



## NEET SAMPLE PAPER – 3 (ANSWER KEY & SOLUTION)

### PART – A (PHYSICS)

#### KEY:

|       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. c  | 2. b  | 3. d  | 4. a  | 5. c  | 6. b  | 7. a  | 8. d  | 9. d  | 10. a |
| 11. b | 12. a | 13. b | 14. a | 15. c | 16. a | 17. c | 18. a | 19. d | 20. a |
| 21. b | 22. b | 23. a | 24. a | 25. c | 26. a | 27. a | 28. b | 29. b | 30. d |
| 31. a | 32. a | 33. c | 34. b | 35. c | 36. a | 37. b | 38. a | 39. b | 40. b |
| 41. c | 42. b | 43. d | 44. d | 45. a |       |       |       |       |       |

#### SOLUTION:

1. By verifying options

$$\frac{h}{e^2} = \frac{\text{joule-second}}{C.C} = \frac{\text{volt-C-s}}{C.C} = \frac{\text{volt}}{\text{ampere}} = \text{ohm}$$

2.  $u = \sqrt{2^2 + 1^2} = \sqrt{5}$

$$\theta = \tan^{-1} 2$$

$$\text{Equation: } y = x \tan \theta - \frac{gx^2}{2u^2 \cos^2 \theta}$$

$$y = 2x - \frac{10x^2}{2 \times 5 \times \frac{1}{5}}$$

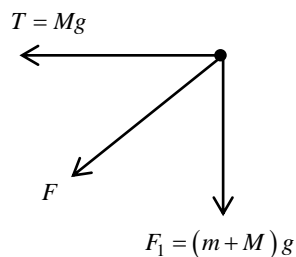
$$y = 2x - 5x^2$$

3. F.B.D of pulley

$$F_1 = (m+M)g$$

The resultant force on pulley is  $F = \sqrt{F_1^2 + T^2}$

$$F = \left[ \sqrt{(m+M)^2 + M^2} \right] g$$



4. The kinetic energy at altitude  $2R = \frac{GMm}{6R}$

The gravitational potential energy at altitude  $2R = \frac{GMm}{3R}$

$\therefore$  Total energy =  $k\varepsilon + PE = -\frac{GMm}{6R}$

Potential energy at the surface is  $-\frac{GMm}{R}$

$\therefore$  Req. kinetic energy =  $\frac{GMm}{R} - \frac{GMm}{6R} = \frac{5GMm}{6R}$

5.  $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{57 \times 10^{-3} \times 1.6 \times 10^{-19}} = 217100 \text{ \AA}$ .

6. Heat required to melt 1g of ice at  $0^\circ\text{C}$  is 80 cal.

Heat required to convert 1g of water at  $0^\circ\text{C}$  into 1g of water at  $100^\circ\text{C} = 1 \times 1 \times 100 = 100 = 100 \text{ cal}$ .

Heat required condensing 1g of steam =  $1 \times 540 \text{ cal} = 540 \text{ cal}$

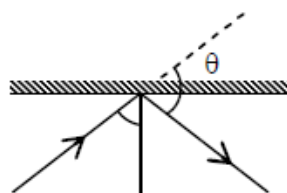
Clearly, whole of steam is not condensed. So, temperature of the mixture is  $100^\circ\text{C}$ .

7. Let angle between the directions of incident ray and reflected ray be  $\theta$

$$\cos \theta = \frac{1}{2}(\hat{i} + \sqrt{3}\hat{j}) \cdot \frac{1}{2}(\hat{i} - \sqrt{3}\hat{j})$$

$$\cos \theta = -\frac{1}{2}$$

$$\theta = 120^\circ$$



8.  $rT = I\alpha$

$$r^2T = I\alpha r$$

$$r^2T = Ia \quad (1)$$

$$Ma = Mg - T \quad (2)$$

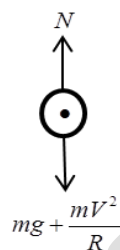
$$5 = \frac{1}{2}a(2)^2 \quad (3)$$

$$\Rightarrow I = 1.5 \text{ kg m}^2$$

9. Point O is free end. After reflection from free end, the wave is in phase. Constructive interference takes places.

10. From WET,

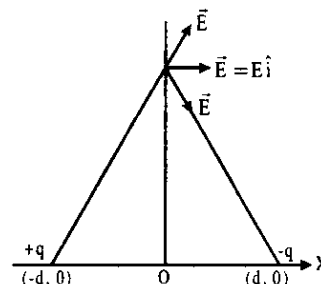
$$\begin{aligned}
 mgR &= \frac{1}{2} I\omega^2 + \frac{1}{2} mV^2 \\
 &= \frac{1}{2} \frac{mr^2}{2} \times \left(\frac{V}{r}\right)^2 + \frac{1}{2} mV^2 \\
 gR &= \frac{3V^2}{4} \\
 mV^2 &= \frac{4}{3} mgR \\
 N &= mg + \frac{mv^2}{R} = mg + \frac{4mg}{3}
 \end{aligned}$$



11. The diagram representation of the given problem is shown in figure. The electrical field  $\vec{E}$  at all points on the X-axis will not have the same direction.

The electric field  $\vec{E}$  at all points on the Y-axis will be parallel to the X-axis (i.e.  $\hat{i}$  – direction).

The electric potential at the origin due to both the charge is zero, hence, no work is done in bringing a test charge from infinity to the origin. Dipole moment is direction from the  $-q$  charge to the  $+q$  charge (i.e.  $-x$  direction).



12. For  $n$ th Bohr orbit,  $r = \frac{\epsilon_0 n^2 h^2}{\pi m Z e^2}$

De-Broglie wavelength  $\lambda = \frac{h}{mV}$

Ratio of both  $r$  and  $\lambda$ , we have

$$\begin{aligned}
 \frac{r}{\lambda} &= \frac{\epsilon_0 n^2 h^2}{\pi m Z e^2} \times \frac{mV}{h} \\
 &= \frac{\epsilon_0 n^2 h V}{\pi Z e^2}
 \end{aligned}$$

But  $V = \frac{Ze^2}{2h\epsilon_0 n}$  for  $n$  th orbit

Hence,  $\frac{r}{\lambda} = \frac{n}{2\pi}$

13.  $f_1$  = frequency of the police car heard by motorcyclist,

$f_2$  = frequency of the siren heard by motorcyclist.

$$f_1 = \frac{330-v}{330-22} \times 176; f_2 = \frac{330+v}{330} \times 165;$$

$$\therefore f_1 - f_2 = 0 \Rightarrow v = 22 \text{ m/s}$$

14. Current in  $20\Omega$  resistor  $i_1 = \frac{40}{20} = 2 \text{ A}$   $\therefore$  current in  $R$ ,  $i_2 = 8 + 2 = 10 \text{ A}$

$$\text{In case loop, we have } -i_2 R - i_1 \times 10 + 100 - 40 = 0 \Rightarrow R = 4\Omega$$

15. For plano convex lens we have

$$\frac{1}{f} = (\mu - 1) \left( \frac{1}{R} \right)$$

Here  $f = 30 \text{ cm}$ ,  $R = 10 \text{ cm}$ . This gives  $\mu = 1.33$

$$16. \phi = \frac{2\pi}{\lambda} \Delta x = \frac{2\pi}{\lambda} \times \frac{\lambda}{6} = \frac{\pi}{3}$$

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

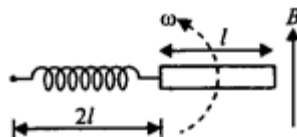
$$I' = I + I + 2I \cos \frac{\pi}{3} = 3I$$

$$\text{and } I_0 = I + I + 2I \cos 0^\circ = 4I$$

$$\therefore \frac{I'}{I_0} = \frac{3}{4}$$

$$17. e = \frac{d\phi}{dt} = \frac{BdA}{dt} = \frac{B\pi[(3l)^2 - (2l)^2]}{\frac{1}{n}} = B\pi n \times 5l^2$$

$$e = B(2\pi n) \times \frac{5}{2} l^2 = -\frac{5}{2} B\omega l^2$$



18.  $\omega = 300 \text{ rpm} = 10\pi \text{ rad s}^{-1}$

$$\omega^2 - \omega_0^2 = 2\alpha\theta$$

$$0 - 100\pi^2 = 2 \times \alpha \times 25 \times 2\pi$$

$$\alpha = -\pi$$

$$\tau = I\alpha$$

$$= \frac{10}{\pi} \times \pi = 10 \text{ Nm}$$

19. Here  $X_L = 2\pi fL = 2\pi \times 50 \times \frac{200}{\pi} \times 10^{-3} = 20\Omega$  and

$$X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi \times 50 \times \frac{10^{-3}}{\pi}} = 10\Omega$$

$$\tan \phi = \frac{X_L - X_C}{R} = \frac{20 - 10}{10} = 1 \therefore \phi = 45^\circ = \frac{\pi}{4} \text{ rad}$$

20. When a charged particle enters perpendicular to a magnetic field, then it moves in a circular path of radius

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

where  $q$  = Charge of the particle

$p$  = Momentum of the particle

$B$  = Magnetic field

Here  $p$ ,  $q$  and  $B$  are constant for electron and proton, therefore the radius will be same.

21.  $\therefore$  Mass number of final nucleus =  $A - 12$

Atomic number of final nucleus =  $Z - 8$

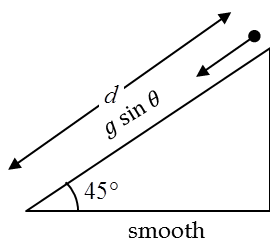
$\therefore$  Number of neutrons =  $(A - 12) - (Z - 8)$

$$= A - Z - 4$$

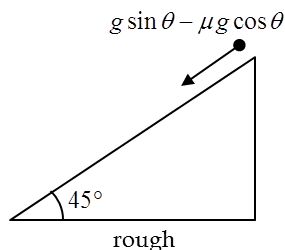
Number of protons =  $Z - 8$

$\therefore$  Required ratio =  $\frac{A - Z - 4}{Z - 8}$

22.



When surface is smooth



When surface is rough

$$d = \frac{1}{2}(g \sin \theta)t_1^2, d = \frac{1}{2}(g \sin \theta - \mu g \cos \theta)t_2^2$$

$$t_1 = \sqrt{\frac{2d}{g \sin \theta}}, t_2 = \sqrt{\frac{2d}{g \sin \theta - \mu g \cos \theta}}$$

According to question,  $t_2 = nt_1$ 

$n\sqrt{\frac{2d}{g \sin \theta}} = \sqrt{\frac{2d}{g \sin \theta - \mu g \cos \theta}}$   $\mu$ , as applicable here, is coefficient of kinetic friction as the block moves over the inclined plane.

$$n = \frac{1}{\sqrt{1 - \mu_k}} \quad \left( \because \cos 45^\circ = \sin 45^\circ = \frac{1}{\sqrt{2}} \right)$$

$$n^2 = \frac{1}{1 - \mu_k} \quad \text{or} \quad 1 - \mu_k = \frac{1}{n^2} \quad \text{or} \quad \mu_k = 1 - \frac{1}{n^2}$$

23. Here,  $\frac{50}{100}$  (KE of rotation) =  $cm\theta$ 

$$\frac{1}{2} \left( \frac{1}{2} I \omega^2 \right) = \frac{1}{4} \left( \frac{2}{5} mr^2 \right) (2\pi n)^2 = cm\theta$$

$$\theta = \frac{2 \pi^2 n^2 r^2}{5 c}$$

24.  $\frac{l}{L} = \frac{\mu}{\mu + 1} = \frac{1}{5} = 20\%$ 25. Let  $v$  be the velocity of projection and  $\theta$  the angle of projection.

Kinetic energy at highest point

$$= \frac{1}{2} mv^2 \cos^2 \theta \quad \text{or} \quad E_k \cos^2 \theta$$

Potential energy at highest point

$$= E_k - E_k \cos^2 \theta = E_k (1 - \cos^2 \theta) = E_k \sin^2 \theta$$

26.  $K \propto P^x V^y T^z$  writing the dimensional formulae on both sides  $MLT^{-2} = [ML^{-1}T^{-2}]^x [LT^{-1}]^y T^z$ , equating the powers of  $M, L$  and  $T$  on both sides we get  $x=1, y=2$  and  $z=2$ .  $\therefore F = PV^2T^2$

27.  $V_{avg} = \frac{\text{total distance}}{\text{total time}}$

28. When a body is released from the top of a building, the motion of the body is uniformly accelerated.

29.  $F = (m+m)a$

$$T = ma \Rightarrow T = \frac{F}{2}$$

30.  $T - 6g = 6a$

$$10g - T = 10a \Rightarrow T = \frac{15g}{2}$$

31.  $F \times t = mv - mu \Rightarrow F \times 0.1 = 0.1(10 - 0) \Rightarrow F = 10N$

32. Both will store same P.E. so difference of P.E. will be zero.

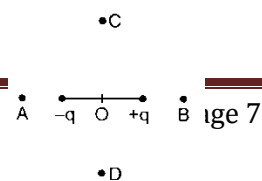
33.  $A_1 = 10$  and  $A_2 = \left[5^2 + (5\sqrt{3})^2\right]^{1/2} = 10$

34.  $f_{open} = \frac{u}{2L}$  and  $f_{closed} = \frac{u}{4L/2} = \frac{u}{2L}$

Clearly  $f_{open} = f_{closed}$

35. The straight part will contribute no magnetic field at the center of the semicircle. Because every element of the straight part will be at  $0^\circ$  or  $180^\circ$  with the line joining the center and the element.

36. As is clear from figure, A, B lie on axial line and C, D lie on equatorial line of dipole.



$$\therefore |V_A| = |V_B| \text{ and } |V_C| = |V_D|$$

As potential on axial line is higher and on equatorial line,  $V = 0$ , therefore, out of given choices, most appropriate is  $|V_A| = |V_B| > |V_C| = |V_D|$ .

37. Using  $E = -\frac{dV}{dx}$ , we get,  $dV = -E \cdot dx$  or  $dV = -\frac{1}{4\pi\epsilon_0} \frac{q}{x^2} dx$

$$\therefore V = -\frac{1}{4\pi\epsilon_0} \frac{q}{x^2} dx = \frac{q}{4\pi\epsilon_0} \left[ \frac{1}{x} \right]_b^a = \frac{q}{4\pi\epsilon_0} \left[ \frac{1}{a} - \frac{1}{b} \right]$$

or  $W = QV = \frac{qQ}{4\pi\epsilon_0} \left[ \frac{1}{a} - \frac{1}{b} \right]$

$\therefore$  Choice (b) is correct

38.  $W = \int_{\theta_1=0^\circ}^{\theta_2=60^\circ} MB \sin \theta d\theta = MB [-\cos \theta]_{0^\circ}^{60^\circ}$

$$= -MB [\cos 60^\circ - \cos 0^\circ] = -MB \left[ \frac{1}{2} - 1 \right] = \frac{MB}{2}$$

$\therefore MB = 2W$

Now, torque,  $\tau = MB \sin \theta = 2W \sin 60^\circ = 2W \times \frac{\sqrt{3}}{2} = \sqrt{3}W$

39.  $v = at = qEt / m$ ;  $K.E. = \frac{1}{2} mv^2 = \frac{q^2 E^2 t^2}{2m}$

40. For a transformer  $\frac{I_p}{I_s} = \frac{N_s}{N_p}$  i.e.  $I_p = \frac{N_s}{N_p} \times I_s = \frac{25}{1} \times 2 = 50A$

41. Considering the given equation for  $V$  and  $I$ ,  $E_0 = 100V$ ,  $I_0 = 100A$  and  $\phi = \frac{\pi}{3}$

Then,  $E_{r.m.s.} = \frac{E_0}{\sqrt{2}} = \frac{100}{\sqrt{2}}$  and  $I_{r.m.s.} = \frac{I_0}{\sqrt{2}} = \frac{100}{\sqrt{2}}$

Now, Power dissipated in the circuit is given by  $P = E_{r.m.s.} I_{r.m.s.} \cos \phi = \frac{100}{\sqrt{2}} \times \frac{100}{\sqrt{2}} \times \cos \frac{\pi}{3} = \frac{100 \times 100}{2} \times \frac{1}{2} = 2500W$



42. *E.m.f.* induced,  $\varepsilon = \frac{-d\phi}{dt} = \frac{-d}{dt}(8t^2 - 4t + 1) = -[(2 \times 8)t - 4] = [16t - 4]$

Here,  $t = 0.1s$

$$\therefore \varepsilon = -[16 \times 0.1 - 4] = 4 - 1.6 = 2.4V$$

Current induced  $I = \frac{\varepsilon}{R} = \frac{2.4}{10} = 0.24A$

43.  $[R] = [L^2MT^{-3}I^{-2}]$ ,  $[L] = [L^2MT^{-2}I^{-2}]$ ,  $[C] = [L^{-2}M^{-1}T^4I^2]$  and  $[f] = [M^{\circ}L^{\circ}T^{-1}]$ .

44. On the basis of given graph, following table is possible.

| A | B | C |
|---|---|---|
| 0 | 0 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |

It is truth table of AND gate

45. Number of half lives  $n = \frac{15}{5} = 3$

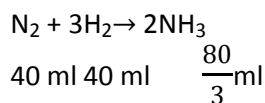
We know that  $N = N_0 \left(\frac{1}{2}\right)^n = N_0 \left(\frac{1}{2}\right)^3 = \frac{N_0}{8}$

## PART (B) CHEMISTRY

|       |        |        |       |       |       |       |       |       |       |
|-------|--------|--------|-------|-------|-------|-------|-------|-------|-------|
| 46. b | 47. a  | 48. c  | 49. c | 50. b | 51. b | 52. d | 53. d | 54. d | 55. c |
| 56. c | 157. d | 158. a | 59. a | 60. c | 61. c | 62. d | 63. d | 64. d | 65. b |
| 66. c | 67. c  | 68. a  | 69. b | 70. c | 71. a | 72. b | 73. c | 74. b | 75. b |
| 76. d | 77. b  | 78. c  | 79. c | 80. d | 81. b | 82. d | 83. c | 84. d | 85. c |
| 86. d | 87. a  | 88. d  | 89. b | 90. c |       |       |       |       |       |

### SOLUTIONS:

46. Sol: (b)



H<sub>2</sub> is limiting reagent

$$V_{NH_3} \text{ obtained} = \frac{80}{3} \times \frac{25}{100} = \frac{20}{3} \text{ ml}$$

$$V_{N_2} \text{ left} = 40 - \frac{10}{3} = \frac{110}{3}$$

47. Sol: (a)

Above  $T_C$ , a gas cannot be liquefied

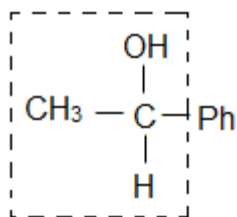
48. Sol: (c)

Conceptual

49. Sol: (c)

Elimination product is obtained

50. Sol: (b)



It will give iodoform test.

51. Sol: (b)

$$\ell = 2$$

$$m = -2, -1, 0, 1, 2$$

we get 5 orbitals

52. Sol: (d)

| Compound                                        | i |
|-------------------------------------------------|---|
| KCl                                             | 2 |
| BaCl <sub>2</sub>                               | 3 |
| FeCl <sub>3</sub>                               | 4 |
| Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> | 6 |

Compound with maximum value of i will show maximum  $\Delta T_b$ .

53. Sol: (d)

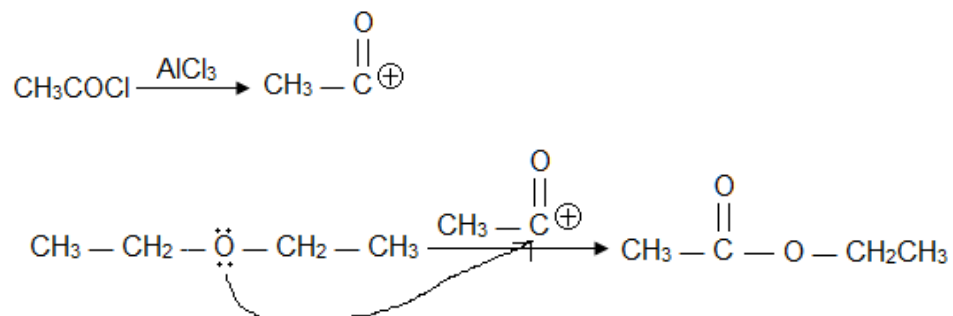
Conceptual

54. Sol: (d)

Reaction (a) takes place in presence of peroxide. Reaction (c) is allylic substitution.

Reaction (d) is free radical substitution

55. Sol: (c)



56. Sol: (c)

$$E_{\text{cell}}^{\circ} = 0.72 - 0.72$$

$$= 0.3$$

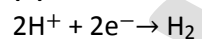
$$E_{\text{cell}} = 0.3 - \frac{0.0591}{6} \log \frac{0.1^2}{0.01^3}$$

$$= 0.3 - 0.1 \times 4$$

$$= 0.3 - 0.04$$

$$= 0.26$$

57. Sol: (d)



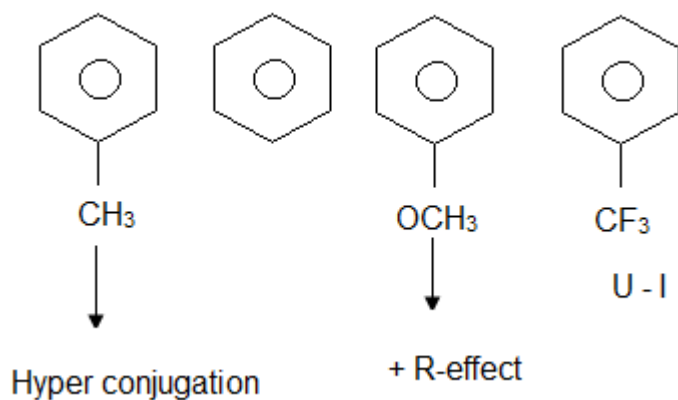
$$E_{\text{cell}} = 0 - \frac{0.0591}{2} \log \frac{P_{\text{H}_2}}{[\text{H}^+]^2}$$

$$\frac{P_{\text{H}_2}}{[\text{H}^+]^2} > \text{ for negative reduction potential.}$$

58. Sol: (a)

Conceptual

59. Sol: (a)



60. Sol: (c)

[Co(gly)<sub>3</sub>] is [M(AB)<sub>3</sub>] type complex.

61. Sol: (c)

$$\Delta H = \Delta E + \Delta n_g RT$$

$$\Delta n_g = 3$$

$$\Delta E = \Delta H = 3RT$$

62. Sol: (d)

$$\frac{\Delta P}{P^o} = 0.5 = \frac{i \times n}{n + N}$$

$$i = 1.25$$

$$1.25 = 1 + (2 - 1)\alpha$$

$$\alpha = 0.25$$

2 mol of NaCl will produce 0.5 mol of Cl<sup>-</sup> in solution.

63. Sol: (d)

Conceptual

64. Sol: (d)

Alcohol has more BP than aldehydes and ketones of comparable MW. This is due to H-bonding in alcohol.

65. Sol: (b)

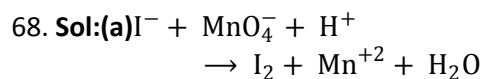
Conceptual

66. Sol: (c)

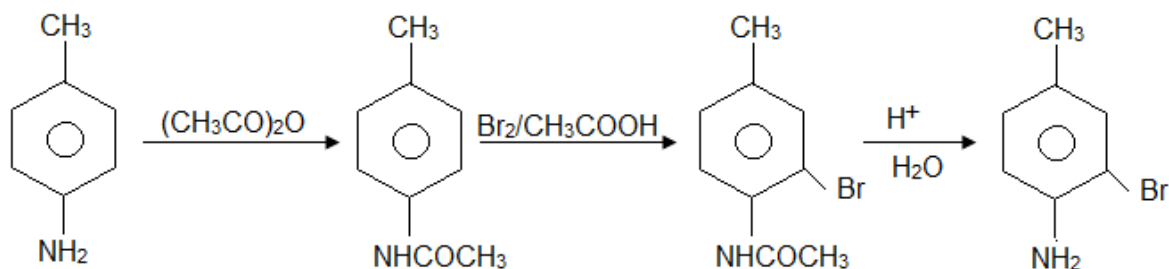
On increasing temperature internal energy and entropy increases.

67. Sol: (c)

Conceptual



69. Sol: (b)



70. Sol: (c)

$[Pt(NH_3)_6]Cl_4$  produces more no. of ions.

71. Sol: (a)

$$K_a = \frac{K_w}{K_c}$$

$$= \frac{10^{-14}}{8 \times 10^{-5}} = 1.2 \times 10^{-10}$$

72. Sol: (b)

$$\frac{1}{4} \frac{d[NO_2]}{dt} = \frac{-1}{2} \frac{d[NO_5]}{dt}$$

$$\frac{d[NO_2]}{dt} = 2 \times \frac{4 - 2.5}{3}$$

$$= 2 \times \frac{1.5}{3} = 1$$

73. Sol: (c)

KI is ionic in nature so, as dielectric constant increases solubility increases.

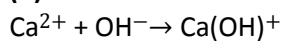
74. Sol: (b)

Conceptual

75. Sol: (b)

Glucose with  $NH_2OH$  forms oxime.

76. Sol: (d)

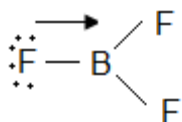


77. Sol: (b)

100 ml of solution requires =  $10 \times 0.5 = 5$  milli moles

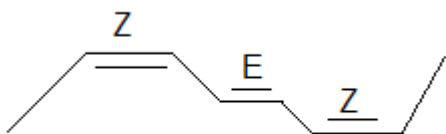
1000 ml solution requires = 50 milli moles

78. Sol: (c)

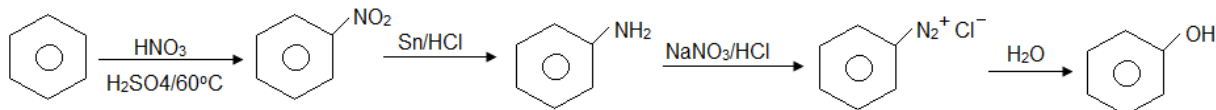


There is double bond characteristics between B – F bond due to back bonding.

79. Sol: (c)



80. Sol: (d)



81. Sol: (b)

Less acidity  $\Rightarrow$  more pH

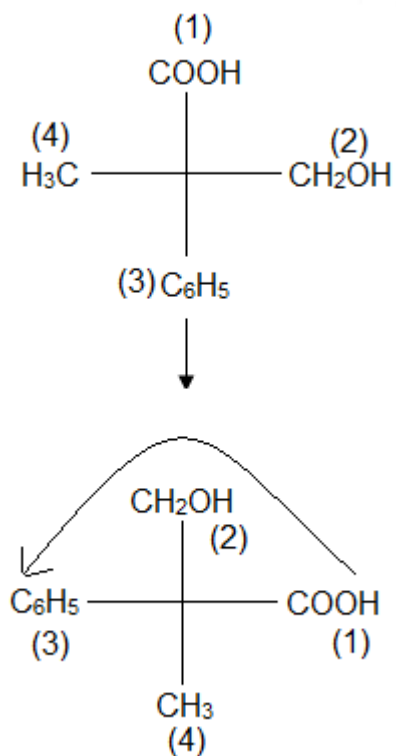
82. Sol: (d)

$\text{ICl}_4^-$  is square planar

83. Sol: (c)

Conceptual

84. Sol: (d)



85. Sol: (c)

Conceptual

86. Sol: (d)

Total voids = 8 + 4 = 12

Ag<sup>+</sup> ions occupy tetrahedral voids

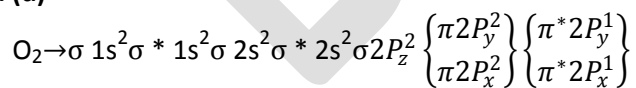
$$\% \text{ voids occupied} = \frac{4}{12} \times 100$$

$$= 33.33 \%$$

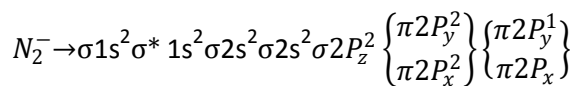
87. Sol: (a)

Conceptual

88. Sol: (d)



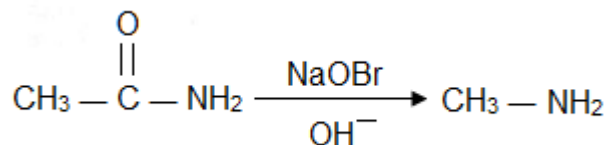
O<sub>2</sub> has a unpaired electrons



N<sub>2</sub><sup>-</sup> has one unpaired electron

89. Sol: (b)

Hoffmann bromamide degradation reaction.



90. Sol: (c)

Conceptual

### PART – C (BIOLOGY)

|       |       |       |       |       |       |       |       |       |       |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 91.b  | 92.c  | 93.c  | 94.a  | 95.a  | 96.c  | 97.c  | 98.a  | 99.c  | 100.d |
| 101.c | 102.d | 103.a | 104.a | 105.d | 106.b | 107.d | 108.c | 109.a | 110.c |
| 111.a | 112.a | 113.d | 114.c | 115.d | 116.c | 117.d | 118.d | 119.d | 120.a |
| 121.b | 122.b | 123.d | 124.d | 125.b | 126.c | 127.c | 128.a | 129.a | 130.d |
| 131.a | 132.a | 133.d | 134.d | 135.  | 136.d | 137.a | 138.d | 139.a | 140.c |
| 141.c | 142.c | 143.b | 144.d | 145.a | 146.c | 147.b | 148.b | 149.c | 150.c |
| 151.b | 152.b | 153.d | 154.b | 155.d | 156.b | 157.b | 158.b | 159.b | 160.c |
| 161.d | 162.d | 163.a | 164.d | 165.c | 166.d | 167.b | 168.c | 169.a | 170.b |
| 171.a | 172.d | 173.b | 174.a | 175.b | 176.c | 177.d | 188.d | 179.d | 180.a |

91. Sol: (b) Classifying organisms on the basis of descent from a common ancestor is called **phylogenetic classification**. It is based on evolutionary ancestry and generates trees called cladograms. Cladistics also identifies clades, which are groups of organisms that include an ancestor species and its descendants.

92. Sol: (c) All taxonomic categories are referred to by the general term taxon. Every level in the taxonomic hierarchy is a taxon.

93. Sol: (c) Arboviruses have double stranded DNA or Single stranded RNA as their genetic material, riboviruses have single stranded RNA (retroviruses are not included in this group), reoviruses include those with double stranded RNA as their genetic material.

94. Sol: (a) The disease caused by *Entamoeba histolytica* is Amoebic dysentery. It is characterised by the presence of blood and mucous in stools associated with pain in the abdomen.

95. Sol: (a) Mosses in the Class Bryopsida are commonly known as the “joint-toothed” or “arthrodontous” mosses. The Bryopsids display an diverse assortment of species. More than 95% of moss species belong to the Bryopsida.

96. Sol: (c) Both coniferales and cycadales are gymnosperms and include conifers and cycads respectively. Conifers have non-motile sperms whereas cycads have motile sperms.



97. Sol: (c) Ctenophores have smooth muscle fibres in mesoglea whereas cnidarians lack it.  
A few more salient differences are listed below:
- Cnidarians are highly diversified in terms of the number of species compared to ctenophores.
  - The body size range is higher among ctenophores than in cnidarians.
  - The majority of cnidarians live in the ocean while a very little number of species could be found in freshwater, whereas all the ctenophores have been recorded only from the saltwater environments.
  - Cnidarians are radially symmetrical while ctenophores are either radial or biradial in their body symmetry.
  - The alteration of generations is present among cnidarians but not in ctenophores.
  - Cnidarians have Cnidocytes to disable the prey while ctenophores have colloblasts to capture prey.
  - Bioluminescence is more common among ctenophores than in cnidarians.
  - Digestive tract is complete in ctenophores but not in cnidarians.
  - Ctenophores have a comb plate but never in cnidarians.
98. Sol: (a) All the given options are excretory structures. Metanephridia are of mollusca, malpighian tubules are seen in insects, green glands in crustaceans and kidneys in reptiles, birds and mammals.
99. Sol: (c) Pear is a false fruit (pseudocarp) developed from the thalamus of its flower. As the fruit development happens, the thalamus enlarges, becomes fleshy and the ovary with seeds remain underdeveloped.
100. Sol: (d) Aleurone layer is a proteinaceous coat around the monocot seed inner to the outer covering made up of pericarp + seed coats.
101. Sol: (c) Hypodermis is made up of a few layers of sclerenchymatous cells in monocot stem. It provides rigidity and strength to the stems as secondary growth is not seen in monocots. Hypodermis is generally not found in roots but if it is present (it is called exodermis in roots) it is sclerenchymatous.
102. (d) Alburnum or sapwood is the soft, newer wood in the trunk of a tree found between the bark and the hardened heartwood.
103. Sol: (a) Cytochromes and myoglobin are iron containing haemoproteins which help in respiration by binding oxygen. They are present in higher concentrations in red muscles and act as a reserve of oxygen to ensure oxidative metabolism during high muscle activity.
104. Sol: (a) Organisms are classified based on the nature of excretory products. Those that excrete ammonia are ammoniotelic, those that excrete urea are ureotelic and those with ureic acid as their principle nitrogenous wastes are uricotelic. Cockroach is uricotelic whereas frog, man and earthworms are ureotelic.
105. Sol: (d) Mitosis occurs in all kinds of cells whereas meiosis occurs only in germ cells or reproductive cells.
106. Sol: (b) (consider human beings) At the end of meiosis I, the number of chromosomes in daughter cells will be 23. But each of these 23 chromosomes contain 2 sister chromatids (genetically identical), making the daughter cells have 2 copies of the same genetic material. Meiosis II separates the sister chromatids and makes the daughter cells haploid.
107. Sol: (d) Coenzymes are small molecules. They cannot by themselves catalyze a reaction but they can help

enzymes to do so. In technical terms, coenzymes are organic nonprotein molecules that bind with the protein molecule (apoenzyme) to form the active enzyme (holoenzyme).

A number of the water-soluble vitamins such as vitamins B1, B2 and B6 serve as coenzymes.

108. Sol: (c) **Lyases** are enzymes that catalyze the cleavage of C-C, C-O, C-N bonds by other means than by hydrolysis or oxidation. These bonds are cleaved by the process of elimination and the resulting product is the formation of a double bond or a new ring.

An enzyme present in red blood cells, **carbonic anhydrase**, aids in the conversion of carbon dioxide to **carbonic** acid and bicarbonate ions. When red blood cells reach the lungs, the same enzyme helps to convert the bicarbonate ions back to carbon dioxide, which we breathe out.

109. Sol: (a) Lack of vitamin D results in reduced absorption of calcium and phosphorus. Difficulty to maintain proper calcium and phosphorus levels in bones can cause rickets.

Symptoms include delayed growth, bow legs, weakness and pain in the spine, pelvis and legs.

**Rickets** in adults is known as osteomalacia or soft bones.

110. Sol: (c) Noncompetitive inhibition occurs when an inhibitor binds to the enzyme at a location other than the active site. In some cases of noncompetitive inhibition, the inhibitor is thought to bind to the enzyme in such a way as to physically block the normal active site.

111. Sol: (a) The opening and closing of the stomata is controlled by the **guard cells**. In light, **guard cells** take up water by osmosis and become **turgid**. Because their inner walls are rigid they are pulled apart, opening the pore. In darkness water is lost and the inner walls move together closing the pore.

112. Sol: (a) Plants can only absorb soluble minerals (those that can dissolve in water). They absorb minerals dissolved in solution from the soil through their *root hair cells*. However, the concentration of minerals in the soil is very low.

Minerals cannot be absorbed by osmosis because this is the movement of water only. They cannot be absorbed by *diffusion*, because the minerals are in very low concentration. Instead, **active transport** is used.

The root hair cells have carrier molecules on their cell membranes. These pick up the mineral ions and move them across the membrane into the cell against the *concentration gradient*.

113. Sol: (d) Field water capacity is defined by the Soil Science Glossary Terms Committee (2008) as the content of water, on a mass or volume basis, remaining in a soil 2 or 3 days after having been wetted with water and after free drainage is negligible. Gravitational water would reach the water table deep down and runaway water flows on the surface, hence not being available in the soil.

114. Sol: (c) A **lenticel** is a porous tissue consisting of cells with large intercellular spaces in the periderm of the secondarily thickened organs and the bark of woody stems and roots of dicotyledonous flowering plants. It functions as a pore, providing a pathway for the direct exchange of gases between the internal tissues and atmosphere through the bark, which is otherwise impermeable to gases.

115. Sol: (d) Complete girdling (the bark removed from a band completely encircling the tree) will certainly kill the tree. The reason for damage due to girdling is that the phloem layer of tissue just below the bark is responsible for carrying food produced in the leaves by photosynthesis to the roots.

116. Sol: (c) **Macronutrients:** nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), sulfur (S), magnesium (Mg) **Micronutrients (or trace minerals):** boron (B), chlorine (Cl), manganese (Mn), iron (Fe), zinc (Zn), copper (Cu), molybdenum (Mo), nickel (Ni).

117. Sol: (d) The **Emerson effect** is the increase in the rate of photosynthesis after chloroplasts are exposed to light of wavelength 670 nm (red light) and 700 nm (far red light). When simultaneously exposed to light of both wavelengths, the rate of photosynthesis is far higher than the sum of the red light and far red light photosynthesis rates. The effect was early evidence that two photosystems, processing different wavelengths, cooperate in photosynthesis.

118. Sol: (b) Reactions a, c and d are irreversible in glycolysis. The reaction 'd' catalysed by Phosphofructokinase is the rate limiting reaction of glycolysis.

119. Sol: (d) The term "photoperiodism" was coined to describe a plant's ability to flower in response to changes in the photoperiod: the relative lengths of day and night. Florigens are hormones associated with flowering in plants.

120. Sol: (a) Eleidin is a substance related to keratin and occurring in small granules that stain deeply with hematoxylin and are located in the cells of the stratum lucidum of the epidermis.

121. Sol: (b) The **gastrocolic reflex** or **gastrocolic** response is one of a number of physiological **reflexes** controlling the motility, or peristalsis, of the gastrointestinal tract. It involves an increase in motility of the colon in response to stretch in the stomach and byproducts of digestion in the small intestine.

122. Sol: (b) **Achalasia** is a failure of smooth muscle fibers to relax, which can cause a sphincter to remain closed and fail to open when needed. Achalasia is characterized by difficulty in swallowing, regurgitation, and sometimes chest pain.

123. Sol: (d) Respiratory distress syndrome (RDS) is a breathing disorder that affects newborns. RDS rarely occurs in full-term infants. The disorder is more common in premature infants born about 6 weeks or more before their due dates.

RDS is more common in premature infants because their lungs aren't able to make enough surfactant. Surfactant is a liquid that coats the inside of the lungs. It helps keep them open so that infants can breathe in air once they're born. Dipalmitoyl lecithin is the primary surfactant.

Without enough surfactant, the lungs collapse and the infant has to work hard to breathe. He or she might not be able to breathe in enough oxygen to support the body's organs. The lack of oxygen can damage the baby's brain and other organs if proper treatment isn't given.

124. Sol: (d) **Chloride shift** (also known as the Hamburger **shift** or Hamburger phenomenon, named after Hartog

Jakob Hamburger) is a process which occurs in a cardiovascular system and refers to the exchange of bicarbonate ( $\text{HCO}_3^-$ ) and **chloride** ( $\text{Cl}^-$ ) across the membrane of red blood cells (RBCs). Chloride shift is a major mechanism for the transportation of carbon dioxide in blood.

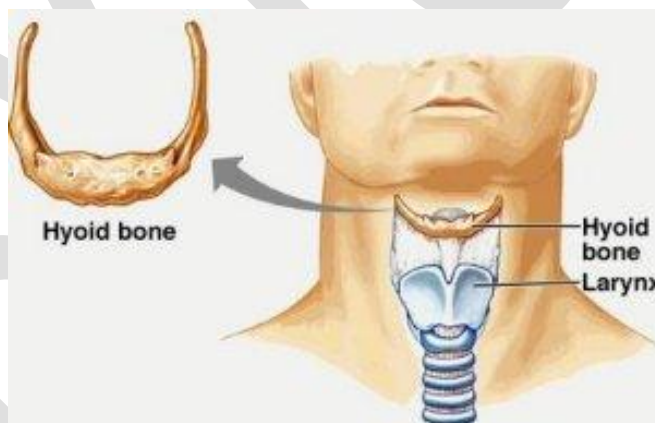
125. Sol: (b) Transudation is the process of exuding; the slow escape of liquids from blood vessels through pores or breaks in the cell membranes. The capillaries are porous and lead to the loss of fluid through those pores. Such escaped fluid is called transudate.

126. Sol: (c) Fibrinogen is one of the 3 major plasma proteins; Albumin, globulin and fibrinogen. The site of synthesis of fibrinogen is liver.

127. Sol: (c) Aldosterone is a mineralocorticoid secreted from the adrenal cortex. It brings about sodium reabsorption and helps in regulation of blood pressure. Activity of aldosterone causes increase in blood pressure.

128. Sol: (a) Uraemia is the presence of high levels of urea in blood. Uremia is a clinical syndrome associated with fluid, electrolyte, and hormone imbalances and metabolic abnormalities, which develop in parallel with deterioration of renal function.

129. Sol: (a) Hyoid bone is the bone found in the anterior aspect of the neck.

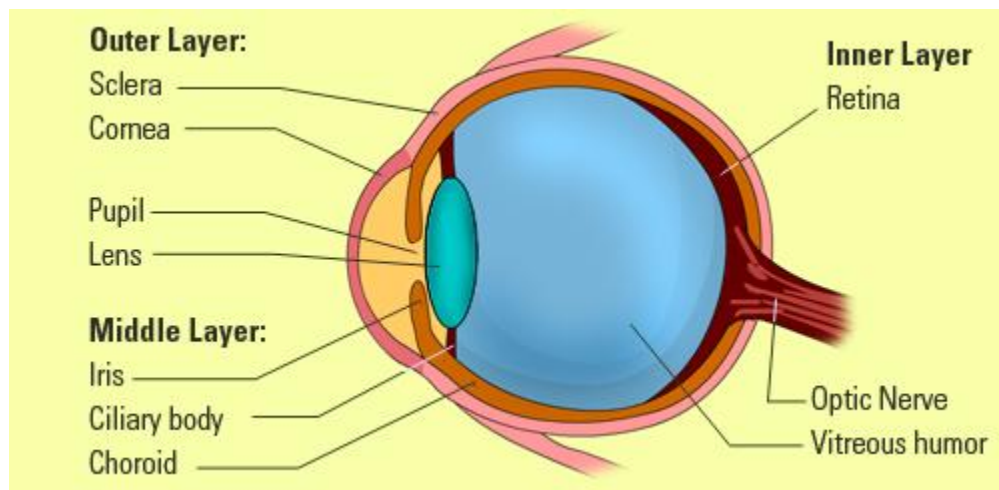


130. Sol: (d) Autonomic nervous system regulates the automatic functions of the body. It constitutes sympathetic and parasympathetic systems and is regulated by centres present in both hypothalamus and medulla oblongata.

131. Sol: (a) Among the many causes attributed to Alzheimer's disease, one of the strong propositions is that AD is caused by reduced synthesis of the neurotransmitter acetylcholine. The most common early symptom is difficulty in remembering recent events (short-term memory loss). As the disease advances, symptoms can include problems with language, disorientation (including easily getting lost), mood swings, loss of motivation, not managing self-care, and behavioural issues. As a person's condition

declines, they often withdraw from family and society. Gradually, bodily functions are lost, ultimately leading to death.

132. Sol: (a)



133. Sol: (d) The ciliary muscle is located in the eye and surrounds the lens. It contracts or relaxes in order for an individual to see at multiple distances. When it contracts, it pulls forward, moving to a frontal portion to relax the fibers that hold the lens in place; this process also allows it to take on a more spherical shape to provide short range focus

134. Sol: (d) Corpus luteum, yellow hormone-secreting body in the female reproductive system. It is formed in an ovary at the site of a follicle, or sac, that has matured and released its ovum, or egg, in the process known as ovulation. The corpus luteum is made up of lutein cells (from the Latin luteus, meaning "saffron-yellow"), which develop immediately following ovulation, when yellow pigment and lipids accumulate within the granulosa cells lining the follicle. The size of the corpus luteum is highly variable.

The corpus luteum secretes estrogens and progesterone. The latter hormone causes changes in the uterus that make it more suitable for implantation of the fertilized ovum and the nourishment of the embryo. If the egg is not fertilized, the corpus luteum becomes inactive after 10–14 days, and menstruation occurs.

135. Sol: (d) In Addison's disease, the adrenal cortex does not secrete hormones sufficiently, due to immune system attack (autoimmunity) or an infection such as tuberculosis. Signs and symptoms include decreased blood sodium, increased blood potassium, low blood glucose level (hypoglycemia), dehydration, low blood pressure, and increased skin pigmentation. Without treatment, death comes within days from severe disturbances in electrolyte balance.

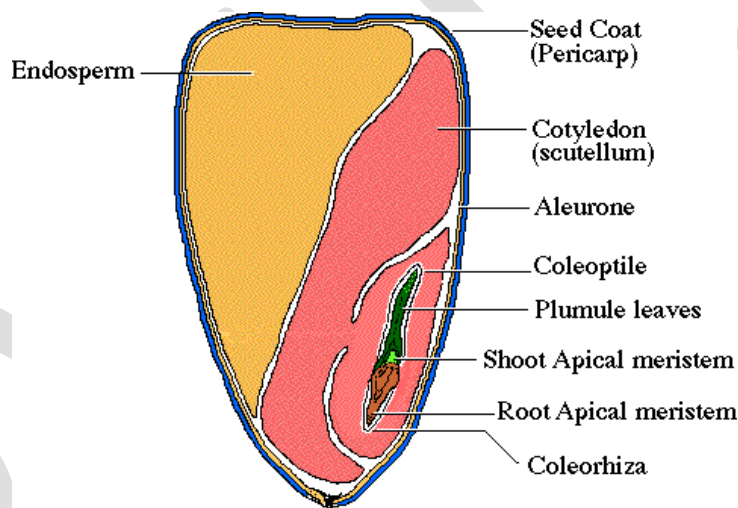
136. Sol: (d) All three options involve the fusion of 2 different cells to produce the progeny which is characteristic of sexual reproduction.

137. Sol: (a) Layering is a method of propagating a plant in which a shoot is fastened down to form roots while still attached to the parent plant.

Grafting or graftage is a horticultural technique whereby tissues of plants are joined so as to continue their growth together. The upper part of the combined plant is called the scion while the lower part is called the rootstock.

Cutting is a means of vegetative propagation where a cut portion of a plant forms a full adult plant.

138. Sol: (d) Sperms or the male gametes (two in number) are released into the synergids of the egg apparatus which acts as a guide for the male gametes into the female gamete as well as the central cell.
139. Sol: (a) Microspore mother cell undergoes meiosis to produce 4 microspores. Each of the microspore further develops into a pollen grain thereby giving rise to 4 pollen tubes.
140. Sol: (c) As the generative cell moves down the pollen tube a callus plug is formed to close it behind the generative cell. Once fertilization occurs, the pollen tube collapses and becomes non-functional.
141. Sol: (c) Cereal grain is a monocotyledonous seed. In the monocot seed, cotyledon is represented by the structure called scutellum.



142. Sol: (c) Oogonium, archaegonium and ovule are all associated with female reproductive structures in plants. Whereas, antheridium is the male structure.
143. Sol: (b) Dartos muscle is found in the wall of scrotum. The contraction of the muscle leads to retraction of scrotum, pulling testes closer to the body thereby keeping it warm.
144. Sol: (d) Clitoris is a small, sensitive, erectile part of the female genitals at the anterior end of the vulva. It is the equivalent of male glans penis.
145. Sol: (a) Cells of the ovarian follicles synthesize Oestrogen. Theca interna cells of a mature Graaffian follicle synthesise oestrogen.
146. Sol: (c) Derivatives of the primary Germ Layers

| Ectoderm           | Mesoderm                             | Endoderm                              |
|--------------------|--------------------------------------|---------------------------------------|
| All nervous tissue | Skeletal, smooth, and cardiac muscle | Epithelium of digestive tract (except |

|                                                                                                        |                                                                                |                                                             |
|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------|
| Epidermis of skin and epidermal derivatives (hairs, hair follicles, sebaceous and sweat glands, nails) | Cartilage, bone, and other connective tissues                                  | that of oral and anal cavities)                             |
| Cornea and lens of eye                                                                                 | Blood, bone marrow, and lymphoid tissues                                       | Glandular derivatives of digestive tract (liver, pancreas)  |
| Epithelium of oral and nasal cavities, of Paranasal sinuses, and of anal canal                         | Endothelium of blood vessels and lymphatics                                    | Epithelium of respiratory tract, auditory tube, and tonsils |
| Tooth enamel                                                                                           | Serosae of ventral body cavity                                                 | Thyroid, parathyroid, and thymus glands                     |
| Epithelium of pineal and pituitary glands and adrenal medulla                                          | Fibrous and vascular tunics of eyes                                            | Epithelium of reproductive ducts and glands                 |
| Melanocytes                                                                                            | Synovial membranes of joint cavities                                           | Epithelium of urethra and bladder                           |
| Some cranial bones and branchial Cartilages (derived from neural crest)                                | Organs of urogenital system (ureters, kidneys, gonads, and reproductive ducts) |                                                             |

147. Sol: (b) An ectopic pregnancy is a pregnancy that occurs outside the womb (uterus). It is life-threatening to the mother. In most pregnancies, the fertilized egg travels through the fallopian tube to the womb (uterus). If the movement of the egg is blocked or slowed through the tubes, it can lead to an ectopic pregnancy. The most common site for an ectopic pregnancy is within 1 of the 2 fallopian tubes. In rare cases, ectopic pregnancies can occur in the ovary, abdomen, or cervix.

148. Sol: (b) Relaxin is a hormone produced by the ovary and the placenta with important effects in the female reproductive system and during pregnancy. In preparation for childbirth, it relaxes the ligaments in the pelvis and softens and widens the cervix.

149. Sol: (c) Oligospermia is deficiency of sperm cells in the semen. Polyspermia is an abnormally profuse production of semen. Azoospermia is the absence of sperms in semen.

150. Sol: (c) Contraceptive pills contain high concentrations of progesterone and low doses of oestrogen. This leads to suppression of FSH and LH secretion (because progesterone has inhibitory effect on FSH and LH). The menstrual cycles continue but without ovulation thereby providing contraception.

151. Sol: (b) Chancre is a painless ulcer, particularly one that develops on the genitals in venereal disease. It is the main sign of primary syphilis. Syphilis is caused by the infection of *Treponema pallidum*.

152. Sol: (b) Mendelian cross involves the crossing between homozygous dominant and homozygous recessive individuals. In the first generation all the progeny will be heterozygous. So, the character that is seen will be the dominant one (because, dominant character expresses in heterozygous condition).

153. Sol: (d) Skin colour inheritance in man is controlled by multiple genes and hence it is an example of polygenic inheritance. The genes have an additive effect. The inheritance of skin colour is quantitative. Hence, the effects of genes is cumulative.

154. Sol: (b) Crossing over leads to genetic diversity by bringing about variations in expression of characters. Since

crossing over is a characteristic feature of sexual reproduction it leads to variations continuously generation after generation.

155. Sol: (d) The genotype of parent with blood group A can be  $I^A I^A$  or  $I^A i$ . Genotype of the parent with blood group AB will be  $I^A I^B$ . Working out the possibilities of the genetic combinations it is the only impossibility. That means, blood group 'O' is not possible for the progeny.

156. Sol: (b) Lampbrush chromosomes are a special form of chromosome found in the growing oocytes (immature eggs) of most animals, except mammals. It is most prominently seen in the diplotene stage of prophase I of meiosis.

157. Sol: (b) Reverse transcriptase is the enzyme that can produce a strand of DNA with RNA as the template.

158. Sol: (b) Mutation is in the male parent. Mitochondria of sperms are left behind during fertilization and hence the mitochondria of the progeny is completely of maternal origin (from the mother).

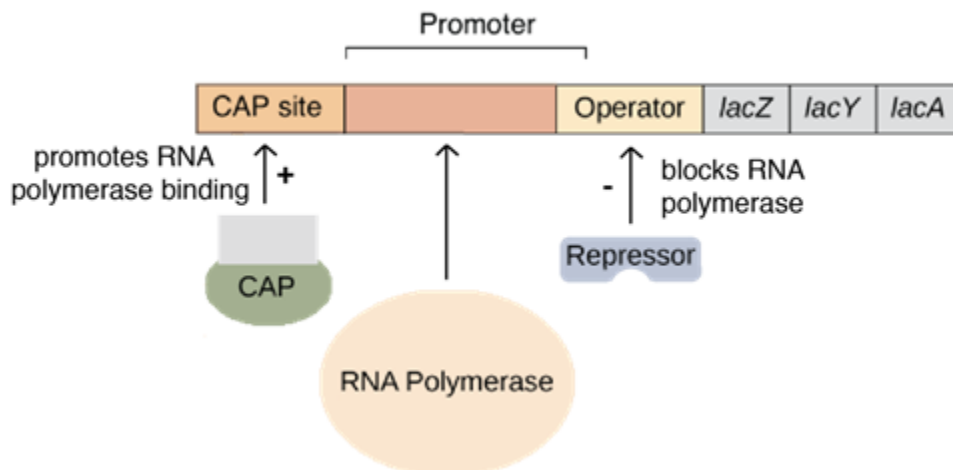
159. Sol: (b) Cataract is not a hereditary disorder. It is a disease in which the lens of the eyes becomes opaque leading to obstruction of vision. The causes can be varied. Some of the causes are listed below:

- Ultraviolet radiation from sunlight and other sources
- Diabetes
- Hypertension
- Obesity
- Smoking
- Prolonged use of corticosteroid medications
- Statin medicines used to reduce cholesterol
- Previous eye injury or inflammation
- Previous eye surgery
- Hormone replacement therapy
- Significant alcohol consumption
- High myopia

160. Sol: (c) Adenine and guanine are purines. Cytosine, thymine and uracil are pyrimidines.

161. Sol: (d) The lac operon consists of three structural genes, and a promoter, a terminator, regulator, and an operator. The three structural genes are: lacZ, lacY, and lacA.



**The *lac* operon:**

162. Sol: (d) Photosynthesis, respiration and transpiration are higher metabolic processes. Formation of macromolecules from simpler molecules was one of the earliest developments in the origin of life.
163. Sol: (a) Age of fishes – Devonian period.  
Age of amphibians – Permian period  
Age of reptiles – Mesozoic era  
Age of mammals – cenozoic era
164. Sol: (d) Mutualism, commensalism and parasitism are different types of interactions among organisms. All these are evolutionary adaptations that increase the chances of survival of one or both the interacting organisms. Hence, all three support evolution.
165. Sol: (c)

| Link                                       | Between the groups              |
|--------------------------------------------|---------------------------------|
| 1. Actinomycetes                           | Bacteria & Fungi                |
| 2. Archaeopteryx                           | Reptiles & Birds                |
| 3. Balanoglossus                           | Chordates & Non-chordates       |
| 4. Chimera (Rabbit fish/Ratfish)           | Cartilaginous & Bony fishes     |
| 5. Club moss                               | Bryophytes & Pteridophytes      |
| 6. Ctenophora                              | Coelenterates & Platyhelminthes |
| 7. Cycas                                   | Pteridophytes & Gymnosperms     |
| 8. Echidna (Spiny ant eater)               | Reptiles & Mammals              |
| 9. Euglena                                 | Animals & Plants                |
| 10. Gnetum                                 | Gymnosperms & Angiosperms       |
| 11. Hornworts                              | Protista & Bryophytes           |
| 12. Latimeria                              | Pisces & Amphibia               |
| 13. Myxomycetes                            | Protista & Fungi                |
| 14. Neopilina                              | Annelida & Mollusca             |
| 15. Ornithorhynchus (Duck billed platypus) | Reptiles & Mammals              |
| 16. Peripatus (walking worm)               | Annelida & Arthropoda           |
| 17. Proterospongia                         | Protozoa & Porifera             |

|                                      |                          |
|--------------------------------------|--------------------------|
| 18. Protopterus (Lung fishes)        | Bony fishes & Amphibia   |
| 19. Rickettsia                       | Virus & Bacteria         |
| 20. Seymouria                        | Amphibia & Reptiles      |
| 21. Sphenodon (Living fossil lizard) | Amphibia & Reptilia      |
| 22. Tornaria larva                   | Echinodermata & Chordata |
| 23. Trochophore larva                | Annelida & Mollusca      |
| 24. Virus                            | Living & non-living      |
| 25. Xenoturbella                     | Protozoa & Metazoa       |

166. Sol: (d) It is hard to know exactly why many species are on the verge of extinction now, let alone species in the deep past that are already gone. However, we can assume some of the same basic ecological processes driving animals to extinction today are part of the puzzle. In the case of Neanderthals, competition and changes to their habitat due to climate change were two of the main factors.

167. Sol: (b) Yellow fever, mountain fever and Q-fever are viral diseases whereas plague is caused by the infection of bacterium *Yersinia pestis*.

168. Sol: (c) Kwashiorkor is one of the more severe forms of protein malnutrition and is caused by inadequate protein intake. It is, therefore, a macronutrient deficiency.

169. Sol: (a) Gamma globulins are a class of globulins, identified by their position after serum protein electrophoresis. The most significant gamma globulins are immunoglobulins (antibodies), although some immunoglobulins are not gamma globulins, and some gamma globulins are not immunoglobulins.

170. Sol: (b) Spirulina is a natural "algae" (cyanobacteria) powder that is incredibly high in protein and a good source of antioxidants, B-vitamins and other nutrients. It is largely made up of protein and essential amino acids, and is typically recommended to vegetarians due to its high natural iron content.

The high concentration of protein and iron also makes it ideal during pregnancy, after surgery, or anytime the immune system needs a boost.

171. Sol: (a) The disease is also called as **New Castle Disease** or Doyle's disease. It is an acute, infectious & highly **contagious** disease of fowls, characterized by **respiratory Distress**, nervous symptoms & high mortality. Ranikhet disease has become a major menace to the world's poultry industry.

172. Sol: (d) **Genetic erosion** is a process whereby an already limited **gene** pool of an endangered species of plant or animal diminishes even more when individuals from the surviving population die off without getting a chance to meet and breed with others in their endangered low population.

173. Sol: (b) Sporeine is the trade name given to the commercial product made from Bt toxin. (*Bacillus thuringiensis*). Bt toxin is used as an insecticide.

174. Sol: (a) Prophage is a stable, inherited form of bacteriophage in which the genetic material of the virus is integrated into, replicated, and expressed with the genetic material of the bacterial host.

175. Sol: (b) cDNA is complementary DNA produced by using mRNA as a primary template. Reverse transcriptase produces DNA with RNA as the template. So, it is a main requirement for the production of cDNA.

176. Sol: (c) **Bergmann's rule** is an ecogeographical **rule** that states that within a broadly distributed taxonomic clade, populations and species of larger size are found in colder environments, and species of smaller size are found in warmer regions.

**Allen's rule.** The principle holding that in a warm-blooded animal species having distinct geographic populations, the limbs, ears, and other appendages of the animals living in cold climates tend to be shorter than in animals of the same species living in warm climates.

**Blackman's law of limiting factors:** When a process depends on a number of **factors**, its rate is limited by the pace of the slowest **factor**. **Blackman's law of limiting factors** determines the rate of photosynthesis.

**Cope's rule:** Population lineages tend to increase in body size over **evolutionary** time.

177. Sol: (d) Biological **Altruism:** In evolutionary biology, an organism is said to behave **altruistically** when its behaviour benefits other organisms, at a cost to itself. The costs and benefits are measured in terms of reproductive fitness, or expected number of offspring.

178. Sol: (d) Insect feeds on plants which makes it the primary consumer. Frog feeding on the insect therefore becomes the secondary consumer.

179. Sol: (d) A **nutrient cycle** (or ecological recycling) is the movement and exchange of organic and inorganic matter back into the production of living matter. Edaphic nutrient cycles are the ones in which there is involvement of soil in the cycling of nutrients.

180. Sol: (a) The **Kyoto Protocol** is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits State Parties to reduce greenhouse gas emissions, based on the premise that (a) global warming exists and (b) human-made CO<sub>2</sub> emissions have caused it.