All India Aakash Test Series for NEET - 2025

TEST - 2 (Code-A)

Click Here for Code-B Sol.

Test Date : 29/09/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (4)

Hint & Sol.: Due to random motion of free electrons in a conductor, in the absence of external electric field $\langle u \rangle = 0$

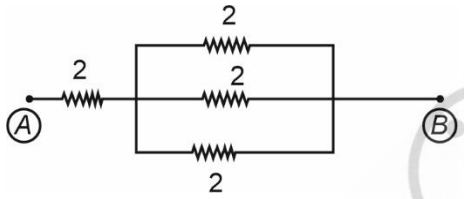
2. Answer (4)

Hint & Sol.: We know, $\vec{j} = \sigma\vec{E}$ is Ohm's law in vector form.

3. Answer (3)

Hint: Point *B*, *C*, *D* and *L* are equipotential

Sol.: The circuit can be modified as



$$R_{net} = 2 + \frac{2}{3} = \frac{8}{3}\ \Omega$$

4. Answer (4)

Hint: During discharging terminal potential difference across cell decreases while it increases during charging.

Sol.: Since 4 V > 2 V, $\therefore$ 4 V is discharging while 2 V is charging. Hence $V_1 < 4$ V while $V_2 > 2$ V

Here, $I = \frac{4-2}{4} = 0.5$ A

$\therefore \quad V_1 = 4 - 0.5(2) = 3$ V

and $V_2 = 2 + 0.5(2) = 3$ V

5. Answer (3)

Hint & Sol.: $i = neAv_d$

$$\Rightarrow \quad \frac{50}{100} = \frac{\frac{\pi}{4}d^2 \times v}{\frac{\pi}{4} \times \frac{d^2}{16}v'} \Rightarrow \frac{1}{2} = \frac{16d^2v}{d^2v'}$$

$\Rightarrow \quad v' = 32v$

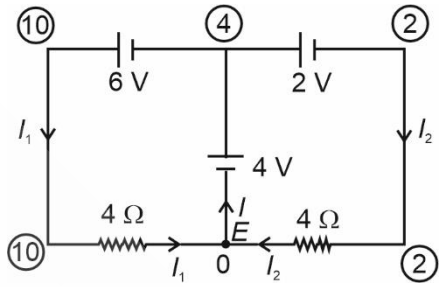
6. Answer (2)

Hint & Sol.: Kirchhoff's junction rule is a manifestation of law of conservation of charge.

7. Answer (3)

Hint: Assume *E* at zero potential, then potential at *B* will be 4 V and thus *A* will be at 10 V and *C* at 2 V.

Sol.: Potential of various points in the circuit (modified) is encircled.



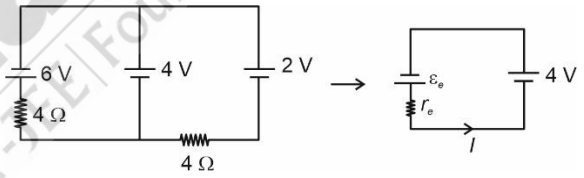
Here, $I = I_1 + I_2$

$$I = \frac{10-0}{4} + \frac{2-0}{4}$$

$I = 2.5 + 0.5$

$I = 3$ A

Method-2



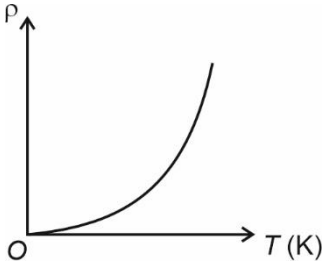
$$\varepsilon_e = \frac{\frac{6}{4} - \frac{2}{4}}{\frac{1}{4} + \frac{1}{4}} = 2\text{V}$$

$r_e = 2\ \Omega$

$$I = \frac{2+4}{2}\text{A} = 3\text{ A}$$

8. Answer (2)

Hint & Sol.: The graph of ρ vs *T* of copper is as shown



9. Answer (4)

Hint & Sol.: Relative magnetic permeability $\left[\mu_r = \frac{\mu}{\mu_0}\right]$ has no unit.

10. Answer (4)

Hint: Use, $F = qvB\sin\theta$ and note $v = 0$

Sol.: Inspite of space varying magnetic field if $v = 0$ then $F = 0$

Thus, the charged particle will remain at rest.

11. Answer (2)

Hint: Use momentum $p = mv = \sqrt{2m(\text{K.E.})}$

Sol.: We know, Radius $R = \frac{mv}{qB} = \frac{\sqrt{2m(\text{KE})}}{qB}$

For proton and deuteron q, B and K.E. are same

$\therefore \quad R \propto \sqrt{m}$

$\frac{R_1}{R_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{2}} = 1:\sqrt{2}$

12. Answer (1)

Hint: Direction of $\vec{E}, \vec{B}$ and $\vec{v}$ is same

Sol.: Since $\vec{v} \parallel \vec{B} \ \therefore F = qvB\sin\theta = 0$

Thus, the electron will keep moving rectilinearly along X-axis due to force by electric field only.

13. Answer (2)

Hint & Sol.: Due to infinitely long current carrying wire intensity of magnetic field, $B = \frac{\mu_0}{4\pi}\frac{2I}{r}$

14. Answer (4)

Hint: Magnetic field due to a segment of circular current carrying wire is $B = \frac{\mu_0}{4\pi}\frac{I\theta}{r}$

Sol.: $B = B_2 - B_1 = \frac{\mu_0}{4\pi}\frac{I\pi}{3}\left(\frac{1}{a} - \frac{1}{2a}\right) \quad \begin{bmatrix} B_2 \to \odot \\ B_1 \to \otimes \end{bmatrix}$

$= \frac{\mu_0 I}{12}\left(\frac{2-1}{2a}\right) = \frac{\mu_0 I}{24a}$

15. Answer (4)

Hint: Use $\tau_{max} = NBIA\sin 90^\circ$

Sol.: $\tau_{max} = (100)(20)(40)\frac{22}{7} \times \frac{7}{100} \times \frac{7}{100}$

$\tau_{max} = 8 \times 22 \times 7 = 1232 \text{ N m}$

16. Answer (4)

Hint & Sol.: Voltage sensitivity of a moving coil galvanometer is defined as deflection produced per unit applied voltage.

17. Answer (4)

Hint & Sol.: Retentivity of a specimen is measure of the magnetic field remaining in ferromagnetic specimen when magnetising field is removed. Hence retentivity is equal to 2 T.

18. Answer (2)

Hint & Sol.: A voltmeter has to be connected in parallel to the circuit. Hence, in ideal condition it should not draw any current and thus should have infinite resistance ideally.

19. Answer (3)

Hint: $\vec{B}_{\text{axial}} = -2\vec{B}_{\text{equatorial}}$

Sol.: We know, bar magnetic is a magnetic dipole in which geometric length > magnetic length.

20. Answer (4)

Hint & Sol.: We know, $U = -MB \quad [\because \theta = 0^\circ]$

$-2 \times 10^{-3} = -M(4)$

$M = 0.5 \times 10^{-3} \text{ Am}^2$

21. Answer (1)

Hint: A shunt resistance is connected in parallel to galvanometer.

Sol.: Value of shunt resistance $S = \frac{I_g G}{I - I_g} = \frac{(2\times10^{-3})(10)}{2 - 2\times10^{-3}}$

$S = \frac{2\times10^{-2}}{2} = 10^{-2} = 0.01\,\Omega \ [I_g << I]$

$\therefore$ Net resistance $R_{\text{net}} = \frac{GS}{G+S} = \frac{10(0.01)}{10+0.01}$

$R_{\text{net}} = \frac{0.1}{10.01} = \frac{10}{1001} = \frac{1}{100} \quad [S << G]$

22. Answer (4)

Hint: Bohr magneton is actually magnetic moment

Sol.: $M = IA$

$[M] = [M^0L^2T^0A]$

23. Answer (4)

Hint: Use $\mu_r = 1 + \chi_m$

Sol.: Since, μ_r is always positive

$\therefore$ μ is also always positive.

24. Answer (4)

Hint: Intensity of magnetisation, $I = \frac{m}{A}\frac{(\text{Pole strength})}{(\text{Area})}$

Sol.: We know, $I = \frac{m}{A} = \frac{10}{10 \times 10^{-4}}$

$I = 10^4$ A m^{-1}

25. Answer (2)

Hint & Sol.: We know, $\oint \vec{B} \cdot d\vec{s} = 0$ for any closed surface thus magnetism will always exist in dipole form. Thus, it indicates absence of magnetic mono poles.

26. Answer (3)

Hint & Sol.: There is no change in speed of charged particle because no work is done by the magnetic field while magnetic field can change the momentum of charged particle. Hence assertion is true and reason is false.

27. Answer (2)

Hint: In paramagnetic materials, $\chi_m \propto \frac{1}{T}$

Sol.: For paramagnetic, susceptibility decreases with increase in temperature and ferromagnetic materials turn paramagnetic above curie temperature.

28. Answer (1)

Hint: For long solenoid, $B = \mu_0 nI$

Sol.: We know, $I = \frac{V}{R} = \frac{1000}{100} = 10$ A

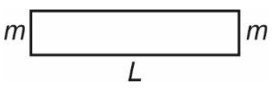
$\therefore$ $B = 4\pi \times 10^{-7} \times 10^3 \times 10$

$B = 4\pi \times 10^{-3}$ T

29. Answer (3)

Hint: Magnetic moment, $M = m \cdot l_{\text{eff}}$

Sol.: $M = mL$



For semicircle

$L = \pi r \Rightarrow r = \frac{L}{\pi}$

$\therefore M' = m \cdot 2r = m \times \frac{2L}{\pi} = \frac{2M}{\pi}$

30. Answer (2)

Hint: Use $F = I\ell_{\text{eff}} B\sin\theta$

Sol.: $F = (10)\,(8)\,(2)\sin 90°$

$F = 160$ N

31. Answer (4)

Hint & Sol.: Since the angle between magnetic field and area vector is 90°, the flux would be zero.

32. Answer (4)

Hint: Emf induced in rod $\varepsilon = (\vec{v} \times \vec{B}) \cdot \vec{l}$

Sol.: To determine ε, the information about angle between $\vec{v}$ and $\vec{B}$ along with angle between $\vec{v} \times \vec{B}$ and $\vec{l}$ is needed.

33. Answer (2)

Hint: Current $i \propto \frac{1}{R}$ and $R \propto l$

Sol.: We know, eddy currents are produced in the form of whirls

$\therefore$ In B the length for flow of current is maximum. Thus, it will have maximum resistance and hence minimum current.

34. Answer (1)

Hint & Sol.: Ampere's law = $\oint \vec{B} \cdot d\vec{l} = \mu_0 i$

Intensity of magnetic field due to current carrying semicircular loop at its centre $= \frac{\mu_0 i}{4r}$

Lorentz force $\Rightarrow \vec{F} = q\left[\vec{E} + \vec{v} \times \vec{B}\right]$

Intensity of magnetic field on the axis of solenoid = $\mu_0 ni$

Intensity of magnetic field on the axis of current carrying thin long pipe = Zero

35. Answer (3)

Hint: $V_A = V_D = \frac{1}{2} Bl^2 \omega$

Sol.: $\because$ $V_A = V_D$

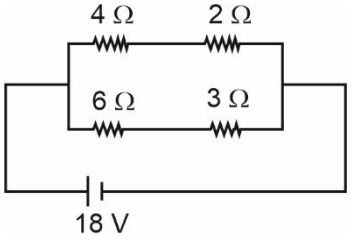
$\therefore$ $V_0 - V_A = V_0 - V_D$

SECTION-B

36. Answer (3)

Hint: The given arrangement is a balanced wheat stone bridge

Sol.: The circuit can be modified as



$$R_{net} = \left(\frac{1}{6} + \frac{1}{9}\right)^{-1} = \frac{18}{5}\ \Omega$$

$$I = \frac{V}{R_{net}} = \frac{18}{\frac{18}{5}} = 5\ \text{A}$$

37. Answer (2)

Hint: Intensity of magnetic field inside a solenoid = $\mu_0\mu_r ni$

Sol.: $B = \mu_0\mu_r ni \Rightarrow 4\pi \times 10^{-7} \times \mu_r \times 10^3 \times 2$

$\Rightarrow \mu_r = 5000$ and $\mu_r = 1 + \chi$

$\Rightarrow \chi = 4999$

38. Answer (4)

Hint: Self inductance of a solenoid, $L = \frac{\mu_0\mu_r N^2 A}{l}$

Sol.: $L = \frac{\mu_0\mu_r N^2 A}{l} \Rightarrow L \propto \frac{N^2}{l}$

$$\Rightarrow \frac{L_A}{L_B} = \left(\frac{N_A}{N_B}\right)^2 \times \left(\frac{I_B}{I_A}\right)$$

$$\Rightarrow \frac{L_A}{L_B} = \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{2}\right) = \frac{1}{8}$$

39. Answer (4)

Hint: Potential drop across inductor $= -\frac{LdI}{dt}$

Sol.: Using Kirchhoff's law,

$V_A - 0.4(20) - 2 - (4) + 6 = V_B$

$V_A - 8 - 2 - 4 + 6 = V_B$

$\therefore\ V_A - V_B = 8$ V

40. Answer (2)

Hint: Induced current, $I = \frac{1}{R}\frac{d\phi}{dt} \Rightarrow \frac{dq}{dt} = \frac{d\phi}{Rdt}$

$$\Rightarrow\ q = \frac{\Delta\phi}{R}$$

Sol.: $q = \frac{A(\Delta B)}{R} = \frac{40 \times 10^{-4}(0.4)}{10}$

$q = 160 \times 10^{-6}$ C $= 160\ \mu$C

41. Answer (2)

Hint: $U = \frac{1}{2}LI^2$

Sol.: We known, $U \propto I^2$

$$\therefore\ \frac{U_1}{U_2} = \left(\frac{I}{3I}\right)^2 \Rightarrow U_2 = 9U_1$$

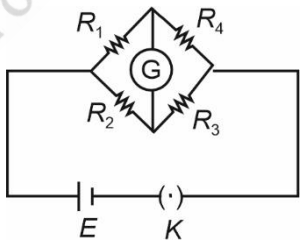
42. Answer (3)

Hint & Sol.: Mutual inductance depends on the number of turns in both the coils as well as on the orientation of the coils.

43. Answer (2)

Hint: For balanced wheatstone bridge product of diagonally opposite resistors should be equal.

Sol.: For null deflection:



$R_1R_3 = R_2R_4$

In all the given circuits

$R_1 = 5\ \Omega$, $R_3 = 10\ \Omega$

$\therefore\ R_1R_3 = 50\ \Omega$

Hence, R_2R_4 should be equal to 50 Ω which is possible in circuit (2) only.

44. Answer (4)

Hint & Sol.: Force applied by uniform magnetic field on a current carrying closed loop is always zero.

45. Answer (2)

Hint & Sol.: Paramagnetic substances are weekly attracted towards magnetic field. The susceptibility of paramagnetic substance is greater than zero.

46. Answer (4)

Hint: $\frac{\Delta\phi}{\Delta t} = \frac{L\Delta i}{\Delta t}$

Sol.: $\varepsilon = \frac{-\Delta\phi}{\Delta t} = -\frac{L\Delta i}{\Delta t}$

$\varepsilon = \frac{-L\times(3-(-1))}{0.4} \Rightarrow 0.2 = \left|-\frac{L\times 4}{0.4}\right|$

L = 20 mH

47. Answer (3)

Hint & Sol.: Emf can be induced in a coil by changing magnetic flux.

48. Answer (4)

Hint: Time period, $T = 2\pi\sqrt{\frac{I}{MB}}$

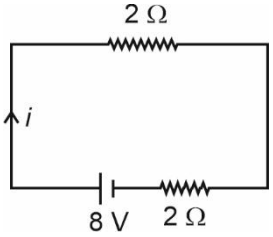
Sol.: $T \propto \sqrt{I} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{1}{4}}$

$\therefore \quad \frac{T_1}{T_2} = \frac{1}{2}$

49. Answer (2)

Hint: At steady state, the capacitor will not allow current to pass through it.

Sol.: The simplified circuit at steady state will be



$i = \frac{V}{R} = \frac{8}{4} = 2$ A

Potential difference across 2 Ω is 2 × 2 = 4 volt

$Q = CV \Rightarrow Q = 3 \times 4 = 12\ \mu C$

50. Answer (2)

Hint: Use formula $\frac{\theta}{i} = \frac{NAB}{k}$

Sol.: Current sensitivity $\frac{\theta}{i} = \frac{NAB}{k}$

By increasing magnetic field (B) current sensitivity can be increased.

[CHEMISTRY]

SECTION-A

51. Answer (3)

Hint: For expressing the rate of a reaction, the rate of disappearance of reactants or the rate of appearance of products is divided by their respective stoichiometric coefficients.

Sol.: $2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$

The rate of this reaction is given by

$$\frac{-1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{2}\frac{d[N_2O_4]}{dt} = \frac{d[O_2]}{dt}$$

52. Answer (1)

Hint: For a general reaction

aA + bB → cC + dD

Rate = $k[A]^x[B]^y$

where x + y = n = order of reaction

Rate constant = $k = \frac{\text{Rate}}{[A]^x[B]^y}$

$k = \frac{\text{concentration}}{\text{time}} \times \frac{1}{(\text{concentration})^n}$

Unit of k for n^{th} order = $(\text{concentration})^{1-n}\ \text{time}^{-1}$

Sol.: For zero order reaction, n = 0

Unit of k = $(\text{mol L}^{-1})^{1-0}\ \text{s}^{-1}$

= $\text{mol L}^{-1}\text{s}^{-1}$

For second order reaction, n = 2

Unit of k = $(\text{mol L}^{-1})^{1-2}\ \text{s}^{-1}$

= $\text{mol}^{-1}\text{L s}^{-1}$

53. Answer (2)

Hint: For first order reaction

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t}$$

where, k = rate constant of the reaction

t = time of reaction

$[A]_0$ = Initial concentration of reactant

$[A]_t$ = Concentration of reactant after time 't'

Sol.: $t = \frac{2.303}{k}\log\frac{[A]_0}{[A]_t}$

$[A]_0$ = 100 g

$[A]_t$ = 10 g

$k = 10^{-3}$ s

$t = \frac{2.303}{10^{-3}}\log\frac{100}{10}$

$t = 2.303 \times 10^3 = 2303$ s

54. Answer (1)

Hint: The oxoacids in +3 oxidation state of phosphorus tend to disproportionate to higher and lower oxidation states.

Sol.: H_3PO_3 on heating disproportionates to give phosphoric acid and phosphine.

$4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$

55. Answer (2)

Hint: The sum of powers of the concentration of the reactants in the rate law expression is called the order of the chemical reaction.

Sol.: For the given reaction,

$A + B \rightarrow$ Product

Rate = $k[A]^{1/2}[B]^2$ [given]

If A is taken in excess modified rate law : $R = k[B]^2$

The overall order of the reaction = 2

56. Answer (3)

Hint: The plot of ln k v/s $\frac{1}{T}$ gives a straight line

$$\ln k = \frac{-E_a}{RT} + \ln A$$

Slope = $\frac{-E_a}{R}$ and intercept = ln A

Sol.: $\ln k = \ln A - \frac{E_a}{RT}$

Slope = $\frac{-E_a}{R}$

$$\frac{-E_a}{R} = -4 \times 10^2$$

$E_a = 4 \times 10^2 \times 8.314$

$E_a = 3.325$ kJ mol^{-1}

57. Answer (2)

Hint: For a bimolecular elementary reaction

$A + B \rightarrow$ Products

Rate of the reaction can be expressed as,

$$\text{Rate} = PZ_{AB}e^{-E_a/RT}$$

Sol.: Z_{AB} = Collision frequency of reactants, A and B

P = Probability or steric factor

$e^{-E_a/RT}$ = Fraction of molecules with energies equal to or greater than E_a.

58. Answer (4)

Hint: The decomposition of gaseous ammonia on a hot platinum surface is a zero order reaction at high pressure.

Sol.: Inversion of cane sugar is pseudo first order reaction

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \text{Glucose} + \text{Fructose}$$

Rate = $k[C_{12}H_{22}O_{11}]$

59. Answer (3)

Hint: For every 10° rise in temperature, rate becomes two times.

Sol.:

$T_1 = 50° \xrightarrow[2 \text{ times}]{} 60° \xrightarrow[4 \text{ times}]{} 70° \xrightarrow[8 \text{ times}]{}$

$T_2 = 80°$

$(\text{Rate})_{new} = 2^3 (\text{Rate})_{old}$

$(\text{Rate})_{new} = 8 (\text{Rate})_{old}$

60. Answer (3)

Hint: For 1st order

$$K = \frac{2.303}{t}\log\left(\frac{P_i}{P_i - x}\right)$$

Sol.:

	A(g)	→	B(g)	+	C(g)
$t = 0$	p_i atm		0 atm		0 atm
time : t	$(p_i - x)$ atm		x atm		x atm

$p_t = (p_i - x) + x + x$

$p_t = p_i + x$

$x = p_t - p_i$

Partial pressure of A(g) at time t = $p_i - x$

$= p_i - (p_t - p_i)$

$= 2p_i - p_t$

$$k = \frac{2.303}{t}\log\frac{p_i}{p_i - x}$$

$$k = \frac{2.303}{t}\log\frac{p_i}{2p_i - p_t}$$

61. Answer (2)

Hint: Red phosphorus is much less reactive than white phosphorus.

Sol.: Red phosphorus is obtained by heating white phosphorus at 573 K in an inert atmosphere for several days.

62. Answer (4)

Hint: Concentrated HNO_3 is a strong oxidising agent and products of reaction depends upon the concentration of the acid.

Sol.: Zinc reacts with dilute HNO_3 to give N_2O and with concentrated HNO_3 to give NO_2.

$4Zn + 10HNO_3(\text{dilute}) \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$

$Zn + 4HNO_3\ (\text{conc.}) \rightarrow Zn(NO_3)_2 + 2H_2O + 2NO_2$

63. Answer (1)

Hint & Sol.: A brown ring at the interface between the solution and sulphuric acid layers indicates the presence of nitrate ion in the solution.

$$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \longrightarrow \underset{\text{(brown)}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

64. Answer (2)

Hint: Boiling point of NH_3 is higher than PH_3 due to presence of intermolecular hydrogen bonding in NH_3.

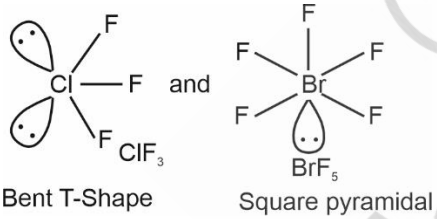
Sol.:

Molecule	Boiling point/K
NH_3	238.5
PH_3	185.5
AsH_3	210.6
SbH_3	254.6
BiH_3	290

65. Answer (4)

Hint: The hybridisation of Cl and Br in ClF_3 and BrF_5 are sp^3d and sp^3d^2 respectively.

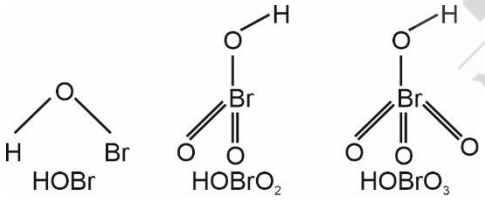
Sol.:



Bent T-Shape Square pyramidal

66. Answer (2)

Hint & Sol.: In case of bromine, HOBr, $HOBrO_2$ and $HOBrO_3$ are only possible oxoacid.



67. Answer (3)

Hint: F_2 is more reactive than interhalogen compounds.

Sol.: In general, interhalogen compounds (XX′) are more reactive than halogens (X_2) except F_2 due to weak X–X′ bond than X–X except F–F bond.

68. Answer (3)

Hint: More the acidic strength of a substance, less will be the value of pK_a.

Sol.:

Compound	pK_a value
H–F	3.2
H–Cl	–7.0
H–Br	–9.5
H–I	–10.0

69. Answer (3)

Hint: The ions which contains partially filled *d*-orbitals shows colour in aqueous medium

Sol.:

Configuration	Ions	Colour
$3d^0$	Sc^{3+}	Colourless
$3d^0$	Ti^{4+}	Colourless
$3d^4$	Cr^{2+}	Blue
$3d^{10}$	Zn^{2+}	Colourless

70. Answer (1)

Hint: Ozone is used as oxidising agent for the preparation of $KMnO_4$.

Sol.: Pure ozone is a pale blue gas, dark blue liquid and violet-black solid.

71. Answer (3)

Hint: In vapour state sulphur partly exists as S_2 molecule.

Sol.: S_2 molecule has two unpaired electrons in the antibonding π^* orbitals like O_2 and hence, exhibits paramagnetism.

72. Answer (3)

Hint & Sol.: Sulphur dioxide gas reacts with chlorine in the presence of charcoal (which acts as a catalyst) to give sulphuryl chloride, SO_2Cl_2.

73. Answer (3)

Hint: XeF_2 is a powerful fluorinating agent.

Sol.: XeF_2 is hydrolysed to give Xe, HF and O_2.

$2XeF_2(s) + 2H_2O(l) \rightarrow 2Xe(g) + 4HF(aq) + O_2(g)$

74. Answer (2)

Hint: Noble gases have stable electronic configurations; hence they have no tendency to accept the electrons and therefore, have large positive values of electron gain enthalpy.

Sol.:

Element	Electron gain enthalpy (kJ/mol)
He	48
Ne	116
Ar	96
Xe	77

75. Answer (4)

Hint: The general electronic configuration of Lanthanoids is $[Xe]4f^{1-14}\ 5d^{0-1}6s^2$

Sol.: Electronic configuration of Gd (Z = 64) is $[Xe]4f^7 5d^1 6s^2$, while

Electronic configuration of Yb (Z = 70) is $[Xe]4f^{14}6s^2$

76. Answer (3)

Hint: Lanthanoids liberate hydrogen gas when treated with dilute acids.

Sol.: Ln —(with acids)→ H_2; Ln —(heated with N)→ LnN

77. Answer (3)

Hint: In general, the actinoids shows +3 oxidation state.

Sol.:

Element	Possible oxidation states
Th	+4 only
Pa	+3, +4 and +5 only
U	+3, +4, +5 and +6 only
Np	+3, +4, +5, +6 and +7 only
Pu	+3, +4, +5, +6 and +7 only
Am	+3, +4, +5 and +6 only
Cf	+3 only

78. Answer (2)

Hint: $KMnO_4$ on heating at 513 K gives K_2MnO_4, MnO_2 and O_2.

Sol.: $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

79. Answer (3)

Hint: In acidic medium, the half-reaction for $K_2Cr_2O_7$ as reducing agent is

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

Sol.:

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

80. Answer (2)

Hint: The species having central atom has highest oxidation state has strongest oxidising power.

Sol.: The correct order of oxidising power in the series is $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

81. Answer (2)

Hint: Stronger the interatomic interaction, higher the enthalpies of atomisation.

Sol.:

Elements	Enthalpy of atomisation (kJ/mol)
Ti	475
V	515
Mn	281
Zn	126

82. Answer (1)

Hint: Cu(I) compounds are unstable in aqueous solution and undergo disproportionation.

$2Cu^+(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$

Sol.: The stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than $Cu^+(aq)$, which more than compensates for the second ionisation enthalpy of Cu.

83. Answer (2)

Hint: Magnetic moment (μ) is calculated as

$\mu = \sqrt{n(n+2)}$ BM

where 'n' denotes number of unpaired electrons.

Sol.:

Ion	Unpaired electron(s)	Calculated magnetic moment (BM)
Ti^{2+}	2	2.84
V^{2+}	3	3.87
Fe^{2+}	4	4.90
Cu^{2+}	1	1.73

84. Answer (4)

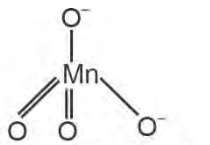
Hint: Transition metal has ability to form alloy.

Sol.: Alloys of transition metals with non-transition metals such as brass (copper-zinc) and bronze (copper-tin).

85. Answer (1)

Hint: The manganate ion is MnO_4^{2-}, in which central Mn atom is sp^3 hybridised.

Sol.:



Tetrahedral manganate (green) ion

SECTION-B

86. Answer (1)

Hint: For first order reaction,

$t_{½} = \frac{0.693}{k}$

where, k = rate constant of the reaction.

Sol.: When reaction is completed 99.9%

$[A]_t = [A]_0 - 0.999\,[A]_0$

$[A]_t = 10^{-3}\,[A]_0$

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t}$$

$$k = \frac{2.303}{t}\log\frac{[A]_0}{10^{-3}[A]_0}$$

$$t = \frac{2.303}{t}\log 10^3 = \frac{2.303\times 3}{k} = \frac{6.909}{k}$$

For half life of first order reaction,

$$t = \frac{0.693}{k}$$

$$\frac{t_{99.9}}{t_{½}} = \frac{6.909}{k}\times\frac{k}{0.693} \cong 10$$

87. Answer (1)

Hint: Lower the value of activation energy faster will be the rate of reaction.

Sol.: A catalyst, catalyses the forward as well as backward reaction to the same extent. A catalyst does not alter the ΔG of reaction.

Order is applicable to elementary as well as complex reaction whereas molecularity is applicable only for elementary reactions.

88. Answer (1)

Hint: For a first order reaction,

$\ln[R] = \ln[R]_0 - kt$

where, $[R]_0$ = Initial concentration of reactant

[R] = Concentration of reactant after time 't'

Sol.: At time 't_1'

$\ln[R]_1 = -kt_1 + \ln[R]_0$ ...(1)

At time 't_2'

$\ln[R]_2 = -kt_2 + \ln[R]_0$ ...(2)

Subtract eq (2) from eq (1)

$\ln[R]_1 - \ln[R]_2 = -kt_1 - (-kt_2)$

$$\ln\frac{[R]_1}{[R]_2} = k(t_2 - t_1)$$

$$k = \frac{1}{t_2 - t_1}\ln\frac{[R]_1}{[R]_2}$$

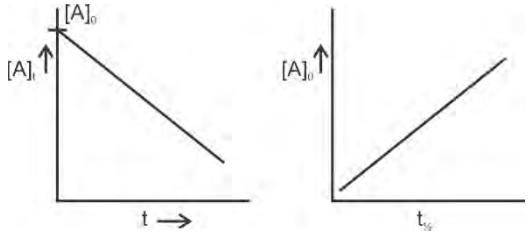
89. Answer (1)

Hint: For zero order reaction

$A \rightarrow B$

$[A]_t = [A]_0 - kt$

Sol.:



90. Answer (3)

Hint: Phosphorus disproportionate in present to NaOH.

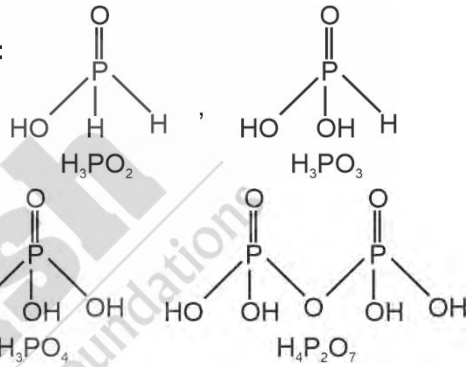
Sol.:

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + \underset{\text{(sodium hypophosphite)}}{3NaH_2PO_2}$$

91. Answer (2)

Hint: In oxoacids, phosphorous is tetrahedrally surrounded by other atoms.

Sol.:



92. Answer (1)

Hint: Order can be defined for both elementary and complex reaction.

Sol.: Order of a reaction is an experimental quantity whose value can be 0, 1, 2, 3 and even a fraction.

93. Answer (1)

Hint: Aqua regia is a very strong oxidising agent that can react with noble metals also.

Sol.: When three parts of concentrated HCl and one part of concentrated HNO_3 are mixed.

94. Answer (1)

Hint: In Deacon's process, hydrogen chloride gas is oxidised by atmospheric oxygen in the presence of $CuCl_2$ (catalyst) at 723 K.

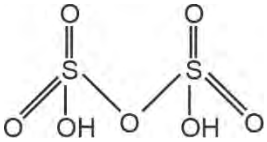
$$4HCl + O_2 \xrightarrow{CuCl_2} 2Cl_2 + 2H_2O$$

Sol.:

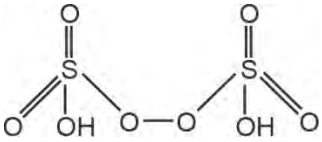
Species	Method of preparation
Cl_2	Deacon's process
H_2SO_4	Contact process
HNO_3	Ostwald's process
NH_3	Haber's process

95. Answer (3)

Hint: The correct structure of $H_2S_2O_7$ is



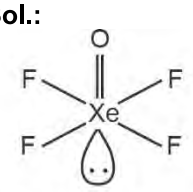
Sol.: In $H_2S_2O_8$, there is one peroxy linkage between two sulphur atoms.



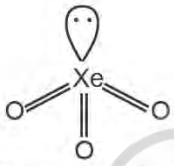
96. Answer (2)

Hint: The hybridisation of Xenon in $XeOF_4$ and XeO_3 are sp^3d^2 and sp^3 respectively.

Sol.:



Structure: Square pyramidal
Hybridisation: sp^3d^2



Structure: Pyramidal
Hybridisation: sp^3

97. Answer (1)

Hint: Due to lanthanoid contraction, Zr (160 pm) and Hf (159 pm) have almost identical radii.

Sol.: Mischmetal consists of a lanthanoid metal (~95%), iron (~5%) and traces of S, C, Ca and Al.

98. Answer (3)

Hint: In actinoids, there is a gradual decrease in the size of atoms or M^{3+} ions across the series.

Sol.:

Ion (M^{3+})	Radii/pm
U	103
Np	101
Am	99
Bk	98

99. Answer (1)

Hint: Interstitial compounds are those which are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals.

Sol.: Interstitial compounds retain metallic conductivity and they are chemically inert.

100. Answer (4)

Hint: Al_2O_3 is an amphoteric oxide which reacts with both acids as well as alkalies.

Sol.: $Al_2O_3(s) + 6HCl(aq) + 9H_2O(l) \rightarrow 2[Al(H_2O)_6]^{3+}(aq) + 6Cl^-(aq)$

$Al_2O_3(s) + 6NaOH(aq) + 3H_2O(l) \rightarrow 2Na_3[Al(OH)_6]\ (aq)$

[BOTANY]

SECTION-A

101. Answer (1)

Hint: In bacteria, transcription and translation are coupled.

Sol.: In bacteria, since the mRNA does not require any processing to become active, and also since transcription and translation takes place in the same compartment (there is no separation of cytosol and nucleus in bacteria), many times the translation can begin much before the mRNA is fully transcribed.

102. Answer (4)

Hint: According to this law segregation of one pair of traits is independent to the other pair of traits.

Sol.: Law of independent assortment was derived from dihybrid cross performed by Mendel.

103. Answer (2)

Hint: In the given transcription unit, 'A' represents template strand that acts as a template for the synthesis of mRNA.

Sol.: 'B' represents coding strand that does not code for anything. 'C' represents promoter which possesses the binding site for RNA polymerase. 'D' represents structural gene that is polycistronic in case of *lac* operon in bacteria.

104. Answer (4)

Hint: Recessive trait is expressed only in homozygous condition.

Sol.: Green seed colour being recessive trait will express only in homozygous condition.

105. Answer (4)

Hint: A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and stop codon.

Sol.:

106. Answer (4)

Hint: Rediscovery of Mendel's law was done in the year 1900.

Sol.: Sutton and Boveri proposed chromosomal theory of inheritance.

Hugo de Vries, Correns and Tschermak rediscovered Mendel's result.

107. Answer (3)

Hint: The sequence of chromosome 1 was completed in May 2006.

Sol.: Chromosome 1 has 2968 genes.

108. Answer (2)

Hint: Heterochromatin is densely packed region of chromatin.

Sol.: Heterochromatin is the region which is transcriptionally inactive in nature.

109. Answer (2)

Hint: Both DNA and protein contain carbon and hydrogen.

Sol.: In the given case both supernatant (containing virus) and the bacteria will show the radioactivity of both carbon and hydrogen.

110. Answer (1)

Hint: 4.6×10^6 bp are present in *Escherichia coli*.

Sol.: 5386 nucleotides are present in $\phi \times 174$ bacteriophage.

111. Answer (2)

Hint: In DNA fingerprinting, detection of hybridised DNA fragments is done by autoradiography.

Sol.: The sensitivity of DNA fingerprinting technique has been increased by the use of polymerase chain reaction.

112. Answer (3)

Hint: Passive processes do not require energy for its occurrence.

Sol.: Binding of mRNA with smaller subunit of ribosome is energy independent process.

113. Answer (4)

Hint: Some amino acids are coded by more than one codon, hence the code is degenerate.

Sol.: UGG is non-degenerate codon. Tryptophan is coded by this codon only. One codon codes for only one amino acid.

114. Answer (4)

Hint: DNA gyrase has topoisomerase activity.

Sol.: During DNA replication, the discontinuously synthesised fragments of DNA are joined by the enzyme DNA ligase.

115. Answer (3)

Hint: One nucleosome has 200 bp.

Sol.: Number of nucleosome $= \frac{\text{No. of bp in the chromatin}}{\text{No. of bp in one nucleosome}} = \frac{6.6 \times 10^9 \text{ bp}}{200 \text{ bp}}$

$= 3.3 \times 10^7$

116. Answer (3)

Hint: Non-sense mutation produces non-functional protein, as a sequence change will give rise to a premature stop codon.

Sol.: Non-sense mutation in *lac i* gene will produce a non-functional repressor. As a result of this, the structural gene will express themselves even in the absence of lactose.

117. Answer (1)

Hint: Phosphodiester linkage is present between two nucleotides.

Sol.: A nitrogenous base is linked to the OH of 1′C pentose sugar through a N-glycosidic linkage to form a nucleoside.

118. Answer (1)

Hint: RNA polymerase III transcribes tRNA, scRNA, 5S rRNA and snRNA.

Sol.: During splicing, introns are removed by small nuclear RNA (snRNA) and protein complex called small nuclear ribonucleoproteins or SnRNPs (Snurps).

119. Answer (1)

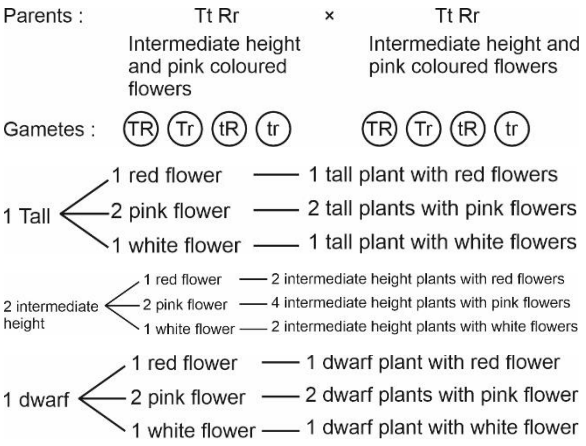
Hint: Taylor used the root of *Vicia faba* to prove semi-conservative nature of chromosome replication.

Sol.: Frederick Griffith used *Streptococcus pneumoniae* and mice to propose the transforming principle.

120. Answer (4)

Hint: In incomplete dominance, phenotypic and genotypic ratios are same.

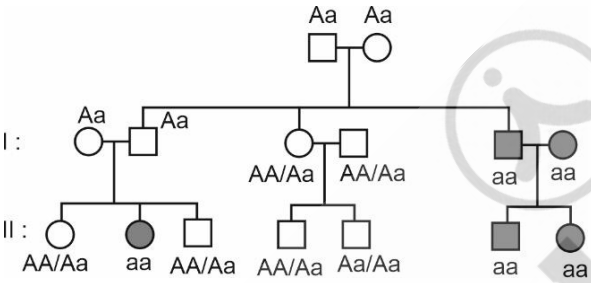
Sol.:



121. Answer (2)

Hint: The pedigree is of autosomal recessive trait.

Sol.: Thalassemia is an autosomal recessive disorder.



122. Answer (1)

Hint: Genes are unit of inheritance.

Sol.: The two alleles of a gene pair are located on homologous sites on homologous chromosomes. Chromosomal disorders can be traced by karyotype study.

123. Answer (2)

Hint: Gynaecomastia is shown by the patients inflicted with Klinefelter's syndrome.

Sol.: Klinefelter's syndrome is caused due to the presence of an additional copy of X-chromosome resulting into 44 + XXY type chromosome complement.

124. Answer (3)

Hint: Down's syndrome is caused due to trisomy of chromosome 21.

Sol.: α-Thalassemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16.

125. Answer (2)

Hint: Haemophilia-B is also known as Christmas disease.

Sol.: People affected with haemophilia-B lacks plasma thromboplastin. Cystic fibrosis is an autosomal recessive disorder.

126. Answer (4)

Hint: Polyploidy implies for having more than two sets of chromosomes in a cell.

Sol.: Failure of cytokinesis after the telophase stage of cell division results in an increase in whole set of chromosomes and this phenomenon is called polyploidy.

127. Answer (4)

Hint: Recombination frequency depends upon the distance between the genes.

Sol.: Closely located genes assorted together, and distantly located genes, due to recombination, assorted independently. Linkage maps, therefore, corresponded to arrangement of genes on a chromosome.

128. Answer (4)

Hint: *Drosophila* shows sexual dimorphism and produces large number of offspring in a single mating.

Sol.: Being an insect, *Drosophila* was not taken as a criteria to consider it as an experimental material.

129. Answer (4)

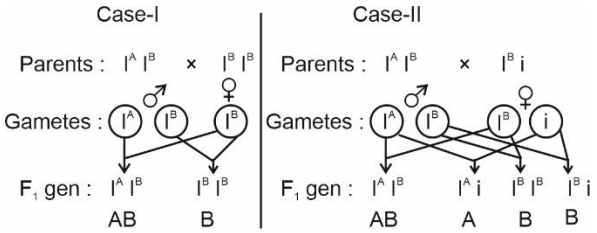
Hint: 1% of recombination frequency = 1 cM

Sol.: Distance between genes of eye colour and wings size in *Drosophila* is 37.2 cM.

130. Answer (3)

Hint: AB blood group shows co-dominance.

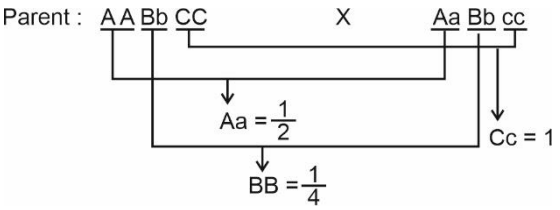
Sol.:



131. Answer (4)

Hint: Probability of having Aa from the cross of AA and Aa is $\frac{1}{2}$.

Sol.:



Probability of having AaBBCc

$$= \frac{1}{2} \times \frac{1}{4} \times 1 = \frac{1}{8}$$

132. Answer (2)

Hint: In co-dominance, the hybrid progeny resembles both the parents.

Sol.: A gene showing co-dominance has both alleles independently expressed in the heterozygote.

133. Answer (1)

Hint: It is a cross when a test organism is crossed with homozygous recessive parent.

Sol.: The progenies of test cross can be easily analysed to predict the genotype of a test organism.

134. Answer (1)

Hint: Types of gametes = 2^n

Sol.: n = 2 (number of hybrids)

$\therefore$ types of gametes = $2^2 = 4$

135. Answer (4)

Hint: Post-transcriptional modification of mRNA occurs in eukaryotes.

Sol.: In prokaryotes, the mRNA does not require any processing to become active. In eukaryotes, translation is not possible if cap (methyl guanosine triphosphate) is lacking, because cap is identified by 18S rRNA of ribosomal unit.

SECTION - B

136. Answer (1)

Hint: *E. coli* completes the process of replication within 18 minutes.

Sol.: When a phosphate group is linked to –OH of 5′C of a nucleoside through phosphoester linkage, a corresponding nucleotide is formed. RNA is the genetic material in QB bacteriophage. RNA is a better genetic material for the transmission of genetic information.

137. Answer (1)

Hint: While proposing the double helical structure of DNA, Watson and Crick immediately proposed a scheme for replication of DNA.

Sol.: Jacob and Monod were the first to elucidate a transcriptionally regulated system. Avery, MacLeod and McCarty concluded that DNA is the hereditary material. X-ray diffraction data for DNA was produced by Wilkins and Franklin.

138. Answer (3)

Hint: Thymine is 5-methyl uracil. Uracil is not present in DNA.

Sol.: Sugar-phosphate backbone is present in both RNA and DNA. The plane of one base pair stacks over the other in double helix. This in addition to H-bonds, confers stability to the helical structure. Presence of thymine at the place of uracil also confers additional stability to DNA.

139. Answer (1)

Hint: This RNA carries amino acid during translation.

Sol.: tRNA acts as an adapter molecule during translation.

140. Answer (2)

Hint: Anticodon is complementary to codon.

Sol.: Codon – 5′ - GUC - 3′

Anticodon – 3′ - CAG - 5′

141. Answer (1)

Hint: He also developed the method for DNA sequencing.

Sol.: Frederick Sanger is credited for developing method for determination of amino acid sequence in proteins.

142. Answer (3)

Hint: This enzyme was discovered by Severo Ochoa.

Sol.: Polynucleotide phosphorylase is helpful in polymerising RNA with defined sequences in a template-independent manner.

143. Answer (1)

Hint: According to principle of complementarity A pairs with T or U and G pairs with C.

Sol.: Like DNA replication, the principle of complementarity governs the process of transcription.

144. Answer (2)

Hint: Males are heterogametic in grasshopper and fruit flies. Females are heterogametic in butterflies and birds.

Sol.:

Mode of sex determination	Organisms
XX – XY	Fruit flies
XX – XO	Grasshopper
ZW – ZZ	Birds
ZO – ZZ	Butterflies

145. Answer (1)

Hint: Loss or gain of a segment of DNA, results in alteration in chromosomes.

Sol.: Since genes are known to be located on chromosome, alteration in chromosomes result in abnormalities or aberrations.

146. Answer (3)

Hint:  denotes affected female.

Sol.:  denotes unspecified sex.

147. Answer (4)

Hint: Polygenic traits are controlled by three or more genes.

Sol.: Human skin colour is a polygenic trait.

148. Answer (2)

Hint: Alec Jeffreys used satellite DNA as probe that shows very high degree of polymorphism. It was called variable number of tandem repeats (VNTR).

Sol.: The VNTR belongs to a class of satellite DNA referred to as mini-satellite. A small DNA sequence is arranged tandemly in many copy numbers. The copy number of VNTR varies from chromosome to chromosome in an individual. The number of repeats show very high degree of polymorphism. As a result the size of VNTR varies in size from 0.1 to 20 kb.

149. Answer (3)

Hint: The given figure depicts the electron micrograph of chromatin in an interphasic nucleus.

Sol.: Nucleosome constitute the repeating unit of a structure in nucleus called chromatin. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.

150. Answer (1)

Hint: Turner's syndrome is caused due to monosomy of allosomes.

Sol.: 45 with X0 is the chromosomal complement of Turner's syndrome.

[ZOOLOGY]

SECTION-A

151. Answer (3)

Hint: One of the causes of venereal disease transmission

Sol.: Counselling and creating awareness among people about reproductive organs, adolescence and associated changes, safe and hygienic sexual practices, sexually transmitted infections (STIs) including AIDS, *etc*., are the primary steps towards reproductive health.

152. Answer (4)

Hint: Viral disease

Sol.: Except for hepatitis-B, genital herpes and HIV infections, other sexually transmitted diseases are completely curable if detected early and treated properly.

153. Answer (2)

Hint: Popular brand for male condom

Sol.: LNG-20 is a hormone releasing intra uterine device. Oral administration of small doses of either progestogens or progestogen-estrogen combinations is a contraceptive method used by the females.

Progestogens alone or in combination with estrogen can also be used by females as injections or implants under the skin.

154. Answer (4)

Hint: Favourite idea for some astronomers

Sol.: The Big Bang theory attempts to explain to us the origin of universe. It talks of a singular huge explosion unimaginable in physical terms. The universe expanded and hence, the temperature came down. Hydrogen and helium formed sometime later. The gases condensed under gravitation and formed the galaxies of the present

day universe. In the solar system of the milky way galaxy, Earth was supposed to have been formed about 4.5 bya.

According to Panspermia, units of life were transferred to different planets including Earth.

155. Answer (4)

Hint: Proposed by Charles Darwin

Sol.: Industrial melanism represents an example of evolution by natural selection. It also represents directional selection.

156. Answer (2)

Hint: A French naturalist

Sol.: Branching descent and natural selection are the two key concepts of Darwinian theory of evolution. Even before Darwin, a French naturalist, Lamarck, had said that evolution of life forms had occurred but driven by use and disuse of organs. He gave the examples of Giraffes, who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks. As they passed on this acquired character of elongated neck to succeeding generations, Giraffes slowly over the years, came to acquire long necks.

157. Answer (3)

Hint: Features associated with Darwinian variations

Sol.: Hugo de Vries based on his work on evening primrose brought forth the idea of mutations – large difference arising suddenly in a population. He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about. Mutations are random and directionless.

158. Answer (1)

Hint: Exclude placental mammals

Sol.:

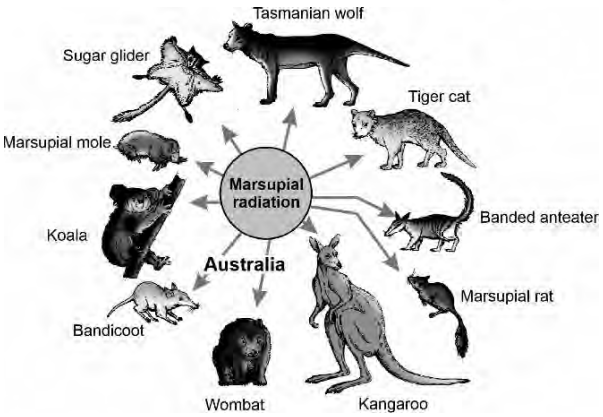


Fig:- Adaptive radiation of marsupials of Australia

159. Answer (2)

Hint: Barrier method

Sol.: Diaphragms, cervical caps and vaults are barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through the cervix. They are reusable but do not prevent the transmission of STIs.

160. Answer (4)

Hint: One of them is a selective estrogen receptor modulator

Sol.: Saheli – the new oral contraceptive for the females contains a non-steroidal preparation. It is 'once a week' pill with very few side effects and high contraceptive value. It does not inhibit ovulation. Contraceptive injections contain progestogens alone or combinations of estrogen and progestogens.

161. Answer (1)

Hint: Calculate the fertile period

Sol.: Periodic abstinence is one of the natural methods of contraception in which the couples avoid from coitus from day 10 to 17 of the 28 days menstrual cycle when ovulation could be expected. As chances of fertilisation are very high during this period, conception could be prevented. In a 32 days menstrual cycle, ovulation will be expected on 18^{th} day. Hence, she should abstain from coitus from day 14 to 21 to prevent the conception.

162. Answer (3)

Hint: Include adolescence period

Sol.: Infections or diseases which are transmitted through sexual intercourse are collectively called Sexually Transmitted Infections (STIs), Venereal Diseases (VDs) or Reproductive Tract Infections (RTIs). Early symptoms of most of these are minor and include itching, fluid discharge, *etc*. Infected females may often be asymptomatic and hence, may remain undetected for long. Though all individuals are vulnerable to these infections, their incidences are reported to be very high among individuals in the age group of 15-24 years.

163. Answer (2)

Hint: Opinion of two doctors is required after 1^{st} trimester

Sol.: According to MTP (Amendment) act, 2017, a pregnancy may be terminated on certain considered grounds within the first 12 weeks of pregnancy on the opinion of one registered medical practitioner. If the pregnancy has lasted more than 12 weeks, but fewer than 24 weeks, two registered medical practitioners must be of the opinion, formed in good faith that the required ground exists.

164. Answer (1)

Hint: Natural methods of contraception

Sol.: Natural methods work on the principle of avoiding chances of ovum and sperms meeting. Periodic abstinence is one such method. Withdrawal or coitus interruptus is another method in which the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.

165. Answer (2)

Hint: Proposed by Oparin and Haldane

Sol.: Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules (*e.g.* RNA, protein, *etc.*,) and that formation of life was preceded by chemical evolution, *i.e.*, formation of diverse organic molecules from inorganic constituents.

166. Answer (3)

Hint: Here, q^2 is given

Sol.: Given that 25% of the population exhibits the recessive phenotype (aa).

Thus, $q^2 = 0.25$

$q = \sqrt{0.25} = 0.5$

Thus, the frequency of the recessive allele (q) = 0.5.

167. Answer (4)

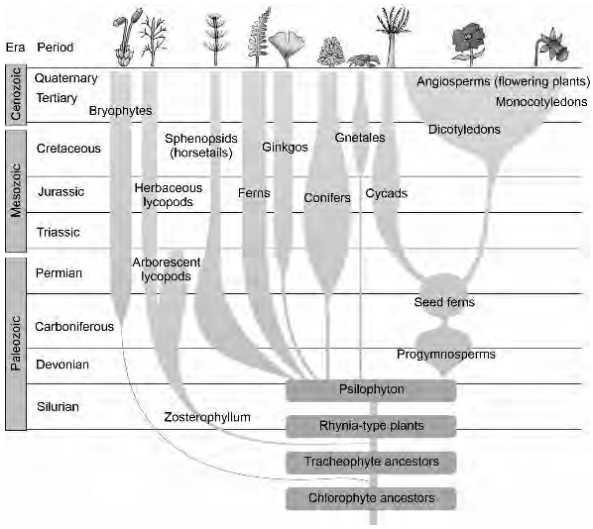
Hint: Exclude the dinosaur having spikes on tail

Sol.: The biggest dinosaur, *i.e.*, *Tyrannosaurus rex* was about 20 feet in height and had huge fearsome dagger-like teeth.

168. Answer (1)

Hint: Conifers and Progymnosperms share same ancestors

Sol.:



169. Answer (3)

Hint: After evolution, they became insectivorous and vegetarian finches.

Sol.: During his journey, Darwin went to Galapagos islands. There he observed an amazing diversity of creatures. Of particular interest, small black birds later called Darwin's finches amazed him. He realised that there were many varieties of finches in the same island. All the varieties, he conjectured, evolved on the island itself. From the original seed-eating finches many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

170. Answer (4)

Hint: Does not involve human intervention

Sol.: The factor thought to have influenced the evolution of different beak shapes in Darwin's finches is competition for resources. Darwin proposed that competition for limited food resources on the Galapagos island was a key driver of natural selection, leading to the evolution of different beak shapes in finches.

Darwin's finches represent a classic example of founder effect.

171. Answer (3)

Hint: Exclude the features associated with analogous structures

Sol.: In plants, thorns and tendrils of *Bougainvillea* and *Cucurbita* respectively, represent homology. Homology is based on divergent evolution. Homologous structures are anatomically similar.

172. Answer (1)

Hint: Embryological support for evolution

Sol.: Embryological support for evolution was proposed by Ernst Heckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adults. For example, the embryos of all vertebrates including human, develop a row of vestigial gill slits just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates. However, this proposal was disapproved on careful study performed by Karl Ernst von Baer. He noted that embryos never pass through the adult stages of other animals.

173. Answer (2)

Hint: Exclude the methods that involve *in-vitro* fertilisation

Sol.: IUI (Intra Uterine Insemination) involves transfer of semen artificially into the uterus.

ZIFT, IUT and ICSI involve *in-vitro* fertilisation.

174. Answer (3)

Hint: Emergency contraceptives are used within 72 hours of coitus

Sol.: IUDs do not inhibit oogenesis.

Administration of progestogens or progestogen-estrogen combinations or IUDs within 72 hours of coitus have been found to be effective as emergency contraceptives as they could be used to avoid possible pregnancy due to rape or casual unprotected intercourse.

Contraceptives are not regular requirements for the maintenance of reproductive health.

175. Answer (1)

Hint: Indian population in May 2011 crossed 1.2 billion.

Sol.: The world population which was around 2 billion in 1900 rocketed to about 6 billion by 2000 and 7.2 billion in 2011. A similar trend was observed in India too. Our population which was approximately 350 million at the time of our independence reached close to the billion mark by 2000 and crossed 1.2 billion in May 2011.

176. Answer (2)

Hint: Cranial capacity of *Homo erectus* was 900cc.

Sol.: The brain capacities of *Homo habilis* were between 650-800cc. They probably did not eat meat. *Homo erectus* had a large brain around 900cc.

The cranial capacity of *Australopithecus* was about 500cc. *Dryopithecus* was more ape-like.

177. Answer (3)

Hint: Evolved into the first amphibians

Sol.: By the time of 500 mya, invertebrates were formed and active. Fish with stout and strong fins could move on land and go back to water. This was about 350 mya. In 1938, a fish caught in South Africa happened to be extinct. These animals called lobefins evolved into the first amphibians that lived on both land and water.

178. Answer (1)

Hint: Result of divergent evolution

Sol.: Whales, bats, cheetah and human (all mammals) share similarities in the pattern of bones of forelimbs. Though these forelimbs perform different functions in these animals, they have similar anatomical structures – all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs. Hence, in these animals, the same structure developed along different directions due to adaptations to different needs. This is divergent evolution and these structures are homologous.

179. Answer (2)

Hint: Primitive Earth atmosphere was reducing with high temperature

Sol.: In 1953, S. L. Miller, an American scientist, created conditions prevailing in the primitive Earth in a laboratory scale. He created electric discharge in a closed flask containing CH_4, H_2, NH_3 and water vapour at 800°C. He observed the formation of amino acids.

180. Answer (1)

Hint: Terminal method

Sol.: In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. This technique is highly effective but its reversibility is very poor.

As no medicines or devices are used in natural methods of contraception, side effects are almost nil, chances of failure, though, of these methods are also high.

Cervical caps belong to the category of barrier methods of contraception.

181. Answer (3)

Hint: Induced abortions

Sol.: Diseases or infections which are transmitted through sexual intercourse are collectively called Sexually Transmitted Infections (STIs) or Venereal Diseases (VDs) or Reproductive Tract Infections (RTIs). Among the common STIs, hepatitis-B and AIDS are not infections of the reproductive organs though their mode of transmission could be *via* sexual contact also. MTPs are not always surgical. Certain pills also induce abortions.

182. Answer (2)

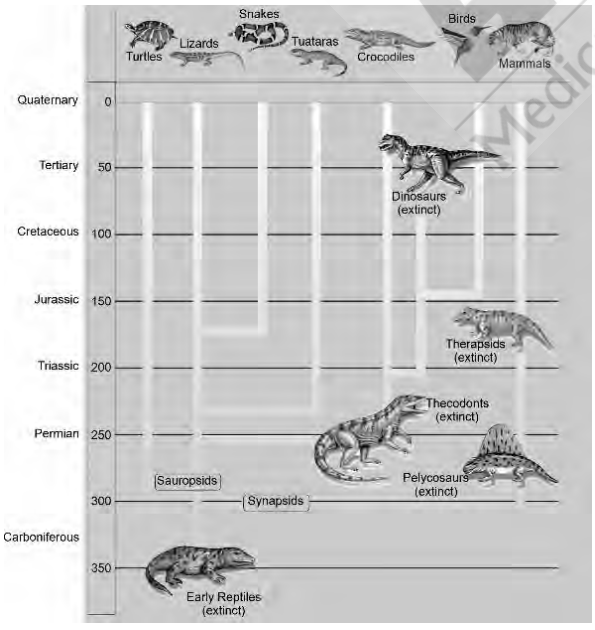
Hint: Exclude assortative mating

Sol.: Five factors are known to affect Hardy-Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection.

183. Answer (3)

Hint: Exclude the ancestors of mammals

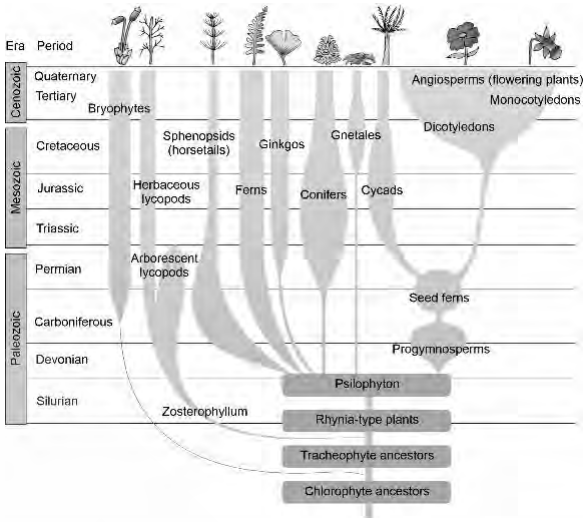
Sol.:



184. Answer (4)

Hint: Sphenopsids were abundant in the Carboniferous period.

Sol.:



185. Answer (2)

Hint: The year in which our population crossed 1.2 billion

Sol.: According to the 2011 census report, the population growth rate of India was less than 2 per cent *i.e.*, 20/1000/year, a rate at which our population could increase rapidly.

SECTION-B

186. Answer (2)

Hint: Exclude the year in which family planning programmes were initiated

Sol.: The Government of India legalised Medical Termination of Pregnancy (MTP) in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides which are reported to be high in India.

187. Answer (1)

Hint: Basis of lactational amenorrhea

Sol.: Breast feeding stimulates prolactin secretion and evidence suggests that prolactin inhibits GnRH secretion and thus inhibits secretions of gonadotropins.

188. Answer (4)

Hint: Analogous structures

Sol.: Analogous structures are a result of convergent evolution-different structures evolving for the same function and hence having similarity. Examples are: Flippers of penguins and dolphins, wings of butterfly and birds, *etc*.

Vertebrate hearts or brains are examples of homologous structures.

Homologous structures are a result of divergent evolution.

189. Answer (1)

Hint: Seen in Raisen district

Sol.: Pre-historic cave art developed about 18,000 years ago. One such cave paintings by pre-historic humans can be seen at Bhimbetka rock shelter in Raisen district of Madhya Pradesh.

190. Answer (2)

Hint: Exclude the naturalist who worked in Malay Archipelago

Sol.: Alfred Wallace, a naturalist who worked in Malay Archipelago had also come to similar conclusions made by Charles Darwin around the same time.

Mendel talked of 'inheritable factors' influencing phenotype, Darwin either ignored these observations or kept silence.

Hugo de Vries based on his work on evening primrose brought forth the idea of mutations.

191. Answer (2)

Hint: Exclude the observations made by Darwin

Sol.: Conventional religious literature tells us about the theory of special creation. This theory has three connotations. One, that all living organisms (species or types) that we see today were created as such. Two, that the diversity was always the same since creation and will be the same in future also. Three, the Earth is about 4000 years old.

192. Answer (3)

Hint: Like shrews

Sol.: The first mammals were like shrews. Their fossils are small sized. They were mainly viviparous and protected their unborn young inside the mother's body. Mammals were more intelligent in sensing and avoiding danger atleast.

193. Answer (4)

Hint: Fertilisation outside the female body

Sol.: *In-vitro* fertilisation (fertilisation outside the body in almost similar conditions as that in the female body) followed by embryo transfer is observed in ZIFT, IUT and ICSI.

194. Answer (4)

Hint: Feature associated with ZIFT

Sol.: Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by Artificial Insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI-Intra Uterine Insemination).

195. Answer (1)

Hint: Caused by HPV

Sol.: Except for hepatitis-B, genital herpes and HIV infections, other venereal diseases are completely curable if detected early and treated properly.

196. Answer (4)

Hint: Identify an IUD

Sol.: Condoms are barriers made of thin rubber/latex sheath that are used to cover the penis in the male or vagina and cervix in the female.

Diaphragms, cervical caps and vaults are also barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus.

197. Answer (1)

Hint: Increasing trend of cranial capacity

Sol.: Among the stories of evolution of individual species, the story of evolution of modern man is most interesting and appears to parallel evolution of human brain and language.

198. Answer (4)

Hint: Related to natural selection

Sol.: According to Charles Darwin, the organic evolution is due to interspecific competition.

199. Answer (3)

Hint: Lichens got reduced post-industrialisation.

Sol.: *Pteranodon* – Flying reptile

Lichen – Pollution indicator

Saltation – Single step large mutation

Ginkgos – Descendant of Psilophyton

200. Answer (4)

Hint: Associated with the one who existed 2 mya

Sol.: Two mya, *Australopithecines* probably lived in East African grasslands.

- Cranial capacity of modern *Homo sapiens* is 1350cc while that of Neanderthal man is 1400cc.
- *Dryopithecus* was more ape-like.

❑ ❑ ❑

All India Aakash Test Series for NEET - 2025

TEST - 2 (Code-B)

Click Here for Code-A Sol.

Test Date : 29/09/2024

ANSWERS

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

HINTS & SOLUTIONS

[PHYSICS]

SECTION-A

1. Answer (4)

Hint & Sol.: Due to random motion of free electrons in a conductor, in the absence of external electric field $\langle u \rangle = 0$

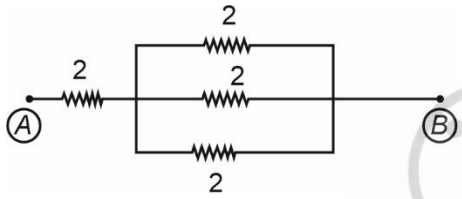
2. Answer (4)

Hint & Sol.: We know, $\vec{j} = \sigma\vec{E}$ is Ohm's law in vector form.

3. Answer (3)

Hint: Point *B*, *C*, *D* and *L* are equipotential

Sol.: The circuit can be modified as



$$R_{net} = 2 + \frac{2}{3} = \frac{8}{3}\ \Omega$$

4. Answer (4)

Hint: During discharging terminal potential difference across cell decreases while it increases during charging.

Sol.: Since 4 V > 2 V, $\therefore$ 4 V is discharging while 2 V is charging. Hence $V_1 < 4$ V while $V_2 > 2$ V

Here, $I = \frac{4-2}{4} = 0.5$ A

$\therefore \quad V_1 = 4 - 0.5(2) = 3$ V

and $V_2 = 2 + 0.5(2) = 3$ V

5. Answer (3)

Hint & Sol.: $i = neAv_d$

$$\Rightarrow \quad \frac{50}{100} = \frac{\frac{\pi}{4}d^2 \times v}{\frac{\pi}{4} \times \frac{d^2}{16}v'} \Rightarrow \frac{1}{2} = \frac{16d^2v}{d^2v'}$$

$\Rightarrow \quad v' = 32v$

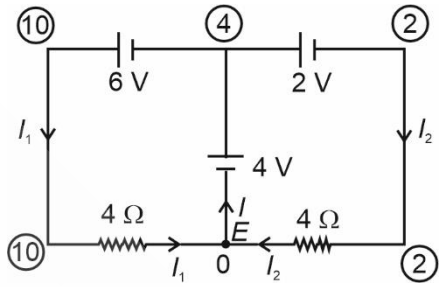
6. Answer (2)

Hint & Sol.: Kirchhoff's junction rule is a manifestation of law of conservation of charge.

7. Answer (3)

Hint: Assume *E* at zero potential, then potential at *B* will be 4 V and thus *A* will be at 10 V and *C* at 2 V.

Sol.: Potential of various points in the circuit (modified) is encircled.



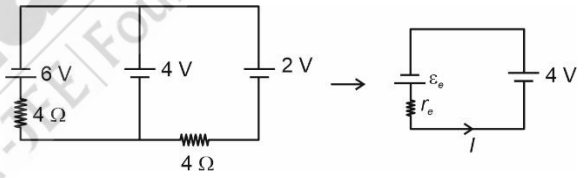
Here, $I = I_1 + I_2$

$$I = \frac{10-0}{4} + \frac{2-0}{4}$$

$I = 2.5 + 0.5$

$I = 3$ A

Method-2



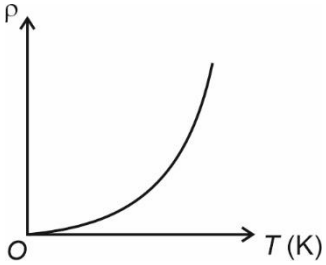
$$\varepsilon_e = \frac{\frac{6}{4} - \frac{2}{4}}{\frac{1}{4} + \frac{1}{4}} = 2\text{V}$$

$r_e = 2\ \Omega$

$$I = \frac{2+4}{2}\text{A} = 3\text{ A}$$

8. Answer (2)

Hint & Sol.: The graph of ρ vs *T* of copper is as shown



9. Answer (4)

Hint & Sol.: Relative magnetic permeability $\left[\mu_r = \frac{\mu}{\mu_0}\right]$ has no unit.

10. Answer (4)

Hint: Use, $F = qvB\sin\theta$ and note $v = 0$

Sol.: Inspite of space varying magnetic field if $v = 0$ then $F = 0$

Thus, the charged particle will remain at rest.

11. Answer (2)

Hint: Use momentum $p = mv = \sqrt{2m(\text{K.E.})}$

Sol.: We know, Radius $R = \frac{mv}{qB} = \frac{\sqrt{2m(\text{KE})}}{qB}$

For proton and deuteron q, B and K.E. are same

$\therefore \quad R \propto \sqrt{m}$

$\frac{R_1}{R_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{2}} = 1:\sqrt{2}$

12. Answer (1)

Hint: Direction of $\vec{E}$, $\vec{B}$ and $\vec{v}$ is same

Sol.: Since $\vec{v} \parallel \vec{B}$ $\therefore F = qvB\sin\theta = 0$

Thus, the electron will keep moving rectilinearly along X-axis due to force by electric field only.

13. Answer (2)

Hint & Sol.: Due to infinitely long current carrying wire intensity of magnetic field, $B = \frac{\mu_0}{4\pi}\frac{2I}{r}$

14. Answer (4)

Hint: Magnetic field due to a segment of circular current carrying wire is $B = \frac{\mu_0}{4\pi}\frac{I\theta}{r}$

Sol.: $B = B_2 - B_1 = \frac{\mu_0}{4\pi}\frac{I\pi}{3}\left(\frac{1}{a} - \frac{1}{2a}\right)$ $\left[\begin{matrix}B_2 \to \odot \\ B_1 \to \otimes\end{matrix}\right]$

$= \frac{\mu_0 I}{12}\left(\frac{2-1}{2a}\right) = \frac{\mu_0 I}{24a}$

15. Answer (4)

Hint: Use $\tau_{max} = NBIA\sin 90^\circ$

Sol.: $\tau_{max} = (100)(20)(40)\frac{22}{7}\times\frac{7}{100}\times\frac{7}{100}$

$\tau_{max} = 8\times 22\times 7 = 1232$ N m

16. Answer (4)

Hint & Sol.: Voltage sensitivity of a moving coil galvanometer is defined as deflection produced per unit applied voltage.

17. Answer (4)

Hint & Sol.: Retentivity of a specimen is measure of the magnetic field remaining in ferromagnetic specimen when magnetising field is removed. Hence retentivity is equal to 2 T.

18. Answer (2)

Hint & Sol.: A voltmeter has to be connected in parallel to the circuit. Hence, in ideal condition it should not draw any current and thus should have infinite resistance ideally.

19. Answer (3)

Hint: $\vec{B}_{\text{axial}} = -2\vec{B}_{\text{equatorial}}$

Sol.: We know, bar magnetic is a magnetic dipole in which geometric length > magnetic length.

20. Answer (4)

Hint & Sol.: We know, $U = -MB$ $[\because \theta = 0^\circ]$

$-2\times 10^{-3} = -M(4)$

$M = 0.5\times 10^{-3}$ Am^2

21. Answer (3)

Hint: $V_A = V_D = \frac{1}{2}Bl^2\omega$

Sol.: $\because V_A = V_D$

$\therefore V_0 - V_A = V_0 - V_D$

22. Answer (1)

Hint & Sol.: Ampere's law = $\oint \vec{B}\cdot d\vec{l} = \mu_0 i$

Intensity of magnetic field due to current carrying semicircular loop at its centre $= \frac{\mu_0 i}{4r}$

Lorentz force $\Rightarrow \vec{F} = q\left[\vec{E} + \vec{v}\times\vec{B}\right]$

Intensity of magnetic field on the axis of solenoid = $\mu_0 ni$

Intensity of magnetic field on the axis of current carrying thin long pipe = Zero

23. Answer (2)

Hint: Current $i \propto \frac{1}{R}$ and $R \propto l$

Sol.: We know, eddy currents are produced in the form of whirls

$\therefore$ In B the length for flow of current is maximum. Thus, it will have maximum resistance and hence minimum current.

24. Answer (4)

Hint: Emf induced in rod $\varepsilon = (\vec{v} \times \vec{B}) \cdot \vec{l}$

Sol.: To determine ε, the information about angle between $\vec{v}$ and $\vec{B}$ along with angle between $\vec{v} \times \vec{B}$ and $\vec{l}$ is needed.

25. Answer (4)

Hint & Sol.: Since the angle between magnetic field and area vector is 90°, the flux would be zero.

26. Answer (2)

Hint: Use $F = I\ell_{\text{eff}} B\sin\theta$

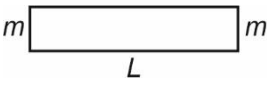
Sol.: F = (10) (8) (2)sin90°

F = 160 N

27. Answer (3)

Hint: Magnetic moment, $M = m \cdot l_{\text{eff}}$

Sol.: $M = mL$



For semicircle

$L = \pi r \qquad \Rightarrow r = \frac{L}{\pi}$

$\therefore M' = m \cdot 2r = m \times \frac{2L}{\pi} = \frac{2M}{\pi}$

28. Answer (1)

Hint: For long solenoid, $B = \mu_0 nI$

Sol.: We know, $I = \frac{V}{R} = \frac{1000}{100} = 10$ A

$\therefore \quad B = 4\pi \times 10^{-7} \times 10^3 \times 10$

$B = 4\pi \times 10^{-3}$ T

29. Answer (2)

Hint: In paramagnetic materials, $\chi_m \propto \frac{1}{T}$

Sol.: For paramagnetic, susceptibility decreases with increase in temperature and ferromagnetic materials turn paramagnetic above curie temperature.

30. Answer (3)

Hint & Sol.: There is no change in speed of charged particle because no work is done by the magnetic field while magnetic field can change the momentum of charged particle. Hence assertion is true and reason is false.

31. Answer (2)

Hint & Sol.: We know, $\oint \vec{B} \cdot d\vec{s} = 0$ for any closed surface thus magnetism will always exist in dipole form. Thus, it indicates absence of magnetic mono poles.

32. Answer (4)

Hint: Intensity of magnetisation, $I = \frac{m}{A}\frac{(\text{Pole strength})}{(\text{Area})}$

Sol.: We know, $I = \frac{m}{A} = \frac{10}{10 \times 10^{-4}}$

$I = 10^4$ A m^{-1}

33. Answer (4)

Hint: Use $\mu_r = 1 + \chi_m$

Sol.: Since, μ_r is always positive

$\therefore$ μ is also always positive.

34. Answer (4)

Hint: Bohr magneton is actually magnetic moment

Sol.: $M = IA$

$[M] = [M^0L^2T^0A]$

35. Answer (1)

Hint: A shunt resistance is connected in parallel to galvanometer.

Sol.: Value of shunt resistance $S = \frac{I_g G}{I - I_g} = \frac{(2 \times 10^{-3})(10)}{2 - 2 \times 10^{-3}}$

$S = \frac{2 \times 10^{-2}}{2} = 10^{-2} = 0.01\,\Omega$ [I_g << I]

$\therefore$ Net resistance $R_{\text{net}} = \frac{GS}{G+S} = \frac{10(0.01)}{10 + 0.01}$

$R_{\text{net}} = \frac{0.1}{10.01} = \frac{10}{1001} = \frac{1}{100}$ [S << G]

SECTION-B

36. Answer (2)

Hint: Use formula $\frac{\theta}{i} = \frac{NAB}{k}$

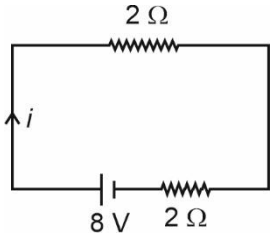
Sol.: Current sensitivity $\frac{\theta}{i} = \frac{NAB}{k}$

By increasing magnetic field (B) current sensitivity can be increased.

37. Answer (2)

Hint: At steady state, the capacitor will not allow current to pass through it.

Sol.: The simplified circuit at steady state will be



$i = \frac{V}{R} = \frac{8}{4} = 2$ A

Potential difference across 2 Ω is 2 × 2 = 4 volt

$Q = CV \Rightarrow Q = 3 \times 4 = 12\ \mu C$

38. Answer (4)

Hint: Time period, $T = 2\pi\sqrt{\frac{I}{MB}}$

Sol.: $T \propto \sqrt{I} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{I_1}{I_2}} = \sqrt{\frac{1}{4}}$

$\therefore \quad \frac{T_1}{T_2} = \frac{1}{2}$

39. Answer (3)

Hint & Sol.: Emf can be induced in a coil by changing magnetic flux.

40. Answer (4)

Hint: $\frac{\Delta\phi}{\Delta t} = \frac{L\Delta i}{\Delta t}$

Sol.: $\varepsilon = \frac{-\Delta\phi}{\Delta t} = -\frac{L\Delta i}{\Delta t}$

$\varepsilon = \frac{-L \times (3-(-1))}{0.4} \Rightarrow 0.2 = \left|-\frac{L \times 4}{0.4}\right|$

L = 20 mH

41. Answer (2)

Hint & Sol.: Paramagnetic substances are weekly attracted towards magnetic field. The susceptibility of paramagnetic substance is greater than zero.

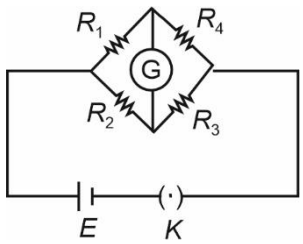
42. Answer (4)

Hint & Sol.: Force applied by uniform magnetic field on a current carrying closed loop is always zero.

43. Answer (2)

Hint: For balanced wheatstone bridge product of diagonally opposite resistors should be equal.

Sol.: For null deflection:



$R_1R_3 = R_2R_4$

In all the given circuits

R_1 = 5 Ω, R_3 = 10 Ω

$\therefore \quad R_1R_3$ = 50 Ω

Hence, R_2R_4 should be equal to 50 Ω which is possible in circuit (2) only.

44. Answer (3)

Hint & Sol.: Mutual inductance depends on the number of turns in both the coils as well as on the orientation of the coils.

45. Answer (2)

Hint: $U = \frac{1}{2}LI^2$

Sol.: We known, $U \propto I^2$

$\therefore \quad \frac{U_1}{U_2} = \left(\frac{I}{3I}\right)^2 \Rightarrow U_2 = 9U_1$

46. Answer (2)

Hint: Induced current, $I = \frac{1}{R}\frac{d\phi}{dt} \Rightarrow \frac{dq}{dt} = \frac{d\phi}{Rdt}$

$\Rightarrow \quad q = \frac{\Delta\phi}{R}$

Sol.: $q = \frac{A(\Delta B)}{R} = \frac{40 \times 10^{-4}(0.4)}{10}$

$q = 160 \times 10^{-6}$ C = 160 μC

47. Answer (4)

Hint: Potential drop across inductor $= -\frac{Ldl}{dt}$

Sol.: Using Kirchhoff's law,

$V_A - 0.4(20) - 2 - (4) + 6 = V_B$

$V_A - 8 - 2 - 4 + 6 = V_B$

$\therefore \quad V_A - V_B = 8$ V

48. Answer (4)

Hint: Self inductance of a solenoid, $L = \frac{\mu_0\mu_r N^2 A}{l}$

Sol.: $L = \frac{\mu_0 \mu_r N^2 A}{l} \Rightarrow L \propto \frac{N^2}{l}$

$\Rightarrow \frac{L_A}{L_B} = \left(\frac{N_A}{N_B}\right)^2 \times \left(\frac{I_B}{I_A}\right)$

$\Rightarrow \frac{L_A}{L_B} = \left(\frac{1}{2}\right)^2 \times \left(\frac{1}{2}\right) = \frac{1}{8}$

49. Answer (2)

Hint: Intensity of magnetic field inside a solenoid = $\mu_0 \mu_r ni$

Sol.: $B = \mu_0 \mu_r ni \Rightarrow 4\pi \times 10^{-7} \times \mu_r \times 10^3 \times 2$

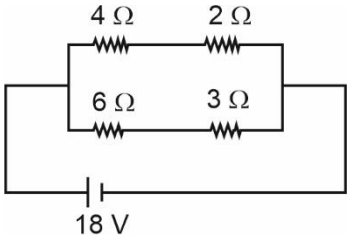
$\Rightarrow \mu_r = 5000$ and $\mu_r = 1 + \chi$

$\Rightarrow \chi = 4999$

50. Answer (3)

Hint: The given arrangement is a balanced wheat stone bridge

Sol.: The circuit can be modified as



$R_{net} = \left(\frac{1}{6} + \frac{1}{9}\right)^{-1} = \frac{18}{5}\ \Omega$

$I = \frac{V}{R_{net}} = \frac{18}{\frac{18}{5}} = 5\ A$

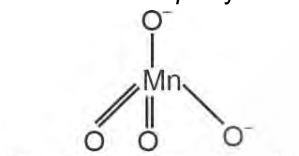
[CHEMISTRY]

SECTION-A

51. Answer (1)

Hint: The manganate ion is MnO_4^{2-}, in which central Mn atom is sp^3 hybridised.

Sol.:



Tetrahedral manganate (green) ion

52. Answer (4)

Hint: Transition metal has ability to form alloy.
Sol.: Alloys of transition metals with non-transition metals such as brass (copper-zinc) and bronze (copper-tin).

53. Answer (2)

Hint: Magnetic moment (μ) is calculated as

$\mu = \sqrt{n(n+2)}$ BM

where 'n' denotes number of unpaired electrons.

Sol.:

Ion	Unpaired electron(s)	Calculated magnetic moment (BM)
Ti^{2+}	2	2.84
V^{2+}	3	3.87
Fe^{2+}	4	4.90
Cu^{2+}	1	1.73

54. Answer (1)

Hint: Cu(I) compounds are unstable in aqueous solution and undergo disproportionation.

$2Cu^+(aq) \rightarrow Cu^{2+}(aq) + Cu(s)$

Sol.: The stability of $Cu^{2+}(aq)$ rather than $Cu^+(aq)$ is due to much more negative $\Delta_{hyd}H°$ of $Cu^{2+}(aq)$ than $Cu^+(aq)$, which more than compensates for the second ionisation enthalpy of Cu.

55. Answer (2)

Hint: Stronger the interatomic interaction, higher the enthalpies of atomisation.

Sol.:

Elements	Enthalpy of atomisation (kJ/mol)
Ti	475
V	515
Mn	281
Zn	126

56. Answer (2)

Hint: The species having central atom has highest oxidation state has strongest oxidising power.

Sol.: The correct order of oxidising power in the series is $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$.

57. Answer (3)

Hint: In acidic medium, the half-reaction for $K_2Cr_2O_7$ as reducing agent is

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

Sol.:

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

58. Answer (2)

Hint: $KMnO_4$ on heating at 513 K gives K_2MnO_4, MnO_2 and O_2.

Sol.: $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

59. Answer (3)

Hint: In general, the actinoids shows +3 oxidation state.

Sol.:

Element	Possible oxidation states
Th	+4 only
Pa	+3, +4 and +5 only
U	+3, +4, +5 and +6 only
Np	+3, +4, +5, +6 and +7 only
Pu	+3, +4, +5, +6 and +7 only
Am	+3, +4, +5 and +6 only
Cf	+3 only

60. Answer (3)

Hint: Lanthanoids liberate hydrogen gas when treated with dilute acids.

Sol.: Ln → (with acids) H_2; (heated with N) LnN

61. Answer (4)

Hint: The general electronic configuration of Lanthanoids is $[Xe]4f^{1-14}\ 5d^{0-1}6s^2$

Sol.: Electronic configuration of Gd (Z = 64) is $[Xe]4f^7 5d^1 6s^2$, while

Electronic configuration of Yb (Z = 70) is $[Xe]4f^{14}6s^2$

62. Answer (2)

Hint: Noble gases have stable electronic configurations; hence they have no tendency to accept the electrons and therefore, have large positive values of electron gain enthalpy.

Sol.:

Element	Electron gain enthalpy (kJ/mol)
He	48
Ne	116
Ar	96
Xe	77

63. Answer (3)

Hint: XeF_2 is a powerful fluorinating agent.

Sol.: XeF_2 is hydrolysed to give Xe, HF and O_2.

$2XeF_2(s) + 2H_2O(l) \rightarrow 2Xe(g) + 4HF(aq) + O_2(g)$

64. Answer (3)

Hint & Sol.: Sulphur dioxide gas reacts with chlorine in the presence of charcoal (which acts as a catalyst) to give sulphuryl chloride, SO_2Cl_2.

65. Answer (3)

Hint: In vapour state sulphur partly exists as S_2 molecule.

Sol.: S_2 molecule has two unpaired electrons in the antibonding π^* orbitals like O_2 and hence, exhibits paramagnetism.

66. Answer (1)

Hint: Ozone is used as oxidising agent for the preparation of $KMnO_4$.

Sol.: Pure ozone is a pale blue gas, dark blue liquid and violet-black solid.

67. Answer (3)

Hint: The ions which contains partially filled *d*-orbitals shows colour in aqueous medium

Sol.:

Configuration	Ions	Colour
$3d^0$	Sc^{3+}	Colourless
$3d^0$	Ti^{4+}	Colourless
$3d^4$	Cr^{2+}	Blue
$3d^{10}$	Zn^{2+}	Colourless

68. Answer (3)

Hint: More the acidic strength of a substance, less will be the value of pK_a.

Sol.:

Compound	pK_a value
H–F	3.2
H–Cl	–7.0
H–Br	–9.5
H–I	–10.0

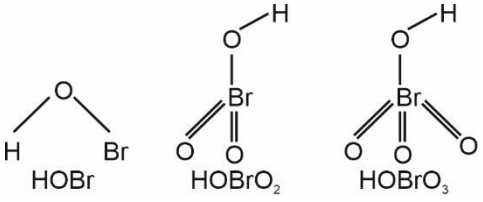
69. Answer (3)

Hint: F_2 is more reactive than interhalogen compounds.

Sol.: In general, interhalogen compounds (XX′) are more reactive than halogens (X_2) except F_2 due to weak X–X′ bond than X–X except F–F bond.

70. Answer (2)

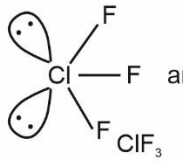
Hint & Sol.: In case of bromine, HOBr, $HOBrO_2$ and $HOBrO_3$ are only possible oxoacid.



71. Answer (4)

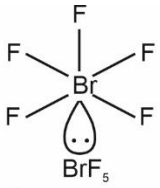
Hint: The hybridisation of Cl and Br in ClF_3 and BrF_5 are sp^3d and sp^3d^2 respectively.

Sol.:



Bent T-Shape

and



Square pyramidal

72. Answer (2)

Hint: Boiling point of NH_3 is higher than PH_3 due to presence of intermolecular hydrogen bonding in NH_3.

Sol.:

Molecule	Boiling point/K
NH_3	238.5
PH_3	185.5
AsH_3	210.6
SbH_3	254.6
BiH_3	290

73. Answer (1)

Hint & Sol.: A brown ring at the interface between the solution and sulphuric acid layers indicates the presence of nitrate ion in the solution.

$$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \longrightarrow \underset{\text{(brown)}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

74. Answer (4)

Hint: Concentrated HNO_3 is a strong oxidising agent and products of reaction depends upon the concentration of the acid.

Sol.: Zinc reacts with dilute HNO_3 to give N_2O and with concentrated HNO_3 to give NO_2.

$4Zn + 10HNO_3(\text{dilute}) \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$

$Zn + 4HNO_3\ (\text{conc.}) \rightarrow Zn(NO_3)_2 + 2H_2O + 2NO_2$

75. Answer (2)

Hint: Red phosphorus is much less reactive than white phosphorus.

Sol.: Red phosphorus is obtained by heating white phosphorus at 573 K in an inert atmosphere for several days.

76. Answer (3)

Hint: For 1st order

$$K = \frac{2.303}{t}\log\left(\frac{P_i}{P_i - x}\right)$$

Sol.:

	A(g)	→	B(g)	+	C(g)
$t = 0$	p_i atm		0 atm		0 atm
time : t	$(p_i - x)$ atm		x atm		x atm

$p_t = (p_i - x) + x + x$

$p_t = p_i + x$

$x = p_t - p_i$

Partial pressure of A(g) at time $t = p_i - x$

$= p_i - (p_t - p_i)$

$= 2p_i - p_t$

$$k = \frac{2.303}{t}\log\frac{p_i}{p_i - x}$$

$$k = \frac{2.303}{t}\log\frac{p_i}{2p_i - p_t}$$

77. Answer (3)

Hint: For every 10° rise in temperature, rate becomes two times.

Sol.:

$T_1 = 50° \xrightarrow[2\text{ times}]{} 60° \xrightarrow[4\text{ times}]{} 70° \xrightarrow[8\text{ times}]{}$

$T_2 = 80°$

$(\text{Rate})_{new} = 2^3\,(\text{Rate})_{old}$

$(\text{Rate})_{new} = 8\,(\text{Rate})_{old}$

78. Answer (4)

Hint: The decomposition of gaseous ammonia on a hot platinum surface is a zero order reaction at high pressure.

Sol.: Inversion of cane sugar is pseudo first order reaction

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} \text{Glucose} + \text{Fructose}$$

$\text{Rate} = k[C_{12}H_{22}O_{11}]$

79. Answer (2)

Hint: For a bimolecular elementary reaction

$A + B \rightarrow$ Products

Rate of the reaction can be expressed as,

$$\text{Rate} = PZ_{AB}e^{-E_a/RT}$$

Sol.: Z_{AB} = Collision frequency of reactants, A and B

P = Probability or steric factor

$e^{-E_a/RT}$ = Fraction of molecules with energies equal to or greater than E_a.

80. Answer (3)

Hint: The plot of ln k v/s $\frac{1}{T}$ gives a straight line

$$\ln k = \frac{-E_a}{RT} + \ln A$$

Slope = $\frac{-E_a}{R}$ and intercept = ln A

Sol.: $\ln k = \ln A - \frac{E_a}{RT}$

Slope = $\frac{-E_a}{R}$

$\frac{-E_a}{R} = -4 \times 10^2$

$E_a = 4 \times 10^2 \times 8.314$

$E_a = 3.325$ kJ mol^{-1}

81. Answer (2)

Hint: The sum of powers of the concentration of the reactants in the rate law expression is called the order of the chemical reaction.

Sol.: For the given reaction,

A + B $\rightarrow$ Product

Rate = k[A]^{½} [B]^2 [given]

If A is taken in excess modified rate law : R = k[B]^2

The overall order of the reaction = 2

82. Answer (1)

Hint: The oxoacids in +3 oxidation state of phosphorus tend to disproportionate to higher and lower oxidation states.

Sol.: H_3PO_3 on heating disproportionates to give phosphoric acid and phosphine.

$4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$

83. Answer (2)

Hint: For first order reaction

$k = \frac{2.303}{t} \log \frac{[A]_0}{[A]_t}$

where, k = rate constant of the reaction

t = time of reaction

$[A]_0$ = Initial concentration of reactant

$[A]_t$ = Concentration of reactant after time 't'

Sol.: $t = \frac{2.303}{k} \log \frac{[A]_0}{[A]_t}$

$[A]_0 = 100$ g

$[A]_t = 10$ g

$k = 10^{-3}$ s

$t = \frac{2.303}{10^{-3}} \log \frac{100}{10}$

$t = 2.303 \times 10^3 = 2303$ s

84. Answer (1)

Hint: For a general reaction

aA + bB $\rightarrow$ cC + dD

Rate = k[A]^x[B]^y

where x + y = n = order of reaction

Rate constant = $k = \frac{\text{Rate}}{[A]^x[B]^y}$

$k = \frac{\text{concentration}}{\text{time}} \times \frac{1}{(\text{concentration})^n}$

Unit of k for nth order = (concentration)$^{1-n}$ time^{-1}

Sol.: For zero order reaction, n = 0

Unit of k = (mol L^{-1})$^{1-0}$ s^{-1}

= mol L^{-1}s^{-1}

For second order reaction, n = 2

Unit of k = (mol L^{-1})$^{1-2}$ s^{-1}

= mol^{-1}L s^{-1}

85. Answer (3)

Hint: For expressing the rate of a reaction, the rate of disappearance of reactants or the rate of appearance of products is divided by their respective stoichiometric coefficients.

Sol.: $2N_2O_5(g) \rightarrow 2N_2O_4(g) + O_2(g)$

The rate of this reaction is given by

$\frac{-1}{2}\frac{d[N_2O_5]}{dt} = \frac{1}{2}\frac{d[N_2O_4]}{dt} = \frac{d[O_2]}{dt}$

SECTION-B

86. Answer (4)

Hint: Al_2O_3 is an amphoteric oxide which reacts with both acids as well as alkalies.

Sol.: $Al_2O_3(s) + 6HCl(aq) + 9H_2O(l) \rightarrow 2[Al(H_2O)_6]^{3+}(aq) + 6Cl^-(aq)$

$Al_2O_3(s) + 6NaOH(aq) + 3H_2O(l) \rightarrow 2Na_3[Al(OH)_6]\ (aq)$

87. Answer (1)

Hint: Interstitial compounds are those which are formed when small atoms like H, C or N are trapped inside the crystal lattices of metals.

Sol.: Interstitial compounds retain metallic conductivity and they are chemically inert.

88. Answer (3)

Hint: In actinoids, there is a gradual decrease in the size of atoms or M^{3+} ions across the series.

Sol.:

Ion (M^{3+})	Radii/pm
U	103
Np	101
Am	99
Bk	98

89. Answer (1)

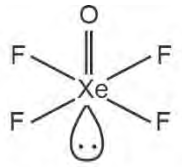
Hint: Due to lanthanoid contraction, Zr (160 pm) and Hf (159 pm) have almost identical radii.

Sol.: Mischmetal consists of a lanthanoid metal (~95%), iron (~5%) and traces of S, C, Ca and Al.

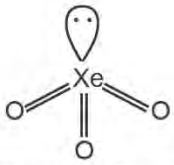
90. Answer (2)

Hint: The hybridisation of Xenon in $XeOF_4$ and XeO_3 are sp^3d^2 and sp^3 respectively.

Sol.:



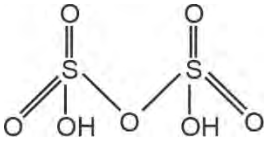
Structure: Square pyramidal
Hybridisation: sp^3d^2



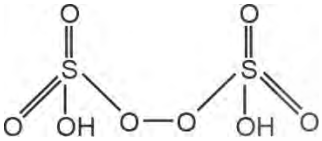
Structure: Pyramidal
Hybridisation: sp^3

91. Answer (3)

Hint: The correct structure of $H_2S_2O_7$ is



Sol.: In $H_2S_2O_8$, there is one peroxy linkage between two sulphur atoms.



92. Answer (1)

Hint: In Deacon's process, hydrogen chloride gas is oxidised by atmospheric oxygen in the presence of $CuCl_2$ (catalyst) at 723 K.

$$4HCl + O_2 \xrightarrow{CuCl_2} 2Cl_2 + 2H_2O$$

Sol.:

Species	Method of preparation
Cl_2	Deacon's process
H_2SO_4	Contact process
HNO_3	Ostwald's process
NH_3	Haber's process

93. Answer (1)

Hint: Aqua regia is a very strong oxidising agent that can react with noble metals also.

Sol.: When three parts of concentrated HCl and one part of concentrated HNO_3 are mixed.

94. Answer (1)

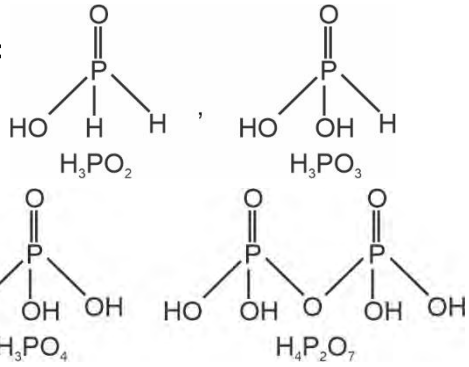
Hint: Order can be defined for both elementary and complex reaction.

Sol.: Order of a reaction is an experimental quantity whose value can be 0, 1, 2, 3 and even a fraction.

95. Answer (2)

Hint: In oxoacids, phosphorous is tetrahedrally surrounded by other atoms.

Sol.:



H_3PO_2 , H_3PO_3

H_3PO_4 , $H_4P_2O_7$

96. Answer (3)

Hint: Phosphorus disproportionate in present to NaOH.

Sol.:

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + \underset{\text{(sodium hypophosphite)}}{3NaH_2PO_2}$$

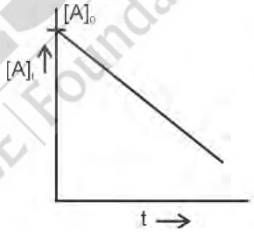
97. Answer (1)

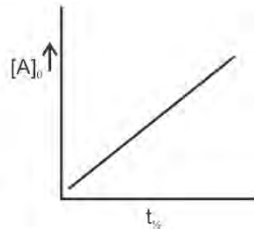
Hint: For zero order reaction

$A \rightarrow B$

$[A]_t = [A]_0 - kt$

Sol.:





98. Answer (1)

Hint: For a first order reaction,

$\ln[R] = \ln[R]_0 - kt$

where, $[R]_0$ = Initial concentration of reactant

[R] = Concentration of reactant after time 't'

Sol.: At time 't_1'

$\ln[R]_1 = -kt_1 + \ln[R]_0$ ...(1)

At time 't_2'

$\ln[R]_2 = -kt_2 + \ln[R]_0$ ...(2)

Subtract eq (2) from eq (1)

$\ln[R]_1 - \ln[R]_2 = -kt_1 - (-kt_2)$

$$\ln\frac{[R]_1}{[R]_2} = k(t_2 - t_1)$$

$$k = \frac{1}{t_2 - t_1}\ln\frac{[R]_1}{[R]_2}$$

99. Answer (1)

Hint: Lower the value of activation energy faster will be the rate of reaction.

Sol.: A catalyst, catalyses the forward as well as backward reaction to the same extent. A catalyst does not alter the ΔG of reaction.

Order is applicable to elementary as well as complex reaction whereas molecularity is applicable only for elementary reactions.

100. Answer (1)

Hint: For first order reaction,

$$t_{½} = \frac{0.693}{k}$$

where, k = rate constant of the reaction.

Sol.: When reaction is completed 99.9%

$[A]_t = [A]_0 - 0.999\,[A]_0$

$[A]_t = 10^{-3}\,[A]_0$

$$k = \frac{2.303}{t}\log\frac{[A]_0}{[A]_t}$$

$$k = \frac{2.303}{t}\log\frac{[A]_0}{10^{-3}[A]_0}$$

$$t = \frac{2.303}{t}\log 10^3 = \frac{2.303\times 3}{k} = \frac{6.909}{k}$$

For half life of first order reaction,

$$t = \frac{0.693}{k}$$

$$\frac{t_{99.9}}{t_{½}} = \frac{6.909}{k}\times\frac{k}{0.693} \cong 10$$

[BOTANY]

SECTION-A

101. Answer (4)

Hint: Post-transcriptional modification of mRNA occurs in eukaryotes.

Sol.: In prokaryotes, the mRNA does not require any processing to become active. In eukaryotes, translation is not possible if cap (methyl guanosine triphosphate) is lacking, because cap is identified by 18S rRNA of ribosomal unit.

102. Answer (1)

Hint: Types of gametes = 2^n

Sol.: n = 2 (number of hybrids)

$\therefore$ types of gametes = $2^2 = 4$

103. Answer (1)

Hint: It is a cross when a test organism is crossed with homozygous recessive parent.

Sol.: The progenies of test cross can be easily analysed to predict the genotype of a test organism.

104. Answer (2)

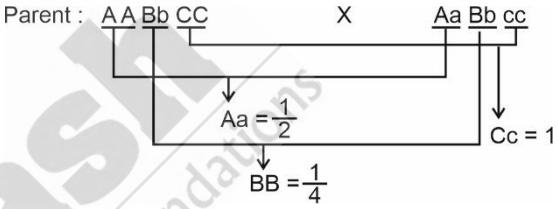
Hint: In co-dominance, the hybrid progeny resembles both the parents.

Sol.: A gene showing co-dominance has both alleles independently expressed in the heterozygote.

105. Answer (4)

Hint: Probability of having Aa from the cross of AA and Aa is $\frac{1}{2}$.

Sol.:



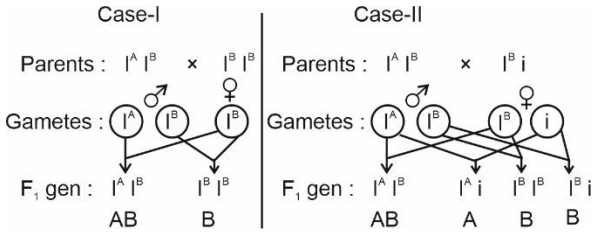
Probability of having AaBBCc

$$= \frac{1}{2}\times\frac{1}{4}\times 1 = \frac{1}{8}$$

106. Answer (3)

Hint: AB blood group shows co-dominance.

Sol.:



107. Answer (4)

Hint: 1% of recombination frequency = 1 cM

Sol.: Distance between genes of eye colour and wings size in *Drosophila* is 37.2 cM.

108. Answer (4)

Hint: *Drosophila* shows sexual dimorphism and produces large number of offspring in a single mating.

Sol.: Being an insect, *Drosophila* was not taken as a criteria to consider it as an experimental material.

109. Answer (4)

Hint: Recombination frequency depends upon the distance between the genes.

Sol.: Closely located genes assorted together, and distantly located genes, due to recombination, assorted independently. Linkage maps, therefore, corresponded to arrangement of genes on a chromosome.

110. Answer (4)

Hint: Polyploidy implies for having more than two sets of chromosomes in a cell.

Sol.: Failure of cytokinesis after the telophase stage of cell division results in an increase in whole set of chromosomes and this phenomenon is called polyploidy.

111. Answer (2)

Hint: Haemophilia-B is also known as Christmas disease.

Sol.: People affected with haemophilia-B lacks plasma thromboplastin. Cystic fibrosis is an autosomal recessive disorder.

112. Answer (3)

Hint: Down's syndrome is caused due to trisomy of chromosome 21.

Sol.: α-Thalassemia is controlled by two closely linked genes HBA1 and HBA2 on chromosome 16.

113. Answer (2)

Hint: Gynaecomastia is shown by the patients inflicted with Klinefelter's syndrome.

Sol.: Klinefelter's syndrome is caused due to the presence of an additional copy of X-chromosome resulting into 44 + XXY type chromosome complement.

114. Answer (1)

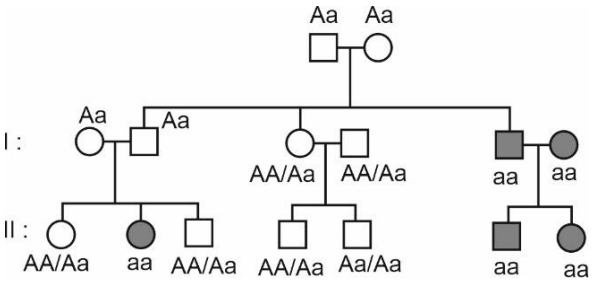
Hint: Genes are unit of inheritance.

Sol.: The two alleles of a gene pair are located on homologous sites on homologous chromosomes. Chromosomal disorders can be traced by karyotype study.

115. Answer (2)

Hint: The pedigree is of autosomal recessive trait.

Sol.: Thalassemia is an autosomal recessive disorder.



116. Answer (4)

Hint: In incomplete dominance, phenotypic and genotypic ratios are same.

Sol.:

Parents : Tt Rr (Intermediate height and pink coloured flowers) × Tt Rr (Intermediate height and pink coloured flowers)

Gametes : TR Tr tR tr TR Tr tR tr

1 Tall
- 1 red flower — 1 tall plant with red flowers
- 2 pink flower — 2 tall plants with pink flowers
- 1 white flower — 1 tall plant with white flowers

2 intermediate height
- 1 red flower — 2 intermediate height plants with red flowers
- 2 pink flower — 4 intermediate height plants with pink flowers
- 1 white flower — 2 intermediate height plants with white flowers

1 dwarf
- 1 red flower — 1 dwarf plant with red flower
- 2 pink flower — 2 dwarf plants with pink flower
- 1 white flower — 1 dwarf plant with white flower

117. Answer (1)

Hint: Taylor used the root of *Vicia faba* to prove semi-conservative nature of chromosome replication.

Sol.: Frederick Griffith used *Streptococcus pneumoniae* and mice to propose the transforming principle.

118. Answer (1)

Hint: RNA polymerase III transcribes tRNA, scRNA, 5S rRNA and snRNA.

Sol.: During splicing, introns are removed by small nuclear RNA (snRNA) and protein complex called small nuclear ribonucleoproteins or SnRNPs (Snurps).

119. Answer (1)

Hint: Phosphodiester linkage is present between two nucleotides.

Sol.: A nitrogenous base is linked to the OH of 1′C pentose sugar through a N-glycosidic linkage to form a nucleoside.

120. Answer (3)

Hint: Non-sense mutation produces non-functional protein, as a sequence change will give rise to a premature stop codon.

Sol.: Non-sense mutation in *lac i* gene will produce a non-functional repressor. As a result of this, the structural gene will express themselves even in the absence of lactose.

121. Answer (3)

Hint: One nucleosome has 200 bp.

Sol.: Number of nucleosome $= \frac{\text{No. of bp in the chromatin}}{\text{No. of bp in one nucleosome}} = \frac{6.6 \times 10^9 \text{ bp}}{200 \text{ bp}}$

$= 3.3 \times 10^7$

122. Answer (4)

Hint: DNA gyrase has topoisomerase activity.

Sol.: During DNA replication, the discontinuously synthesised fragments of DNA are joined by the enzyme DNA ligase.

123. Answer (4)

Hint: Some amino acids are coded by more than one codon, hence the code is degenerate.

Sol.: UGG is non-degenerate codon. Tryptophan is coded by this codon only. One codon codes for only one amino acid.

124. Answer (3)

Hint: Passive processes do not require energy for its occurrence.

Sol.: Binding of mRNA with smaller subunit of ribosome is energy independent process.

125. Answer (2)

Hint: In DNA fingerprinting, detection of hybridised DNA fragments is done by autoradiography.

Sol.: The sensitivity of DNA fingerprinting technique has been increased by the use of polymerase chain reaction.

126. Answer (1)

Hint: 4.6×10^6 bp are present in *Escherichia coli*.

Sol.: 5386 nucleotides are present in $\phi \times 174$ bacteriophage.

127. Answer (2)

Hint: Both DNA and protein contain carbon and hydrogen.

Sol.: In the given case both supernatant (containing virus) and the bacteria will show the radioactivity of both carbon and hydrogen.

128. Answer (2)

Hint: Heterochromatin is densely packed region of chromatin.

Sol.: Heterochromatin is the region which is transcriptionally inactive in nature.

129. Answer (3)

Hint: The sequence of chromosome 1 was completed in May 2006.

Sol.: Chromosome 1 has 2968 genes.

130. Answer (4)

Hint: Rediscovery of Mendel's law was done in the year 1900.

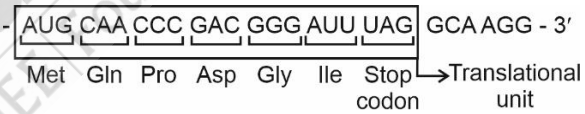
Sol.: Sutton and Boveri proposed chromosomal theory of inheritance.

Hugo de Vries, Correns and Tschermak rediscovered Mendel's result.

131. Answer (4)

Hint: A translational unit in mRNA is the sequence of RNA that is flanked by the start codon (AUG) and stop codon.

Sol.:



132. Answer (4)

Hint: Recessive trait is expressed only in homozygous condition.

Sol.: Green seed colour being recessive trait will express only in homozygous condition.

133. Answer (2)

Hint: In the given transcription unit, 'A' represents template strand that acts as a template for the synthesis of mRNA.

Sol.: 'B' represents coding strand that does not code for anything. 'C' represents promoter which possesses the binding site for RNA polymerase. 'D' represents structural gene that is polycistronic in case of *lac* operon in bacteria.

134. Answer (4)

Hint: According to this law segregation of one pair of traits is independent to the other pair of traits.

Sol.: Law of independent assortment was derived from dihybrid cross performed by Mendel.

135. Answer (1)

Hint: In bacteria, transcription and translation are coupled.

Sol.: In bacteria, since the mRNA does not require any processing to become active, and also since transcription and translation takes place in the same compartment (there is no separation of cytosol and nucleus in bacteria), many times the translation can begin much before the mRNA is fully transcribed.

SECTION - B

136. Answer (1)

Hint: Turner's syndrome is caused due to monosomy of allosomes.

Sol.: 45 with X0 is the chromosomal complement of Turner's syndrome.

137. Answer (3)

Hint: The given figure depicts the electron micrograph of chromatin in an interphasic nucleus.

Sol.: Nucleosome constitute the repeating unit of a structure in nucleus called chromatin. The negatively charged DNA is wrapped around the positively charged histone octamer to form a structure called nucleosome.

138. Answer (2)

Hint: Alec Jeffreys used satellite DNA as probe that shows very high degree of polymorphism. It was called variable number of tandem repeats (VNTR).

Sol.: The VNTR belongs to a class of satellite DNA referred to as mini-satellite. A small DNA sequence is arranged tandemly in many copy numbers. The copy number of VNTR varies from chromosome to chromosome in an individual. The number of repeats show very high degree of polymorphism. As a result the size of VNTR varies in size from 0.1 to 20 kb.

139. Answer (4)

Hint: Polygenic traits are controlled by three or more genes.

Sol.: Human skin colour is a polygenic trait.

140. Answer (3)

Hint:  denotes affected female.

Sol.:  denotes unspecified sex.

141. Answer (1)

Hint: Loss or gain of a segment of DNA, results in alteration in chromosomes.

Sol.: Since genes are known to be located on chromosome, alteration in chromosomes result in abnormalities or aberrations.

142. Answer (2)

Hint: Males are heterogametic in grasshopper and fruit flies. Females are heterogametic in butterflies and birds.

Sol.:

Mode of sex determination	Organisms
XX – XY	Fruit flies
XX – XO	Grasshopper
ZW – ZZ	Birds
ZO – ZZ	Butterflies

143. Answer (1)

Hint: According to principle of complementarity A pairs with T or U and G pairs with C.

Sol.: Like DNA replication, the principle of complementarity governs the process of transcription.

144. Answer (3)

Hint: This enzyme was discovered by Severo Ochoa.

Sol.: Polynucleotide phosphorylase is helpful in polymerising RNA with defined sequences in a template-independent manner.

145. Answer (1)

Hint: He also developed the method for DNA sequencing.

Sol.: Frederick Sanger is credited for developing method for determination of amino acid sequence in proteins.

146. Answer (2)

Hint: Anticodon is complementary to codon.

Sol.: Codon – 5′ - GUC - 3′

Anticodon – 3′ - CAG - 5′

147. Answer (1)

Hint: This RNA carries amino acid during translation.

Sol.: tRNA acts as an adapter molecule during translation.

148. Answer (3)

Hint: Thymine is 5-methyl uracil. Uracil is not present in DNA.

Sol.: Sugar-phosphate backbone is present in both RNA and DNA. The plane of one base pair stacks over the other in double helix. This in addition to H-bonds, confers stability to the helical structure. Presence of thymine at the place of uracil also confers additional stability to DNA.

149. Answer (1)

Hint: While proposing the double helical structure of DNA, Watson and Crick immediately proposed a scheme for replication of DNA.

Sol.: Jacob and Monod were the first to elucidate a transcriptionally regulated system. Avery, MacLeod and McCarty concluded that DNA is the hereditary material. X-ray diffraction data for DNA was produced by Wilkins and Franklin.

150. Answer (1)

Hint: *E. coli* completes the process of replication within 18 minutes.

Sol.: When a phosphate group is linked to –OH of 5′C of a nucleoside through phosphoester linkage, a corresponding nucleotide is formed. RNA is the genetic material in QB bacteriophage. RNA is a better genetic material for the transmission of genetic information.

[ZOOLOGY]

SECTION-A

151. Answer (2)

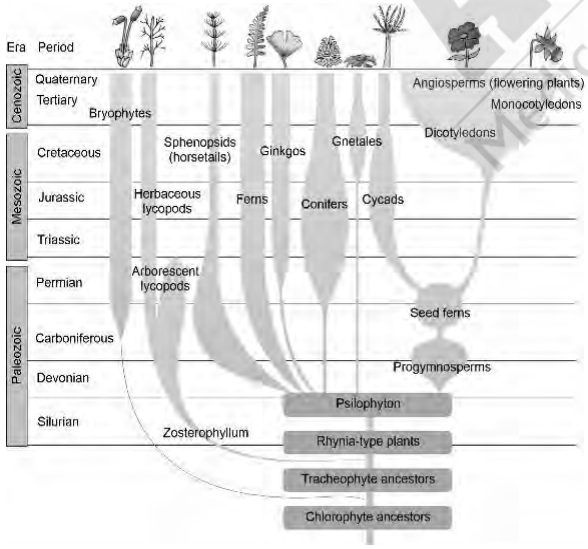
Hint: The year in which our population crossed 1.2 billion

Sol.: According to the 2011 census report, the population growth rate of India was less than 2 per cent *i.e.*, 20/1000/year, a rate at which our population could increase rapidly.

152. Answer (4)

Hint: Sphenopsids were abundant in the Carboniferous period.

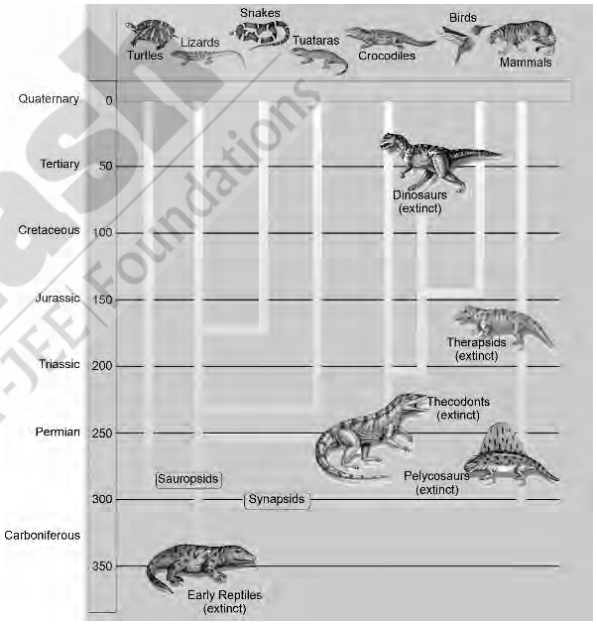
Sol.:



153. Answer (3)

Hint: Exclude the ancestors of mammals

Sol.:



154. Answer (2)

Hint: Exclude assortative mating

Sol.: Five factors are known to affect Hardy-Weinberg equilibrium. These are gene migration or gene flow, genetic drift, mutation, genetic recombination and natural selection.

155. Answer (3)

Hint: Induced abortions

Sol.: Diseases or infections which are transmitted through sexual intercourse are collectively called Sexually Transmitted Infections (STIs) or Venereal

Diseases (VDs) or Reproductive Tract Infections (RTIs). Among the common STIs, hepatitis-B and AIDS are not infections of the reproductive organs though their mode of transmission could be *via* sexual contact also. MTPs are not always surgical. Certain pills also induce abortions.

156. Answer (1)

Hint: Terminal method

Sol.: In tubectomy, a small part of the fallopian tube is removed or tied up through a small incision in the abdomen or through vagina. This technique is highly effective but its reversibility is very poor.

As no medicines or devices are used in natural methods of contraception, side effects are almost nil, chances of failure, though, of these methods are also high.

Cervical caps belong to the category of barrier methods of contraception.

157. Answer (2)

Hint: Primitive Earth atmosphere was reducing with high temperature

Sol.: In 1953, S. L. Miller, an American scientist, created conditions prevailing in the primitive Earth in a laboratory scale. He created electric discharge in a closed flask containing CH_4, H_2, NH_3 and water vapour at 800°C. He observed the formation of amino acids.

158. Answer (1)

Hint: Result of divergent evolution

Sol.: Whales, bats, cheetah and human (all mammals) share similarities in the pattern of bones of forelimbs. Though these forelimbs perform different functions in these animals, they have similar anatomical structures – all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs. Hence, in these animals, the same structure developed along different directions due to adaptations to different needs. This is divergent evolution and these structures are homologous.

159. Answer (3)

Hint: Evolved into the first amphibians

Sol.: By the time of 500 mya, invertebrates were formed and active. Fish with stout and strong fins could move on land and go back to water. This was about 350 mya. In 1938, a fish caught in South Africa happened to be extinct. These animals called lobefins evolved into the first amphibians that lived on both land and water.

160. Answer (2)

Hint: Cranial capacity of *Homo erectus* was 900cc.

Sol.: The brain capacities of *Homo habilis* were between 650-800cc. They probably did not eat meat. *Homo erectus* had a large brain around 900cc.

The cranial capacity of *Australopithecus* was about 500cc. *Dryopithecus* was more ape-like.

161. Answer (1)

Hint: Indian population in May 2011 crossed 1.2 billion.

Sol.: The world population which was around 2 billion in 1900 rocketed to about 6 billion by 2000 and 7.2 billion in 2011. A similar trend was observed in India too. Our population which was approximately 350 million at the time of our independence reached close to the billion mark by 2000 and crossed 1.2 billion in May 2011.

162. Answer (3)

Hint: Emergency contraceptives are used within 72 hours of coitus

Sol.: IUDs do not inhibit oogenesis.

Administration of progestogens or progestogen-estrogen combinations or IUDs within 72 hours of coitus have been found to be effective as emergency contraceptives as they could be used to avoid possible pregnancy due to rape or casual unprotected intercourse.

Contraceptives are not regular requirements for the maintenance of reproductive health.

163. Answer (2)

Hint: Exclude the methods that involve *in-vitro* fertilisation

Sol.: IUI (Intra Uterine Insemination) involves transfer of semen artificially into the uterus.

ZIFT, IUT and ICSI involve *in-vitro* fertilisation.

164. Answer (1)

Hint: Embryological support for evolution

Sol.: Embryological support for evolution was proposed by Ernst Heckel based upon the observation of certain features during embryonic stage common to all vertebrates that are absent in adults. For example, the embryos of all vertebrates including human, develop a row of vestigial gill slits just behind the head but it is a functional organ only in fish and not found in any other adult vertebrates. However, this proposal was disapproved on careful study performed by Karl Ernst von Baer. He noted that embryos never pass through the adult stages of other animals.

165. Answer (3)

Hint: Exclude the features associated with analogous structures

Sol.: In plants, thorns and tendrils of *Bougainvillea* and *Cucurbita* respectively, represent homology. Homology is based on divergent evolution. Homologous structures are anatomically similar.

166. Answer (4)

Hint: Does not involve human intervention

Sol.: The factor thought to have influenced the evolution of different beak shapes in Darwin's finches is competition for resources. Darwin proposed that competition for limited food resources on the Galapagos island was a key driver of natural selection, leading to the evolution of different beak shapes in finches.

Darwin's finches represent a classic example of founder effect.

167. Answer (3)

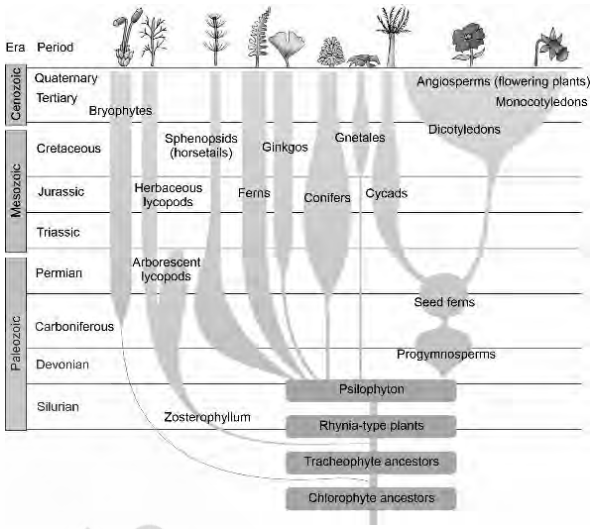
Hint: After evolution, they became insectivorous and vegetarian finches.

Sol.: During his journey, Darwin went to Galapagos islands. There he observed an amazing diversity of creatures. Of particular interest, small black birds later called Darwin's finches amazed him. He realised that there were many varieties of finches in the same island. All the varieties, he conjectured, evolved on the island itself. From the original seed-eating finches many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches. This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

168. Answer (1)

Hint: Conifers and Progymnosperms share same ancestors

Sol.:



169. Answer (4)

Hint: Exclude the dinosaur having spikes on tail

Sol.: The biggest dinosaur, *i.e.*, *Tyrannosaurus rex* was about 20 feet in height and had huge fearsome dagger-like teeth.

170. Answer (3)

Hint: Here, q^2 is given

Sol.: Given that 25% of the population exhibits the recessive phenotype (aa).

Thus, $q^2 = 0.25$

$q = \sqrt{0.25} = 0.5$

Thus, the frequency of the recessive allele (q) = 0.5.

171. Answer (2)

Hint: Proposed by Oparin and Haldane

Sol.: Oparin of Russia and Haldane of England proposed that the first form of life could have come from pre-existing non-living organic molecules (*e.g.* RNA, protein, *etc.*,) and that formation of life was preceded by chemical evolution, *i.e.*, formation of diverse organic molecules from inorganic constituents.

172. Answer (1)

Hint: Natural methods of contraception

Sol.: Natural methods work on the principle of avoiding chances of ovum and sperms meeting. Periodic abstinence is one such method. Withdrawal or coitus interruptus is another method in which the male partner withdraws his penis from the vagina just before ejaculation so as to avoid insemination.

173. Answer (2)

Hint: Opinion of two doctors is required after 1st trimester

Sol.: According to MTP (Amendment) act, 2017, a pregnancy may be terminated on certain considered grounds within the first 12 weeks of pregnancy on the opinion of one registered medical practitioner. If the pregnancy has lasted more than 12 weeks, but fewer than 24 weeks, two registered medical practitioners must be of the opinion, formed in good faith that the required ground exists.

174. Answer (3)

Hint: Include adolescence period

Sol.: Infections or diseases which are transmitted through sexual intercourse are collectively called Sexually Transmitted Infections (STIs), Venereal Diseases (VDs) or Reproductive Tract Infections (RTIs). Early symptoms of most of these are minor and include itching, fluid discharge, *etc*. Infected females may often be asymptomatic and hence, may remain undetected for long. Though all individuals are vulnerable to these infections, their incidences are reported to be very high among individuals in the age group of 15-24 years.

175. Answer (1)

Hint: Calculate the fertile period

Sol.: Periodic abstinence is one of the natural methods of contraception in which the couples avoid from coitus from day 10 to 17 of the 28 days menstrual cycle when ovulation could be expected. As chances of fertilisation are very high during this period, conception could be prevented. In a 32 days menstrual cycle, ovulation will be expected on 18th day. Hence, she should abstain from coitus from day 14 to 21 to prevent the conception.

176. Answer (4)

Hint: One of them is a selective estrogen receptor modulator

Sol.: Saheli – the new oral contraceptive for the females contains a non-steroidal preparation. It is 'once a week' pill with very few side effects and high contraceptive value. It does not inhibit ovulation. Contraceptive injections contain progestogens alone or combinations of estrogen and progestogens.

177. Answer (2)

Hint: Barrier method

Sol.: Diaphragms, cervical caps and vaults are barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus. They prevent conception by blocking the entry of sperms through the cervix. They are reusable but do not prevent the transmission of STIs.

178. Answer (1)

Hint: Exclude placental mammals

Sol.:

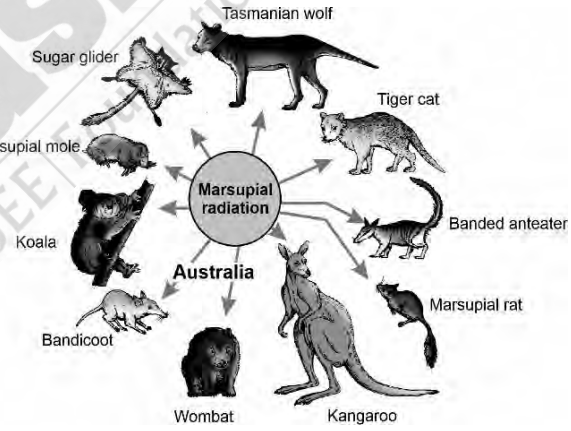


Fig:- Adaptive radiation of marsupials of Australia

179. Answer (3)

Hint: Features associated with Darwinian variations

Sol.: Hugo de Vries based on his work on evening primrose brought forth the idea of mutations – large difference arising suddenly in a population. He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about. Mutations are random and directionless.

180. Answer (2)

Hint: A French naturalist

Sol.: Branching descent and natural selection are the two key concepts of Darwinian theory of evolution. Even before Darwin, a French naturalist, Lamarck, had said that evolution of life forms had occurred but driven by use and disuse of organs. He gave the examples of Giraffes, who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks. As they passed on this acquired character of elongated neck to succeeding generations, Giraffes slowly over the years, came to acquire long necks.

181. Answer (4)

Hint: Proposed by Charles Darwin

Sol.: Industrial melanism represents an example of evolution by natural selection. It also represents directional selection.

182. Answer (4)

Hint: Favourite idea for some astronomers

Sol.: The Big Bang theory attempts to explain to us the origin of universe. It talks of a singular huge explosion unimaginable in physical terms. The universe expanded and hence, the temperature came down. Hydrogen and helium formed sometime later. The gases condensed under gravitation and formed the galaxies of the present day universe. In the solar system of the milky way galaxy, Earth was supposed to have been formed about 4.5 bya.

According to Panspermia, units of life were transferred to different planets including Earth.

183. Answer (2)

Hint: Popular brand for male condom

Sol.: LNG-20 is a hormone releasing intra uterine device. Oral administration of small doses of either progestogens or progestogen-estrogen combinations is a contraceptive method used by the females.

Progestogens alone or in combination with estrogen can also be used by females as injections or implants under the skin.

184. Answer (4)

Hint: Viral disease

Sol.: Except for hepatitis-B, genital herpes and HIV infections, other sexually transmitted diseases are completely curable if detected early and treated properly.

185. Answer (3)

Hint: One of the causes of venereal disease transmission

Sol.: Counselling and creating awareness among people about reproductive organs, adolescence and associated changes, safe and hygienic sexual practices, sexually transmitted infections (STIs) including AIDS, *etc.*, are the primary steps towards reproductive health.

SECTION-B

186. Answer (4)

Hint: Associated with the one who existed 2 mya

Sol.: Two mya, *Australopithecines* probably lived in East African grasslands.

- Cranial capacity of modern *Homo sapiens* is 1350cc while that of Neanderthal man is 1400cc.
- *Dryopithecus* was more ape-like.

187. Answer (3)

Hint: Lichens got reduced post-industrialisation.

Sol.: *Pteranodon* – Flying reptile

Lichen – Pollution indicator

Saltation – Single step large mutation

Ginkgos – Descendant of Psilophyton

188. Answer (4)

Hint: Related to natural selection

Sol.: According to Charles Darwin, the organic evolution is due to interspecific competition.

189. Answer (1)

Hint: Increasing trend of cranial capacity

Sol.: Among the stories of evolution of individual species, the story of evolution of modern man is most interesting and appears to parallel evolution of human brain and language.

190. Answer (4)

Hint: Identify an IUD

Sol.: Condoms are barriers made of thin rubber/latex sheath that are used to cover the penis in the male or vagina and cervix in the female.

Diaphragms, cervical caps and vaults are also barriers made of rubber that are inserted into the female reproductive tract to cover the cervix during coitus.

191. Answer (1)

Hint: Caused by HPV

Sol.: Except for hepatitis-B, genital herpes and HIV infections, other venereal diseases are completely curable if detected early and treated properly.

192. Answer (4)

Hint: Feature associated with ZIFT

Sol.: Infertility cases either due to inability of the male partner to inseminate the female or due to very low sperm counts in the ejaculates, could be corrected by Artificial Insemination (AI) technique. In this technique, the semen collected either from the husband or a healthy donor is artificially introduced either into the vagina or into the uterus (IUI-Intra Uterine Insemination).

193. Answer (4)

Hint: Fertilisation outside the female body

Sol.: *In-vitro* fertilisation (fertilisation outside the body in almost similar conditions as that in the female body) followed by embryo transfer is observed in ZIFT, IUT and ICSI.

194. Answer (3)

Hint: Like shrews

Sol.: The first mammals were like shrews. Their fossils are small sized. They were mainly viviparous and protected their unborn young inside the mother's body. Mammals were more intelligent in sensing and avoiding danger atleast.

195. Answer (2)

Hint: Exclude the observations made by Darwin

Sol.: Conventional religious literature tells us about the theory of special creation. This theory has three connotations. One, that all living organisms (species or types) that we see today were created as such. Two, that the diversity was always the same since creation and will be the same in future also. Three, the Earth is about 4000 years old.

196. Answer (2)

Hint: Exclude the naturalist who worked in Malay Archipelago

Sol.: Alfred Wallace, a naturalist who worked in Malay Archipelago had also come to similar conclusions made by Charles Darwin around the same time.

Mendel talked of 'inheritable factors' influencing phenotype, Darwin either ignored these observations or kept silence.

Hugo de Vries based on his work on evening primrose brought forth the idea of mutations.

197. Answer (1)

Hint: Seen in Raisen district

Sol.: Pre-historic cave art developed about 18,000 years ago. One such cave paintings by pre-historic humans can be seen at Bhimbetka rock shelter in Raisen district of Madhya Pradesh.

198. Answer (4)

Hint: Analogous structures

Sol.: Analogous structures are a result of convergent evolution-different structures evolving for the same function and hence having similarity. Examples are: Flippers of penguins and dolphins, wings of butterfly and birds, *etc*.

Vertebrate hearts or brains are examples of homologous structures.

Homologous structures are a result of divergent evolution.

199. Answer (1)

Hint: Basis of lactational amenorrhea

Sol.: Breast feeding stimulates prolactin secretion and evidence suggests that prolactin inhibits GnRH secretion and thus inhibits secretions of gonadotropins.

200. Answer (2)

Hint: Exclude the year in which family planning programmes were initiated

Sol.: The Government of India legalised Medical Termination of Pregnancy (MTP) in 1971 with some strict conditions to avoid its misuse. Such restrictions are all the more important to check indiscriminate and illegal female foeticides which are reported to be high in India.

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