Monthly Progressive Test

Class: XII

Subject: PCMB

Academic Excellence Programme
TECHNO ACE

Test Booklet No.: MPT-02 **Test Date: 07082025**

Time: 120 mins **Full Marks: 200**

Important Instructions :

1. The Test is of 120 mins duration and the Test Booklet contains 100 multiple choice questions of single correct option only. There are four sections with four subjects. You have to attempt all 100 questions (Candidates are advised to read all 100 questions). Questions 1 to 25 contain Physics, Questions 26 to 50 contain Chemistry, Questions 51 to 75 contain Mathematics, Questions 76 to 100 contain Biology.
2. Each question carries 2 marks. For each correct response, the candidate will get 2 marks. There is no negative mark for wrong response. The maximum mark is 200.
3. Use Blue / Black Ball point Pen only for writing particulars marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate must handover the Answer Sheet to the invigilator before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. The CODE for this Booklet is Off Line MPT02 07082025.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your UID No. anywhere else except in the specified space. Use of white fluid for correction is NOT permissible on the Answer Sheet. **Do not scribble or write on or beyond discrete bars of OMR Sheet at both sides**.
8. Each candidate must show on-demand his/her Registration document to the Invigilator.
9. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
10. Use of Electronic Calculator/Cellphone is prohibited.
11. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
12. No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.
13. There is no scope for altering response mark in Answer Sheet.

Space For Rough Works

Physics

1. An alternating current is given by the equation $I = I_1 \sin wt + I_2 \cos wt$. The rms current is given by

Ⓐ $\frac{1}{\sqrt{2}}(I_1 + I_2)$ Ⓑ $\frac{1}{\sqrt{2}}(i_1 + i_2)^2$ Ⓒ $\frac{\sqrt{i_1^2 + i_2^2}}{\sqrt{2}}$ Ⓓ $\frac{\sqrt{i_1^2 + i_2^2}}{2}$

2. A 10 μF capacitor is connected across a (220V, 50 Hz) ac supply. The peak current through the circuit is

Ⓐ 0.6A Ⓑ $0.6\sqrt{2}$ A Ⓒ $\frac{0.6}{\sqrt{2}}$ A Ⓓ $\frac{0.6}{2}$ A

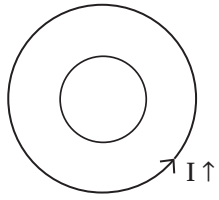
3. An alternating voltage $E = 200\sqrt{2}$ sin 100 t is connected to a 1μF capacitor through an ac ammeter. The reading of the ammeter is

Ⓐ 20 mA Ⓑ $20\sqrt{2}$ mA Ⓒ $10\sqrt{2}$ mA Ⓓ 40 mA

4. A circular coil of radius 10 c.m placed in a uniform magnetic field of 4T, the radius of the coil starts increasing at a rate of $\frac{1}{\pi}$ c. m/s, the emf induced in the coil is

Ⓐ 8 mV Ⓑ 8V Ⓒ 80 mV Ⓓ zero

5. According to the diagram, the bigger coil flows a current, which is increasing at a contact rate current flow through the smaller coil.



Ⓐ clockwise direction

Ⓑ anticlockwise direction

Ⓒ current varies with time

Ⓓ constant current flow through anticlockwise direction

6. Lenz's law states

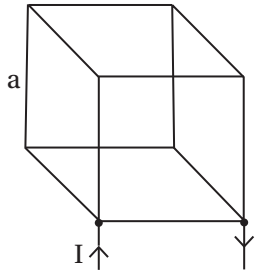
Ⓐ conservation of charge Ⓑ conservation of energy

Ⓒ conservation of magnetic flux Ⓓ conservation of momentum

7. Dimension of self inductance is

Ⓐ $ML^2T^{-2}I^{-2}$ Ⓑ MLT^2I^{-2} Ⓒ $MLTI^{-1}$ Ⓓ $MLT^{-1}I^{-2}$

8. Find the magnetic field at the centre of the following cube



Ⓐ $\frac{\mu_0}{4\pi} \times \frac{6I}{a}$

Ⓑ $\frac{\mu_0}{4\pi} \times \frac{4I}{a}$

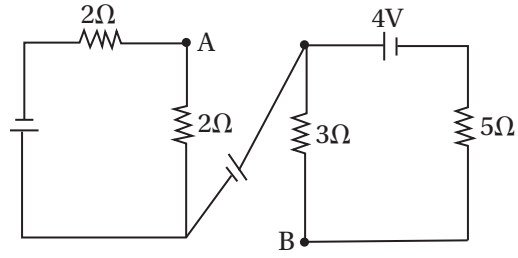
Ⓒ $\frac{\mu_0}{4\pi} \times \frac{I}{a}$

Ⓓ Zero

9. Two electrons from infinity throws with velocity 'V' towards each other, then their minimum separation will be—

Ⓐ $\frac{1}{4\pi\epsilon_0}\frac{2e^2}{mv^2}$ Ⓑ $\frac{1}{4\pi\epsilon_0} \times \frac{4e^2}{mV^2}$ Ⓒ Zero Ⓓ $\frac{1}{4\pi\epsilon_0} \times \frac{e^2}{mV^2}$

10. Find the potential difference between the points A and B



Ⓐ 3 V

Ⓑ 3.7 V

Ⓒ 5 V

Ⓓ 4.1 V

11. A uniformly charged non-conducting solid sphere of radius R carries a total charge Q distributed throughout its volume. What is the work done in moving a test charge q from the center of the sphere to its surface?

Ⓐ $\frac{1}{4\pi\epsilon_0}\cdot\frac{3Qq}{5R}$ Ⓑ $\frac{1}{4\pi\epsilon_0}\cdot\frac{3Qq}{2R}$ Ⓒ $\frac{1}{4\pi\epsilon_0}\cdot\frac{Qq}{R}$ Ⓓ $\frac{1}{4\pi\epsilon_0}\cdot\frac{Qq}{2R}$

12. A thin conducting spherical shell of radius R carries a total charge Q. A point charge of –Q/2 is placed at a distance R/2 from the center (inside the shell). What are the induced charges on the inner and outer surfaces of the shell, respectively?

Ⓐ $-\frac{Q}{2},+\frac{Q}{2}$ Ⓑ $+\frac{Q}{2},-\frac{Q}{2}$ Ⓒ $-\frac{Q}{2},+\frac{3Q}{2}$ Ⓓ $-\frac{Q}{2},+Q$

13. A potentiometer wire is 100 cm long and has a resistance of 10 Ω. It is connected in series with a battery of emf 5V and internal resistance 0.5 Ω. A cell of unknown emf is found to balance at 40 cm. What is the emf of the unknown cell?

Ⓐ 1.80 V Ⓑ 2.00 V Ⓒ 2.35 V Ⓓ 2.50 V

14. In a Wheatstone bridge circuit, all four resistors are equal to R, and the battery emf is ϵ. A galvanometer connects the midpoints of opposite sides. What is the current drawn from the battery?

Ⓐ $\frac{\epsilon}{R}$ Ⓑ $\frac{\epsilon}{2R}$ Ⓒ 0 Ⓓ $\frac{2\epsilon}{R}$

15. Two small identical conducting spheres A and B, each carrying a charge +q, are placed at a distance d apart. A third identical uncharged sphere C is first touched with A, then with B, and finally removed. What is the final force between A and B?

Ⓐ $\frac{1}{4\pi\epsilon_0}\cdot\frac{q^2}{d^2}$ Ⓑ $\frac{1}{4\pi\epsilon_0}\cdot\frac{q^2}{9d^2}$ Ⓒ $\frac{1}{4\pi\epsilon_0}\cdot\frac{q^2}{16d^2}$ Ⓓ $\frac{1}{4\pi\epsilon_0}\cdot\frac{q^2}{36d^2}$

ASSERTION AND REASON (16–19):

Directions: Read the following questions and choose any one of the following four responses.

A: Assertion and Reason both are correct and Reason is the correct explanation of Assertion.

B: Assertion and Reason both are correct and Reason is not the correct explanation of Assertion.

C: Assertion is correct but Reason is wrong.

D: Assertion is wrong but Reason is correct.

16. **Assertion:** The direction of induced electric field is always perpendicular to the direction of the changing magnetic field.

Reason: The induced electric field is a non-conservative field.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

17. **Assertion:** If electric current flowing through a circuit changes in magnitude then eddy currents are induced in a nearby iron piece.

Reason: Changing current produce a varying magnetic field.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

18. **Assertion:** A spark occur between the poles of a switch when switch is opened.

Reason: Current flowing in a conducting wire produces a magnetic field.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

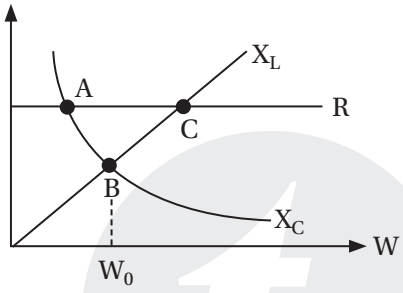
19. **Assertion:** At resonating frequency power dissipation is maximum.

Reason: Power factor at resonating frequency is maximum.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

Case Based Questions (20–22):

Inductive reactance, capacitive reactance and resistance of a AC circuit varies with angular frequency is as follows.



20. When $W < W_0$ circuit behave like

Ⓐ Capacitive Ⓑ Inductive Ⓒ Resistive Ⓓ Any one of the above

21. When $W = W_0$ circuit behave like

Ⓐ Capacitive Ⓑ Inductive

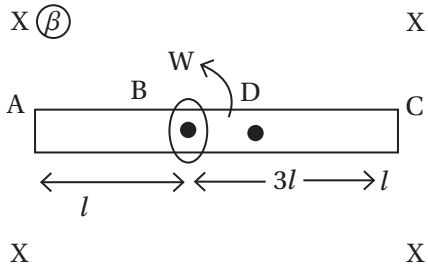
Ⓒ Resistive Ⓓ Any one of the above

22. Impidence of the circuit is minimum when

Ⓐ $W > W_0$ Ⓑ $W < W_0$ Ⓒ $W = W_0$ Ⓓ $W = 0$

Case Based Questions (23–25):

According to the diagram a rod (AC) rotate about point 'B' in a uniform magnetic field



23. Potential difference between A and C is

Ⓐ $2\beta\omega l^2$ Ⓑ $3\beta\omega l^2$ Ⓒ $4\beta\omega l^2$ Ⓓ $\frac{1}{2}\beta\omega l^2$

24. Potential maximum at point

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

25. Potential difference between A and B is

Ⓐ $4\beta\omega l^2$ Ⓑ $\frac{1}{2}\beta\omega l^2$ Ⓒ $2\beta\omega l^2$ Ⓓ Zero

Chemistry

26. The weight of silver (at wt = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at S.T.P. will be :

Ⓐ 5.4 g Ⓑ 10.8 g Ⓒ 54 g Ⓓ 108 g

27. When 0.1 mol MnO_4^{2-} is oxidised, the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is :

Ⓐ 96500 C Ⓑ 2 × 96500 C Ⓒ 9650 C Ⓓ 96.50 C

28. Molar conductivity of 0.025 $mol(L)^{-1}$ methanoic acid is 46.1 $S\,cm^2(mol)^{-1}$, the degree of dissociation and dissociation constant will be : [Given : $\lambda^0_{H^+} = 349.6\ S\cdot cm^2\cdot(mol)^{-1}$ and $\lambda^0_{HCOO^-} = 54.63\ S\cdot cm^2\cdot(mol)^{-1}$]

Ⓐ 11.4%, $3.67\times10^{-4}\,(mol)(L)^{-1}$ Ⓑ 22.8%, $1.83\times10^{-4}\,(mol)(L)^{-1}$

Ⓒ 52.2%, $4.25\times10^{-4}\,(mol)(L)^{-1}$ Ⓓ 1.14%, $3.67\times10^{-6}\,(mol)(L)^{-1}$

29. $Zn\,|Zn^{2+}(C_1)|\,||Zn^{2+}(C_2)|\,Zn$ for the cell ΔG is negative if :

Ⓐ $C_1 = C_2$ Ⓑ $C_1 > C_2$ Ⓒ $C_2 > C_1$ Ⓓ None of these

30. The nature of curve of E^0_{cell} Vs $\log k_e$ is

Ⓐ Straight line Ⓑ Parabola Ⓒ Hyperbola Ⓓ Elliptical curve

31. If $E^0_{Fe^{2+}/Fe}$ is x_1, $E^0_{Fe^{3+}Fe}$ is x_2 then $E^0_{Fe^{3+}/Fe^{2+}}$ will be :

Ⓐ $3x_2 - 2x_1$ Ⓑ $x_2 - x_1$ Ⓒ $x_2 + x_1$ Ⓓ $2x_1 + 3x_2$

32. The specific conductances of four electrolytes in $ohm^{-1}\,cm^{-1}$ are given in option below. Which one offers highest resistance to the passage of electric current?

Ⓐ 7×10^{-3} Ⓑ 9.2×10^{-9} Ⓒ 6×10^{-7} Ⓓ 4×10^{-8}

33. Molar conductivity of 0.15 M solution of KCl at 298 k, if its conductivity is 0.0152 $S\,cm^{-1}$ will be :

Ⓐ $124\,\Omega^{-1}\,cm^2\,(mol)^{-1}$ Ⓑ $204\,\Omega^{-1}\,cm^2\,(mol)^{-1}$ Ⓒ $101\,\Omega^{-1}\,cm^2\,(mol)^{-1}$ Ⓓ $300\,\Omega^{-1}\,cm^2\,(mol)^{-1}$

34. What is the cell constant of a cell of KCl containing $\frac{N}{50}$ solution, if the conductivity and resistance of cell is 0.002765 $S\,cm^{-1}$ and 400 Ohm respectively?

Ⓐ 6.91 cm^{-1} Ⓑ 1.106 cm^{-1} Ⓒ 14.46 cm^{-1} Ⓓ 2.212 cm^{-1}

35. The molar ionic conductivities of NH_4^+ and OH^- at infinite dilution are 72 & 198 $ohm^{-1}\,cm^2$ respectively. The molar conductivity of a centinormal NH_4OH solution at the same temperature is formed to be 9 $ohm^{-1}\,cm^2$. The percentage dissociation of NH_4OH at this concentration will be :

Ⓐ 3.33% Ⓑ 7.14% Ⓒ 12.5% Ⓓ 4.5%

Assertion-Reason Based Questions

Read the two statements carefully and select the correct option given below.

A: Assertion and Reason both are correct and Reason is the correct explanation of Assertion

B: Assertion and Reason both are correct and Reason is not the correct explanation of Assertion

C: Assertion is correct but Reason is wrong

D: Assertion is wrong but Reason is correct

36. **Assertion (A):** For the Daniel Cell; $Zn|Zn^{++}||Cu^{2+}|Cu$ with E_{cell} = 1.1 V, the application of opposite potential greater than 1.1 V, results into flow of electron from cathode to anode.

Reason (R): Zinc is deposited at anode and copper dissolved at cathode.

Ⓐ a Ⓑ b Ⓒ c Ⓓ d

37. **Assertion (A):** Lithium has the lowest electrode potential (reduction potential)

Reason (R): Lithium ion is the strongest oxidising agent.

Ⓐ a Ⓑ b Ⓒ c Ⓓ d

38. **Assertion (A):** Cu^{2++} ions get reduced more easily than H^+ ions.

Reason (R): Standard electrode potential of copper is 0.34 V.

Ⓐ a Ⓑ b Ⓒ c Ⓓ d

39. **Assertion (A):** Current stops flowing when $E_{cell} = 0$

Reason (R): Equilibrium of the cell reaction is a attained

Ⓐ a Ⓑ b Ⓒ c Ⓓ d

40. 0.002 (M) solution of a weak acid has an equivalent conductance (Λ_{eq}) 60 Ohm^{-1} cm^2 (eq) what will be the pH? [Given = 400 Ω^{-1} cm^2 $(eq)^{-1}$ & $\log_{10}3 = 0.48$]

Ⓐ 3.52 Ⓑ 2.52 Ⓒ 1.87 Ⓓ 2.7

41. Blood cells retains their normal shape in solution which are :

Ⓐ hypotonic to blood Ⓑ isotonic to blood Ⓒ hypertonic to blood Ⓓ equinormal to blood

42. Calculate the molality of 1 (M) $NaNO_3$ solution. (Given density of solution d = 1.25 g/ml)

Ⓐ 0.8 m Ⓑ 0.858 m Ⓒ 1.6 m Ⓓ 1 m

43. The amount of ice that will separate out on cooling a solution containing 50 g of ethylene glycol in 200 g water to –9.3 cc is [k_f for water = 1.86 k kg $(mol)^{-1}$]

Ⓐ 38.71 mg Ⓑ 166.20 g Ⓒ 38.71 g Ⓓ 42 g

44. A 0.2 molal aqueous solution of weak acid HX 20% ionised. The freezing point of solution is (K_f = 1.86)

Ⓐ –0.45°C Ⓑ –0.9°C Ⓒ –0.31°C Ⓓ –0.53°C

Case Based Type Questions (Q. No. 45–47)

Properties such as boiling point, freezing point and vapour pressure of a pure solvent change when solute molecules are added to get homogeneous solution. These are called colligative properties. Application of colligative properties are very useful in day to day life. One of its example is the use of ethylene glycol and water mixture as antifreezing liquid in the radiator of automobiles. A solution M is prepared by mixing ethanol and water. The mole fraction of ethanol is the mixture is 0.9.

Given : $K_f\ (H_2O) = 1.86$ k kg$(mole)^{-1}$

K_f (ethanol) = 2.0 k kg$(mole)^{-1}$

K_b (water) = 0.52 k kg $(mole)^{-1}$

K_b (ethanol) = 1.2 k kg $(mole)^{-1}$

Vapour pressure of pure water = 32.8 mm Hg

Vapour pressure of pure ethanol = 40 mm Hg

M.W. of H_2O = 18, M.W. of ethanol = 46

Considering ideal solution, answer the following.

45. The freezing point of the solution M is :

Ⓐ 268.7 k Ⓑ 268.5 k Ⓒ 234.2 k Ⓓ 150.9 k

46. The vapour pressure of the solution M is :

Ⓐ 39.3 mm Hg Ⓑ 36 mm Hg Ⓒ 29.5 mm Hg Ⓓ 28.8 mm Hg

47. Water is added to the solution 'M' such that the mole fraction of water in the solution becomes 0.9. The boiling point of this solution is :

Ⓐ 380.4 k Ⓑ 376.2 k Ⓒ 375.5 k Ⓓ 354.7 k

Case Based Type Questions (Q. No. 48–50)

If a cell has cell potential E and standard cell potential E^0 then free energy change of cell process may be calculated as,

$\Delta G = -W = -nFE$

$\Delta G^0 = -W_{max} = -nFE^0$

Where, n is the number of electrons involved in overall cell process.

According to Gibbs—Helmholtz equation :

$\Delta G = -\Delta H - T\Delta S$

$\Delta G = \Delta H + T\left(\frac{d\Delta G}{dt}\right)_p$

Temperature co-efficient of cell μ will be equal to $\left(\frac{dE}{dt}\right)_p$; Given $\left(\frac{dE}{dT}\right)_p = \frac{\Delta s}{nF}$

48. ΔG^0 for the Daniel Cell :

$Zn(s) \mid ZnSO_4 \mid\mid CuSO_4 \mid Cu(s)$

$E^0_{Zn^{++}/Zn} = -0.76$ V ; $E^0_{Cu^{2+}/Cu} = +0.34$ V

Will be :

Ⓐ –312.3 kJ Ⓑ –212.3 kJ Ⓒ –123.2 kJ Ⓓ –323.1 kJ

49. The temperature co-efficient of a cell whose cell reaction is :

$Pb(s) + HgCl_2(aq) \rightarrow PbCl_2(aq) + Hg(l)$

$\left(\frac{dE}{dt}\right)_p = 1.5\times10^{-4}\ V\ (k)^{-1}$ at 298 k.

The change in entropy in J $(k)^{-1}$ $(mol)^{-1}$ for the given cell reaction will be :

Ⓐ 14.475 Ⓑ 28.95 Ⓒ 57.9 Ⓓ 86.82

50. When the concentration of NaOH in the electrolytic solution (in a fuel cell) is doubled the cell potential will be :

In fuel cell.

Anodic process : $[H_2 + 2OH^- \rightarrow 2H_2O + 2e^-] \times 2 \rightarrow$ oxidation

Cathodic process : $O_2 + 2H_2O + 4e^- \rightarrow 4OH^- \rightarrow$ Reduction

Overall process : $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$

Ⓐ unchanged
Ⓑ reduced half
Ⓒ increased by a factor of 4
Ⓓ increased by a factor of 2

Mathematics

51. Sin $\left(\frac{1}{2}\cos^{-1}\frac{4}{5}\right)$ is equal to

Ⓐ $-\frac{1}{\sqrt{10}}$ Ⓑ $\frac{1}{\sqrt{10}}$ Ⓒ $-\frac{1}{10}$ Ⓓ $\frac{1}{10}$

52. $\cos^{-1}\left(-\frac{1}{2}\right)-2\sin^{-1}\left(\frac{1}{2}\right)+3\cos^{-1}\left(-\frac{1}{\sqrt{2}}\right)-4\tan^{-1}(-1)$

Ⓐ $\frac{19\pi}{12}$ Ⓑ $\frac{35\pi}{12}$ Ⓒ $\frac{47\pi}{12}$ Ⓓ $\frac{43\pi}{12}$

53. The domain of the function

$f(x)=\sqrt{\log_2 \sin x}$ is

Ⓐ $\left\{(2n+1)\frac{\pi}{2}: n\in z\right\}$ Ⓑ $\left\{(4n+1)\frac{\pi}{2}: n\in z\right\}$ Ⓒ $\left\{(3n-1)\frac{\pi}{2}: n\in z\right\}$ Ⓓ $\left\{\frac{n\pi}{2}: n\in z\right\}$

54. The range of the function $f(x) = \sin^{-1}x + \tan^{-1}x + \sec^{-1}x$ is

Ⓐ $\left(\frac{\pi}{4},\frac{3\pi}{4}\right)$ Ⓑ $\left[\frac{\pi}{4},\frac{3\pi}{4}\right]$ Ⓒ $\left\{\frac{\pi}{4},\frac{3\pi}{4}\right\}$ Ⓓ none of these

55. If A and B are square matrics of order 3 such that $|A|=-1, |B|=3$, then $|3AB|$ equals

Ⓐ –9 Ⓑ –81 Ⓒ –27 Ⓓ 81

56. The value of he determinant $\Delta=\begin{vmatrix} x+2 & x+3 & x+5 \\ x+4 & x+6 & x+9 \\ x+8 & x+11 & x+15 \end{vmatrix}$ is

Ⓐ 2 Ⓑ –2 Ⓒ 3 Ⓓ x – 1

57. Let R = {(3, 3), (6, 6),(9, 9),(12, 12),(6, 12),(3, 9),(3, 12),(3, 6)} be a relation on the set A = {3, 6, 9, 12}. Then relation is

Ⓐ Reflexive and symmetric only
Ⓑ an equivalence relation
Ⓒ reflexive only
Ⓓ reflexive and transitive only

58. The set of points of discontinuity of the greatest integer function [x] is

Ⓐ N Ⓑ Z Ⓒ R Ⓓ ϕ

59. It is given hat $f'(a)$ exists, then

$\lim_{x\to a}\frac{xf(a)-af(x)}{x-a}$

Ⓐ $f(a) - af'(a)$ Ⓑ $f'(a)$ Ⓒ $-f'(a)$ Ⓓ $f(a) + af'(a)$

60. The number of critical points of the function $f(x) = (x-2)^{2/3}(2x+1)$ is

Ⓐ 2 Ⓑ 0 Ⓒ 1 Ⓓ 3

61. Let $A = \left\{x_i \in R \middle| x_i \neq x_j \text{ for } i \neq j \text{ and } 1 \leq i, j \leq 4\right\}$. The number of symmetric relation of A is

Ⓐ 2^{4^2} Ⓑ 4^{4^2} Ⓒ 2^{4^4} Ⓓ none of these

62. The function $f(x) = \begin{cases} \frac{\sin x}{x} + \cos x, & \text{if } x \neq 0 \\ k, & \text{if } x = 0 \end{cases}$

is continuous at x = 0, Then the value of 'k' is :

Ⓐ 3 Ⓑ 2 Ⓒ 1 Ⓓ 1.5

63. Let, $f(x) = \sin^{-1} x + \cos^{-1} x + \tan^{-1} x$ then $f_{max} = ?$

Ⓐ $\frac{\pi}{4}$ Ⓑ $\frac{\pi}{2}$ Ⓒ $\frac{3\pi}{4}$ Ⓓ $\frac{5\pi}{4}$

64. Let, $f(x) = \left|\sin\frac{x}{4}\right| + \left|\cos\frac{x}{4}\right|$ then period of f(x) is

Ⓐ $\frac{\pi}{2}$ Ⓑ 8π Ⓒ 2π Ⓓ 4π

65. Let $f : R \longrightarrow R$ be a polynomial function of degree four having extreme values at x = 4 and x = 5. If $\lim\limits_{x\to 0} \frac{f(x)}{x^2} = 5$, then f(2) is equal to

Ⓐ 8 Ⓑ 10 Ⓒ 12 Ⓓ 14

Assertion and Reasoning Based Questions [Q. 66–69] :

Directions: Read the following questions and choose any one of the following four responses.

A: Assertion and Reason both are correct and Reason is the correct explanation of Assertion.

B: Assertion and Reason both are correct and Reason is not the correct explanation of Assertion.

C: Assertion is correct but Reason is wrong.

D: Assertion is wrong but Reason is correct.

66. **Assertion (A) :** If the surface area of a cube is increasing at a rate of 3.6 cm^2/sec retaining its shape, then the rate of change of its volume (in cm^3/sec), when the length of a side of the cube is 10 cm, is 9

Reason (R) : Rate of change of y w.r.t x is $\frac{dy}{dx}$

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

67. **Assertion (A) :** If the function $f : A \longrightarrow B$ is surjective then B is R – {–1}, where $f(x) = \frac{x^2}{1-x^2}$ and $A = IR - \{-1, 1\}$

Reason (R) : A function is called surjective if rang = codomain.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

68. **Assertion (A) :** Let A be a 2 × 2 matrix such that tr (A) = 4 and tr (A^2) = 10 then det (A) is 3.

Reason (R) : For any square matrix A of order n × n

$A.(AdjA) = (AdjA).A = |A| I_n$

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

69. **Assertion (A) :** Polar form of the complex number $z=-1-i, i=\sqrt{-1}$ is $\left(\sqrt{2}, -\frac{3\pi}{4}\right)$

Reason (R) : If $z = -1 - i$ then its conjugate is $\bar{z}=1+i$

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

Case Study Based Question-I (Q.70 to Q.72)

Let the function f(x) be twice differentiable. And $f'(x_0) = 0$ (If $f'(x_0)$ exists) at a critical point x_0. If $f''(x_0) < 0$ then at x_0 the function has a maximum, if $f''(x_0) > 0$, then at x_0 the function has a minimum. At the point of inflection, second order derivative of the function is either zero or undefined.

On the basis of this answer the following question :

70. The number of critical points of the function $f(x)=3.\sqrt[3]{x^2}-x^2$ is

Ⓐ 1 Ⓑ 2 Ⓒ 3 Ⓓ 4

71. The minimum value of the function $f(x)=3.\sqrt[3]{x^2}-x^2$ occurs at

Ⓐ $x = -1$ Ⓑ $x = 1$ Ⓒ $x=\frac{3}{2}$ Ⓓ none of these

72. The maximum value of the above function is

Ⓐ 1 Ⓑ 2 Ⓒ 3 Ⓓ 4

Case Study Based Question-II (Q.73 to Q.75)

To calculate the number of functions, one-one (injective) functions and onto (surjective) functions from a set A to a set B where A has m elements and B has n elements. We use the following formulas :

1. Number of all functions from A to B is n^m
2. Number of one-one function from A to B is ${}^nP_m$ (if $m \le n$)
3. Number of onto function is $\sum_{k=0}^{n}(-1)^k\binom{n}{k}(n-k)^m$ (if $m \ge n$)

On the basis of this answer the following questions.

73. If n(A) = 3 and n(B) = 4 then number of function from A to B is

Ⓐ 3^4 Ⓑ 4^3 Ⓒ $2^{3\times4}$ Ⓓ 2^{3^4}

74. If n(A) = 4 and n(B) = 3 then number of one-one function from A to B is

Ⓐ ${}^4P_3$ Ⓑ 3 ! Ⓒ 4 ! Ⓓ none of these

75. If A {1, 2, 3, ... n} and B = {a, b} then number of onto function from A to B is

Ⓐ $2^n - 1$ Ⓑ $2^n - 2$ Ⓒ 2^n Ⓓ $2^n + 2$

Biology

76. Gene controls

Ⓐ protein synthesis but not heredity Ⓑ both protein synthesis and heredity

Ⓒ heredity but not protein synthesis Ⓓ biochemical reactions of some enzymes

77. In the DNA molecule,

Ⓐ the total amount of purine nucleotides and pyrimidine nucleotides is not always equal

Ⓑ the proportion of adenine, with relation to thymine, varies with the organism

Ⓒ there are two strands which run parallel in the 5′→ 3′ direction

Ⓓ there are two strands which run anti parallel, one in the 5′→3′ direction and the other in the 3′→5′ direction

78. Distance between genes and percentage of recombination shows

Ⓐ a direct relationship Ⓑ an inverse relationship Ⓒ a parallel relationship Ⓓ no relationship

79. Which of the following will not result in variations among siblings?

Ⓐ Independent assortment of genes Ⓑ Linkage

Ⓒ Mutation Ⓓ Crossing over

80. A child of blood group O has a B–group father. The genotype of the father will be

Ⓐ $I^0 I^0$ Ⓑ $I^B I^B$ Ⓒ $I^A I^B$ Ⓓ $I^B I^0$

81. Down's syndrome is due to

Ⓐ Crossing over Ⓑ Linkage

Ⓒ Sex linked inheritance Ⓓ Non disjunction of chromosomes

82. Genes located on the same locus of a chromosome:

Ⓐ Multiple alleles Ⓑ Polygenes

Ⓒ Oncogenes Ⓓ None of the above

83. What are the number of chromosomes in the secondary spermatocyte and spermatozoa?

Ⓐ 46 and 23, respectively Ⓑ 23 and 46, respectively

Ⓒ 23 and 23, respectively Ⓓ 46 and 46, respectively

84. The equivalent of a structural gene is

Ⓐ Operon Ⓑ Recon Ⓒ Muton Ⓓ Cistron

85. Which is not a salient feature of genetic code?

Ⓐ Ambiguous Ⓑ Universal Ⓒ Specific Ⓓ Degenerate

86. Removal of introns and joining the exons in a defined order in a transcription unit is:

Ⓐ Splicing Ⓑ Capping Ⓒ Tailing Ⓓ Transformation

87. If a ds DNA has 20 % of Cytosine, what will be the percentage of Adenine in the DNA?

Ⓐ 10% Ⓑ 50% Ⓒ 30% Ⓓ 40%

88. Which of the following genotypes will produce four different types of gametes?

Ⓐ AAbbccddEE Ⓑ aaBBCCdd

Ⓒ AaBbCc Ⓓ AaBb

89. Complementary genes were demonstrated by Bateson in

Ⓐ Capsella Ⓑ *Lathyrus odoratus*

Ⓒ Summer squash Ⓓ *Mirabilis jalapa*

90. Mice coat colour is an example of:

Ⓐ Complementary genes Ⓑ Duplicate genes

Ⓒ Recessive epistasis Ⓓ All of the above

The questions 91 to 94 have two statements – Assertion (A) and Reason (R). Of the two statements, mark the correct answer from the options given below:

A. Both A and R are true and R is the correct explanation of A.

B. Both A and R are true but R is not the correct explanation of A.

C. A is true but R is false.

D. A is false but R is true.

91. **Assertion (A) :** ABO blood group system is a good example of pleiotropic genes.
Reason (R) : In ABO blood group system, when I^A and I^B alleles are present together, both express themselves.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

92. **Assertion (A) :** Females suffer from haemophilia only in the homozygous condition.
Reason (R) : The gene for haemophilia is located on X chromosome.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

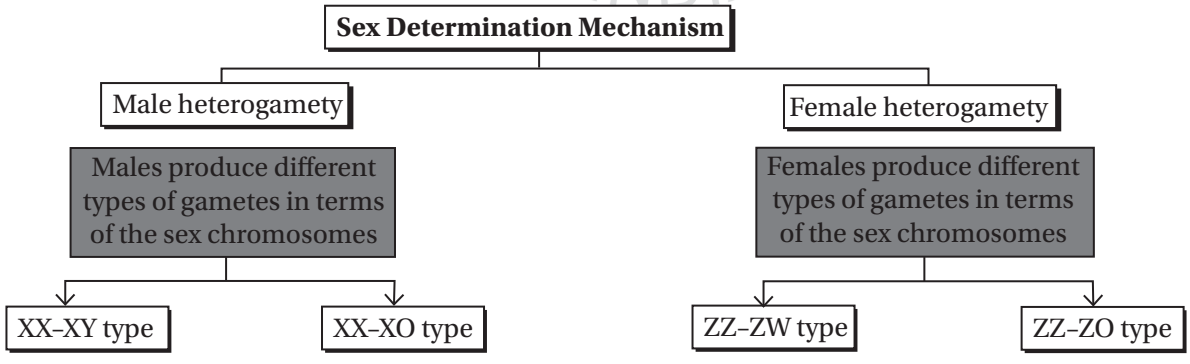
93. **Assertion (A) :** The mRNA is linear.
Reason (R) : The mRNA carries coded information.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

94. **Assertion (A) :** Replication and transcription occur in the nucleus, but translation occurs in the cytoplasm.
Reason (R) : mRNA is transferred from the nucleus into the cytoplasm where ribosomes and amino acids are available for protein synthesis.

Ⓐ A Ⓑ B Ⓒ C Ⓓ D

Study the chart given below and answer the following questions (95-97):



95. Drosophila shows _____ type of sex determination:

Ⓐ XX-XY Ⓑ XX-XO Ⓒ ZZ-ZW Ⓓ ZO-ZZ

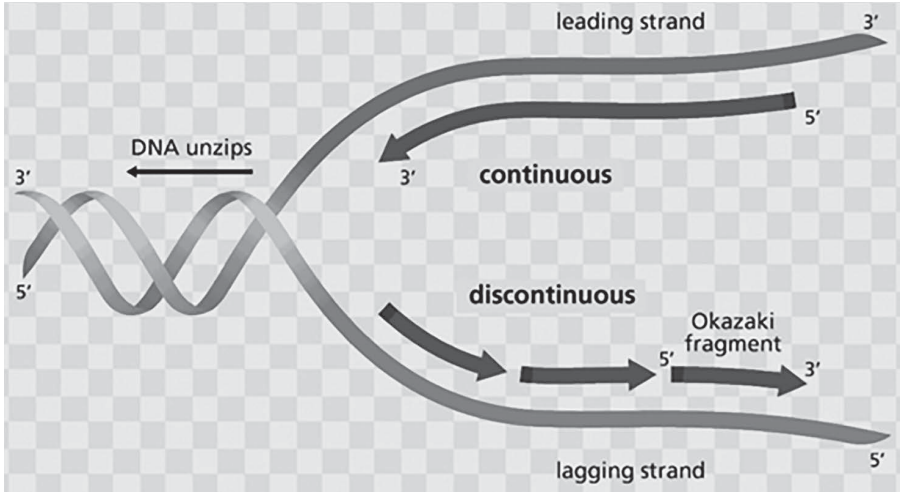
96. ZZ-ZW type of sex determination is shown by:

Ⓐ Grasshopper Ⓑ Cockroach Ⓒ Fowl Ⓓ None of the above

97. In which of the following organisms, do males have a pair of Z chromosomes?

Ⓐ Butterfly Ⓑ Cockroach Ⓒ Fish Ⓓ Humans

Study the diagram of DNA replication given below and answer the following questions(98-100):



98. Why do you see two different types of replicating strands in the given DNA replication fork?

Ⓐ The DNA dependent DNA polymerase catalyses polymerisation only in the 5′→3′ direction

Ⓑ The DNA dependent DNA polymerase catalyses polymerisation only in the 3′→5′ direction

Ⓒ The DNA dependent DNA polymerase catalyses polymerisation in both 5′→3′ and 3′→5′ direction

Ⓓ The enzyme primase synthesises the RNA primer

99. If the base sequence of one strand of DNA is TACTAGGAT, what will be the base sequence of RNA after transcription of the given sequence?

Ⓐ AUGAUCCUA Ⓑ TUGAUCCUA Ⓒ TACTAGGAT Ⓓ TACTAGCUA

100. What is the distance maintained between the two consecutive pairs of bases in the DNA molecule?

Ⓐ 0.34 nm Ⓑ 3.4 nm Ⓒ 4.3 nm Ⓓ 0.43 nm