154.*

171. (b): The world is facing accelerated rates of species extinctions, largely due to human interference. There are four major causes – (i) habitat loss and fragmentation, (ii) over-exploitation, (iii) alien species invasions and (iv) co-extinctions.

Non-native of alien species are often introduced inadvertently for their economic and other uses. They often become invasive and drive away the local species. The exotic species are considered to be second major cause of extinction of species (the first being habitat destruction).

172. (b): Meiosis consists of two divisions, meiosis I and meiosis II. The first division of meiosis is called heterotypic or reduction division. During this division the number of chromosomes is reduced to half. The two chromatids of a chromosome become genetically different due to crossing over. These chromatids are separated in

the second division of meiosis. The second meiotic division is known as homotypic or equational division, because the chromosome number remains the same as produced after the end of the first division. Though meiosis II is similar to mitosis, meiosis II is not mitosis because (i) it always occurs in haploid cells, (ii) it is not preceded by DNA replication, (iii) the two chromatids of a chromosome are often dissimilar, (iv) the daughter cells formed after meiosis II are neither similar to each other nor similar to the parent cell.

173. **(c):** Periodic abstinence is a natural method of birth control in which the couples avoid or abstain from coitus (copulation or intercourse) from day 10 to 17 of the menstrual cycle because ovulation can occur during this period. The chances of fertilization are very high during this period, therefore, it is called the fertile period.

174. **(b):** The cerebrum is the largest and most complex of all the parts of the human brain. It consists of left and right hemispheres connected by a large bundle of myelinated fibres, the corpus callosum. Association areas interpret the input, store the input and initiate a response in light of similar past experience. Thus, the association areas are involved in memory, learning and reasoning.

175. **(d):** Sickle cell anaemia is an autosomal recessive hereditary disorder in which the erythrocytes become sickle-shaped under oxygen deficiency as during strenuous exercise and at high altitudes. The disorder or disease is caused by the formation of an abnormal haemoglobin called haemoglobin-S. As found out by Ingram (1958), haemoglobin-S differs from normal haemoglobin-A in only one amino acid – 6^{th} amino acid of β-chain, glutamic acid, is replaced by valine due to substitution (transversion) of T by A in the second position of the triplet codon (CTC) which is changed to CAC in the β-haemoglobin gene situated on chromosome 11.

176. **(a) :** The efficiency of C_4 plants is more than those of C_3 plants because (i) C_4 plants are more efficient in picking up CO_2 even when it is found in low concentration because of the high affinity of PEP, (ii) concentric arrangement of mesophyll cells produces a smaller area in relation to volume for better utilization of available water and reduce the intensity of solar radiations, (iii) they can tolerate excess salts because of the presence of organic acids, (iv) normal oxygen concentration is not inhibitory for the growth in contrast to C_3 plants, (v) they are adapted to high temperature and intense radiation of tropics.

177. **(a) :** The cattles, buffaloes, goats, sheep, deer and camels are herbivorous animals that feed on plant leaves, twigs, etc. Their stomach consists of 4 chambers: rumen (paunch), reticulum (honeycomb), omasum (psalterium) and abomasum (rennet). In the rumen, food undergoes mechanical and chemical breakdown. Mechanical breakdown results from thorough churning brought about by muscular contractions and aided by cornified surface of villi. Chemical breakdown is caused by symbiotic micro-organisms bacteria such as *Ruminococcus* and ciliate such as *Entodinium caudatum*. These micoorganisms live as symbionts in the rumen and reticulum of the stomach of the ruminants (*e.g.*, cows and buffaloes) and in the large intestine of other herbivorous mammals (*e.g.*, horses and donkeys) and release enzymes, cellulases, which act on cellulose and simplify it to short-chain fatty acids. Cellulose is not digested in human being.

178. **(b) :** The secondary structure of proteins is the development of new stearic relationships of amino acids present in the linear sequence inside the polypeptides. Some of the new relationship are of regular nature and give periodicity to the structure. There are three types of secondary structures – α-helix, β-pleated and collagen helix. They are held in a particular structure due hydrogen bonds between oxygen of carboxylic group (–CO group) of one amino acid residue and >NH group of another amino acid.

The protein enzymes have active sites which are capable of attracting and holding particular substrate molecules by is specific charge, size and shape so as to allow the chemical change. An active site consists of a few amino acids and their side groups which are brought together in a particular fashion due to secondary and tertiary

folding of a protein molecule and its association with the cofactor, if any. Tertiary structure is bending and folding of various types to form spheres, rods or fibres. It further brings new stearic relationships of amino acids specially those which are far apart in the linear sequence. Tertiary structure is stabilized by several types of bonds— hydrogen bonds, ionic bonds, van der Waal's interactions, covalent bonds, hydrophobic bonds. Tertiary structure gives the protein a three dimensional conformation.

179. (c) : Glutamine is one of the 20 amino acids. Its side chain is an amide formed by replacing the side chain hydroxyl of glutamic acid with an amine functional group, making it the amide of glutamic acid. In human blood, glutamine is the most abundant free amino acid. The isoelectric point is the pH at which a particular molecule or surface carries no net electrical charge. The isoelectric point (pH) of glutamine is 5.65.

180. (d) : Principal organ for digestion and absorption for nutrients is small intestine. Small intestine is distinguishable into three regions, a 'U' shaped duodenum, a long coiled middle portion jejunum and a highly coiled ileum. Mainly iron, calcium and amino acids are absorbed in duodenum; fatty acids, glycerol, monosaccharides and vitamins are absorbed in jejunum, and absorption of vitamin B_{12}, bile salts and water occur in ileum.

GENERAL KNOWLEDGE

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