All India Aakash Test Series for NEET - 2025

TEST - 3 (Code-A)

For Code-B Sol. Click Here

Test Date : 10/11/2024

ANSWERS

1. (4)	41. (4)	81. (4)	121. (3)	161. (3)
2. (1)	42. (3)	82. (2)	122. (2)	162. (4)
3. (4)	43. (2)	83. (3)	123. (2)	163. (3)
4. (3)	44. (4)	84. (2)	124. (1)	164. (3)
5. (4)	45. (3)	85. (3)	125. (4)	165. (2)
6. (3)	46. (1)	86. (4)	126. (3)	166. (4)
7. (3)	47. (1)	87. (3)	127. (4)	167. (3)
8. (2)	48. (3)	88. (4)	128. (2)	168. (3)
9. (3)	49. (3)	89. (3)	129. (3)	169. (3)
10. (3)	50. (2)	90. (1)	130. (1)	170. (1)
11. (3)	51. (3)	91. (4)	131. (4)	171. (1)
12. (2)	52. (2)	92. (1)	132. (4)	172. (2)
13. (3)	53. (3)	93. (3)	133. (4)	173. (3)
14. (1)	54. (3)	94. (2)	134. (3)	174. (2)
15. (3)	55. (3)	95. (3)	135. (3)	175. (2)
16. (1)	56. (2)	96. (2)	136. (3)	176. (4)
17. (3)	57. (3)	97. (4)	137. (1)	177. (4)
18. (3)	58. (2)	98. (4)	138. (2)	178. (4)
19. (3)	59. (1)	99. (1)	139. (1)	179. (4)
20. (2)	60. (3)	100. (3)	140. (2)	180. (4)
21. (2)	61. (1)	101. (3)	141. (2)	181. (4)
22. (1)	62. (4)	102. (1)	142. (1)	182. (1)
23. (3)	63. (2)	103. (1)	143. (4)	183. (4)
24. (2)	64. (1)	104. (1)	144. (3)	184. (1)
25. (2)	65. (1)	105. (4)	145. (2)	185. (3)
26. (1)	66. (4)	106. (1)	146. (2)	186. (2)
27. (4)	67. (4)	107. (3)	147. (3)	187. (3)
28. (2)	68. (2)	108. (3)	148. (4)	188. (1)
29. (2)	69. (4)	109. (1)	149. (3)	189. (4)
30. (3)	70. (1)	110. (4)	150. (3)	190. (4)
31. (4)	71. (2)	111. (2)	151. (4)	191. (3)
32. (4)	72. (3)	112. (4)	152. (3)	192. (4)
33. (4)	73. (3)	113. (1)	153. (3)	193. (3)
34. (1)	74. (2)	114. (3)	154. (3)	194. (1)
35. (2)	75. (3)	115. (2)	155. (3)	195. (4)
36. (3)	76. (3)	116. (1)	156. (3)	196. (4)
37. (3)	77. (2)	117. (1)	157. (4)	197. (4)
38. (4)	78. (1)	118. (3)	158. (3)	198. (4)
39. (2)	79. (2)	119. (2)	159. (4)	199. (2)
40. (4)	80. (1)	120. (2)	160. (3)	200. (4)

HINTS & SOLUTIONS

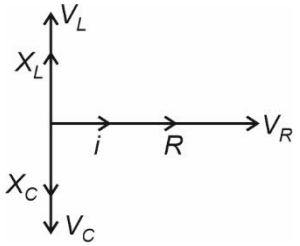
[PHYSICS]

SECTION-A

1. Answer (4)

Hint: Draw appropriate phasor diagram.

Sol.: Phasor diagram for the series *LCR* circuit is



All statements are true.

Current through *C* and *R* are in same phase because current is same through each elements.

2. Answer (1)

Hint: Maxwell's equations

Sol.: $\oint \vec{E}.d\vec{l} = \frac{-d\phi_B}{dt}$ is Faraday's law of electromagnetic induction.

$\oint \vec{B}.d\vec{s} = 0$ is Gauss's law in magnetism.

3. Answer (4)

Hint: The EM waves originate from an accelerating charge.

Sol.: For EM waves,

Wavelength of wave changes when it travels from one medium to another. Frequency of wave remains unchanged when it travels from one medium to another. Both electric and magnetic field vectors attain maxima at the same time.

4. Answer (3)

Hint: $i_d = \varepsilon_0 A \frac{dE}{dt}$

Sol.: $i_d = \varepsilon_0 \frac{d(EA)}{dt} = \varepsilon_0 A \frac{dE}{dt}$

$$\Rightarrow \frac{dE}{dt} = \frac{i_d}{\varepsilon_0 A} = \frac{17.7}{8.85\times10^{-12}\pi(0.1)^2}$$

$$\Rightarrow \frac{dE}{dt} = \frac{2\times10^{14}}{\pi}\ \text{V m}^{-1}\ \text{s}^{-1}$$

5. Answer (4)

Hint: When ray of light goes from rarer to denser medium, it bends towards the normal.

Sol.: Ray does not suffer any deviation on entering the lens. $\therefore \mu_1 = \mu_2$.

The ray leaving second surface is bending towards the normal.

$\therefore$ $\mu_3 > \mu_2$ (as μ_3 is denser than μ_2)

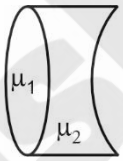
6. Answer (3)

Hint & Sol: Concave lens form virtual and erect image of a real object.

7. Answer (3)

Hint: Equivalent focal length is given by $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

Sol.:



$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = (\mu_1 - 1)\left[\frac{1}{R} - \left(-\frac{1}{R}\right)\right] + (\mu_2 - 1)\left[-\frac{1}{R} - \frac{1}{R}\right]$$

$$\frac{1}{F} = (\mu_1 - 1)\frac{2}{R} - \frac{2}{R}(\mu_2 - 1) = \frac{2}{R}(\mu_1 - \mu_2)$$

$$\therefore \quad F = \frac{R}{2(\mu_1 - \mu_2)}$$

8. Answer (2)

Hint & Sol: Since the object is placed at centre of curvature of the given concave mirror, the magnification will be one, and hence the height of the image will be equal to 2 cm.

9. Answer (3)

Hint & Sol.: In purely inductive AC circuit, the power consumption by the inductor is zero.

10. Answer (3)

Hint: $c = \frac{\omega}{k}$

Sol.: Velocity or speed of EM wave through vacuum = $\frac{\omega}{k} = \frac{2\pi f}{\frac{2\pi}{\lambda}} = f\lambda = c$

11. Answer (3)

Hint: $E_0 = cB_0$

Sol.: $B_0 = \frac{E_0}{c} \Rightarrow \frac{B_0}{E_0} = \frac{1}{c}$ where c = speed of EM wave in vacuum

$$\left[\frac{B_0}{E_0}\right] = \left[\frac{1}{c}\right] = [c]^{-1} = [LT^{-1}]^{-1} = [L^{-1}T] = [M^0L^{-1}T]$$

12. Answer (2)

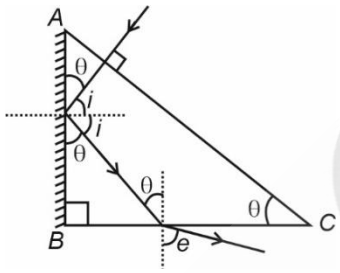
Hint: Ozone protects Earth from UV radiations.

Sol.: Ozone blocks ultraviolet radiation from reaching the surface of Earth. These have wavelength $\lambda < 400$ nm.

13. Answer (3)

Hint: Application of Snell's law

Sol.:



Applying Snell's law at surface BC,

$\mu\sin\theta = \sin e$

$$\Rightarrow \quad \sqrt{3}\sin 30^\circ = \sin e \Rightarrow \sin e = \frac{\sqrt{3}}{2} \Rightarrow e = 60^\circ$$

14. Answer (1)

Hint: Impedance of a series AC circuit:

$$z = \sqrt{R^2 + (X_L - X_C)^2}$$

Sol.: Given $R = 12\ \Omega$, $X_C = 5\ \Omega$, $X_L = 0$

$$z = \sqrt{R^2 + (X_L - X_C)^2} \Rightarrow z = \sqrt{12^2 + 5^2} = 13\ \Omega$$

15. Answer (3)

Hint: Application of electromagnetic waves

Sol.:

A. Microwaves are suitable for radar systems.

B. Radiowaves are used for broadcasting because these waves have very long wavelength.

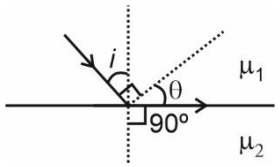
C. UV rays are used to kill germs in water purifiers.

D. Gamma rays are used to destroy cancer cells because they are high frequency radiation.

16. Answer (1)

Hint: At critical angle, the refracted ray grazes along the refracting surface.

Sol.: From the shape of wavefront, we draw the diagram of incident ray.



$\mu_1 \sin i = \mu_2 \sin 90^\circ$ (by Snell's law)

$$\Rightarrow \quad \sin i = \sin\theta = \frac{\mu_2}{\mu_1}$$

Note: θ is critical angle for this pair of media.

17. Answer (3)

Hint: Fringe width is given by $\beta = \frac{\lambda D}{d}$

Sol.: $\beta' = \frac{\lambda D}{\mu d} < \beta$ as $\mu > 1$

18. Answer (3)

Hint: Resultant amplitude A

$$= \sqrt{(a_1)^2 + (a_2)^2 + 2a_1a_2\cos\phi}$$

Sol.: Individual wave amplitudes $a_1 = 2$ and $a_2 = \sqrt{3}$

Phase difference

$$\phi = \frac{\pi}{9} - \left(\frac{-\pi}{18}\right) = \frac{\pi}{9} + \frac{\pi}{18} = \frac{2\pi + \pi}{18} = \frac{\pi}{6} = 30^\circ$$

Resultant amplitude

$$A = \sqrt{2^2 + (\sqrt{3})^2 + 2 \times 2 \times \sqrt{3} \times \frac{\sqrt{3}}{2}} = \sqrt{13}$$

19. Answer (3)

Hint: Two coherent sources cannot be obtained from two different light sources.

Sol.: If both sources are coherent, then phase difference between the two sources must be constant with time. Then interference can happen. Two independent sources can't produce a sustained interference pattern.

20. Answer (2)

Hint: $E_{rms} = \frac{E_0}{\sqrt{2}}$

Sol.: Average total energy density = $\frac{1}{2}\varepsilon_0 E_0^2 = \varepsilon_0 E_{rms}^2 = 8.85\times10^{-6}$

$\Rightarrow \quad E_{rms}^2 = \frac{8.85\times10^{-6}}{8.85\times10^{-12}} = 10^6$

$\Rightarrow \quad E_{rms} = 10^3$ N/C

21. Answer (2)

Hint: Path difference = $d\sin\theta$

Sol.: $\Delta x = d\sin\theta = \left(n+\frac{1}{2}\right)\lambda$ with $d = 4\lambda$ = maximum path difference

The minima will be at $\pm\frac{\lambda}{2}, \pm\frac{3\lambda}{2}, \pm\frac{5\lambda}{2}$ and $\pm\frac{7\lambda}{2}$

So, 8 minima will be observed.

22. Answer (1)

Hint: Wattful component of current is along supply voltage.

Sol.: $\tan\phi = \frac{X_L}{R} = \frac{3}{4} = \tan37^\circ \Rightarrow \phi = 37^\circ$

E leads current i by 37°.

Wattless component of current i, is perpendicular to supply voltage.

23. Answer (3)

Hint & Sol.: When the convex lens is dipped in water then the difference in the refractive indices of glass and water will reduce and therefore focal length of the lens in water will increase.

24. Answer (2)

Hint: Shift = thickness of slab × $\left(1-\frac{1}{\mu}\right)$

Sol.: $\Delta x = t\left(1-\frac{1}{\mu}\right)$

$2 = t\left(1-\frac{1}{3/2}\right) \Rightarrow 2 = t\times\frac{1}{3}$

t = 6 cm

25. Answer (2)

Hint: Total internal reflection

Sol.: When the diamond is cut in different angles suitably, total internal reflection occurs and they sparkle brilliantly.

26. Answer (1)

Hint: Use Malus law

Sol.: Initial intensity of unpolarised light = I_0

After passing through first polaroid, $I_1 = \frac{I_0}{2}$

After passing through second polaroid, $I_2 = I_1\cos^2 30^\circ$ (as per Malus law)

$\Rightarrow \quad I_2 = \frac{I_0}{2}\left(\frac{\sqrt{3}}{2}\right)^2 = \frac{3I_0}{8}$

% of light that pass through

$= \frac{\frac{3I_0}{8}}{I_0}\times100 = 37.5\%$

27. Answer (4)

Hint: $\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{i_S}{i_P}$

Sol.: As it is step-down transformer, $V_S < V_P$

$\therefore N_S < N_P$

$\therefore$ Turns ratio

$= 5 = \frac{N_P}{N_S} = \frac{V_P}{V_S} = \frac{V_P}{50} \Rightarrow V_P = 5\times50 = 250$ V

28. Answer (2)

Hint: Total average value of energy density = $\frac{1}{2}\varepsilon_0 E_0^2$

Sol.: Average value of magnetic energy density = $\frac{B_0^2}{4\mu_0}$

Average value of electric energy density = $\frac{\varepsilon_0 E_0^2}{4}$

Total average value of energy density = $\frac{B_0^2}{4\mu_0} + \frac{\varepsilon_0 E_0^2}{4}$

29. Answer (2)

Hint: Power factor of A.C. circuit = $\cos\phi = \frac{R}{Z}$

Sol.: Frequency, $f' = 4f$

Impedance of circuit,

$Z' = \sqrt{R^2 + (X_L)^2} = \sqrt{R^2 + (\omega L)^2}$

$\sqrt{R^2 + (2\pi f' L)^2} = \sqrt{R^2 + (8\pi f L)^2}$

Power factor = $\frac{R}{Z'} = \frac{R}{\sqrt{R^2 + (8\pi f L)^2}}$

30. Answer (3)

Hint: Width of central maxima = $\frac{2\lambda D}{b}$

Sol.: If λ = same and b increases, then width of central maxima = 2θ also decreases.

31. Answer (4)

Hint: $I_{rms} = \frac{I_{peak}}{\sqrt{2}}$ and $V_{rms} = \frac{V_{peak}}{\sqrt{2}}$

Sol.: Statement I is wrong because V_{rms} = 220 V in domestic AC circuit and peak voltage = $220\sqrt{2}$ V.

There could be a half time period in AC current which may have zero average value.

32. Answer (4)

Hint: Use concept of total energy dissipated.

Sol.: $(i_{eff})^2Rt = (i_{DC})^2Rt + (i_{AC})^2Rt$

$\Rightarrow \quad (i_{eff})^2 = (i_{DC})^2 + (i_{AC})^2 = (4)^2 + (i_{rms})^2$

$(i_{eff})^2 = 16 + \left(\frac{3}{\sqrt{2}}\right)^2 = 16 + \frac{9}{2} = \frac{41}{2}$

33. Answer (4)

Hint: Electromagnetic spectrum

Sol.: Gamma rays have the highest frequency while long radiowaves have the lowest frequency among the three given wavelengths in question. Higher the frequency, lower the wavelength.

34. Answer (1)

Hint: Use lens maker's formula

Sol.: $\frac{1}{f_1} = (\mu_{L/air} - 1)\left(-\frac{1}{R_1} - \frac{1}{R_2}\right) = P$

$\frac{1}{f_2} = (\mu_{L/oil} - 1)\left(-\frac{1}{R_1} - \frac{1}{R_2}\right)$

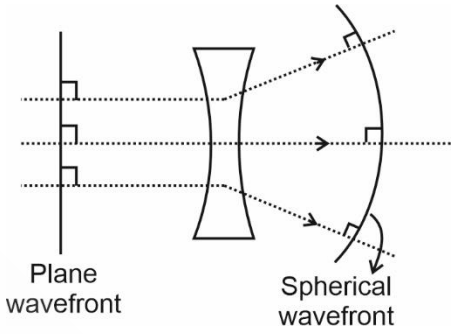
$\frac{\frac{1}{f_2}}{\frac{1}{f_1}} = \frac{\mu_{L/oil} - 1}{\mu_{L/air} - 1} = \frac{\frac{3}{2} \times \frac{1}{1.4} - 1}{\frac{3}{2} - 1} = \frac{\frac{30}{28} - 1}{0.5} = \frac{\frac{15}{14} - 1}{0.5}$

$\frac{1}{f_2} = \frac{P}{14 \times 0.5} = \frac{P}{7} \Rightarrow f_2 = \frac{7}{P}$

35. Answer (2)

Hint: Ray of light travels perpendicular to wavefront

Sol.:



SECTION-B

36. Answer (3)

Hint: Diffraction is bending of light around the boundary. The diffraction of light wave occur when size of obstacle is comparable to wavelength.

37. Answer (3)

Hint: Electromagnetic waves are transverse waves.

Sol.: Wave travelling in +y direction. So, vector equation should have term ($\omega t - ky$) as argument for cos function.

$\hat{j} \,||\, \left(\vec{E} \times \vec{B}\right) \Rightarrow \hat{j} \,||\, \left(\hat{i} \times [-\hat{k}]\right)$

So, $\vec{B}$ in $-\hat{k}$ direction.

38. Answer (4)

Hint: Pressure exerted $P = \frac{F}{A} = \frac{1}{A} \cdot \frac{\Delta p}{\Delta t}$

Sol.: Initial momentum, $p = \frac{E}{c}$

Change in momentum, $\Delta p = 0 - \left(-\frac{E}{c}\right) = \frac{E}{c}$

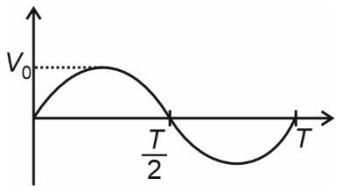
Force exerted, $F = \frac{\Delta p}{\Delta t} = \frac{E}{ct}$

Average pressure exerted = $\frac{F}{A} = \frac{E}{ctA}$

39. Answer (2)

Hint: $V_{mean} = \frac{\int_{t_1}^{t_2} V dt}{\int_{t_1}^{t_2} dt}$

Sol.:



$$V_{avg} = \frac{\int_0^{T/2} V dt}{\int_0^{T/2} dt} = \frac{5\int_0^{T/2} \sin(\omega t)dt}{\frac{T}{2}} = \frac{\frac{5}{\omega}\left[\cos(\omega t)\right]_0^{T/2}}{\frac{T}{2}}$$

$$= \frac{10}{\omega T}\left[\cos\left(\omega\frac{T}{2}\right) - \cos(0)\right]$$

$$= \frac{10}{\frac{\omega 2\pi}{\omega}}\left[\cos\left(\omega\cdot\frac{\pi}{\omega}\right) - \cos(0)\right] = \frac{10}{\pi}$$

40. Answer (4)

Hint & Sol.: Below resonance, $\omega < \frac{1}{\sqrt{LC}}$

$\Rightarrow \omega^2 < \frac{1}{LC} \Rightarrow \omega L < \frac{1}{\omega C}$

$\Rightarrow X_L < X_C$

$\therefore$ Current leads voltage in phasor diagram.

41. Answer (4)

Hint: Objective and eye-piece lenses have different focal lengths in different optical instruments.

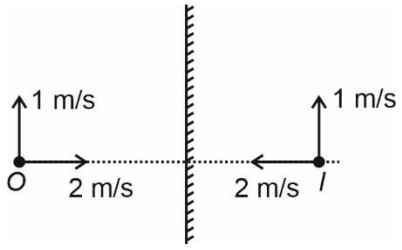
Sol.: Changing aperture of objective lens doesn't affect magnifying power of compound microscope.

To get maximum magnification in compound microscope, $f_o < f_e$.

To ensure large magnification in telescope, $f_o > f_e$.

42. Answer (3)

Hint: Velocity component of image parallel to plane mirror remains same as object.



Sol.:

Velocity of image = $-2\hat{i} + \hat{j}$

43. Answer (2)

Hint: Phase difference = $\frac{2\pi}{\lambda}$ × Path difference

Sol.: Fringe width $\beta = \frac{\lambda D}{d} = \frac{250\times10^{-9}\times1}{0.5\times10^{-3}}$

$= 500\times10^{-6}$ m

$y = \frac{\phi}{2\pi}\times\beta$

Phase difference $\phi = \frac{y}{\beta}\times2\pi = \frac{125\times10^{-6}}{500\times10^{-6}}\times2\pi$

$\Rightarrow \phi = \frac{\pi}{2} = 90^\circ$

44. Answer (4)

Hint: X_C depends on ω

Sol.: When connected to DC source, $\omega = 0$.

$\therefore$ Capacitive reactance = $X_C = \frac{1}{\omega C} = \infty$

45. Answer (3)

Hint: Tube length = $f_o + f_e$

Sol.: In normal adjustment, the final image forms at infinity. The tube length is $f_o + f_e = L$ = (33 + 6) cm = 39 cm

46. Answer (1)

Hint: $V_{rms} = i_{rms} Z$

Sol.: $i_{rms} = \frac{10}{\sqrt{2}}$

$\therefore V = i_{rms}(X_L - X_C) = \frac{10}{\sqrt{2}}\times20 = \frac{200}{\sqrt{2}}$ V

$\frac{V}{\sqrt{2}} = \frac{100\sqrt{2}}{\sqrt{2}} = 100$ V

47. Answer (1)

Hint: Curve of δ vs i is not a perfect parabola.

Sol.: The graph of δ vs i is more steep in the left part.

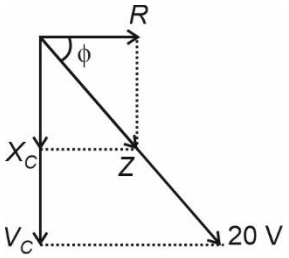
$\therefore 60^\circ - x > x - 30^\circ \Rightarrow 60^\circ + 30^\circ > x + x \Rightarrow 90^\circ > 2x$

$\Rightarrow x < 45^\circ$ is satisfied by option (1).

48. Answer (3)

Hint: Voltage across capacitor lags behind supply voltage.

Sol.:



$$\tan\phi = \frac{X_C}{R} = \frac{3}{4} = \tan 37^\circ \Rightarrow \phi = 37^\circ$$

$\therefore$ $90^\circ - \phi = 53^\circ$

V_C lags E_{max} by 53°

$$V_C = 20\sin\phi = 20 \times \frac{3}{5} = 12 \text{ V}$$

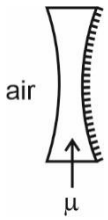
Voltage across capacitor = $V_C \sin(\omega t - 53^\circ)$

$= 12\sin(\omega t - 53^\circ)$ V

49. Answer (3)

Hint: $\frac{1}{F} = \frac{-2}{f_{lens}} + \frac{1}{f_{mirror}}$

Sol.:



$$\frac{1}{f_l} = (\mu - 1)\left(\frac{-1}{R} - \frac{1}{R}\right) = \frac{-2(\mu-1)}{R} \text{ and } \frac{1}{f_m} = \frac{2}{R}$$

$$\frac{1}{F} = \frac{-2}{f_l} + \frac{1}{f_m} = \frac{4(\mu-1)}{R} + \frac{2}{R}$$

$$\Rightarrow \frac{1}{F} = \frac{4\mu - 2}{R} \Rightarrow F = \frac{R}{2(2\mu-1)}$$

50. Answer (2)

Hint: $i_d \propto A$

Sol.: Displacement current

$$i_d = \varepsilon_0 A\frac{dE}{dt} \Rightarrow i_d \propto A$$

$$\therefore \quad \frac{i}{i'} = \frac{\pi(2R)^2}{\pi(2R)^2 - \pi\left(\frac{3R}{2}\right)^2} = \frac{4\pi R^2}{\frac{7\pi R^2}{4}} = \frac{16}{7}$$

$$\Rightarrow \quad i' = \frac{7}{16}i$$

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: Ligand with synergic bonding and chelation effect tend to have more field strength.

Sol.: Order of field strength of given ligands is

$CO > CN^- > NH_3 > C_2O_4^{2-}$

52. Answer (2)

Hint:

Hybridisation	Geometry
sp^3	Tetrahedral
dsp^2	Square planar
d^2sp^3	Octahedral
sp^3d^2	Octahedral

Sol.:

Compound	Hybridisation	Geometry
$[Fe(H_2O)_6]SO_4$	sp^3d^2	Octahedral
$[Ni(CO)_4]$	sp^3	Tetrahedral
$K_2[PtCl_4]$	dsp^2	Square planar
$[Sc(NH_3)_6]Cl_3$	d^2sp^3	Octahedral

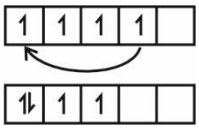
53. Answer (3)

Hint: Magnetic moment $\mu = \sqrt{n(n+2)}$ BM

Where n = number of unpaired electrons

Sol.: For inner orbital complex, two inner d orbitals will be made empty to form coordinate bonds.

$d^4 \Rightarrow$



After pairing there will be two unpaired electrons hence complex will be paramagnetic with magnetic moment of $\sqrt{8}$ B.M.

54. Answer (3)

Hint: Metal carbon bond strength increases due to synergic bonding in metal carbonyls.

Sol.: Synergic bonding increases with increase in electron density on central metal.

Hence $[Co(CO)_4]^-$ will have strongest metal carbon bond.

55. Answer (3)

Hint: Isomers have same molecular formula but different structure or spatial orientation.

Sol.: Aqueous solution of $[Co(NH_3)_5Cl]Br$ and $[Co(NH_3)_5Br]Cl$ will give test of different ions hence they are ionisation isomers.

56. Answer (2)

Hint: H_2O acts as strong field ligand with Co^{3+}.

Sol.: $[Co(H_2O)_6]^{3+}$ will be inner orbital complex with d^2sp^3 hybridisation and octahedral structure.

57. Answer (3)

Hint: Heteroleptic complex has more than one different type of ligand.

Sol.: $[PtCl_2(NH_3)_2]$ is a heterolyptic complex.

58. Answer (2)

Hint: As field strength of ligand increases CFSE increases.

Sol.: CFSE increases with chelation, synergic bonding and oxidation state of central metal ion.

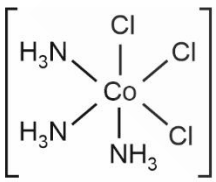
Hence order of CFSE

$[Fe(CN)_6]^{3-} > [Fe(CN)_6]^{4-} > [Fe(C_2O_4)_3]^{3-} > [Fe(H_2O)_6]^{3+}$

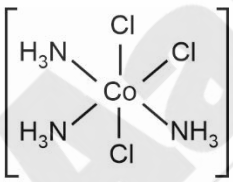
59. Answer (1)

Hint: fac-mer isomerism is exhibited by $[MA_3B_3]$ type of complex.

Sol.:



fac



mer

60. Answer (3)

Hint: Polydentated ligands form chelate ring.

Sol.: Hydrazine $H_2N - NH_2$ is a monodentate ligand.

61. Answer (1)

Hint: Oxidising agents are electron acceptor.

Sol.: Metal carbonyl with EAN less than atomic number of nearest inert gas can act as oxidising agent for $[V(CO)_6]$

EAN = 35 hence it will be an oxidising agent.

62. Answer (4)

Hint: Terminal alkynes are acidic in nature

Sol.: $CH_3C \equiv CH + NaNH_2 \longrightarrow CH_3C \equiv CNa + H_2$ (A)

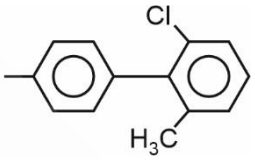
$\xrightarrow{CH_3CH_2Br}$

$CH_3C \equiv CCH_2CH_3$ (B)

63. Answer (2)

Hint: Ortho substituted biphenyl can be optically active

Sol.:



is optically inactive as one of the phenyl is not substituted at ortho position, so it has plane of symmetry.

64. Answer (1)

Hint: Halogenation of alkane is free radical substitution reaction and products depend upon type of hydrogen present.

Sol.:

Two products.

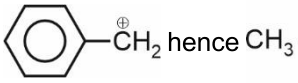
65. Answer (1)

Hint & Sol.: $C_2H_5Br + KCN \rightarrow C_2H_5CN$

66. Answer (4)

Hint: Reactivity towards S_N1 depends upon stability of carbocation.

Sol.: Since $CH_3 - \overset{\oplus}{C}(CH_3)_2 - CH_3$ is more stable than

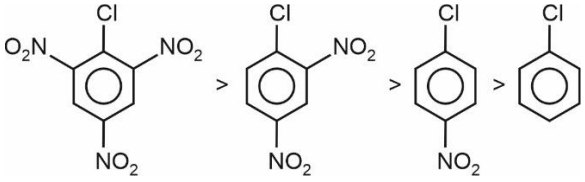


hence $CH_3 - C(CH_3)_2 - Cl$ is more reactive towards S_N1.

67. Answer (4)

Hint: Presence of electron withdrawing groups at ortho or para positions of haloarenes makes it more reactive towards nucleophilic substitution.

Sol.: Order of reactivity



68. Answer (2)

Hint & Sol.: Weak bases are good leaving groups. Order of leaving group tendency is

$F^{\ominus} > \overset{\ominus}{O}H > \overset{\ominus}{N}H_2 > \overset{\ominus}{C}H_3$

69. Answer (4)

Hint: S_N2 reaction is preferred in polar aprotic solvent

Sol.: Vinyl chloride is less reactive than allyl chloride due to partial double bond nature of C – Cl bond.

For chiral alkyl halide there is inversion in configuration during S_N2 mechanism.

70. Answer (1)

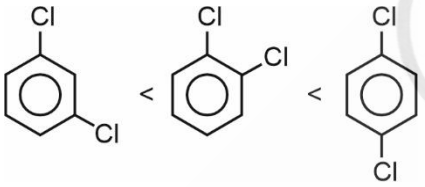
Hint: Meso compound has plane of symmetry.

Sol.: Meso compounds are optically inactive with chiral carbon.

71. Answer (2)

Hint: p-dichlorobenzene tend to have high MP due to symmetry.

Sol.:



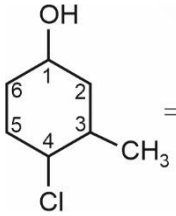
72. Answer (3)

Hint & Sol.: Chloroform is placed in dark coloured bottle and filled till top to avoid its oxilation to toxic phosgene gas.

73. Answer (3)

Hint: IUPAC naming is done on the basis to lowest locant rule.

Sol.:

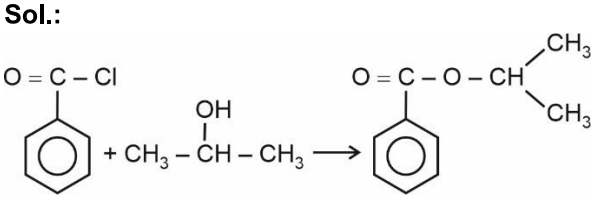


⇒ 4-chloro-3-methylcyclo hexane-1-ol

74. Answer (2)

Hint: Reaction of acid halide and alcohol gives ester.

Sol.:



75. Answer (3)

Hint: Reaction of Grignard reagent with compounds having acidic hydrogen gives alkane.

Sol.: $CH_3MgBr + C_2H_5OH \rightarrow CH_4$

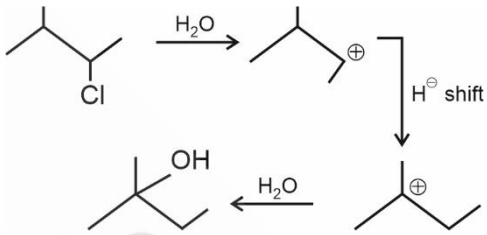
76. Answer (3)

Hint & Sol.: Esterification is a nucleophilic substitution reaction in which alcohol behaves as nucleophile.

77. Answer (2)

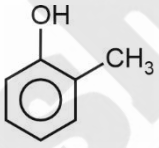
Hint: Reaction of secondary alkyl halide with water follows S_N1 mechanism.

Sol.:



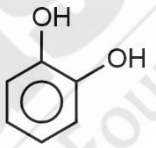
78. Answer (1)

Hint:

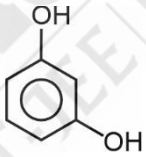


is ortho cresol

Sol.:



– Catechol



– Resorcinol

– Quinol

79. Answer (2)

Hint: As the acidic strength increases pK_a decreases.

Sol.: C_6H_5OH is strongest acid hence it will have maximum K_a and minimum pK_a.

80. Answer (1)

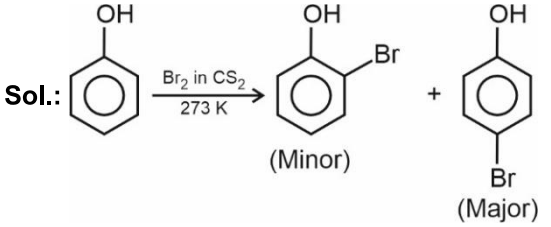
Hint: Lucas reagent test is used to distinguish 1º, 2º and 3º alcohols.

Sol.: Being most reactive 3º alcohol gives instant turbidity with $ZnCl_2$ + conc. HCl and least reactive 1º alcohol gives turbidity on heating.

81. Answer (4)

Hint: Reaction of phenol with Br_2/CS_2 is an electrophilic substitution reaction in which ortho/para substitution takes place.

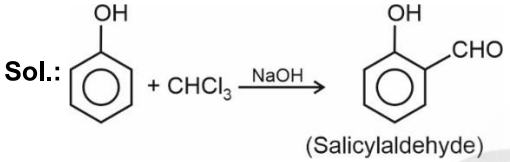
Sol.:



82. Answer (2)

Hint: Reimer-Tiemann reaction is an electrophilic substitution reaction in which ortho/para substitution takes place.

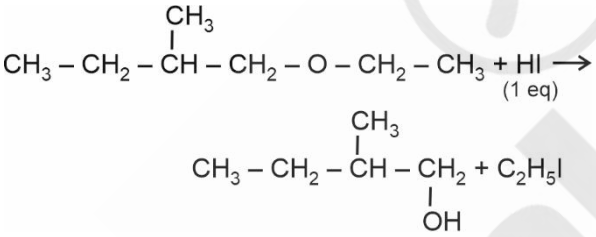
Sol.:



83. Answer (3)

Hint: Reaction of ether with HI is nucleophilic substitution in which O – R bond breaks.

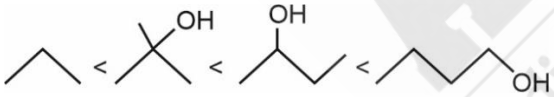
Sol.:



84. Answer (2)

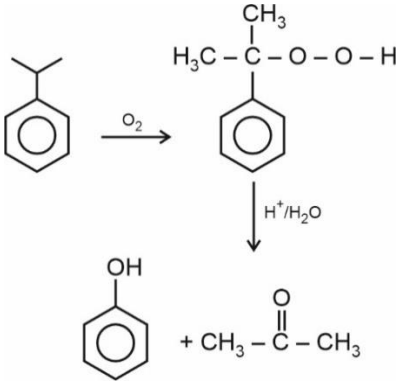
Hint: Boiling point of isomeric alcohol increases as branching decreases.

Sol.: Correct order of B.P.



85. Answer (3)

Hint & Sol.:



SECTION-B

86. Answer (4)

Hint: Jahn-Teller effect can be observed in unsymmetrically filled e_g orbitals

Sol.: Since for high spin d^4 configuration after octahedral splitting it will be $t_{2g}^3 e_g^1$ hence it will show Jahn-Teller effect.

87. Answer (3)

Hint: Complexes with no plane of symmetry can show optical isomerism.

Sol.: $[Co(H_2O)_5NO_2]Cl_2$ and $[Co(H_2O)_4(NO_2)Cl]Cl{\cdot}H_2O$ are hydrate isomers.

$[Co(H_2O)_5NO_2]Cl_2$ and $[Co(H_2O)_4ONO]Cl_2$ are linkage isomers.

88. Answer (4)

Hint: Tetraammineaquachloridocobalt(III) chloride is $[Co(NH_3)_4(H_2O)Cl]Cl_2$. In aqueous medium one mole of the complex will give 2 moles of chloride ions.

Sol.: Milli mole of chloride ions in one solution

$= 50 \times 0.1 \times 2 = 10$

Milli mole of AgCl precipitated = 10

Mole of AgCl precipitated = 10×10^{-3}

$= 0.01$

89. Answer (3)

Hint: Energy of light absorbed increases as splitting increases.

Sol.: As absorbed energy will increase, absorbed wavelength will decrease.

Hence decreasing order of absorbed wavelength is

$[CrCl_6]^{3-} > [Cr(H_2O)_6]^{3+} > [Cr(NH_3)_6]^{3+}$

90. Answer (1)

Hint: $[Ma_5b]$ cannot show geometrical isomerism.

Sol.: $[Ma_4b_2] \Rightarrow [M(aa)\ (aa)\ (bb)]$

$[M(aa)\ (ab)\ (ab)]$

$[Ma_3b_2c] \Rightarrow [M(aa)\ (ab)\ (bc)]$

$[M(aa)\ (ac)\ (bb)]$

$[M(ab)\ (ab)\ (ac)]$

$[Ma_2b_2c_2] \Rightarrow [M(aa)\ (bb)\ (cc)]$

$[M(ab)\ (ab)\ (cc)]$

$[M(ac)\ (bb)\ (ac)]$

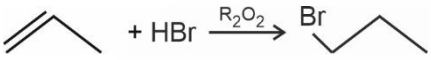
$[M(aa)\ (bc)\ (bc)]$

$[M(ab)\ (bc)\ (ac)]$

91. Answer (4)

Hint: Reaction of HX with unsymmetrical alkene in presence of peroxide may give anti Markovnikov product.

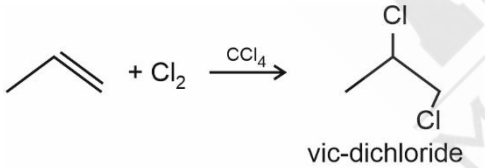
Sol.: Addition of HBr only among all HX with unsymmetrical alkene in presence of peroxide gives anti Markovnikov product.



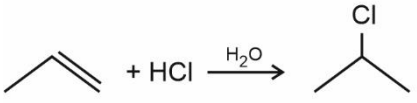
92. Answer (1)

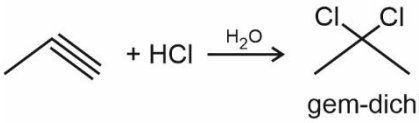
Hint: Addition of Cl_2 in alkene in CCl_4 gives anti addition.

Sol.:

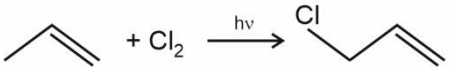


vic-dichloride





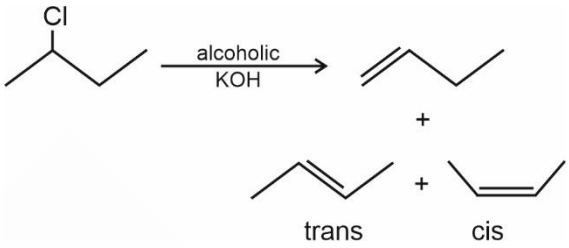
gem-dichloride



93. Answer (3)

Hint: Alkyl halide heated with alcoholic KOH undergoes β-elimination and gives alkene as the product.

Sol.:



Total 3-alkene will be obtained.

94. Answer (2)

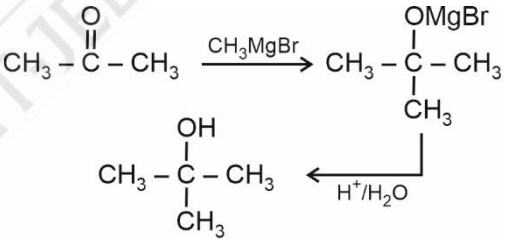
Hint: Phenol when treated with $FeCl_3$ forms a violet-coloured soluble complex.

Sol.: $6C_6H_5OH + FeCl_3 \rightarrow \underset{\text{Violet complex}}{[Fe(OC_6H_5)_6]^{3-}}$

95. Answer (3)

Hint: Carbonyl compounds with Grignard reagent followed by hydrolysis gives alcohol as the product.

Sol.:



96. Answer (2)

Hint:

Sol.: Selectivity ratio for monochlorination with respect to 1°, 2°, 3° carbon is 1 : 3.8 : 5 respectively.

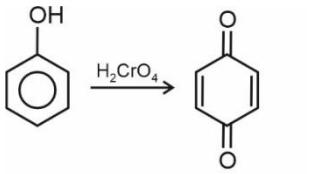
$$\% \text{ primary halide} = \frac{9 \times 1}{9 + 5} \times 100 = 64.28\%$$

$$\% \text{ tertiary halide} = \frac{5}{14} \times 100 = 35.72\%$$

97. Answer (4)

Hint: Phenol can be oxidised by oxidising agent like chromic acid.

Sol.:



Benzoquinone

98. Answer (4)

Hint: Aldehydes can be reduced to primary alcohol with certain reducing agents.

Sol.:

(a) $CH_3CHO \xrightarrow{H_2/Pd} \underset{1^o-\text{alcohol}}{CH_3CH_2OH}$

(b) $CH_3COOH \xrightarrow{NaBH_4/H_2O}$ no reaction

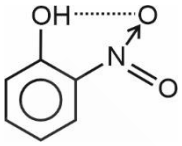
(c) $CH_3COCH_3 \xrightarrow[H_2O]{NaBH_4} \underset{2^o-\text{alcohol}}{CH_3-\overset{\overset{OH}{|}}{CH}-CH_3}$

(d) $C_6H_5CH_2OC_2H_5 \xrightarrow{HI} C_6H_5CH_2I + C_2H_5OH$

99. Answer (1)

Hint: Due to intermolecular H-bonding boiling point increases.

Sol.: o-nitrophenol has less boiling point than p-nitrophenol as it shows intra molecular H-bonding.



100. Answer (3)

Hint & Sol.: Methanol, CH_3OH, also known as 'wood spirit', was produced by destructive distillation of wood. Today, most of the methanol is produced by catalytic hydrogenation of carbon monoxide at high pressure and temperature and in the presence of $ZnO - Cr_2O_3$ catalyst.

$$CO + 2H_2 \xrightarrow[200-300\ atm,\ 573-673\ K]{ZnO-Cr_2O_3} CH_3OH$$

[BOTANY]

SECTION-A

101. Answer (3)

Hint: This phenomenon is also known as biological antagonism.

Sol.: Amensalism is an interaction, where growth of one organism is inhibited by another organism. One of the example of amensalism is, *Penicillium* secreting penicillin which inhibits the growth of large number of bacteria.

102. Answer (1)

Hint: The first antibiotic was discovered by Alexander Fleming.

Sol.: *Penicillium notatum* was the source of first antibiotic discovered.

103. Answer (1)

Hint: Species of yeast is used in the production of alcoholic beverages.

Sol.: *S. cerevisiae*, is commonly known as Brewer's yeast. It is used in the production of wine and beer.

104. Answer (1)

Hint: Adaptation is any attribute of an organism that enables the organism to survive and reproduce in its habitat.

Sol.:

- Mammals from colder climates generally have shorter ears and limbs to minimise heat loss.
- Desert lizards deal with the high temperature due to behavioural adaptations.

105. Answer (4)

Hint: Large holes in Swiss Cheese are due to production of CO_2.

Sol.: Ripening of Swiss Cheese is done by the bacterium, *Propionibacterium shermanii*. Large holes in the Swiss Cheese are formed due to production of CO_2.

106. Answer (1)

Hint: Epiphytes growing on other trees is an example of (+, 0) kind of population interaction.

Sol.: Epiphytes (orchids) growing on other plants like mango is an example of commensalism.

107. Answer (3)

Hint: Cyclosporin A, is produced by a fungus.

Sol.: Immunosuppressive agent, like Cyclosporin A, is produced by fungus *Trichoderma polysporum.*

108. Answer (3)

Hint: The effluent from the primary settling tank is taken for secondary treatment.

Sol.: Aeration tank shows growth of flocs which reduces BOD. In anaerobic sludge digester bacteria produces a mixture of gases, e.g., methane, H_2S and CO_2.

109. Answer (1)

Hint: This kind of population interaction is beneficial (+) to one species and detrimental (–) to another.

Sol.: 'Predation' is the type of interaction, on which most of biological control methods are based.

110. Answer (4)

Hint: The influence of environmental resistance over biotic potential is denoted by $\left(\frac{K-N}{K}\right)$.

Sol.: Logistic growth is described by the equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$, where

N = Population density at time t

K = Carrying capacity

r = Intrinsic rate of natural increase

111. Answer (2)

Hint: Competitive exclusion theory states that closely related species competing for the same resource cannot co-exist indefinitely and the competitive inferior one will be eliminated.

Sol.: Competitive release is the phenomena, where there is increase in population of a less distributed species in a geographical area, when its superior competitor is removed experimentally from that area.

112. Answer (4)

Hint: In mutualism and protocooperation both the species are benefitted.

Sol.: Competition $\rightarrow$ (–, –)

Parasitism $\rightarrow$ (+, –)

Predation $\rightarrow$ (+, –)

113. Answer (1)

Hint: Parasites, generally have a high rate of reproduction.

Sol.:

(i) Parasites have less developed sense organs.

(ii) Parasites render the host more vulnerable to predation by making it physically weak.

(iii) Parasites have adhesive organs and suckers to cling on the host.

(iv) Loss of digestive system is found in parasites.

114. Answer (3)

Hint : Lactic acid bacteria (LAB), convert milk into curd.

Sol. : During the process of curd formation, vitamin B_{12} is formed and thus, its concentration is increased. Curd is a good source of vitamin B_{12}.

115. Answer (2)

Hint: Patient suffering from myocardial infarction are administered "clot buster" for removal of clots.

Sol.: Streptokinase produced by the bacterium *Streptococcus* is used as a "clot buster" for treating patients undergoing myocardial infarction.

116. Answer (1)

Hint: Statins have been commercialised as blood cholesterol lowering agent.

Sol.: Statins resemble mevalonate and competitively inhibit enzyme HMG CoA reductase and bring about reduction in cholesterol biosynthesis.

117. Answer (1)

Hint: Scientific name of the tree, from which toddy is prepared is *Caryota urens*.

Sol.: Toddy is a traditional drink in some parts of southern India. It is prepared by fermentation of the sap from palm (*Caryota urens*) trees.

118. Answer (3)

Hint: This kind of interaction is between two species, where both are benefited but can live without association as well.

Sol.: Sea anemone attached to the body of hermit crab is an example of protocooperation.

119. Answer (2)

Hint: Competition can occur between totally unrelated species and even when the resources are unlimited.

Sol.: Intraspecific competition is more acute as compared to interspecific competition.

120. Answer (2)

Hint: Mosquitoes are controlled by Dragonflies.

Sol.: Ladybird beetles are used to control aphids.

121. Answer (3)

Hint: *Azospirillum* and *Azotobacter* are some of the most common, free-living and aerobic nitrogen fixing bacteria.

Sol.:

(i) *Aulosira* is the most active, non-symbiotic N_2 fixer in rice fields.

(ii) *Azospirillum* is free living and aerobic N_2 fixing bacterium.

122. Answer (2)

Hint: Mediterranean orchid, *Ophrys* employs a form of sexual deceit.

Sol.: Pseudocopulation is the sexual deceit employed by orchid *Ophrys* to get pollinated by the bee.

123. Answer (2)

Hint: *Clostridium butylicum* is used in the production of butyric acid.

Sol.:

(i) *Aspergillus niger* is used for the production of citric acid and gluconic acid.

(ii) Amylases are produced by *Aspergillus*, *Rhizopus* and *Bacillus* species.

(iii) Acetic acid is produced by *Acetobacter aceti.*

124. Answer (1)

Hint: It is a fungus that helps in controlling plant diseases.

Sol.: *Trichoderma* is free living fungi found in root ecosystem.

125. Answer (4)

Hint: Floating debris is removed by sequential filtration in primary treatment.

Sol.: BOD test measures the rate of uptake of oxygen by micro-organisms in sample of water.

126. Answer (3)

Hint: Star fish (*Pisaster*) has predatory relationship with invertebrate species.

Sol.: Removal of *Pisaster* resulted in extinction of more than 10 species of invertebrate within a year due to interspecific competition.

127. Answer (4)

Hint: Parasites spends a part or whole of its life, on or in the body of other organism and gets nourishment and shelter from the host.

Sol.: Female mosquito is not considered a parasite because it needs blood for its reproduction. It never spends a short duration as other parasites do.

128. Answer (2)

Hint : In a logistic growth curve, four phases, namely, lag phase, phase of acceleration, phase of deceleration followed by asymptote, can be seen.

Sol.: Asymptote in a logistic growth curve is obtained when population density reaches the carrying capacity.

129. Answer (3)

Hint: Interaction between fig and wasp is mutualism.

Sol.:

(i) Prickly pear cactus introduced into Australia and it was controlled by the predator cactus feeding moth.

(ii) Gause's experiment of competitive exclusion was on two ciliate protozoan *Paramecium caudatum* and *P. aurelia.*

(iii) Crocodile bird (plover) enters the mouth of crocodile to feed parasitic leeches. Plover gets food and crocodile gets rid of leeches.

130. Answer (1)

Hint: *Calotropis* species has natural metabolites that can affect the heart muscles.

Sol.: *Calotropis* protects itself from cattle by producing poisonous cardiac glycosides.

131. Answer (4)

Hint: Predators regulate prey population.

Sol.: Predation is the interaction responsible for conduits for energy transfer across the trophic levels.

132. Answer (4)

Hint: A cyanobacterium is involved in this symbiotic N_2 fixation process.

Sol.: *Anabaena*, helps in N_2 fixation in association with *Azolla*.

133. Answer (4)

Hint: This gas is produced by an archaebacteria, which is commonly found in marshy region.

Sol.: Major component of biogas is methane (50 –70%)

134. Answer (3)

Hint: Bacteria are one of the main source of biofertilizers.

Sol.: Main sources of biofertilizer are bacteria, fungi and cyanobacteria.

135. Answer (3)

Hint: ICAR has not played any role in biogas plant development.

Sol.: Technology for biogas production was jointly developed by Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC).

SECTION - B

136. Answer (3)

Hint : Heat loss or heat gain is a function of surface area.

Sol.: Small animals have a larger surface area relative to their volume.

137. Answer (1)

Hint: Competitive interference is the phenomena where feeding efficiency of one species might be reduced due to the presence of other species.

Sol.: Natural selection operates at the population level. In nature populations of different species in a habitat do not live in isolation but interact in many ways.

138. Answer (2)

Hint: Logistic growth curve was described by Verhulst and Pearl.

Sol.: Principle of "competitive exclusion was given by Gause.

139. Answer (1)

Hint: This interaction involves two unrelated species, striving for common food, the zooplankton.

Sol.: Competition is observed between visiting flamingoes and resident fishes for zooplankton.

140. Answer (2)

Hint: Carnivores are less adversely affected due to competition.

Sol.: In general, herbivores and plants appear to be more adversely affected by competition than carnivores.

141. Answer (2)

Hint: Milk is converted into curd by the help of *Lactobacillus*.

Sol.: During curd formation, lactic acid bacteria produce acid which leads to coagulation and partially digestion of milk proteins.

142. Answer (1)

Hint: Ripening of roquefort cheese is done by a eukaryotic organism.

Sol.: Roquefort cheese is ripened by fungus *Penicillium roqueforti.*

143. Answer (4)

Hint: Alexander Fleming discovered penicillin.

Sol.: The full potential as an effective antibiotic was established by Chain and Florey. Fleming, Chain and Florey were awarded Nobel prize in 1945 for this discovery.

144. Answer (3)

Hint: Primary treatment mainly involves removal of particles by filtration. No microbes are added in this process from outside.

Sol.: Most of treatment of waste water is done during secondary treatment by heterotrophic microbes which are already present in the sewage.

145. Answer (2)

Hint: Such kind of pyramid is observed in case of stable population.

Sol.: Bell-shaped pyramid is observed in a stable population, when growth rate being almost zero.

146. Answer (2)

Hint: Primary treatment of water is a physical process.

Sol.: During the primary treatment of sewage, all solids that settle form primary sludge and supernatant forms primary effluent.

147. Answer (3)

Hint: In a new colony, natality may not contribute significantly to population growth.

Sol.: Immigration is the population of same species coming into a habitat from elsewhere. Here, immigration will contribute more significantly to population growth in a newly colonized habitat.

148. Answer (4)

Hint: Commensalism is an interaction, where one species is benefitted and the other remains unaffected.

Sol.: Competitive exclusion is a phenomenon, where two species competing for same resource, cannot co-exist indefinitely and the competitive inferior one will be eliminated.

149. Answer (3)

Hint: Total number is not an easily adaptable measure if the population is huge and counting is time consuming or impossible.

Sol.: Relative density is a good measure to find total density of fish in a lake by counting the number of fishes caught per trap.

150. Answer (3)

Hint: A represents conformers

B represents regulators

C represents partial regulators

Sol.: Conformers cannot maintain a constant internal environment. Their body temperature changes with surrounding. They are called cold blooded organisms.

[ZOOLOGY]

SECTION-A

151. Answer (4)

Hint: Amongst all non-infectious diseases, it is one of the major causes of death.

Sol.: Among non-infectious diseases, cancer is the major cause of death.

Diseases which can be easily transmitted from one person to another, are called infectious diseases. Amoebiasis, ringworms and pneumonia are infectious diseases which are caused by protozoa, fungi and bacteria respectively.

152. Answer (3)

Hint: Acts as a physical barrier of innate immunity

Sol.: In humans, the innate immunity consists of four types of barriers. These are:

(i) Physical barriers

(ii) Physiological barriers

(iii) Cellular barriers

(iv) Cytokine barriers

Acid in the stomach, saliva in the mouth and tears from eyes, all prevent microbial growth. They fall under the category of physiological barriers of innate immunity.

Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts help in trapping microbes entering our body. It acts as a physical barrier.

153. Answer (3)

Hint: Exclude stimultants that produce euphoria.

Sol.: Drugs like barbiturates, benzodiazepines, and other similar drugs, are normally used as medicines to help patients cope with mental illnesses like depression and insomnia.

Stimulants like cocaine also known as crack stimulate the nervous system; make a person more wakeful, increase alertness and activity, produce excitement, *etc*.

154. Answer (3)

Hint: Related with eosinophilia

Sol.: The exaggerated response of the immune system to certain antigens present in the environment is called allergy. The antibodies produced in response to allergens are of IgE type.

155. Answer (3)

Hint: It is equal to 10 times the number of palm bones in each fore limb of man.

Sol.: There is lymphoid tissue located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called Mucosa Associated Lymphoid Tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.

156. Answer (3)

Hint: Health affects longevity

Sol.: Health increases longevity of people and reduces infant and maternal mortality.

The innate defences of our body like skin, mucous membranes, anti-microbial substances present in our tears, saliva and the phagocytic cells help to block the entry of pathogens into our body.

Health does not simply mean 'absence of diseases' or 'physical fitness'. It could be defined as a state of complete physical, mental and social well-being.

157. Answer (4)

Hint: The causative agents of filariasis and ascariasis belong to the same phylum.

Sol.: Ringworms – *Microsporum*

Filariasis – *Wuchereria bancrofti*

Common cold – Rhino virus

Ascariasis – *Ascaris*

158. Answer (3)

Hint: Allergens induce exaggerated response of the immune system.

Sol.: For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied. Somehow, modern-day life style has resulted in lowering of immunity and more sensitivity to allergens – more and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment. This could be because of the protected environment provided early in life.

159. Answer (4)

Hint: Pneumonia infects the vascularised bag-like structures present in lungs.

Sol.: Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs. As a result of the infection, the alveoli get filled with fluid leading to severe problems in respiration. The symptoms of pneumonia include fever, chills, cough and headache. In severe cases, the lips and finger nails may turn grey to bluish in colour. A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person.

160. Answer (3)

Hint: *Gambusia* can be used to control these diseases.

Sol.: For diseases such as malaria and filariasis that are transmitted through insect vectors, the most important measure is to control or eliminate the vectors and their breeding places. Precautions have become more important especially in the light of widespread incidences of the vector-borne (*Aedes* mosquitoes) diseases like dengue and chikungunya in many parts of India.

Ascariasis and common cold are not vector-borne diseases.

161. Answer (3)

Hint: The causative agent of plague belongs to the group similar to that of the pathogen of pneumonia.

Sol.: Plague is a bacterial disease.

Malaria is caused by a tiny protozoan called *Plasmodium*.

162. Answer (4)

Hint: Rectum is one of the parts of the structure in which the causative pathogen resides.

Sol.: *Entamoeba histolytica* is a protozoan parasite in the large intestine of human which causes amoebiasis (amoebic dysentery). Symptoms of this disease include constipation, abdominal pain and cramps, stools with excess mucous and blood clots. Houseflies act as mechanical carriers and serve to transmit the pathogen from faeces of infected person to food and food products, thereby contaminating them. Drinking water and food contaminated by the faecal matter are the main source of infection.

163. Answer (3)

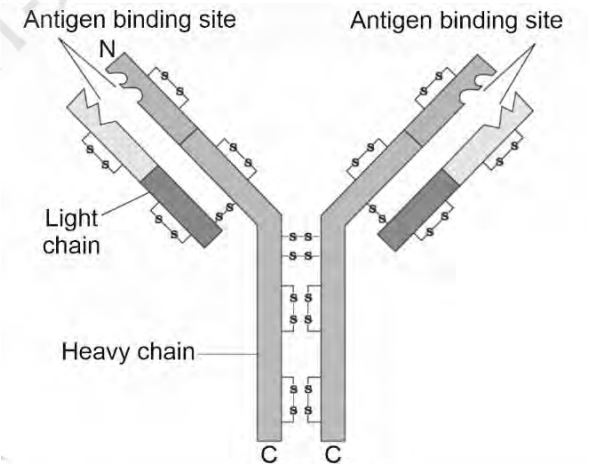
Hint: Subsequent encounter with the same pathogen elicits a highly intensified response.

Sol.: Acquired immunity is pathogen specific. It is characterised by memory. This means when our body encounters a pathogen for the first time, it produces a response called the primary response which is of low intensity. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This is ascribed to the fact that our body appears to have memory of the first encounter.

164. Answer (3)

Hint: The antigen-binding site is found between one heavy chain and one light chain.

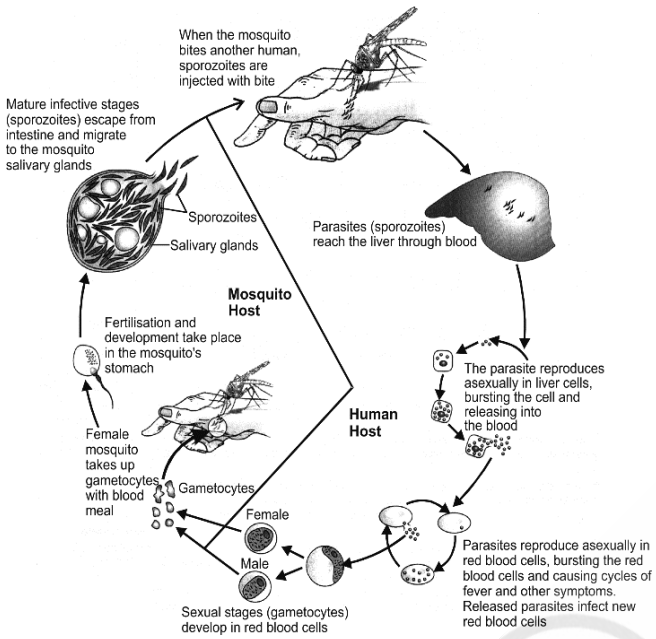
Sol.:



165. Answer (2)

Hint: Sporozoites undergo multiple fission in the liver cells.

Sol.:



For humans, the infective stage of *Plasmodium* is a minute sickle-shaped sporozoite.

166. Answer (4)

Hint: Most serious and fatal form of malaria

Sol.: Different species of *Plasmodium* (*P. vivax, P. malariae* and *P. falciparum*) are responsible for different types of malaria. Of these, malignant malaria caused by *Plasmodium falciparum* is the most serious one and can even be fatal.

167. Answer (3)

Hint: Active immunity is slow

Sol.: If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin). Even in cases of snake bites, the injection which is given to the patients, contain preformed antibodies against the snake venom. This type of immunisation is called passive immunisation.

168. Answer (3)

Hint: Each monomeric form of antibody molecule has four peptide chains.

Sol.: Each monomeric antibody molecule has four peptide chains, two smaller ones are called light chains and two longer ones are called heavy chains.

Hence, a monomeric form of an antibody is represented as H_2L_2.

Hepatitis-B vaccine is produced from yeast by RDT.

Natural killer cells fall under the category of cellular barriers of innate immunity.

169. Answer (3)

Hint: One of the primary lymphoid organs reduce in size with ageing.

Sol.: The thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained, it reduces to a very small size.

170. Answer (1)

Hint: Includes a process in which a copy of DNA is produced from RNA.

Sol.: After getting into the body of the person, HIV enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.

171. Answer (1)

Hint: The pathogen has a cell wall.

Sol.: Diphtheria and plague are bacterial diseases. Dengue and chikungungya are viral diseases. Ringworm is a fungal disease.

172. Answer (2)

Hint: *Papaver somniferum* produces opiate narcotics that act as analgesic.

Sol.: Plants with hallucinogenic properties are *Atropa belladona* and *Datura*.

Drugs obtained from *Erythroxylum coca* has a stimulating effect.

Charas, ganja, hashish and marijuana produced from *Cannabis sativa* are hallucinogenic.

173. Answer (3)

Hint: The proteins present on the surface of HIV mutate rapidly thus, our immune system fails to neutralize it.

Sol.: AIDS is caused by the Human Immuno Deficiency Virus (HIV), a member of a group of viruses called retroviruses, which have an envelope enclosing the RNA genome.

HIV contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase.

HIV evades the immune system by constantly undergoing mutation.

174. Answer (2)

Hint: T-lymphocytes are responsible for graft rejection.

Sol.: Grafts from just any source – an animal, another primate, or any human beings cannot be made since the grafts would be rejected sooner or later. Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this, the patient has to take immuno–suppresants all his/her life. The body is able to differentiate 'self' and 'non-self' and the cell-mediated immune response is responsible for the graft rejection.

175. Answer (2)

Hint: It belongs to the category of opioids.

Sol.: Heroin, commonly called smack, is chemically diacetylmorphine which is a white, odourless and bitter crystalline compound. This is obtained by acetylation of morphine, which is extracted from the latex of poppy plant, *Papaver somniferum.*

176. Answer (4)

Hint: Myasthenia gravis

Sol.: The body is able to differentiate 'self' and 'non-self' cells.

Due to genetic and other unknown reasons, the body attacks self-cells. This results in damage to the body and is called auto-immune disease.

177. Answer (4)

Hint: These organs are primary lymphoid organs.

Sol.: Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

Secondary lymphoid organs like lymph nodes, spleen, tonsils, appendix, *etc.*, provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

178. Answer (4)

Hint: α-interferon is used in immunotherapy.

Sol.: Tumor cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called biological response modifiers such as α-interferon which activates their immune system and helps in destroying the tumor.

179. Answer (4)

Hint: HIV spreads only through body fluids; not by mere touch or physical contact.

Sol.: Transmission of HIV-infection generally occurs by (a) sexual contact with an infected person, (b) by transfusion of contaminated blood and blood products, (c) by sharing infected needles as in the case of intravenous drug abusers and (d) from infected mother to her child through placenta. So, people who are at high risk of getting this infection includes - individuals who have multiple sexual partners, drug addicts who take drugs intravenously, individuals who require repeated blood transfusions and children born to an HIV infected mother.

180. Answer (4)

Hint: Allergy is caused due to release of certain chemicals from the mast cells.

Sol.: Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing. Allergy is due to the release of chemicals like histamine and serotonin from the mast cells. The use of drugs like anti-histamine, adrenaline and steroids (glucocorticoids) quickly reduce the symptoms of allergy.

181. Answer (4)

Hint: Immunoglobulins mediate humoral immune response.

Sol.: After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles. The macrophages continue to produce virus and in this way act like a HIV factory.

Neutrophils constitute about 60-65% of the total WBCs. Basophils are the least abundant agranulocytes.

Macrophages are derived from monocytes and are found in tissues.

182. Answer (1)

Hint: Causative agent is *Salmonella typhi.*

Sol.: Typhoid fever can be confirmed by Widal test. Filariasis is caused by *Wuchereria*. Dengue is a viral disease and amoebiasis is a protozoan disease.

183. Answer (4)

Hint: Colostrum secreted by mother during the initial days of lactation provides passive immunity.

Sol.: When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called active immunity. Active immunity is slow and takes time to give its full effective response. Injecting the microbes deliberately during immunisation or infectious organisms gaining access into body during natural infection induce active immunity. When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.

184. Answer (1)

Hint: Coca alkaloid has a stimulating effect.

Sol.: Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*, native to South America. It interferes with the transport of the neuro-transmitter dopamine. Cocaine, commonly called coke or crack, is usually snorted. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Excessive dosage of cocaine causes hallucinations.

185. Answer (3)

Hint: Addiction is considered as a disorder related to brain.

Sol.:

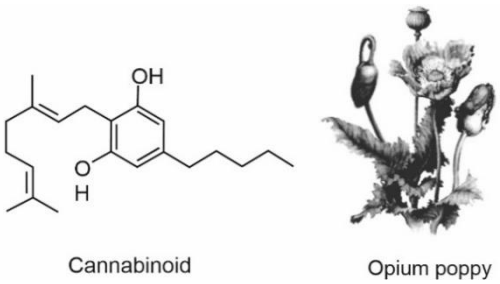
- Addiction is a psychological attachment to certain effects-such as euphoria and a temporary feeling of well-being associated with drugs and alcohol.
- Dependence is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued. This is characterised by anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again. In some cases, withdrawal symptoms can be severe and even life threatening and the person may need medical supervision.

SECTION-B

186. Answer (2)

Hint: Affects both, brain and cardiovascular system.

Sol.:



Cannabinoid

Opium poppy

- Morphine and heroin are obtained from *Papaver somniferum.* They are opioids.
- Natural cannabinoids are obtained from the inflorescences of the plant *Cannabis sativa*. The flower tops, leaves and the resin of *Cannabis* plant are used in various combinations to produce marijuana, hashish, charas and ganja. It is generally taken by inhalation and oral ingestion.

187. Answer (3)

Hint: Sympathetic nervous system can increase the cardiac output.

Sol.: Tobacco contains a large number of chemical substances including nicotine, an alkaloid. Nicotine stimulates adrenal medulla to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.

188. Answer (1)

Hint: Infective stage for mosquitoes.

Sol.: Female mosquito takes up gametocytes with blood meal. Their fertilization and development take place in the mosquito's gut itself.

189. Answer (4)

Hint: Viral disease

Sol.: *Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases.

Common cold is a viral disease.

190. Answer (4)

Hint: Vincristine and vinblastine are some of the chemotherapeutic drugs.

Sol.: Cancer detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests for increased cell counts in the case of leukemia. In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.

Specific antibodies can also be used for the detection of cancer.

Chemotherapy and immunotherapy are used for the treatment of cancer.

191. Answer (3)

Hint: Inflorescences of the plant *Cannabis sativa* is used to obtain cannabinoids.

Sol.: Psoriasis is an auto-immune disorder. Latex of poppy plant is used to obtain 'heroin'.

The causative agent of gonorrhea is *Neisseria*. It is a sexually transmitted disease.

192. Answer (4)

Hint: The pathogen of AIDS destroys the lymphocytes.

Sol.: HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. During this period, the person suffers from bouts of fever, diarrhoea and weight loss. Due to decrease in the number of helper–T lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*.

193. Answer (3)

Hint: It is obtained from *Papaver somniferum*.

Sol.: Morphine is a very effective sedative and painkiller and is very useful in patients who have undergone surgery.

Abrin is a toxin.

Coca alkaloid and amphetamine are stimulants.

194. Answer (1)

Hint: Gamma rays fall under the same category as the X-rays.

Sol.:

- The malignant tumors are a mass of proliferating cells called neoplastic or tumor cells.

  As these cells actively divide and grow, they starve the normal cells by competing for vital nutrients.
- Several genes called cellular oncogenes (*c-onc*) or proto-oncogenes have been identified in normal cells which when activated under certain conditions, could lead to oncogenic transformation of the cells.
- Telomerase activity of cells increases in cancer.

195. Answer (4)

Hint: Vaccines also generate memory-B and T-cells.

Sol.:

- The T-cells themselves do not secrete antibodies but help B-cells to produce them.
- The principle of immunisation or vaccination is based on the property of 'memory' of the immune system. In vaccination, a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen (vaccine) are introduced into the body. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection. The vaccines also generate memory-B and T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.

  Most parasites are pathogenic, not all.

196. Answer (4)

Hint: Site associated with bones

Sol.: The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes. After maturation, the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix. The secondary lymphoid organs

provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

- The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.
- The lymph nodes are small solid structures located at different points along the lymphatic system. Lymph nodes serve to trap the micro-organisms or other antigens, which happen to get into the lymph and tissue fluid. Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

197. Answer (4)

Hint: Cells slough from such tumors reach distant sites and start a new tumor.

Sol.: Tumors are of two types: benign and malignant. Benign tumors normally remain confined to their original location and do not spread to other parts of the body. The malignant tumors, on the other hand are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant tumors.

198. Answer (4)

Hint: Nicotine is an alkaloid

Sol.:

- The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.
- Mumps is an infectious disease caused by the paramyxovirus. In this disease, a person faces difficulty in opening the mouth as a painful swelling occurs in the parotid glands.
- Amoebic dysentery is caused by *Entamoeba histolytica*, which is a protozoan.

199. Answer (2)

Hint: The rays used by MRI share the same property as UV-rays.

Sol.: Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

200. Answer (4)

Hint: Observed in females as a side effect.

Sol.: The side-effects of the use of anabolic steroids in females include deepening of voice. In males it includes acne, increased aggressiveness, mood swings, depression, reduction of size of the testicles, decreased sperm production, potential for kidney and liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate gland.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2025

TEST - 3 (Code-B)

For Code-A Sol. Click Here

Test Date : 10/11/2024

ANSWERS

1. (2)	41. (3)	81. (3)	121. (2)	161. (2)
2. (1)	42. (4)	82. (2)	122. (3)	162. (2)
3. (4)	43. (2)	83. (3)	123. (1)	163. (3)
4. (4)	44. (3)	84. (3)	124. (4)	164. (2)
5. (4)	45. (4)	85. (2)	125. (2)	165. (1)
6. (3)	46. (4)	86. (3)	126. (4)	166. (1)
7. (2)	47. (2)	87. (1)	127. (1)	167. (3)
8. (2)	48. (4)	88. (4)	128. (3)	168. (3)
9. (4)	49. (3)	89. (4)	129. (3)	169. (3)
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12. (2)	52. (2)	92. (2)	132. (1)	172. (3)
13. (3)	53. (3)	93. (3)	133. (1)	173. (3)
14. (1)	54. (3)	94. (1)	134. (1)	174. (4)
15. (2)	55. (3)	95. (4)	135. (3)	175. (3)
16. (2)	56. (2)	96. (1)	136. (3)	176. (3)
17. (3)	57. (3)	97. (3)	137. (3)	177. (4)
18. (3)	58. (2)	98. (4)	138. (4)	178. (3)
19. (3)	59. (1)	99. (3)	139. (3)	179. (4)
20. (1)	60. (3)	100. (4)	140. (2)	180. (3)
21. (3)	61. (1)	101. (3)	141. (2)	181. (3)
22. (1)	62. (4)	102. (3)	142. (3)	182. (3)
23. (3)	63. (2)	103. (4)	143. (4)	183. (3)
24. (2)	64. (1)	104. (4)	144. (1)	184. (3)
25. (3)	65. (1)	105. (4)	145. (2)	185. (4)
26. (3)	66. (4)	106. (1)	146. (2)	186. (4)
27. (3)	67. (4)	107. (3)	147. (1)	187. (2)
28. (2)	68. (2)	108. (2)	148. (2)	188. (4)
29. (3)	69. (4)	109. (4)	149. (1)	189. (4)
30. (3)	70. (1)	110. (3)	150. (3)	190. (4)
31. (4)	71. (3)	111. (4)	151. (3)	191. (4)
32. (3)	72. (2)	112. (1)	152. (1)	192. (1)
33. (4)	73. (3)	113. (2)	153. (4)	193. (3)
34. (1)	74. (2)	114. (2)	154. (1)	194. (4)
35. (4)	75. (4)	115. (3)	155. (4)	195. (3)
36. (2)	76. (1)	116. (2)	156. (4)	196. (4)
37. (3)	77. (2)	117. (2)	157. (4)	197. (4)
38. (3)	78. (1)	118. (3)	158. (4)	198. (1)
39. (1)	79. (2)	119. (1)	159. (4)	199. (3)
40. (1)	80. (3)	120. (1)	160. (4)	200. (2)

HINTS & SOLUTIONS

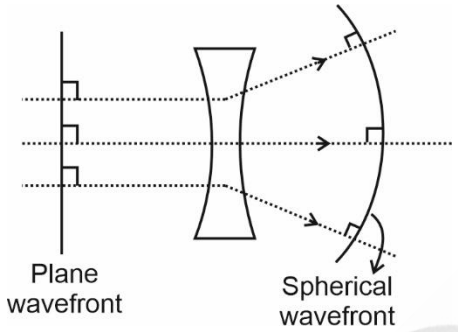
[PHYSICS]

SECTION-A

1. Answer (2)

Hint: Ray of light travels perpendicular to wavefront

Sol.:



2. Answer (1)

Hint: Use lens maker's formula

Sol.: $\frac{1}{f_1} = (\mu_{L/\text{air}} - 1)\left(-\frac{1}{R_1} - \frac{1}{R_2}\right) = P$

$$\frac{1}{f_2} = (\mu_{L/\text{oil}} - 1)\left(-\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{\frac{1}{f_2}}{\frac{1}{f_1}} = \frac{\mu_{L/\text{oil}} - 1}{\mu_{L/\text{air}} - 1} = \frac{\frac{3}{2}\times\frac{1}{1.4} - 1}{\frac{3}{2} - 1} = \frac{\frac{30}{28} - 1}{0.5} = \frac{\frac{15}{14} - 1}{0.5}$$

$$\frac{1}{f_2} = \frac{P}{14 \times 0.5} = \frac{P}{7} \Rightarrow f_2 = \frac{7}{P}$$

3. Answer (4)

Hint: Electromagnetic spectrum

Sol.: Gamma rays have the highest frequency while long radiowaves have the lowest frequency among the three given wavelengths in question. Higher the frequency, lower the wavelength.

4. Answer (4)

Hint: Use concept of total energy dissipated.

Sol.: $(i_{\text{eff}})^2Rt = (i_{DC})^2Rt + (i_{AC})^2Rt$

$\Rightarrow \quad (i_{\text{eff}})^2 = (i_{DC})^2 + (i_{AC})^2 = (4)^2 + (i_{\text{rms}})^2$

$$(i_{\text{eff}})^2 = 16 + \left(\frac{3}{\sqrt{2}}\right)^2 = 16 + \frac{9}{2} = \frac{41}{2}$$

5. Answer (4)

Hint: $I_{\text{rms}} = \frac{I_{\text{peak}}}{\sqrt{2}}$ and $V_{\text{rms}} = \frac{V_{\text{peak}}}{\sqrt{2}}$

Sol.: Statement I is wrong because V_{rms} = 220 V in domestic AC circuit and peak voltage = $220\sqrt{2}$ V.

There could be a half time period in AC current which may have zero average value.

6. Answer (3)

Hint: Width of central maxima = $\frac{2\lambda D}{b}$

Sol.: If λ = same and b increases, then width of central maxima = 2θ also decreases.

7. Answer (2)

Hint: Power factor of A.C. circuit = $\cos\phi = \frac{R}{Z}$

Sol.: Frequency, $f' = 4f$

Impedance of circuit,

$$Z' = \sqrt{R^2 + (X_L)^2} = \sqrt{R^2 + (\omega L)^2}$$

$$\sqrt{R^2 + (2\pi f' L)^2} = \sqrt{R^2 + (8\pi f L)^2}$$

Power factor = $\frac{R}{Z'} = \frac{R}{\sqrt{R^2 + (8\pi f L)^2}}$

8. Answer (2)

Hint: Total average value of energy density = $\frac{1}{2}\varepsilon_0 E_0^2$

Sol.: Average value of magnetic energy density = $\frac{B_0^2}{4\mu_0}$

Average value of electric energy density = $\frac{\varepsilon_0 E_0^2}{4}$

Total average value of energy density = $\frac{B_0^2}{4\mu_0} + \frac{\varepsilon_0 E_0^2}{4}$

9. Answer (4)

Hint: $\frac{V_P}{V_S}=\frac{N_P}{N_S}=\frac{i_S}{i_P}$

Sol.: As it is step-down transformer, $V_S < V_P$ $\therefore N_S < N_P$

$\therefore$ Turns ratio

$= 5=\frac{N_P}{N_S}=\frac{V_P}{V_S}=\frac{V_P}{50}\Rightarrow V_P=5\times 50=250$ V

10. Answer (1)

Hint: Use Malus law

Sol.: Initial intensity of unpolarised light = I_0

After passing through first polaroid, $I_1=\frac{I_0}{2}$

After passing through second polaroid, $I_2 = I_1\cos^2 30°$ (as per Malus law)

$\Rightarrow \quad I_2=\frac{I_0}{2}\left(\frac{\sqrt{3}}{2}\right)^2=\frac{3I_0}{8}$

% of light that pass through

$=\frac{\frac{3I_0}{8}}{I_0}\times 100=37.5\%$

11. Answer (2)

Hint: Total internal reflection

Sol.: When the diamond is cut in different angles suitably, total internal reflection occurs and they sparkle brilliantly.

12. Answer (2)

Hint: Shift = thickness of slab × $\left(1-\frac{1}{\mu}\right)$

Sol.: $\Delta x=t\left(1-\frac{1}{\mu}\right)$

$2=t\left(1-\frac{1}{3/2}\right)\Rightarrow 2=t\times\frac{1}{3}$

t = 6 cm

13. Answer (3)

Hint & Sol.: When the convex lens is dipped in water then the difference in the refractive indices of glass and water will reduce and therefore focal length of the lens in water will increase.

14. Answer (1)

Hint: Wattful component of current is along supply voltage.

Sol.: $\tan\phi=\frac{X_L}{R}=\frac{3}{4}=\tan 37°\Rightarrow \phi=37°$

E leads current i by 37°.

Wattless component of current i, is perpendicular to supply voltage.

15. Answer (2)

Hint: Path difference = $d\sin\theta$

Sol.: $\Delta x=d\sin\theta=\left(n+\frac{1}{2}\right)\lambda$ with $d = 4\lambda$ = maximum path difference

The minima will be at $\pm\frac{\lambda}{2}, \pm\frac{3\lambda}{2}, \pm\frac{5\lambda}{2}$ and $\pm\frac{7\lambda}{2}$

So, 8 minima will be observed.

16. Answer (2)

Hint: $E_{rms}=\frac{E_0}{\sqrt{2}}$

Sol.: Average total energy density = $\frac{1}{2}\varepsilon_0 E_0^2=\varepsilon_0 E_{rms}^2=8.85\times 10^{-6}$

$\Rightarrow \quad E_{rms}^2=\frac{8.85\times 10^{-6}}{8.85\times 10^{-12}}=10^6$

$\Rightarrow \quad E_{rms} = 10^3$ N/C

17. Answer (3)

Hint: Two coherent sources cannot be obtained from two different light sources.

Sol.: If both sources are coherent, then phase difference between the two sources must be constant with time. Then interference can happen. Two independent sources can't produce a sustained interference pattern.

18. Answer (3)

Hint: Resultant amplitude $A = \sqrt{(a_1)^2+(a_2)^2+2a_1a_2\cos\phi}$

Sol.: Individual wave amplitudes a_1 = 2 and $a_2=\sqrt{3}$

Phase difference

$\phi=\frac{\pi}{9}-\left(\frac{-\pi}{18}\right)=\frac{\pi}{9}+\frac{\pi}{18}=\frac{2\pi+\pi}{18}=\frac{\pi}{6}=30°$

Resultant amplitude

$A=\sqrt{2^2+(\sqrt{3})^2+2\times 2\times\sqrt{3}\times\frac{\sqrt{3}}{2}}=\sqrt{13}$

19. Answer (3)

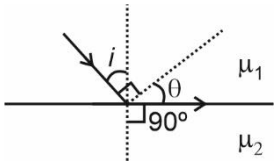
Hint: Fringe width is given by $\beta = \frac{\lambda D}{d}$

Sol.: $\beta' = \frac{\lambda D}{\mu d} < \beta$ as $\mu > 1$

20. Answer (1)

Hint: At critical angle, the refracted ray grazes along the refracting surface.

Sol.: From the shape of wavefront, we draw the diagram of incident ray.



$\mu_1 \sin i = \mu_2 \sin 90°$ (by Snell's law)

$\Rightarrow \sin i = \sin\theta = \frac{\mu_2}{\mu_1}$

Note: θ is critical angle for this pair of media.

21. Answer (3)

Hint: Application of electromagnetic waves

Sol.:

A. Microwaves are suitable for radar systems.

B. Radiowaves are used for broadcasting because these waves have very long wavelength.

C. UV rays are used to kill germs in water purifiers.

D. Gamma rays are used to destroy cancer cells because they are high frequency radiation.

22. Answer (1)

Hint: Impedance of a series AC circuit:

$z = \sqrt{R^2 + (X_L - X_C)^2}$

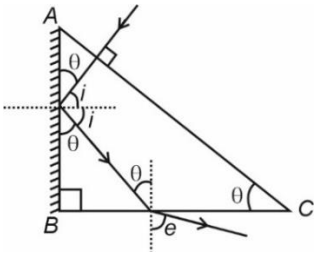
Sol.: Given $R = 12\ \Omega$, $X_C = 5\ \Omega$, $X_L = 0$

$z = \sqrt{R^2 + (X_L - X_C)^2} \Rightarrow z = \sqrt{12^2 + 5^2} = 13\ \Omega$

23. Answer (3)

Hint: Application of Snell's law

Sol.:



Applying Snell's law at surface *BC*,

$\mu \sin\theta = \sin e$

$\Rightarrow \sqrt{3}\sin 30° = \sin e \Rightarrow \sin e = \frac{\sqrt{3}}{2} \Rightarrow e = 60°$

24. Answer (2)

Hint: Ozone protects Earth from UV radiations.

Sol.: Ozone blocks ultraviolet radiation from reaching the surface of Earth. These have wavelength $\lambda < 400$ nm.

25. Answer (3)

Hint: $E_0 = cB_0$

Sol.: $B_0 = \frac{E_0}{c} \Rightarrow \frac{B_0}{E_0} = \frac{1}{c}$ where c = speed of EM wave in vacuum

$\left[\frac{B_0}{E_0}\right] = \left[\frac{1}{c}\right] = [c]^{-1} = [LT^{-1}]^{-1} = [L^{-1}T] = [M^0L^{-1}T]$

26. Answer (3)

Hint: $c = \frac{\omega}{k}$

Sol.: Velocity or speed of EM wave through vacuum = $\frac{\omega}{k} = \frac{2\pi f}{\frac{2\pi}{\lambda}} = f\lambda = c$

27. Answer (3)

Hint & Sol.: In purely inductive AC circuit, the power consumption by the inductor is zero.

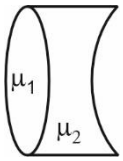
28. Answer (2)

Hint & Sol: Since the object is placed at centre of curvature of the given concave mirror, the magnification will be one, and hence the height of the image will be equal to 2 cm.

29. Answer (3)

Hint: Equivalent focal length is given by $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$

Sol.:



$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2} = (\mu_1 - 1)\left[\frac{1}{R} - \left(-\frac{1}{R}\right)\right] + (\mu_2 - 1)\left[-\frac{1}{R} - \frac{1}{R}\right]$

$\frac{1}{F} = (\mu_1 - 1)\frac{2}{R} - \frac{2}{R}(\mu_2 - 1) = \frac{2}{R}(\mu_1 - \mu_2)$

$\therefore \quad F = \frac{R}{2(\mu_1 - \mu_2)}$

30. Answer (3)

Hint & Sol: Concave lens forms virtual and erect image of a real object.

31. Answer (4)

Hint: When ray of light goes from rarer to denser medium, it bends towards the normal.

Sol.: Ray does not suffer any deviation on entering the lens. $\therefore \mu_1 = \mu_2$.

The ray leaving second surface is bending towards the normal.

$\therefore \mu_3 > \mu_2$ (as μ_3 is denser than μ_2)

32. Answer (3)

Hint: $i_d = \varepsilon_0 A \frac{dE}{dt}$

Sol.: $i_d = \varepsilon_0 \frac{d(EA)}{dt} = \varepsilon_0 A \frac{dE}{dt}$

$$\Rightarrow \frac{dE}{dt} = \frac{i_d}{\varepsilon_0 A} = \frac{17.7}{8.85\times10^{-12}\pi(0.1)^2}$$

$$\Rightarrow \frac{dE}{dt} = \frac{2\times10^{14}}{\pi} \text{ V m}^{-1}\text{ s}^{-1}$$

33. Answer (4)

Hint: The EM waves originate from an accelerating charge.

Sol.: For EM waves,

Wavelength of wave changes when it travels from one medium to another. Frequency of wave remains unchanged when it travels from one medium to another. Both electric and magnetic field vectors attain maxima at the same time.

34. Answer (1)

Hint: Maxwell's equations

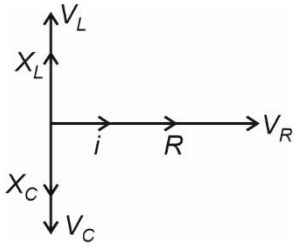
Sol.: $\oint \vec{E}.d\vec{l} = \frac{-d\phi_B}{dt}$ is Faraday's law of electromagnetic induction.

$\oint \vec{B}.d\vec{s} = 0$ is Gauss's law in magnetism.

35. Answer (4)

Hint: Draw appropriate phasor diagram.

Sol.: Phasor diagram for the series *LCR* circuit is



All statements are true.

Current through *C* and *R* are in same phase because current is same through each elements.

SECTION-B

36. Answer (2)

Hint: $i_d \propto A$

Sol.: Displacement current

$$i_d = \varepsilon_0 A \frac{dE}{dt} \Rightarrow i_d \propto A$$

$$\therefore \frac{i}{i'} = \frac{\pi(2R)^2}{\pi(2R)^2 - \pi\left(\frac{3R}{2}\right)^2} = \frac{4\pi R^2}{\frac{7\pi R^2}{4}} = \frac{16}{7}$$

$$\Rightarrow i' = \frac{7}{16} i$$

37. Answer (3)

Hint: $\frac{1}{F} = \frac{-2}{f_{\text{lens}}} + \frac{1}{f_{\text{mirror}}}$

Sol.:

$$\frac{1}{f_l} = (\mu-1)\left(\frac{-1}{R} - \frac{1}{R}\right) = \frac{-2(\mu-1)}{R} \text{ and } \frac{1}{f_m} = \frac{2}{R}$$

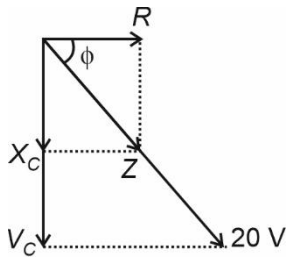
$$\frac{1}{F} = \frac{-2}{f_l} + \frac{1}{f_m} = \frac{4(\mu-1)}{R} + \frac{2}{R}$$

$$\Rightarrow \frac{1}{F} = \frac{4\mu-2}{R} \Rightarrow F = \frac{R}{2(2\mu-1)}$$

38. Answer (3)

Hint: Voltage across capacitor lags behind supply voltage.

Sol.:



$$\tan\phi = \frac{X_C}{R} = \frac{3}{4} = \tan 37^\circ \Rightarrow \phi = 37^\circ$$

$\therefore 90^\circ - \phi = 53^\circ$

V_C lags E_{max} by 53°

$V_C = 20\sin\phi = 20\times\frac{3}{5} = 12$ V

Voltage across capacitor = $V_C \sin(\omega t - 53°)$

$= 12\sin(\omega t - 53°)$ V

39. Answer (1)

Hint: Curve of δ vs i is not a perfect parabola.

Sol.: The graph of δ vs i is more steep in the left part.

$\therefore\ 60° - x > x - 30° \Rightarrow 60° + 30° > x + x \Rightarrow 90° > 2x$

$\Rightarrow\ x < 45°$ is satisfied by option (1).

40. Answer (1)

Hint: $V_{rms} = i_{rms} Z$

Sol.: $i_{rms} = \frac{10}{\sqrt{2}}$

$\therefore\ V = i_{rms}(X_L - X_C) = \frac{10}{\sqrt{2}}\times 20 = \frac{200}{\sqrt{2}}$ V

$\frac{V}{\sqrt{2}} = \frac{100\sqrt{2}}{\sqrt{2}} = 100$ V

41. Answer (3)

Hint: Tube length = $f_o + f_e$

Sol.: In normal adjustment, the final image forms at infinity. The tube length is $f_o + f_e = L$ = (33 + 6) cm = 39 cm

42. Answer (4)

Hint: X_C depends on ω

Sol.: When connected to DC source, $\omega = 0$.

$\therefore$ Capacitive reactance = $X_C = \frac{1}{\omega C} = \infty$

43. Answer (2)

Hint: Phase difference = $\frac{2\pi}{\lambda}$ × Path difference

Sol.: Fringe width $\beta = \frac{\lambda D}{d} = \frac{250\times10^{-9}\times1}{0.5\times10^{-3}}$

$= 500\times10^{-6}$ m

$y = \frac{\phi}{2\pi}\times\beta$

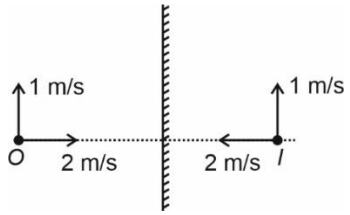
Phase difference $\phi = \frac{y}{\beta}\times 2\pi = \frac{125\times10^{-6}}{500\times10^{-6}}\times 2\pi$

$\Rightarrow\ \phi = \frac{\pi}{2} = 90°$

44. Answer (3)

Hint: Velocity component of image parallel to plane mirror remains same as object.

Sol.:



Velocity of image = $-2\hat{i} + \hat{j}$

45. Answer (4)

Hint: Objective and eye-piece lenses have different focal lengths in different optical instruments.

Sol.: Changing aperture of objective lens doesn't affect magnifying power of compound microscope.

To get maximum magnification in compound microscope, $f_o < f_e$.

To ensure large magnification in telescope, $f_o > f_e$.

46. Answer (4)

Hint & Sol.: Below resonance, $\omega < \frac{1}{\sqrt{LC}}$

$\Rightarrow\ \omega^2 < \frac{1}{LC} \Rightarrow \omega L < \frac{1}{\omega C}$

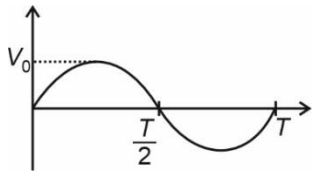
$\Rightarrow\ X_L < X_C$

$\therefore$ Current leads voltage in phasor diagram.

47. Answer (2)

Hint: $V_{mean} = \frac{\int_{t_1}^{t_2} V dt}{\int_{t_1}^{t_2} dt}$

Sol.:



$V_{avg} = \frac{\int_0^{T/2} V dt}{\int_0^{T/2} dt} = \frac{5\int_0^{T/2}\sin(\omega t)dt}{\frac{T}{2}} = \frac{\frac{5}{\omega}[\cos(\omega t)]_0^{T/2}}{\frac{T}{2}}$

$= \frac{10}{\omega T}\left[\cos\left(\omega\frac{T}{2}\right) - \cos(0)\right]$

$= \frac{10}{\frac{\omega 2\pi}{\omega}}\left[\cos\left(\omega\cdot\frac{\pi}{\omega}\right) - \cos(0)\right] = \frac{10}{\pi}$

48. Answer (4)

Hint: Pressure exerted $P = \frac{F}{A} = \frac{1}{A} \cdot \frac{\Delta p}{\Delta t}$

Sol.: Initial momentum, $p = \frac{E}{c}$

Change in momentum, $\Delta p = 0 - \left(-\frac{E}{c}\right) = \frac{E}{c}$

Force exerted, $F = \frac{\Delta p}{\Delta t} = \frac{E}{ct}$

Average pressure exerted = $\frac{F}{A} = \frac{E}{ctA}$

49. Answer (3)

Hint: Electromagnetic waves are transverse waves.

Sol.: Wave travelling in +y direction. So, vector equation should have term ($\omega t - ky$) as argument for cos function.

$\hat{j} \,||\, \left(\vec{E} \times \vec{B}\right) \Rightarrow \hat{j} \,||\, \left(\hat{i} \times [-\hat{k}]\right)$

So, $\vec{B}$ in $-\hat{k}$ direction.

50. Answer (3)

Hint: Diffraction is bending of light around the boundary. The diffraction of light wave occur when size of obstacle is comparable to wavelength.

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: Ligand with synergic bonding and chelation effect tend to have more field strength.

Sol.: Order of field strength of given ligands is

$CO > CN^- > NH_3 > C_2O_4^{2-}$

52. Answer (2)

Hint:

Hybridisation	Geometry
sp^3	Tetrahedral
dsp^2	Square planar
d^2sp^3	Octahedral
sp^3d^2	Octahedral

Sol.:

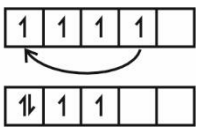
Compound	Hybridisation	Geometry
$[Fe(H_2O)_6]SO_4$	sp^3d^2	Octahedral
$[Ni(CO)_4]$	sp^3	Tetrahedral
$K_2[PtCl_4]$	dsp^2	Square planar
$[Sc(NH_3)_6]Cl_3$	d^2sp^3	Octahedral

53. Answer (3)

Hint: Magnetic moment $\mu = \sqrt{n(n+2)}$ BM

Where n = number of unpaired electrons

Sol.: For inner orbital complex, two inner d orbitals will be made empty to form coordinate bonds.

$d^4 \Rightarrow$ 

After pairing there will be two unpaired electrons hence complex will be paramagnetic with magnetic moment of $\sqrt{8}$ B.M.

54. Answer (3)

Hint: Metal carbon bond strength increases due to synergic bonding in metal carbonyls.

Sol.: Synergic bonding increases with increase in electron density on central metal.

Hence $[Co(CO)_4]^-$ will have strongest metal carbon bond.

55. Answer (3)

Hint: Isomers have same molecular formula but different structure or spatial orientation.

Sol.: Aqueous solution of $[Co(NH_3)_5Cl]Br$ and $[Co(NH_3)_5Br]Cl$ will give test of different ions hence they are ionisation isomers.

56. Answer (2)

Hint: H_2O acts as strong field ligand with Co^{3+}.

Sol.: $[Co(H_2O)_6]^{3+}$ will be inner orbital complex with d^2sp^3 hybridisation and octahedral structure.

57. Answer (3)

Hint: Heteroleptic complex has more than one different type of ligand.

Sol.: $[PtCl_2(NH_3)_2]$ is a heterolyptic complex.

58. Answer (2)

Hint: As field strength of ligand increases CFSE increases.

Sol.: CFSE increases with chelation, synergic bonding and oxidation state of central metal ion.

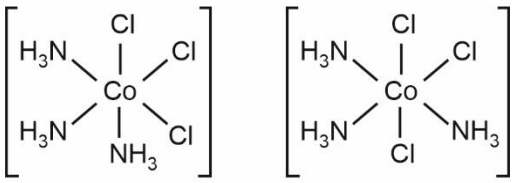
Hence order of CFSE

$[Fe(CN)_6]^{3-}$ > $[Fe(CN)_6]^{4-}$ > $[Fe(C_2O_4)_3]^{3-}$ > $[Fe(H_2O)_6]^{3+}$

59. Answer (1)

Hint: fac-mer isomerism is exhibited by $[MA_3B_3]$ type of complex.

Sol.:



fac mer

60. Answer (3)

Hint: Polydentated ligands form chelate ring.

Sol.: Hydrazine $H_2N - NH_2$ is a monodentate ligand.

61. Answer (1)

Hint: Oxidising agents are electron acceptor.

Sol.: Metal carbonyl with EAN less than atomic number of nearest inert gas can act as oxidising agent for $[V(CO)_6]$

EAN = 35 hence it will be an oxidising agent.

62. Answer (4)

Hint: Terminal alkynes are acidic in nature

Sol.: $CH_3C \equiv CH + NaNH_2 \longrightarrow CH_3C \equiv CNa + H_2$ (A)

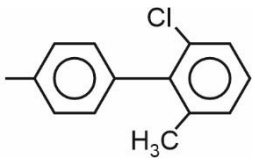
$\xrightarrow{CH_3CH_2Br}$

$CH_3C \equiv CCH_2CH_3$ (B)

63. Answer (2)

Hint: Ortho substituted biphenyl can be optically active

Sol.:

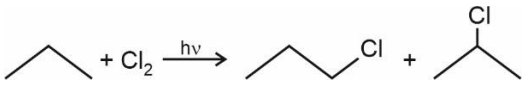


is optically inactive as one of the phenyl is not substituted at ortho position, so it has plane of symmetry.

64. Answer (1)

Hint: Halogenation of alkane is free radical substitution reaction and products depend upon type of hydrogen present.

Sol.:



Two products.

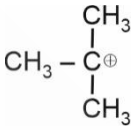
65. Answer (1)

Hint & Sol.: $C_2H_5Br + KCN \rightarrow C_2H_5CN$

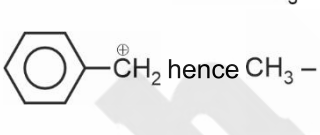
66. Answer (4)

Hint: Reactivity towards S_N1 depends upon stability of carbocation.

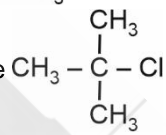
Sol.: Since



is more stable than



hence

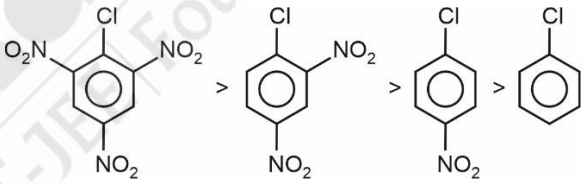


is more reactive towards S_N1.

67. Answer (4)

Hint: Presence of electron withdrawing groups at ortho or para positions of haloarenes makes it more reactive towards nucleophilic substitution.

Sol.: Order of reactivity



68. Answer (2)

Hint & Sol.: Weak bases are good leaving groups. Order of leaving group tendency is

$F^{\ominus} > \overset{\ominus}{O}H > \overset{\ominus}{N}H_2 > \overset{\ominus}{C}H_3$

69. Answer (4)

Hint: S_N2 reaction is preferred in polar aprotic solvent

Sol.: Vinyl chloride is less reactive than allyl chloride due to partial double bond nature of C – Cl bond.

For chiral alkyl halide there is inversion in configuration during S_N2 mechanism.

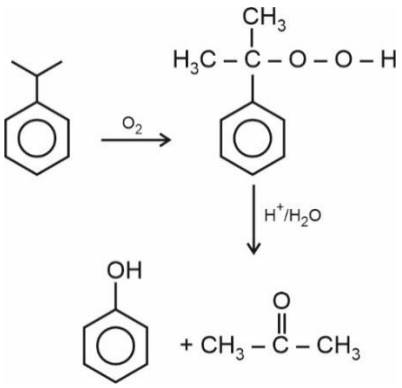
70. Answer (1)

Hint: Meso compound has plane of symmetry.

Sol.: Meso compounds are optically inactive with chiral carbon.

71. Answer (3)

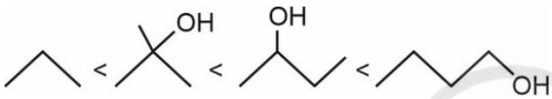
Hint & Sol.:



72. Answer (2)

Hint: Boiling point of isomeric alcohol increases as branching decreases.

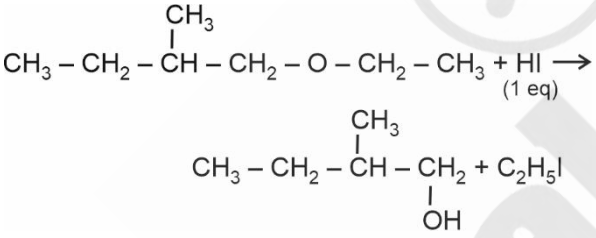
Sol.: Correct order of B.P.



73. Answer (3)

Hint: Reaction of ether with HI is nucleophilic substitution in which O – R bond breaks.

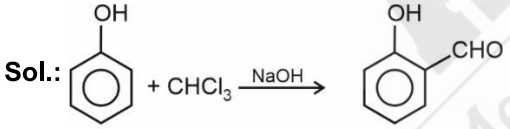
Sol.:



74. Answer (2)

Hint: Reimer-Tiemann reaction is an electrophilic substitution reaction in which ortho/para substitution takes place.

Sol.:

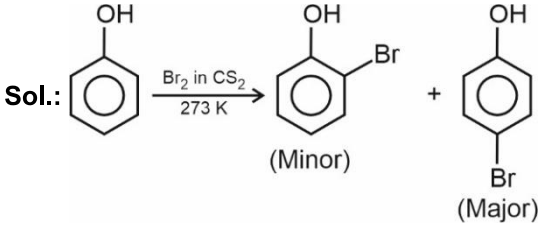


(Salicylaldehyde)

75. Answer (4)

Hint: Reaction of phenol with Br_2/CS_2 is an electrophilic substitution reaction in which ortho/para substitution takes place.

Sol.:



(Minor) (Major)

76. Answer (1)

Hint: Lucas reagent test is used to distinguish 1º, 2º and 3º alcohols.

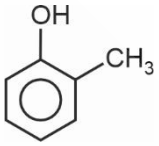
Sol.: Being most reactive 3º alcohol gives instant turbidity with $ZnCl_2$ + conc. HCl and least reactive 1º alcohol gives turbidity on heating.

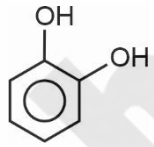
77. Answer (2)

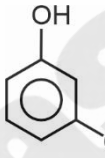
Hint: As the acidic strength increases pK_a decreases.

Sol.: C_6H_5OH is strongest acid hence it will have maximum K_a and minimum pK_a.

78. Answer (1)

Hint:  is ortho cresol

Sol.:  – Catechol

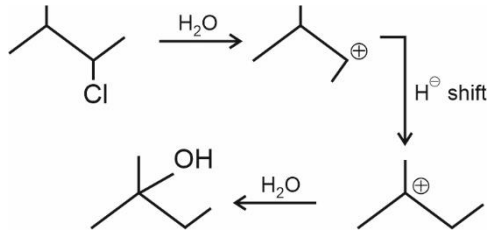
 – Resorcinol

 – Quinol

79. Answer (2)

Hint: Reaction of secondary alkyl halide with water follows S_N1 mechanism.

Sol.:



80. Answer (3)

Hint & Sol.: Esterification is a nucleophilic substitution reaction in which alcohol behaves as nucleophile.

81. Answer (3)

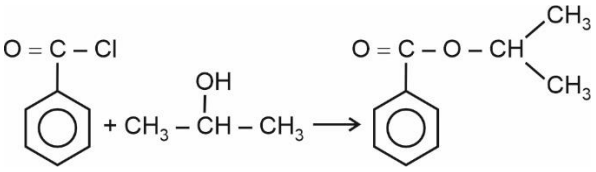
Hint: Reaction of Grignard reagent with compounds having acidic hydrogen gives alkane.

Sol.: $CH_3MgBr + C_2H_5OH \rightarrow CH_4$

82. Answer (2)

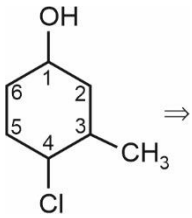
Hint: Reaction of acid halide and alcohol gives ester.

Sol.:



83. Answer (3)

Hint: IUPAC naming is done on the basis to lowest locant rule.

Sol.:  ⇒ 4-chloro-3-methylcyclohexane-1-ol

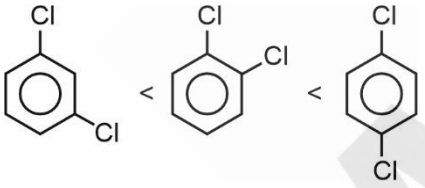
84. Answer (3)

Hint & Sol.: Chloroform is placed in dark coloured bottle and filled till top to avoid its oxilation to toxic phosgene gas.

85. Answer (2)

Hint: p-dichlorobenzene tend to have high MP due to symmetry.

Sol.:



SECTION-B

86. Answer (3)

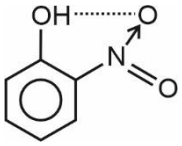
Hint & Sol.: Methanol, CH_3OH, also known as 'wood spirit', was produced by destructive distillation of wood. Today, most of the methanol is produced by catalytic hydrogenation of carbon monoxide at high pressure and temperature and in the presence of $ZnO - Cr_2O_3$ catalyst.

$$CO + 2H_2 \xrightarrow[200-300\ atm,\ 573-673\ K]{ZnO-Cr_2O_3} CH_3OH$$

87. Answer (1)

Hint: Due to intermolecular H-bonding boiling point increases.

Sol.: o-nitrophenol has less boiling point than p-nitrophenol as it shows intra molecular H-bonding.



88. Answer (4)

Hint: Aldehydes can be reduced to primary alcohol with certain reducing agents.

Sol.:

(a) $CH_3CHO \xrightarrow{H_2/Pd} \underset{1^o-alcohol}{CH_3CH_2OH}$

(b) $CH_3COOH \xrightarrow{NaBH_4/H_2O}$ no reaction

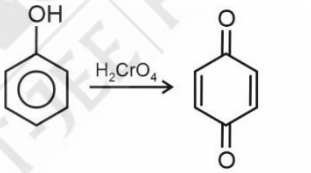
(c) $CH_3COCH_3 \xrightarrow[H_2O]{NaBH_4} \underset{2^o-alcohol}{CH_3-\overset{OH}{\overset{|}{C}}H-CH_3}$

(d) $C_6H_5CH_2OC_2H_5 \xrightarrow{HI} C_6H_5CH_2I + C_2H_5OH$

89. Answer (4)

Hint: Phenol can be oxidised by oxidising agent like chromic acid.

Sol.:



Benzoquinone

90. Answer (2)

Hint:

Sol.: Selectivity ratio for monochlorination with respect to 1°, 2°, 3° carbon is 1 : 3.8 : 5 respectively.

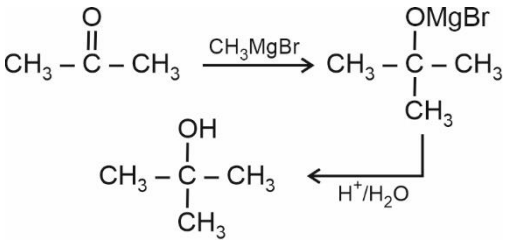
$$\% \text{ primary halide} = \frac{9\times1}{9+5}\times100 = 64.28\%$$

$$\% \text{ tertiary halide} = \frac{5}{14}\times100 = 35.72\%$$

91. Answer (3)

Hint: Carbonyl compounds with Grignard reagent followed by hydrolysis gives alcohol as the product.

Sol.:



92. Answer (2)

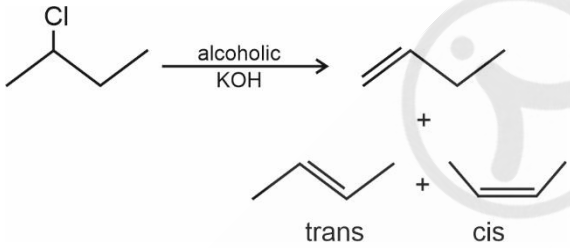
Hint: Phenol when treated with $FeCl_3$ forms a violet-coloured soluble complex.

Sol.: $6C_6H_5OH + FeCl_3 \rightarrow \underset{\text{Violet complex}}{[Fe(OC_6H_5)_6]^{3-}}$

93. Answer (3)

Hint: Alkyl halide heated with alcoholic KOH undergoes β-elimination and gives alkene as the product.

Sol.:

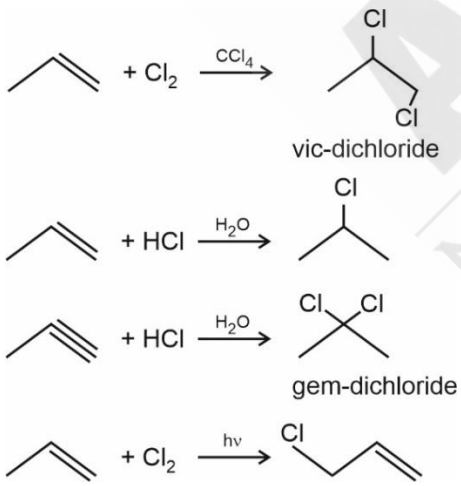


Total 3-alkene will be obtained.

94. Answer (1)

Hint: Addition of Cl_2 in alkene in CCl_4 gives anti addition.

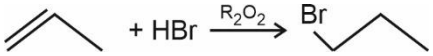
Sol.:



95. Answer (4)

Hint: Reaction of HX with unsymmetrical alkene in presence of peroxide may give anti Markovnikov product.

Sol.: Addition of HBr only among all HX with unsymmetrical alkene in presence of peroxide gives anti Markovnikov product.



96. Answer (1)

Hint: $[Ma_5b]$ cannot show geometrical isomerism.

Sol.: $[Ma_4b_2] \Rightarrow$ [M(aa) (aa) (bb)]

[M(aa) (ab) (ab)]

$[Ma_3b_2c] \Rightarrow$ [M(aa) (ab) (bc)]

[M(aa) (ac) (bb)]

[M(ab) (ab) (ac)]

$[Ma_2b_2c_2] \Rightarrow$ [M(aa) (bb) (cc)]

[M(ab) (ab) (cc)]

[M(ac) (bb) (ac)]

[M(aa) (bc) (bc)]

[M(ab) (bc) (ac)]

97. Answer (3)

Hint: Energy of light absorbed increases as splitting increases.

Sol.: As absorbed energy will increase, absorbed wavelength will decrease.

Hence decreasing order of absorbed wavelength is

$[CrCl_6]^{3-} > [Cr(H_2O)_6]^{3+} > [Cr(NH_3)_6]^{3+}$

98. Answer (4)

Hint: Tetraammineaquachloridocobalt(III) chloride is $[Co(NH_3)_4(H_2O)Cl]Cl_2$. In aqueous medium one mole of the complex will give 2 moles of chloride ions.

Sol.: Milli mole of chloride ions in one solution

$= 50 \times 0.1 \times 2 = 10$

Milli mole of AgCl precipitated = 10

Mole of AgCl precipitated $= 10 \times 10^{-3}$

$= 0.01$

99. Answer (3)

Hint: Complexes with no plane of symmetry can show optical isomerism.

Sol.: $[Co(H_2O)_5NO_2]Cl_2$ and $[Co(H_2O)_4(NO_2)Cl]Cl{\cdot}H_2O$ are hydrate isomers.

$[Co(H_2O)_5NO_2]Cl_2$ and $[Co(H_2O)_4ONO]Cl_2$ are linkage isomers.

100. Answer (4)

Hint: Jahn-Teller effect can be observed in unsymmetrically filled e_g orbitals.

Sol.: Since for high spin d^4 configuration after octahedral splitting it will be $t_{2g}^3 e_g^1$ hence it will show Jahn-Teller effect.

[BOTANY]

SECTION-A

101. Answer (3)

Hint: ICAR has not played any role in biogas plant development.

Sol.: Technology for biogas production was jointly developed by Indian Agricultural Research Institute (IARI) and Khadi and Village Industries Commission (KVIC)

102. Answer (3)

Hint: Bacteria are one of the main source of biofertilizers.

Sol.: Main sources of biofertilizer are bacteria, fungi and cyanobacteria.

103. Answer (4)

Hint: This gas is produced by an archaebacteria, which is commonly found in marshy region.

Sol.: Major component of biogas is methane (50% – 70%)

104. Answer (4)

Hint: A cyanobacterium is involved in this symbiotic N_2 fixation process.

Sol.: *Anabaena*, helps in N_2 fixation in association with *Azolla*.

105. Answer (4)

Hint: Predators regulate prey population.

Sol.: Predation is the interaction responsible for conduits for energy transfer across the trophic levels.

106. Answer (1)

Hint: *Calotropis* species has natural metabolites that can affect the heart muscles.

Sol.: *Calotropis* protects itself from cattle by producing poisonous cardiac glycosides.

107. Answer (3)

Hint: Interaction between fig and wasp is mutualism.

Sol.:

(i) Prickly pear cactus introduced into Australia and it was controlled by the predator cactus feeding moth.

(ii) Gause's experiment of competitive exclusion was on two ciliate protozoan *Paramecium caudatum* and *P. aurelia.*

(iii) Crocodile bird (plover) enters the mouth of crocodile to feed parasitic leeches. Plover gets food and crocodile gets rid of leeches.

108. Answer (2)

Hint : In a logistic growth curve, four phases, namely, lag phase, phase of acceleration, phase of deceleration followed by asymptote, can be seen.

Sol.: Asymptote in a logistic growth curve is obtained when population density reaches the carrying capacity.

109. Answer (4)

Hint: Parasites spends a part or whole of its life, on or in the body of other organism and gets nourishment and shelter from the host.

Sol.: Female mosquito is not considered a parasite because it needs blood for its reproduction. It never spends a short duration as other parasites do.

110. Answer (3)

Hint: Star fish (*Pisaster*) has predatory relationship with invertebrate species.

Sol.: Removal of *Pisaster* resulted in extinction of more than 10 species of invertebrate within a year due to interspecific competition.

111. Answer (4)

Hint: Floating debris is removed by sequential filtration in primary treatment.

Sol.: BOD test measures the rate of uptake of oxygen by micro-organisms in sample of water.

112. Answer (1)

Hint: It is a fungus that helps in controlling plant diseases.

Sol.: *Trichoderma* is free living fungi found in root ecosystem.

113. Answer (2)

Hint: *Clostridium butylicum* is used in the production of butyric acid.

Sol.:

(i) *Aspergillus niger* is used for the production of citric acid and gluconic acid.

(ii) Amylases are produced by *Aspergillus*, *Rhizopus* and *Bacillus* species.

(iii) Acetic acid is produced by *Acetobacter aceti.*

114. Answer (2)

Hint: Mediterranean orchid, *Ophrys* employs a form of sexual deceit.

Sol.: Pseudocopulation is the sexual deceit employed by orchid *Ophrys* to get pollinated by the bee.

115. Answer (3)

Hint: *Azospirillum* and *Azotobacter* are some of the most common, free-living and aerobic nitrogen fixing bacteria.

Sol.:

(i) *Aulosira* is the most active, non-symbiotic N_2 fixer in rice fields.

(ii) *Azospirillum* is free living and aerobic N_2 fixing bacterium.

116. Answer (2)

Hint: Mosquitoes are controlled by Dragonflies.

Sol.: Ladybird beetles are used to control aphids .

117. Answer (2)

Hint: Competition can occur between totally unrelated species and even when the resources are unlimited.

Sol.: Intraspecific competition is more acute as compared to interspecific competition.

118. Answer (3)

Hint: This kind of interaction is between two species, where both are benefited but can live without association as well.

Sol.: Sea anemone attached to the body of hermit crab is an example of protocooperation.

119. Answer (1)

Hint: Scientific name of the tree, from which toddy is prepared is *Caryota urens*.

Sol.: Toddy is a traditional drink in some parts of southern India. It is prepared by fermentation of the sap from palm (*Caryota urens*) trees.

120. Answer (1)

Hint: Statins have been commercialised as blood cholesterol lowering agent.

Sol.: Statins resemble mevalonate and competitively inhibit enzyme HMG CoA reductase and bring about reduction in cholesterol biosynthesis.

121. Answer (2)

Hint: Patient suffering from myocardial infarction are administered “clot buster” for removal of clots.

Sol.: Streptokinase produced by the bacterium *Streptococcus* is used as a “clot buster” for treating patients undergoing myocardial infarction.

122. Answer (3)

Hint : Lactic acid bacteria (LAB), convert milk into curd.

Sol. : During the process of curd formation, vitamin B_{12} is formed and thus, its concentration is increased. Curd is a good source of vitamin B_{12}.

123. Answer (1)

Hint: Parasites, generally have a high rate of reproduction.

Sol.:

(i) Parasites have less developed sense organs.

(ii) Parasites render the host more vulnerable to predation by making it physically weak.

(iii) Parasites have adhesive organs and suckers to cling on the host.

(iv) Loss of digestive system is found in parasites.

124. Answer (4)

Hint: In mutualism and protocooperation both the species are benefitted.

Sol.: Competition $\rightarrow$ (–, –)

Parasitism $\rightarrow$ (+, –)

Predation $\rightarrow$ (+, –)

125. Answer (2)

Hint: Competitive exclusion theory states that closely related species competing for the same resource cannot co-exist indefinitely and the competitive inferior one will be eliminated.

Sol.: Competitive release is the phenomena, where there is increase in population of a less distributed species in a geographical area, when its superior competitor is removed experimentally from that area.

126. Answer (4)

Hint: The influence of environmental resistance over biotic potential is denoted by $\left(\frac{K-N}{K}\right)$.

Sol.: Logistic growth is described by the equation $\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$, where

N = Population density at time t

K = Carrying capacity

r = Intrinsic rate of natural increase

127. Answer (1)

Hint: This kind of population interaction is beneficial (+) to one species and detrimental (–) to another.

Sol.: 'Predation' is the type of interaction, on which most of biological control methods are based.

128. Answer (3)

Hint: The effluent from the primary settling tank is taken for secondary treatment.

Sol.: Aeration tank shows growth of flocs which reduces BOD. In anaerobic sludge digester bacteria produces a mixture of gases, e.g., methane, H_2S and CO_2.

129. Answer (3)

Hint: Cyclosporin A, is produced by a fungus.

Sol.: Immunosuppressive agent, like Cyclosporin A, is produced by fungus *Trichoderma polysporum.*

130. Answer (1)

Hint: Epiphytes growing on other trees is an example of (+, 0) kind of population interaction.

Sol.: Epiphytes (orchids) growing on other plants like mango is an example of commensalism.

131. Answer (4)

Hint: Large holes in Swiss Cheese are due to production of CO_2.

Sol.: Ripening of Swiss Cheese is done by the bacterium, *Propionibacterium shermanii*. Large holes in the Swiss Cheese are formed due to production of CO_2.

132. Answer (1)

Hint: Adaptation is any attribute of an organism that enables the organism to survive and reproduce in its habitat.

Sol.:

- Mammals from colder climates generally have shorter ears and limbs to minimise heat loss.
- Desert lizards deal with the high temperature due to behavioural adaptations.

133. Answer (1)

Hint: Species of yeast is used in the production of alcoholic beverages.

Sol.: *S. cerevisiae*, is commonly known as Brewer's yeast. It is used in the production of wine and beer.

134. Answer (1)

Hint: The first antibiotic was discovered by Alexander Fleming.

Sol.: *Penicillium notatum* was the source of first antibiotic discovered.

135. Answer (3)

Hint: This phenomenon is also known as biological antagonism.

Sol.: Amensalism is an interaction, where growth of one organism is inhibited by another organism. One of the example of amensalism is, *Penicillium* secreting penicillin which inhibits the growth of large number of bacteria.

SECTION - B

136. Answer (3)

Hint: A represents conformers

B represents regulators

C represents partial regulators

Sol.: Conformers cannot maintain a constant internal environment. Their body temperature changes with surrounding. They are called cold blooded organisms.

137. Answer (3)

Hint: Total number is not an easily adaptable measure if the population is huge and counting is time consuming or impossible.

Sol.: Relative density is a good measure to find total density of fish in a lake by counting the number of fishes caught per trap.

138. Answer (4)

Hint: Commensalism is an interaction, where one species is benefitted and the other remains unaffected.

Sol.: Competitive exclusion is a phenomenon, where two species competing for same resource, cannot co-exist indefinitely and the competitive inferior one will be eliminated.

139. Answer (3)

Hint: In a new colony, natality may not contribute significantly to population growth.

Sol.: Immigration is the population of same species coming into a habitat from elsewhere. Here, immigration will contribute more significantly to population growth in a newly colonized habitat.

140. Answer (2)

Hint: Primary treatment of water is a physical process.

Sol.: During the primary treatment of sewage, all solids that settle form primary sludge and supernatant forms primary effluent.

141. Answer (2)

Hint: Such kind of pyramid is observed in case of stable population.

Sol.: Bell-shaped pyramid is observed in a stable population, when growth rate being almost zero.

142. Answer (3)

Hint: Primary treatment mainly involves removal of particles by filtration. No microbes are added in this process from outside.

Sol.: Most of treatment of waste water is done during secondary treatment by heterotrophic microbes which are already present in the sewage.

143. Answer (4)

Hint: Alexander Fleming discovered penicillin.

Sol.: The full potential as an effective antibiotic was established by Chain and Florey. Fleming, Chain and Florey were awarded Nobel prize in 1945 for this discovery.

144. Answer (1)

Hint: Ripening of roquefort cheese is done by a eukaryotic organism.

Sol.: Roquefort cheese is ripened by fungus *Penicillium roqueforti.*

145. Answer (2)

Hint: Milk is converted into curd by the help of *Lactobacillus*.

Sol.: During curd formation, lactic acid bacteria produce acid which leads to coagulation and partially digestion of milk proteins.

146. Answer (2)

Hint: Carnivores are less adversely affected due to competition.

Sol.: In general, herbivores and plants appear to be more adversely affected by competition than carnivores.

147. Answer (1)

Hint: This interaction involves two unrelated species, striving for common food, the zooplankton.

Sol.: Competition is observed between visiting flamingoes and resident fishes for zooplankton.

148. Answer (2)

Hint: Logistic growth curve was described by Verhulst and Pearl.

Sol.: Principle of "competitive exclusion was given by Gause.

149. Answer (1)

Hint: Competitive interference is the phenomena where feeding efficiency of one species might be reduced due to the presence of other species.

Sol.: Natural selection operates at the population level. In nature populations of different species in a habitat do not live in isolation but interact in many ways.

150. Answer (3)

Hint : Heat loss or heat gain is a function of surface area.

Sol.: Small animals have a larger surface area relative to their volume.

[ZOOLOGY]

SECTION-A

151. Answer (3)

Hint: Addiction is considered as a disorder related to brain.

Sol.:

- Addiction is a psychological attachment to certain effects-such as euphoria and a temporary feeling of well-being associated with drugs and alcohol.
- Dependence is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued. This is characterised by anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again. In some cases, withdrawal symptoms can be severe and even life threatening and the person may need medical supervision.

152. Answer (1)

Hint: Coca alkaloid has a stimulating effect.

Sol.: Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*, native to South America. It interferes with the transport of the neuro-transmitter dopamine. Cocaine, commonly called coke or crack, is usually snorted. It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy. Excessive dosage of cocaine causes hallucinations.

153. Answer (4)

Hint: Colostrum secreted by mother during the initial days of lactation provides passive immunity.

Sol.: When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body. This type of immunity is called active immunity. Active immunity is slow and takes time to give its full effective response. Injecting the microbes deliberately during immunisation or infectious organisms gaining access into body during natural infection induce active immunity. When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.

154. Answer (1)

Hint: Causative agent is *Salmonella typhi.*

Sol.: Typhoid fever can be confirmed by Widal test. Filariasis is caused by *Wuchereria*. Dengue is a viral disease and amoebiasis is a protozoan disease.

155. Answer (4)

Hint: Immunoglobulins mediate humoral immune response.

Sol.: After getting into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase. This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles. The macrophages continue to produce virus and in this way act like a HIV factory.

Neutrophils constitute about 60-65% of the total WBCs. Basophils are the least abundant agranulocytes.

Macrophages are derived from monocytes and are found in tissues.

156. Answer (4)

Hint: Allergy is caused due to release of certain chemicals from the mast cells.

Sol.: Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing. Allergy is due to the release of chemicals like histamine and serotonin from the mast cells. The use of drugs like anti-histamine, adrenaline and steroids (glucocorticoids) quickly reduce the symptoms of allergy.

157. Answer (4)

Hint: HIV spreads only through body fluids; not by mere touch or physical contact.

Sol.: Transmission of HIV-infection generally occurs by (a) sexual contact with an infected person, (b) by transfusion of contaminated blood and blood products, (c) by sharing infected needles as in the case of intravenous drug abusers and (d) from infected mother to her child through placenta. So, people who are at high risk of getting this infection includes - individuals who have multiple sexual partners, drug addicts who take drugs intravenously, individuals who require repeated blood transfusions and children born to an HIV infected mother.

158. Answer (4)

Hint: α-interferon is used in immunotherapy.

Sol.: Tumor cells have been shown to avoid detection and destruction by immune system. Therefore, the patients are given substances called biological response modifiers such as α-interferon which activates their immune system and helps in destroying the tumor.

159. Answer (4)

Hint: These organs are primary lymphoid organs.

Sol.: Both bone marrow and thymus provide micro-environments for the development and maturation of T-lymphocytes.

Secondary lymphoid organs like lymph nodes, spleen, tonsils, appendix, *etc.*, provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

160. Answer (4)

Hint: Myasthenia gravis

Sol.: The body is able to differentiate 'self' and 'non-self' cells.

Due to genetic and other unknown reasons, the body attacks self-cells. This results in damage to the body and is called auto-immune disease.

161. Answer (2)

Hint: It belongs to the category of opioids.

Sol.: Heroin, commonly called smack, is chemically diacetylmorphine which is a white, odourless and bitter crystalline compound. This is obtained by acetylation of morphine, which is extracted from the latex of poppy plant, *Papaver somniferum.*

162. Answer (2)

Hint: T-lymphocytes are responsible for graft rejection.

Sol.: Grafts from just any source – an animal, another primate, or any human beings cannot be made since the grafts would be rejected sooner or later. Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this, the patient has to take immuno–suppresants all his/her life. The body is able to differentiate 'self' and 'non-self' and the cell-mediated immune response is responsible for the graft rejection.

163. Answer (3)

Hint: The proteins present on the surface of HIV mutate rapidly thus, our immune system fails to neutralize it.

Sol.: AIDS is caused by the Human Immuno Deficiency Virus (HIV), a member of a group of viruses called retroviruses, which have an envelope enclosing the RNA genome.

HIV contains two identical molecules of single-stranded RNA and two molecules of reverse transcriptase.

HIV evades the immune system by constantly undergoing mutation.

164. Answer (2)

Hint: *Papaver somniferum* produces opiate narcotics that act as analgesic.

Sol.: Plants with hallucinogenic properties are *Atropa belladona* and *Datura*.

Drugs obtained from *Erythroxylum coca* has a stimulating effect.

Charas, ganja, hashish and marijuana produced from *Cannabis sativa* are hallucinogenic.

165. Answer (1)

Hint: The pathogen has a cell wall.

Sol.: Diphtheria and plague are bacterial diseases. Dengue and chikungungya are viral diseases. Ringworm is a fungal disease.

166. Answer (1)

Hint: Includes a process in which a copy of DNA is produced from RNA.

Sol.: After getting into the body of the person, HIV enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of the enzyme reverse transcriptase.

167. Answer (3)

Hint: One of the primary lymphoid organs reduce in size with ageing.

Sol.: The thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained, it reduces to a very small size.

168. Answer (3)

Hint: Each monomeric form of antibody molecule has four peptide chains.

Sol.: Each monomeric antibody molecule has four peptide chains, two smaller ones are called light chains and two longer ones are called heavy chains.

Hence, a monomeric form of an antibody is represented as H_2L_2.

Hepatitis-B vaccine is produced from yeast by RDT.

Natural killer cells fall under the category of cellular barriers of innate immunity.

169. Answer (3)

Hint: Active immunity is slow

Sol.: If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin). Even in cases of snake bites, the injection which is given to the patients, contain preformed antibodies against the snake venom. This type of immunisation is called passive immunisation.

170. Answer (4)

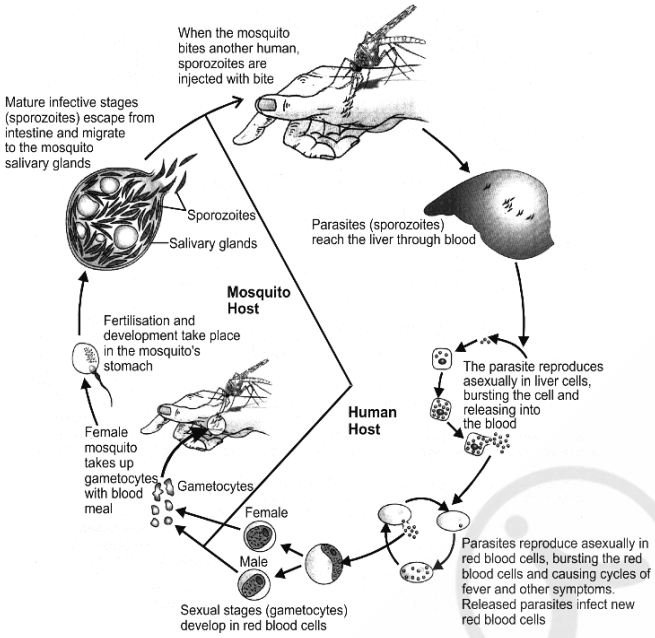
Hint: Most serious and fatal form of malaria

Sol.: Different species of *Plasmodium* (*P. vivax, P. malariae* and *P. falciparum*) are responsible for different types of malaria. Of these, malignant malaria caused by *Plasmodium falciparum* is the most serious one and can even be fatal.

171. Answer (2)

Hint: Sporozoites undergo multiple fission in the liver cells.

Sol.:

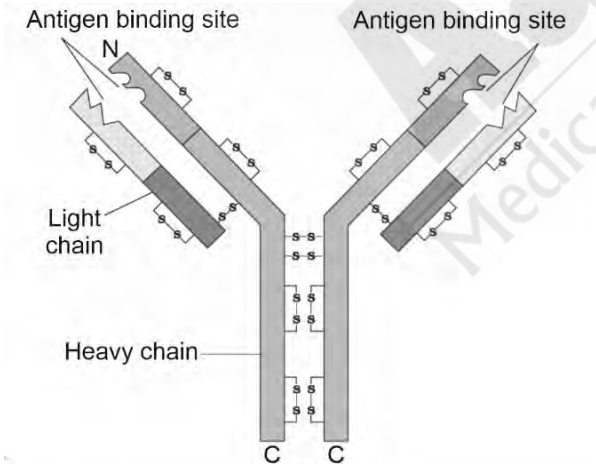


For humans, the infective stage of *Plasmodium* is a minute sickle-shaped sporozoite.

172. Answer (3)

Hint: The antigen-binding site is found between one heavy chain and one light chain.

Sol.:



173. Answer (3)

Hint: Subsequent encounter with the same pathogen elicits a highly intensified response.

Sol.: Acquired immunity is pathogen specific. It is characterised by memory. This means when our body encounters a pathogen for the first time, it produces a response called the primary response which is of low intensity. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This is ascribed to the fact that our body appears to have memory of the first encounter.

174. Answer (4)

Hint: Rectum is one of the parts of the structure in which the causative pathogen resides.

Sol.: *Entamoeba histolytica* is a protozoan parasite in the large intestine of human which causes amoebiasis (amoebic dysentery). Symptoms of this disease include constipation, abdominal pain and cramps, stools with excess mucous and blood clots. Houseflies act as mechanical carriers and serve to transmit the pathogen from faeces of infected person to food and food products, thereby contaminating them. Drinking water and food contaminated by the faecal matter are the main source of infection.

175. Answer (3)

Hint: The causative agent of plague belongs to the group similar to that of the pathogen of pneumonia.

Sol.: Plague is a bacterial disease.

Malaria is caused by a tiny protozoan called *Plasmodium*.

176. Answer (3)

Hint: *Gambusia* can be used to control these diseases.

Sol.: For diseases such as malaria and filariasis that are transmitted through insect vectors, the most important measure is to control or eliminate the vectors and their breeding places. Precautions have become more important especially in the light of widespread incidences of the vector-borne (*Aedes* mosquitoes) diseases like dengue and chikungunya in many parts of India.

Ascariasis and common cold are not vector-borne diseases.

177. Answer (4)

Hint: Pneumonia infects the vascularised bag-like structures present in lungs.

Sol.: Bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae* are responsible for the disease pneumonia in humans which infects the alveoli (air filled sacs) of the lungs. As a result of the infection, the alveoli get filled with fluid leading to severe problems in respiration. The symptoms of pneumonia include fever, chills, cough and headache. In severe cases, the lips and finger nails may turn grey to bluish in colour. A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person.

178. Answer (3)

Hint: Allergens induce exaggerated response of the immune system.

Sol.: For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied. Somehow, modern-day life style has resulted in lowering of immunity and more sensitivity to allergens – more and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment. This could be because of the protected environment provided early in life.

179. Answer (4)

Hint: The causative agents of filariasis and ascariasis belong to the same phylum.

Sol.: Ringworms – *Microsporum*
Filariasis – *Wuchereria bancrofti*
Common cold – Rhino virus
Ascariasis – *Ascaris*

180. Answer (3)

Hint: Health affects longevity

Sol.: Health increases longevity of people and reduces infant and maternal mortality.

The innate defences of our body like skin, mucous membranes, anti-microbial substances present in our tears, saliva and the phagocytic cells help to block the entry of pathogens into our body.

Health does not simply mean 'absence of diseases' or 'physical fitness'. It could be defined as a state of complete physical, mental and social well-being.

181. Answer (3)

Hint: It is equal to 10 times the number of palm bones in each fore limb of man.

Sol.: There is lymphoid tissue located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called Mucosa Associated Lymphoid Tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.

182. Answer (3)

Hint: Related with eosinophilia

Sol.: The exaggerated response of the immune system to certain antigens present in the environment is called allergy. The antibodies produced in response to allergens are of IgE type.

183. Answer (3)

Hint: Exclude stimultants that produce euphoria.

Sol.: Drugs like barbiturates, benzodiazepines, and other similar drugs, are normally used as medicines to help patients cope with mental illnesses like depression and insomnia.

Stimulants like cocaine also known as crack stimulate the nervous system; make a person more wakeful, increase alertness and activity, produce excitement, *etc*.

184. Answer (3)

Hint: Acts as a physical barrier of innate immunity

Sol.: In humans, the innate immunity consists of four types of barriers. These are:

(i) Physical barriers

(ii) Physiological barriers

(iii) Cellular barriers

(iv) Cytokine barriers

Acid in the stomach, saliva in the mouth and tears from eyes, all prevent microbial growth. They fall under the category of physiological barriers of innate immunity.

Mucus coating of the epithelium lining the respiratory, gastrointestinal and urogenital tracts help in trapping microbes entering our body. It acts as a physical barrier.

185. Answer (4)

Hint: Amongst all non-infectious diseases, it is one of the major causes of death.

Sol.: Among non-infectious diseases, cancer is the major cause of death.

Diseases which can be easily transmitted from one person to another, are called infectious diseases. Amoebiasis, ringworms and pneumonia are infectious diseases which are caused by protozoa, fungi and bacteria respectively.

SECTION-B

186. Answer (4)

Hint: Observed in females as a side effect.

Sol.: The side-effects of the use of anabolic steroids in females include deepening of voice. In males it includes acne, increased aggressiveness, mood swings, depression, reduction of size of the testicles, decreased sperm production, potential for kidney and liver dysfunction, breast enlargement, premature baldness, enlargement of the prostate gland.

187. Answer (2)

Hint: The rays used by MRI share the same property as UV-rays.

Sol.: Computed tomography uses X-rays to generate a three-dimensional image of the internals of an object. MRI uses strong magnetic fields and non-ionising radiations to accurately detect pathological and physiological changes in the living tissue.

188. Answer (4)

Hint: Nicotine is an alkaloid

Sol.:

- The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer.
- Mumps is an infectious disease caused by the paramyxovirus. In this disease, a person faces difficulty in opening the mouth as a painful swelling occurs in the parotid glands.
- Amoebic dysentery is caused by *Entamoeba histolytica*, which is a protozoan.

189. Answer (4)

Hint: Cells slough from such tumors reach distant sites and start a new tumor.

Sol.: Tumors are of two types: benign and malignant. Benign tumors normally remain confined to their original location and do not spread to other parts of the body. The malignant tumors, on the other hand are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant tumors.

190. Answer (4)

Hint: Site associated with bones

Sol.: The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes. After maturation, the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix. The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.

- The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.
- The lymph nodes are small solid structures located at different points along the lymphatic system. Lymph nodes serve to trap the micro-organisms or other antigens, which happen to get into the lymph and tissue fluid. Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.

191. Answer (4)

Hint: Vaccines also generate memory-B and T-cells.

Sol.:

- The T-cells themselves do not secrete antibodies but help B-cells to produce them.
- The principle of immunisation or vaccination is based on the property of 'memory' of the immune system. In vaccination, a preparation of antigenic proteins of pathogen or inactivated/weakened pathogen (vaccine) are introduced into the body. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection. The vaccines also generate memory-B and T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.

  Most parasites are pathogenic, not all.

192. Answer (1)

Hint: Gamma rays fall under the same category as the X-rays.

Sol.:

- The malignant tumors are a mass of proliferating cells called neoplastic or tumor cells.

  As these cells actively divide and grow, they starve the normal cells by competing for vital nutrients.
- Several genes called cellular oncogenes (*c-onc*) or proto-oncogenes have been identified in normal cells which when activated under certain conditions, could lead to oncogenic transformation of the cells.
- Telomerase activity of cells increases in cancer.

193. Answer (3)

Hint: It is obtained from *Papaver somniferum*.

Sol.: Morphine is a very effective sedative and painkiller and is very useful in patients who have undergone surgery.

Abrin is a toxin.

Coca alkaloid and amphetamine are stimulants.

194. Answer (4)

Hint: The pathogen of AIDS destroys the lymphocytes.

Sol.: HIV enters into helper T-lymphocytes (T_H), replicates and produces progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. During this period, the person suffers from bouts of fever, diarrhoea and weight loss. Due to decrease in the number of helper-T lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially *Mycobacterium*, viruses, fungi and even parasites like *Toxoplasma*.

195. Answer (3)

Hint: Inflorescences of the plant *Cannabis sativa* is used to obtain cannabinoids.

Sol.: Psoriasis is an auto-immune disorder. Latex of poppy plant is used to obtain 'heroin'.

The causative agent of gonorrhea is *Neisseria*. It is a sexually transmitted disease.

196. Answer (4)

Hint: Vincristine and vinblastine are some of the chemotherapeutic drugs.

Sol.: Cancer detection is based on biopsy and histopathological studies of the tissue and blood and bone marrow tests for increased cell counts in the case of leukemia. In biopsy, a piece of the suspected tissue cut into thin sections is stained and examined under microscope (histopathological studies) by a pathologist.

Specific antibodies can also be used for the detection of cancer.

Chemotherapy and immunotherapy are used for the treatment of cancer.

197. Answer (4)

Hint: Viral disease

Sol.: *Salmonella typhi* is a pathogenic bacterium which causes typhoid fever in human beings. These pathogens generally enter the small intestine through food and water contaminated with them and migrate to other organs through blood. Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases.

Common cold is a viral disease.

198. Answer (1)

Hint: Infective stage for mosquitoes.

Sol.: Female mosquito takes up gametocytes with blood meal. Their fertilization and development take place in the mosquito's gut itself.

199. Answer (3)

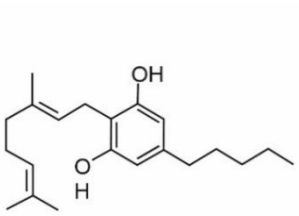
Hint: Sympathetic nervous system can increase the cardiac output.

Sol.: Tobacco contains a large number of chemical substances including nicotine, an alkaloid. Nicotine stimulates adrenal medulla to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate.

200. Answer (2)

Hint: Affects both, brain and cardiovascular system.

Sol.:



Cannabinoid

Opium poppy

- Morphine and heroin are obtained from *Papaver somniferum.* They are opioids.
- Natural cannabinoids are obtained from the inflorescences of the plant *Cannabis sativa*. The flower tops, leaves and the resin of *Cannabis* plant are used in various combinations to produce marijuana, hashish, charas and ganja. It is generally taken by inhalation and oral ingestion.

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