VITEEE 2025
Solved Paper
Memory Based

GENERAL INSTRUCTIONS

- This question paper contains total 125 questions divided into four parts :
  Part I : Physics Q. No - 1 to 35
  Part II : Chemistry Q. No - 36 to 70
  Part III : Mathematics Q. No - 71 to 110
  Part IV : Aptitude Test Q. No - 111 to 120
  Part V : English Q. No - 121 to 125
- All questions are multiple choice questions with four options, only one of them is correct.
- For each correct response, the candidate will get 1 mark.
- There is no negative marking for the wrong answer.
- The test is of 2½ hours duration.

PART - I (PHYSICS)

1. When the force retards the motion of body, the work done is
(a) zero
(b) negative
(c) positive
(d) Positive or negative depending upon the magnitude of force and displacement

2. A steel rod has a radius of 20 mm and a length of 2.0 m. A force of 62.8 kN stretches it along its length. Young's modulus of steel is 2.0×10^{11} N/m^2. The longitudinal strain produced in the wire is
(a) 25×10^{-5} (b) 50×10^{-5}
(c) 75×10^{-5} (d) 100×10^{-5}

3. Which of the following processes is irreversible?
(a) Transfer of heat by radiation
(b) Adiabatic changes performed slowly
(c) Extremely slow extension of a spring
(d) Isothermal changes performed slowly

4. When the wavelength of radiation falling on a metal is changed from 500 nm to 200 nm, the maximum kinetic energy of the photoelectrons becomes three times larger. The work function of the metal is close to :
(a) 0.81 eV (b) 1.02 eV
(c) 0.52 eV (d) 0.61 eV

5. The magnitude of electric field intensity E is such that, an electron placed in it would experience an electrical force equal to its weight is given by
(a) mge (b) $\frac{mg}{e}$ (c) $\frac{e}{mg}$ (d) $\frac{e^2}{m^2}g$

6. A balloon filled with helium (32°C and 1.7 atm.) bursts. Immediately afterwards the expansion of helium can be considered as :
(a) irreversible isothermal (b) irreversible adiabatic
(c) reversible adiabatic (d) reversible isothermal

7. From a point charge, there is a fixed point A at same distance. At A, there is an electric field of 500 V/m and potential difference of 3000 V. Distance between point charge and A will be
(a) 6m (b) 12m
(c) 16m (d) 24m

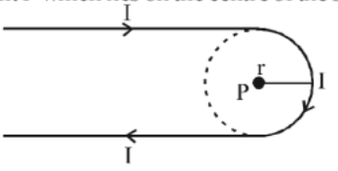
8. In Bernoulli's theorem which of the following is conserved?
(a) Mass (b) Linear momentum
(c) Energy (d) Angular momentum

9. A tightly wound long solenoid carries a current 5A. An electron shot perpendicular to the solenoid axis inside it revolves at a frequency 10^8 rev/s. The number of turns per meter length of the solenoid is
(a) 57 (b) 176
(c) 569 (d) 352

10. Two deuterons undergo nuclear fusion to form a Helium nucleus. Energy released in this process is : (given binding energy per nucleon for deuteron=1.1 MeV and for helium =7.0 MeV)
(a) 30.2 MeV (b) 32.4 MeV
(c) 23.6 MeV (d) 25.8 MeV

11. The magnetic energy stored in an inductor of inductance 4 μH carrying a current of 2 A is
(a) 4 μJ (b) 4 mJ
(c) 8 mJ (d) 8 μJ

12. A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point P which lies on the centre of the semicircle?



(a) $\frac{\mu_0 I}{4\pi r}(2+\pi)$ (b) $\frac{\mu_0 I}{4\pi r}(2-\pi)$

(c) $\frac{\mu_0 I}{2\pi r}(2-\pi)$ (d) $\frac{\mu_0 I}{2\pi r}(2+\pi)$

13. Two bodies of equal masses moving with equal speeds make a perfectly inelastic collision. If the speed after the collision is reduced to half, the angle between their velocities of approach is.

(a) 30° (b) 60° (c) 90° (d) 120°

14. An electromagnetic wave propagating through vacuum is give by $E = E_0 \sin(\omega t - kx)$. Choose correct option

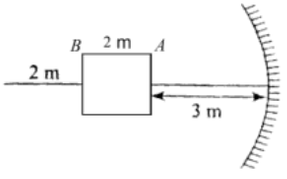
(a) The average value of $E = \frac{E_0}{2}$

(b) The average value of produced magnetic field is zero

(c) The average value of electric energy density is equal to the average value of magnetic energy density

(d) Both (b) and (c)

15. A cube of side 2 m is placed in front of a concave mirror of focal length 1 m with its face A at a distance of 3 m and face B at a distance of 5 m form the mirror. The distance between the images of faces A and B and heights of images of A and B are respectively,



(a) 1 m, 0.5 m, 0.25 m

(b) 0.5 m, 1 m, 0.25 m

(c) 0.5 m, 0.25 m, 1 m

(d) 0.25 m, 1 m, 0.5 m

16. Unpolarised light is incident on a dielectric of refractive index $\sqrt{3}$. What is the angle of incidence if the reflected beam is completely polarised?

(a) 30° (b) 45° (c) 60° (d) 75°

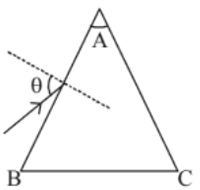
17. Monochromatic light is incident on a glass prism of angle A. If the refractive index of the material of the prism is μ, a ray, incident at an angle θ, on the face AB would get transmitted through the face AC of the prism provided :

(a) $\theta > \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(b) $\theta < \cos^{-1}\left[\mu \sin\left(A + \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(c) $\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

(d) $\theta < \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$



18. Assume that protons and neutrons have equal masses. Mass of a nucleon is 1.6×10^{-27} kg and radius of nucleus is $1.5 \times 10^{-15} A^{1/3}$ m. The approximate ratio of the nuclear density and water density is $n \times 10^{13}$. The value of n is

(a) 11.31 (b) 21 (c) 66 (d) 78

19. Two liquid drops of equal radii are falling through air with the terminal velocity v. If these two drops coalesce to form a single drop, its terminal velocity will be :

(a) $\sqrt{2v}$ (b) $2v$ (c) $(4)^{1/3}$ v (d) $\sqrt[3]{2v}$

20. A 40 μF capacitor is connected to a 200 V, 50 Hz ac supply. The rms value of the current in the circuit is, nearly :

(a) 2.05 A (b) 2.5 A (c) 25.1 A (d) 1.7 A

21. A plane electromagnetic wave of frequency 25 GHz is propagating in vacuum along the z-direction. At a particular point in space and time, the magnetic field is given by $\vec{B} = 5 \times 10^{-8}\,\hat{j}\,T$. The corresponding electric field $\vec{E}$ is (speed of light $c = 3 \times 10^8$ ms^{-1})

(a) $1.66 \times 10^{-16}\,\hat{i}$ V/m (b) $-1.66 \times 10^{-16}\,\hat{i}$ V/m

(c) $-15\,\hat{i}$ V/m (d) $15\,\hat{i}$ V/m

22. The effective resistance of a parallel connection that consists of four wires of equal length, equal area of cross-section and same material is 0.25 Ω. What will be the effective resistance if they are connected in series?

(a) 4 Ω (b) 0.25 Ω (c) 0.5 Ω (d) 1 Ω

23. The coefficient of static friction between two surfaces depends upon

(a) the normal reaction

(b) the shape of the surface in contact

(c) the magnitude of applied force

(d) None of these

24. In an explosion, a body breaks up into two pieces of unequal masses. In this

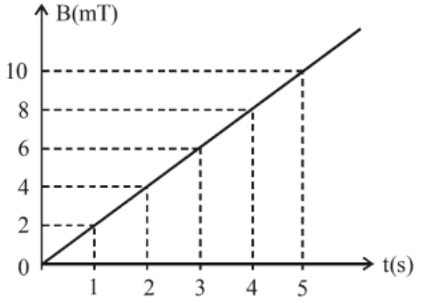
(a) both parts will have numerically equal momentum

(b) lighter part will have more momentum

(c) heavier part will have more momentum

(d) both parts will have equal velocity

25. The magnetic field B crossing normally a square metallic plate of area 4 m^2 is changing with time as shown in figure. The magnitude of induced emf in the plate during t = 2 s to t = 4s, is



(a) 4 mV (b) 8 mV (c) 12 mV (d) 16 mV

26. A particle of mass m has momentum p. Its kinetic energy will b

(a) mp (b) p^2m (c) $\frac{p^2}{m}$ (d) $\frac{p^2}{2m}$

27. The potential energy of a system increases if work is done
(a) upon the system by a non conservative force
(b) by the system against a conservative force
(c) by the system against a non conservative force
(d) upon the system by a conservative force

28. A particle moves under the effect of a force F = cx from x = 0 to x = x_1, the work done in the process is

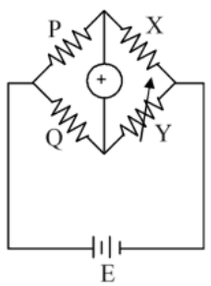
(a) cx_1^2 (b) $\frac{1}{2}cx_1^2$

(c) $2cx_1^2$ (d) zero

29. The Bulk modulus of a liquid is 3×10^{10} Nm^{-2}. The pressure required to reduce the volume of liquid by 2% is :
(a) 3×10^8 Nm^{-2} (b) 9×10^8 Nm^{-2}
(c) 6×10^8 Nm^{-2} (d) 12×10^8 Nm^{-2}

30. An insect is at the bottom of a hemispherical ditch of radius 1 m. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefficient of friction between the ground and the insect is 0.75, then h is : ($g = 10$ ms^{-2})
(a) 0.20m (b) 0.45m (c) 0.60m (d) 0.80m

31. A wheatstone bridge is used to determine the value of unknow resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q:



(a) should be approximately equal and are small
(b) should be very large and unequal
(c) do not play any significant role
(d) should be approximately equal to 2X

32. Two metallic plates form a parallel plate capacitor. The distance between the plates is 'd'. A metal sheet of thickness $\frac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the new capacitance to the original capacitance of the capacitor ?
(a) 2 : 1 (b) 1 : 2 (c) 1 : 4 (d) 4 : 1

33. The velocity of water in a river is 18 km/hr near the surface. If the river is 5 m deep, find the shearing stress between the horizontal layers of water. The co-efficient of viscosity of water = 10^{-2} poise.
(a) 10^{-1} N/m^2 (b) 10^{-2} N/m^2
(c) 10^{-3} N/m^2 (d) 10^{-4} N/m^2

34. After terminal velocity is reached, the acceleration of a body falling through a fluid is
(a) equal to g (b) zero
(c) less than g (d) greater than g

35. A liquid is filled upto a height of 20 cm in a cylindrical vessel. The speed of liquid coming out of a small hole at the bottom of the vessel is ($g = 10$ ms^{-2})
(a) 1.2 ms^{-1} (b) 1 ms^{-1} (c) 2 ms^{-1} (d) 3.2 ms^{-1}

PART - II (CHEMISTRY)

36. In a collection of H-atoms, all the electrons jump from n = 5 to ground level finally (directly or indirectly), without emitting any line in Balmer series. The number of possible different radiations is :
(a) 10 (b) 8 (c) 7 (d) 6

37. According to molecular orbital theory, the species among the following that does not exist is

(a) He_2^- (b) Be_2 (c) He_2^+ (d) O_2^{2-}

38. Which of the following statements/relationships is **not** correct in thermodynamic changes?
(a) $\Delta U = 0$ (isothermal reversible expansion of a gas)
(b) $w = -nRT \ln \frac{V_2}{V_1}$ (isothermal reversible expansion of an ideal gas)
(c) $w = nRT \ln \frac{V_2}{V_1}$ (isothermal reversible expansion of an ideal gas)
(d) For a system of constant volume heat involved directly changes to internal energy.

39. If the reaction between CO_2 and H_2O is

$$CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

If CO_2 escapes from the system
(a) pH will decrease
(b) H^+ concentration will decrease
(c) H_2CO_3 concentration will be altered
(d) The forward reaction is promoted

40. For the reaction :

$$2BaO_2(s) \rightleftharpoons 2BaO(s) + O_2(g);$$

ΔH = +ve. In equilibrium condition, pressure of O_2 is dependent on
(a) mass of BaO_2
(b) mass of BaO
(c) temperature of equilibrium
(d) mass of BaO_2 and BaO both

41. The vapour pressure of a solution of the liquids A ($P^\circ = 80$ mm Hg and $x_A = 0.4$) and B ($P^\circ = 120$ mm Hg and $x_B = 0.6$) is found to be 100 mm Hg. It shows that the solution exhibits
(a) positive deviation from ideal behaviour
(b) negative deviation from ideal behaviour
(c) ideal behaviour
(d) positive deviation for lower conc. and negative for higher conc.

42. Freezing point of an aqueous solution is (–0.186)°C. Elevation of boiling point of the same solution is $K_b = 0.512$°C, $K_f = 1.86$°C, find the increase in boiling point.
(a) 0.186 °C (b) 0.0512 °C
(c) 0.092 °C (d) 0.2372 °C

43. The EMF of the cell
$Tl/Tl^+ (0.001M) \| Cu^{2+} (0.01M) /Cu$ is 0.83. The cell EMF can be increased by
(a) Increasing the concentration of Tl^+ ions.
(b) Increasing the concentration of Cu^{2+} ions.
(c) Increasing the concentration of Tl^+ and Cu^{2+} ions.
(d) None of these

44. Activation energy of a chemical reaction can be determined by
(a) evaluating rate constant at standard temperature
(b) evaluating velocities of reaction at two different temperatures
(c) evaluating rate constants at two different temperatures
(d) changing concentration of reactants

45. Identify the correct statement regarding enzymes_____.
(a) Enzymes are specific biological catalysts that cannot be poisoned
(b) Enzymes are normally heterogeneous catalysts that are very specific in their action
(c) Enzymes are specific biological catalysts that can normally function at very high temperatures (T ≈ 1000K)
(d) Enzymes are specific biological catalysts that possess well-defined active sites

46. The number of P–OH bonds and the oxidation state of phosphorus atom in pyrophosphoric acid ($H_4P_2O_7$) respectively are :
(a) four and four (b) five and four
(c) five and five (d) four and five

47. On the basis of data given below,

$E^\circ_{Sc^{3+}/Sc^{2+}} = -0.37$, $E^\circ_{Mn^{3+}/Mn^{2+}} = +1.57$

$E^\circ_{Cr^{2+}/Cr} = -0.90$, $E^\circ_{Cr^{2+}/Cu} = 0.34$

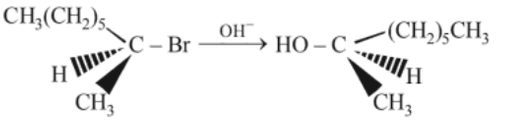
Which of the following statements is incorrect?
(a) Sc^{3+} has good stability due of $[Ar]3d^0 4s^0$ configuration.
(b) Mn^{3+} is more stable than Mn^{2+}.
(c) Cr^{2+} is reducing in nature.
(d) Copper does not give H_2 on reaction with dil. H_2SO_4.

48. In Cannizzaro reaction given below

$$2PhCHO \xrightarrow{:OH^-} PhCH_2OH + PhC\ddot{O}_2^-$$

the slowest step is :
(a) the transfer of proton to the carbonyl group
(b) the abstraction of proton from the carboxylic group
(c) the deprotonation of Ph CH_2OH
(d) the attack of : $\bar{O}H$ at the carboxyl group

49. The reaction is described as



(a) S_E2 (b) S_N1 (c) S_N2 (d) S_N0

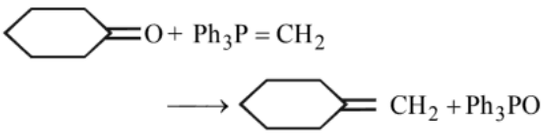
50. The number and type of bonds in ion in CaC_2 are:
(a) One σ bond and one π-bond
(b) One σ bond and two π-bond
(c) Two σ bond and two π-bond
(d) Two σ bond and one π-bond

51. The difference between the reaction enthalpy change ($\Delta_r H$) and reaction internal energy change ($\Delta_r U$) for the reaction:

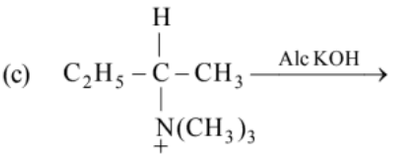
$$2C_6H_6(l) + 15O_2(g) \longrightarrow 12CO_2(g) + 6H_2O(l)$$

at 300 K is ($R = 8.314\ J\ mol^{-1}K^{-1}$)
(a) $0\ J\ mol^{-1}$ (b) $2490\ J\ mol^{-1}$
(c) $-2490\ J\ mol^{-1}$ (d) $-7482\ J\ mol^{-1}$

52. Which of the following reactions is elimination reaction?

(a) 

(b) $C_2H_5Cl + KOH \rightarrow C_2H_5OH + KCl$

(c) 

$$CH_3CH = CH - CH_3 + \ddot{N}(CH_3)_3$$

(d) None of them

53. Vapour pressure of solution containing 2 mol of liquid *A* ($P_A^0 = 80$ torr) and 3 mol of liquid *B* ($P_B^0 = 100$ torr) is 87 torr. We can conclude that
(a) there is negative deviation from Raoult's law
(b) boiling point is higher than that expected for ideal solution
(c) molecular attractions between unlike molecules are stronger than those between like molecules
(d) All of these statements are correct

54. For an electrolyte solution of 0.05 mol L^{-1}, the conductivity has been found to be 0.0110 S cm^{-1}. The molar conductivity is

(a) 0.055 S cm^2 mol^{-1} (b) 550 S cm^2 mol^{-1}

(c) 0.22 S cm^2 mol^{-1} (d) 220 S cm^2 mol^{-1}

55. Given below are a few electrolytes, indicate which one among them will bring about the coagulation of a gold sol quickest and in the least of concentration?

(a) NaCl (b) $MgSO_4$

(c) $Al_2(SO_4)_3$ (d) $K_4[Fe(CN)_6]$

56. In neutral or alkaline solution, MnO_4^- oxidises thiosulphate to:

(a) $S_2O_7^{2-}$ (b) $S_2O_8^{2-}$

(c) SO_3^{2-} (d) SO_4^{2-}

57. Which one of the following statements is not true?

(a) Lactose contains α-glycosidic linkage between C_1 of galactose and C_4 of glucose.

(b) Lactose is a reducing sugar and it gives Fehling's test.

(c) Lactose ($C_{11}H_{22}O_{11}$) is a disaccharide and it contains 8 hydroxyl groups.

(d) On acid hydrolysis, lactose gives one molecule of D(+)-glucose and one molecule of D(+)-galactose.

58. The decreasing order of the ionization potential of the following elements is

(a) Ne > Cl > P > S > Al > Mg

(b) Ne > Cl > P > S > Mg > Al

(c) Ne > Cl > S > P > Mg > Al

(d) Ne > Cl > S > P > Al > Mg

59. Two fast moving particles X and Y are associated with de Broglie wavelengths 1 nm and 4 nm respectively. If mass of X is nine times the mass of Y, the ratio of kinetic energies of X and Y would be

(a) 3 : 1 (b) 9 : 1 (c) 5 : 12 (d) 16 : 9

60. The Nernst equation $E = E° - RT/nF \ln Q$ indicates that the Q will be equal to equilibrium constant K_c when :

(a) $E = E°$ (b) $RT/nF = 1$

(c) E = zero (d) $E° = 1$

61. At 30°C, the half life for the decomposition of AB_2 is 200 s and is independent of the initial concentration of AB_2. The time required for 80% of the AB_2 to decompose is (Given: log 2 = 0.30; log 3 = 0.48)

(a) 200 s (b) 323 s (c) 467 s (d) 532 s

62. Nickel (Z = 28) combines with a uninegative monodentate ligand to form a diamagnetic complex $[NiL_4]^{2-}$. The hybridisation involved and the number of unpaired electrons present in the complex are respectively:

(a) sp^3, two (b) dsp^2, zero

(c) dsp^2, one (d) sp^3, zero

63. Melamine plastic crockery is a codensation polymer of

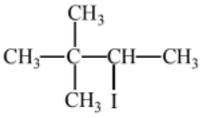
(a) HCHO and melamine

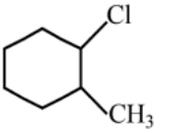
(b) HCHO and ethylene

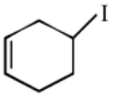
(c) melamine and ethylene

(d) None of these

64. Which of the following alkyl halide undergo rearrangement in S_N1 reaction?

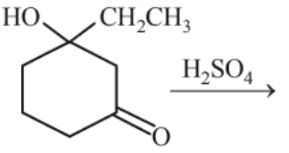
(a) 

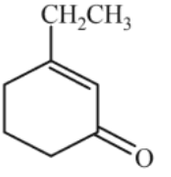
(b) 

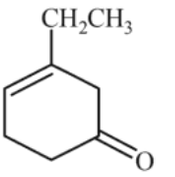
(c) 

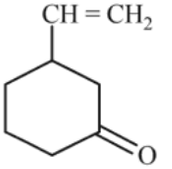
(d) All of these

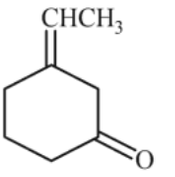
65. The major product of the following reaction is :



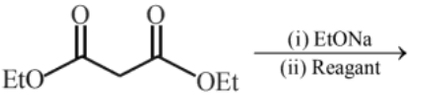
(a) 

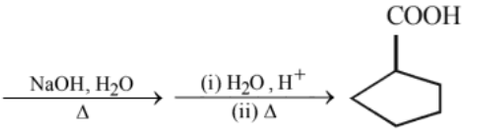
(b) 

(c) 

(d) 

66. What is the missing reagent in the synthesis shown below





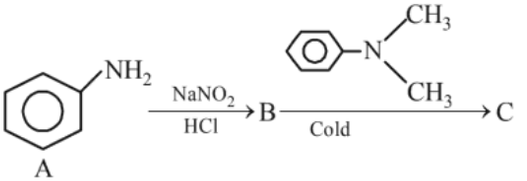
(a) bromocyclopentane

(b) 1, 5 - dibromo pentane

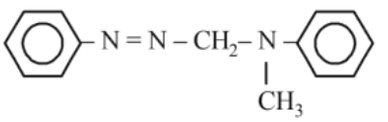
(c) 1, 4 - dibromo butane

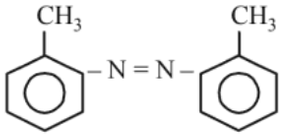
(d) 1, 1 - dibromo cyclopentane

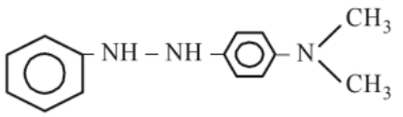
67. In a reaction of aniline a coloured product C was obtained.

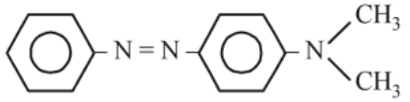


The structure of C would be :

(a) 

(b) 

(c) 

(d) 

68. Which is correct statement?

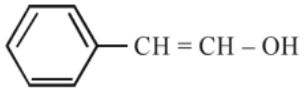
(a) Starch is a polymer of α-glucose

(b) In cyclic structure of fructose, there are four carbons and one oxygen atom

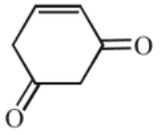
(c) Amylose is a component of cellulose

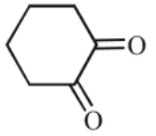
(d) Proteins are composed of only one type of amino acids

69. Tautomerism is exhibited by –

(1) 

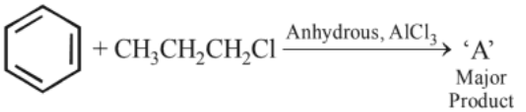
(2) 

(3) 

(4) 

(a) (1), (3) and (4) (b) (2), (3), and (4)

(c) (1), (2) and (4) (d) None of these

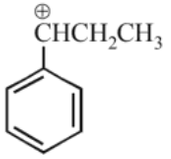
70. 

The stable carbocation formed in the above reaction is :

(a) $CH_3CH_2\overset{\oplus}{C}H_2$

(b) $CH_3\overset{\oplus}{C}HCH_2$

(c) $CH_3-\overset{\oplus}{C}H-CH_3$

(d) 

PART - III (MATHEMATICS)

71. The values of p and q for which the function

$$f(x)=\begin{cases}\dfrac{\sin(p+1)x+\sin x}{x}, & x<0\\ q, & x=0\\ \dfrac{\sqrt{x+x^2}-\sqrt{x}}{x^{3/2}}, & x>0\end{cases}$$

is continuous for all x in R, are

(a) $p=\frac{5}{2},q=\frac{1}{2}$ (b) $p=-\frac{3}{2},q=\frac{1}{2}$

(c) $p=\frac{1}{2},q=\frac{3}{2}$ (d) $p=\frac{1}{2},q=-\frac{3}{2}$

72. If the inverse trigonometric functions take principal values, then

$$\cos^{-1}\left(\frac{3}{10}\cos\left(\tan^{-1}\left(\frac{4}{3}\right)\right)+\frac{2}{5}\sin\left(\tan^{-1}\left(\frac{4}{3}\right)\right)\right)$$

is equal to :

(a) 0 (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{3}$ (d) $\frac{\pi}{6}$

73. The limit $\lim\limits_{x\to 2}\dfrac{2^x+2^{3-x}-6}{\sqrt{2^{-x}}-2^{1-x}}$ is equal to

(a) 1 (b) 2 (c) 4 (d) 8

74. The centre of the smallest circle touching the circles $x^2+y^2-2y-3=0$ and $x^2+y^2-8x-18y+93=0$ is

(a) (3,2) (b) (4,4) (c) (2,7) (d) (2,5)

75. Let E_1, E_2, E_3 be three mutually exclusive events such that $P(E_1)=\frac{2+3p}{6}, P(E_2)=\frac{2-p}{8}$ and $P(E_3)=\frac{1-p}{2}$. If the maximum and minimum values of p are p_1 and p_2, then (p_1+p_2) is equal to:

(a) $\frac{2}{3}$ (b) $\frac{5}{3}$ (c) $\frac{5}{4}$ (d) 1

76. Let $A=\{n\in N: \text{H.C.F.}(n,45)=1\}$ and let $B=\{2k: k\in\{1, 2, ..., 100\}\}$. Then the sum of all the elements of $A\cap B$ is

(a) 5260 (b) 5264 (c) 5236 (d) 5300

77. The function $f(x)=\left|x^2-2x-3\right|.e^{\left|9x^2-12x+4\right|}$ is not differentiable at exactly :

(a) four points (b) three points

(c) two points (d) one point

78. If $f(x)=\int e^{\log_e x^2}\log_{e^x}x\,dx$ and $f(1)=-\frac{1}{4}$, then the value of $f(e)$ is

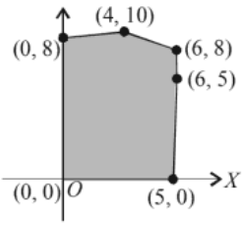
(a) $\frac{e^2}{4}$ (b) $\frac{e^2}{2}$ (c) $-\frac{e^2}{4}$ (d) $-\frac{e^2}{2}$

79. Let S be the set of all real values of k for which the system of linear equations $x+y+z=2;\ 2x+y-z=3;\ 3x+2y+kz=4$ has a unique solution. Then S is

(a) an empty set (b) equal to R

(c) equal to $\{0\}$ (d) equal to $R-\{0\}$

80. The feasible region for a LPP is shown shaded in the figure. Let Z = 3x – 4y be the objective function. Minimum of Z occurs at



(a) (0, 0) (b) (0, 8)

(c) (5, 0) (d) (4, 10)

81. Let p, q, r be three statements. Then $\sim(p\vee(q\wedge r)$ is equal to

(a) $(\sim p\wedge\sim q)\wedge(\sim p\wedge\sim r)$

(b) $(\sim p\vee\sim q)\wedge(\sim p\vee\sim r)$

(c) $(\sim p\wedge\sim q)\vee(\sim p\wedge\sim r)$

(d) $(\sim p\vee\sim q)\vee(\sim p\wedge\sim r)$

82. The function $f:(-\infty,-1)\to(0,e^5]$ defined by

$f(x)=e^{x^3-3x+2}$ is

(a) many-one and onto (b) many-one and into

(c) one-one and onto (d) one-one and into

83. Let A and B be two non-singular square matrices such that $B\neq I$ and $AB^2=BA$. If $A^3=B^{-1}A^3B^n$, then value of n is.

(a) 6 (b) 5 (c) 4 (d) 8

84. If x is real and $(x^2+2x+c)/(x^2+4x+3c)$ can take all real values, then

(a) $0\le c\le 1$ (b) $2<c<3$

(c) $c>4$ (d) None of these

85. Let $f(x)=\dfrac{x}{\sqrt{a^2+x^2}}-\dfrac{d-x}{\sqrt{b^2+(d-x)^2}},\ x\in\mathbf{R}$

where a, b and d are non-zero real constants. Then

(a) f' is not a continuous function of x

(b) f is neither increasing nor decreasing function of x

(c) f is an increasing function of x

(d) f is a decreasing function of x

86. Let $f(x)$ be a function defined as follows :

$f(x)=\sin(x^2-3x),\ x\le 0;$ and $6x+5x^2,\ x>0$

Then at $x=0$, $f(x)$

(a) has a local maximum (b) has a local minimum

(c) is discontinuous (d) None of these

87. Let $f(x)$ be a positive function and $I_1=$

$$\int_{-\frac{1}{2}}^{1}2xf(2x(1-2x))dx \text{ and } I_2=\int_{-1}^{2}f(x(1-x))dx.$$

Then the value of $\dfrac{I_2}{I_1}$ is equal to

(a) 9 (b) 6 (c) 12 (d) 4

88. The solution of the differential equation

$$(1+e^{\frac{x}{y}})\,dx+e^{\frac{x}{y}}\left(1+\frac{x}{y}\right)dy=0 \text{ is}$$

(a) $ye^x+x=C$ (b) $xe^y+y=C$

(c) $ye^{\frac{y}{x}}+y=C$ (d) $ye^{\frac{x}{y}}+x=C$

89. If A is a matrix of order 3 such that $|A|=5$ and $B=\text{adj}\,A$, then the value of $\|A^{-1}|.(AB)^T|$ is equal to

(a) 1 (b) 2 (c) 3 (d) 4

90. The domain of the real valued function

$$f(x)=\frac{\sqrt{6x^2+5x-6}}{\sqrt{4-x}-\sqrt{x+4}} \text{ is}$$

(a) $\left[-4,-\frac{3}{2}\right]\cup\left[\frac{2}{3},4\right]$ (b) $\left(-\infty,\frac{-3}{2}\right]\cup\left[\frac{2}{3},\infty\right)$

(c) $[-4,4]$ (d) $\left[-\frac{3}{2},\frac{2}{3}\right]$

91. Modulus of $z=\dfrac{(1+i\sqrt{3})(\cos\theta+i\sin\theta)}{2(1-i)(\cos\theta-i\sin\theta)}$ is

(a) $\frac{1}{\sqrt{3}}$ (b) $-\frac{1}{\sqrt{2}}$ (c) $\frac{1}{\sqrt{2}}$ (d) 1

92. The area bounded by the curves $y=|x-1|+|x-2|$ and $y=3$ is equal to

(a) 3 (b) 4 (c) 5 (d) 6

93. What is the middle term in the expansion of

$$\left(\frac{x\sqrt{y}}{3}-\frac{3}{y\sqrt{x}}\right)^{12}\ ?$$

(a) $C(12,7)\,x^3y^{-3}$ (b) $C(12,6)\,x^{-3}y^3$

(c) $C(12,7)\,x^{-3}y^3$ (d) $C(12,6)\,x^3y^{-3}$

94. $5^{1+x}+5^{1-x},\ \frac{a}{2},\ 5^{2x}+5^{-2x}$ are in A.P., then the value of a is:

(a) $a<12$ (b) $a\le 12$

(c) $a\ge 42$ (d) $a\ge\frac{17}{4}$

95. If a focal chord of the parabola $y^2 = ax$ is $2x - y - 8 = 0$ then equation of the directrix is

(a) $x + 4 = 0$ (b) $x - 4 = 0$

(c) $y - 4 = 0$ (d) $y + 4 = 0$

96. The minimum and maximum values of $ab \sin x + b\sqrt{(1-a^2)}\cos x + c\ (|a| < 1, b > 0)$ respectively are

(a) $\{b - c, b + c\}$ (b) $\{b + c, b - c\}$

(c) $\{c - b, b + c\}$ (d) None of these

97. The equation of the straight line that passes through the point (3, 4) and perpendicular to the line $3x + 2y + 5 = 0$ is

(a) $2x + 3y + 6 = 0$ (b) $2x - 3y - 6 = 0$

(c) $2x - 3y + 6 = 0$ (d) $2x + 3y - 6 = 0$

98. Two cards from an ordinary deck of 52 cards are missing. What is the probability that a random card drawn from this deck is a spade?

(a) $\frac{3}{4}$ (b) $\frac{2}{3}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$

99. A random variable X has the following distribution.

X	0	1	2	3	4	5	6	7
P(X)	a	4a	3a	7a	8a	10a	6a	9a

Find $P(X < 3)$, $P(X \geq 4)$, $P(0 < X < 5)$ respectively.

(a) $\frac{1}{6}, \frac{11}{24}, \frac{33}{48}$ (b) $\frac{1}{6}, \frac{33}{48}, \frac{11}{24}$

(c) $\frac{1}{4}, \frac{11}{26}, \frac{21}{44}$ (d) $\frac{11}{26}, \frac{1}{4}, \frac{21}{44}$

100. Let $\vec{a} = 3\hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} + 3\hat{k}$. If $\vec{b}$ is a vector such that $\vec{a} = \vec{b} \times \vec{c}$ and $|\vec{b}|^2 = 50$, then $|72 - |\vec{b} + \vec{c}|^2|$ is equal to

(a) 67 (b) 60 (c) 66 (d) 170

101. Find the mean deviation about the mean for the following data.

Mark obtained	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Number of students	2	3	8	14	8	3	2

(a) 12 (b) 10 (c) 11 (d) 9

102. The eccentricity of an ellipse having centre at the origin, axes along the co-ordinate axes and passing through the points (4, –1) and (–2, 2) is :

(a) $\frac{1}{2}$ (b) $\frac{2}{\sqrt{5}}$ (c) $\frac{\sqrt{3}}{2}$ (d) $\frac{\sqrt{3}}{4}$

103. If the sum of the first 20 terms of the series $\log_{(7^{1/2})} x + \log_{(7^{1/3})} x + \log_{(7^{1/4})} x + \ldots$ is 460, then x is equal to :

(a) 7^2 (b) $7^{1/2}$ (c) e^2 (d) $7^{46/21}$

104. The equation of the line passing through the point (1, 2, –4) and perpendicular to the two lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$ will be

(a) $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+4}{6}$

(b) $\frac{x-1}{-2} = \frac{y-2}{3} = \frac{z+4}{8}$

(c) $\frac{x-1}{3} = \frac{y-2}{2} = \frac{z+4}{8}$

(d) None of these

105. The distance of the point P(4, 6, –2) from the line passing through the point (–3, 2, 3) and parallel to a line with direction ratios 3, 3, –1 is equal to :

(a) 3 (b) $\sqrt{6}$ (c) $2\sqrt{3}$ (d) $\sqrt{14}$

106. Find the locus of the point which is equidistant from the point A(0, 2, 3) and B(2, –2, 1)

(a) $x - 2y = 1$ (b) $x + 2y = 1$

(c) $2x + y = 1$ (d) $4x + y = 3$

107. If $f(x) = \frac{\cos x}{(1-\sin x)^{\frac{1}{3}}}$, then

(a) $\lim\limits_{x \to \frac{\pi}{2}^-} f(x) = -\infty$ (b) $\lim\limits_{x \to \frac{\pi}{2}^-} f(x) = \infty$

(c) $\lim\limits_{x \to \frac{\pi}{2}} f(x) = \infty$ (d) None of these

108. Let x < 1, then value of $\begin{vmatrix} x^2+2 & 2x+1 & 1 \\ 2x+1 & x+2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$ is

(a) Non-negative (b) Non-positive

(c) Negative (d) Positive

109. Differential coefficient of $\sqrt{\sec\sqrt{x}}$ is

(a) $\frac{1}{4\sqrt{x}} \sec\sqrt{x} \sin\sqrt{x}$

(b) $\frac{1}{4\sqrt{x}} (\sec\sqrt{x})^{3/2} \cdot \sin\sqrt{x}$

(c) $\frac{1}{2}\sqrt{x} \sec\sqrt{x} \sin\sqrt{x}$

(d) $\frac{1}{2}\sqrt{x} (\sec\sqrt{x})^{3/2} \cdot \sin\sqrt{x}$

110. Let $f\left(x + \frac{1}{x}\right) = x^2 + \frac{1}{x^2}, x \neq 0$ then $f(x) =$

(a) x^2 (b) $x^2 - 1$ (c) $x^2 - 2$ (d) $x^2 + 1$

PART - IV (APTITUDE TEST)

111. **Statement:** All Grapes are Bananas.
Conclusions: I. Some Bananas are Grapes.
II. All Bananas are Grapes.
III. Some Grapes are Bananas.
IV. Some Bananas are not Grapes.
(a) Only I follow. (b) Only II follow.
(c) Only I and III follow. (d) None follow.

112. **Statement:** Some Cows are Hens.
Conclusions: I. Some Hens are Cows
II. All Hens are Cows
III. All Cows are Hens
IV. No Cows are Hens
(a) Only I follow. (b) Only II follow.
(c) Only I and III follow. (d) None follow.

113. **Statement:** No book is Pens.
Conclusions: I. No Pens is book.
II. Some Pens are not books.
III. All books are not Pens.
IV. All books are Pens.
(a) Only I follow. (b) Only II follow.
(c) Only I, II and III follow. (d) None follow.

114. In a code language, 'TIGER' is written as 'JUISF'. How will 'EVENT' be written in that language?
(a) WFUGO (b) WFGUO
(c) WFFUO (d) WFUFO

115. Images of consonants of the capital English alphabets are observed in a mirror. What is the number of images of these which do not look like their original shapes?
(a) 14 (b) 9 (c) 7 (d) 5

116. Identify the pair that follows the same pattern as that followed by first pair.
RDV : IFE : : GWH : ?
(a) PRS (b) TSY (c) TYS (d) RVO

117. A is the brother of D. D is the mother of B. B is the sister of C. How is B related to A?
(a) Nephew (b) Niece
(c) Aunt (d) Cannot be determined

118. How is U related to I?
Statements: I. Q is the son of I.
II. U is the brother of Q.
(a) If Statement I, alone is sufficient to answer the question
(b) If Statement II, alone is sufficient to answer the question
(c) If Statements I and II together are needed to answer the question
(d) If Statements I and II together are not sufficient to answer the question

119. Select the number from among the given options that can replace the question mark (?) in the following series:
1, 4, 10, ?, 46, 94
(a) 22 (b) 24 (c) 20 (d) 28

120. From the given options, choose the correct one that will replace the question mark (?) in the following series:
2, 6, 12, 20, ?, 42, 56
(a) 25 (b) 20 (c) 30 (d) 32

PART - V (ENGLISH)

DIRECTIONS (Qs. 121-125) : *Read the passage carefully and choose the best answer to each questions out of the four alternatives.*

Artificial Intelligence (AI) has evolved rapidly since the mid-20th century, influencing various aspects of modern life. It encompasses adaptive, self-learning technologies used in facial recognition, robotics, speech, and language understanding. AI enhances human abilities and benefits from progress in computing power and data science. AI holds vast potential in promoting global good, aiding the UN's Sustainable Development Goals (SDGs) in areas such as healthcare, agriculture, education, and disaster relief. However, access to AI remains unequal, mainly benefiting powerful nations and corporations. UN Secretary-General António Guterres has emphasized the need for global collaboration to bridge the digital divide and ensure AI supports humanity equitably.
To guide responsible AI use, the UN has formed a High-Level Advisory Body of 39 experts that recommends inclusive governance strategies. Alongside, the Global Digital Compact-adopted in 2024-outlines digital cooperation measures for a safe, human-rights-based digital space. An AI Panel and Global Dialogue, co-led by Costa Rica and Spain, aims to ensure ethical and scientific guidance on AI use and governance with global representation and emphasis on human rights.

121. What does the phrase "bridge the digital divide" most likely mean as used in the passage?
(a) Create a new type of digital platform
(b) Increase competition among tech companies
(c) Reduce the gap in access to AI between nations
(d) Strengthen online security for all users

122. What is the author's purpose in mentioning the "High-Level Advisory Body of 39 experts"?
(a) To highlight the risks of AI
(b) Governance of AI through expert collaboration
(c) Criticizing the lack of global consensus
(d) Suggesting the intervention of UN in AI

123. Which of the following best describes the central theme of the passage?
(a) The economic challenges of AI
(b) The technical limitations of AI systems
(c) How robots can replace humans in jobs
(d) Promoting equitable and ethical AI governance

124. Choose the word that is closest in meaning to "inclusive" as used in the passage.
(a) Comprehensive (b) Exclusive
(c) Unified (d) Selective

125. Which word from the following is the most suitable antonym of "strategies"?
(a) Frameworks (b) Approaches
(c) Chaos (d) Strategies

SOLUTIONS

PART - I (PHYSICS)

1. **(b)** When force retards motion *i.e.*, F –(ve) so, work done –(ve)

2. **(a)** Given,
Radius of rod, r = 20 mm = 20×10^{-6}
Length of rod, $\ell = 2$m
Force, F = 62.8 kN
Young's modulus of steel, Y = 2×10^{11} N/m^2

$$\text{Strain} = \frac{\text{stress}}{Y} = \frac{\frac{62.8 \times 10^3}{\pi \times (0.02)^2}}{2 \times 10^{11}}$$

$$= \frac{62.8 \times 10^3}{3.14 \times 4 \times 10^{-4} \times 2 \times 10^{11}}$$

$$= 2.5 \times 10^{-4} = 25 \times 10^{-5}$$

3. **(a)** Slow isothermal expansion or compression of an ideal gas is reversible process, while the other given processes are irreversible in nature.

4. **(d)** Using equation, $= \frac{hc}{\lambda} - \phi$

$$KE_{max} = \frac{hc}{\lambda} - \phi = \frac{hc}{500} - \phi \qquad ...(i)$$

Again, $3KE_{max} = \frac{hc}{200} - \phi$ ...(ii)

Dividing equation (ii) by (i),

$$\frac{3KE_{max}}{KE_{max}} = \frac{3}{1} = \frac{\frac{hc}{200} - \phi}{\frac{hc}{500} - \phi}$$

Putting the value of $hc = 1237.5$ and solving we get, work function, $\phi = 0.61$ eV.

5. **(b)** $Ee = mg$ or $E = mg/e$

6. **(b)** Bursting of helium balloon is irreversible and in this process $\Delta Q = 0$, so adiabatic.

7. **(a)** E = 500 V/m $\quad \Delta V = 3000$ V.

We know that electric field $|E| = 500 = \frac{\Delta V}{\Delta d}$

or $\Delta d = \frac{3000}{500} = 6$ m

8. **(c)** In Bernoulli's theorem only law of conservation of energy is obeyed.

9. **(c)** $\omega = \frac{qB}{m}$

$$\Rightarrow \omega = \frac{q}{m}\mu_0 nI$$

$$\Rightarrow n = \frac{m\omega}{\mu_0 qI} = \frac{9.1 \times 10^{-31} \times 2\pi \times 10^8}{4\pi \times 10^{-7} \times 1.6 \times 10^{-19} \times 5}$$

$$= \frac{9.1}{16} \times 10^3 = 569$$

10. **(c)** ${}_1H^2 + {}_1H^2 \rightarrow {}_2He^4$
Total binding energy of two deuterium nuclei = 1.1×4 = 4.4 MeV
Binding energy of a (${}_2He^4$) nuclei = $4 \times 7 = 28$ MeV
Energy released in this process = 28 – 4.4 = 23.6 MeV

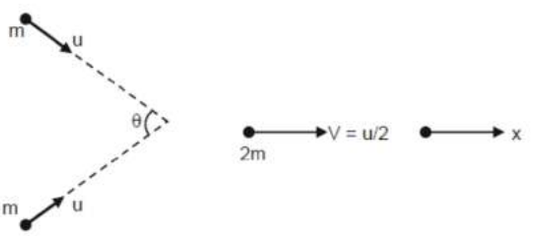
11. **(d)** Magnetic energy stored in an inductor

$$U = \frac{1}{2}Li^2 = \frac{1}{2} \times 4 \times 10^{-6} \times (2)^2$$

$= 8 \times 10^{-6}$ J = 8 μJ

12. **(a)**

13. **(d)**



According to linear momentum conservation along x-axis

$$2mu\cos\frac{\theta}{2} = 2m\frac{u}{2} \qquad \therefore \cos\frac{\theta}{2} = \frac{1}{2}$$

$$\frac{\theta}{2} = 60°$$

Hence $\theta = 120°$

14. **(d)** The average value of magnetic field is zero. Also $u_E = u_B$

15. **(d)** For surface A,

$$\Rightarrow \frac{1}{v_1} = \frac{1}{-f} - \frac{1}{(-u)} = -1 + \frac{1}{3} = -\frac{2}{3}$$

$$\Rightarrow v_1 = -\frac{3}{2}\text{m}$$

For surface B,

$$\Rightarrow \frac{1}{v_2} = \frac{1}{-f} + \frac{1}{u} = -1 + \frac{1}{5} = -\frac{4}{5}$$

$$\Rightarrow v_2 = -\frac{5}{4}\text{m}$$

$$\therefore v_1 - v_2 = 0.25 \text{ m}$$

Magnification of A = $\frac{v_1}{u} = \frac{3/2}{3} = \frac{1}{2}$

$\therefore$ Height of $A = \frac{1}{2} \times 2 = 1\,m$

Magnification of $B = \frac{v_2}{u} = \frac{5/4}{5} = \frac{1}{4}$

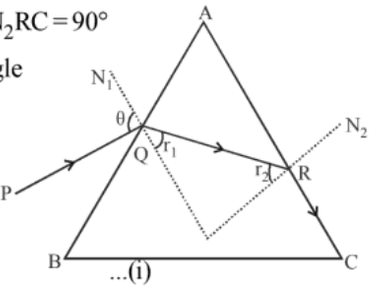
$\therefore$ Height of $B = \frac{1}{4} \times 2 = 0.5\,m$

16. **(c)** $\mu = \tan i$

$\Rightarrow i = \tan^{-1}(\mu) = \tan^{-1}(\sqrt{3}) = 60°.$

17. **(c)** When $r_2 = C, \angle N_2RC = 90°$

Where C = critical angle



As $\sin C = \frac{1}{\mu} = \sin r_2$

Applying Snell's law at 'R'

$\mu \sin r_2 = 1 \sin 90°$ ...(i)

Applying Snell's law at 'Q'

$1 \times \sin\theta = \mu \sin r_1$ ...(ii)

But $r_1 = A - r_2$

So, $\sin\theta = \mu \sin(A - r_2)$

$\sin\theta = \mu \sin A \cos r_2 - \cos A$ ...(iii) [using (i)]

From (i)

$\cos r_2 = \sqrt{1 - \sin^2 r_2} = \sqrt{1 - \frac{1}{\mu^2}}$ ...(iv)

By eq. (iii) and (iv)

$\sin\theta = \mu \sin A \sqrt{1 - \frac{1}{\mu^2}} - \cos A$

on further solving we can show for ray not to transmitted through face AC

$\theta = \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

So, for transmission through face AC

$\theta > \sin^{-1}\left[\mu \sin\left(A - \sin^{-1}\left(\frac{1}{\mu}\right)\right)\right]$

18. **(a)** Density of nuclei,

$$\rho = \frac{A \times 1.6 \times 10^{-27}}{\frac{4}{3}\pi \times \left(1.5 \times 10^{-15}\right)^3 \times A} = 0.113 \times 10^{18}\ kg/m^3$$

Density of water $= \rho_w = 10^3\ kg/m^3$

So, $\frac{\rho}{\rho_w} = 11.31 \times 10^{13}\ kg/m^3$

19. **(c)** $mg = 6\pi\eta r v$

$2mg = 6\pi\eta . 2^{1/3} r v'$

$v' = 2^{2/3} v = 4^{1/3} v = \sqrt[3]{4}v$

20. **(b)** Given :

Capacitance, $C = 40\ \mu F = 40 \times 10^{-6}\ F$

Frequency, $f = 50\ Hz$ $\therefore \omega = 2\pi f = 100\pi$

$\varepsilon_{rms} = 200\ V$ $\therefore I_{rms} = \frac{\varepsilon_{rms}}{X_C} = \frac{\varepsilon_{rms}}{\frac{1}{C\omega}}$

$= 200 \times 40 \times 10^{-6} \times 2\pi \times 50 = 2.5\ A.$

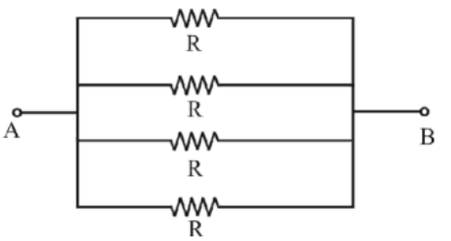
21. **(d)** Amplitude of electric field (E) and Magnetic field (B) of an electromagnetic wave are related by the relation

$\frac{E}{B} = c \Rightarrow E = Bc$

$\Rightarrow E = 5 \times 10^{-8} \times 3 \times 10^8 = 15\ N/C \Rightarrow \vec{E} = 15\hat{i}\ V/m$

22. **(a)** Resistance of each wire in this case will be same as l & A are same and made of same material.

$\therefore R_1 = R_2 = R_3 = R_4 = R$



In parallel, $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

$\therefore R_P = \frac{R}{4} \Rightarrow 0.25 = \frac{R}{4}$

$\therefore R = 1\ \Omega$

When arranged in series then equivalent resistance.

$R_S = R + R + R + R = 4R$

$\therefore R_S = 4 \times 1 = 4\Omega$

23. **(a)** Coefficient of static friction $= \frac{\text{force of friction}}{\text{normal reaction}}$

Therefore, coefficient of static friction depends upon the normal reaction.

24. **(a)** If m_1, m_2 are masses and u_1, u_2 are velocity then by conservation of momentum $m_1u_1 + m_2u_2 = 0$

or $|m_1u_1| = |m_2u_2|$

25. **(b)** Given,

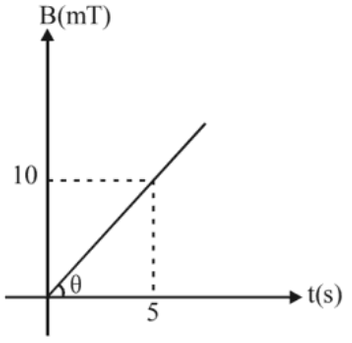
Area of metallic plate, $A = 4\ m^2$

Induced emf,

$\varepsilon = \left|\frac{d\phi}{dt}\right| = \frac{d(BA)}{dt} = \frac{AdB}{dt}$

But $\frac{dB}{dt}$ = Slope of B-t curve

$= \tan\theta = \frac{10}{5} = 2 \Rightarrow \frac{dB}{dt} = 2mT$



$\therefore \varepsilon = 4 \times 2 = 8\,\text{mV}$

26. **(d)** Let the velocity of the particle be v *m/s*.
Momentum of the particle (p) = mv
Kinetic energy of the particle

$$(E) = \frac{1}{2}\, mv^2 = \frac{1}{2}.\frac{(mv)^2}{m} \Rightarrow E = \frac{p^2}{2m}$$

27. **(d)** When work is done upon a system by a conservative force then its potential energy increases.

28. **(b)** $W = \int_0^{x_1} F\,dx = \int_0^{x_1} c\,x\,dx = \left[\frac{1}{2} c\,x^2\right]_0^{x_1}$

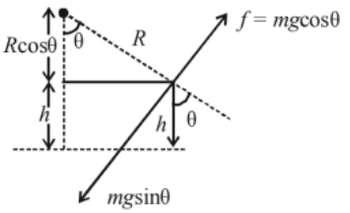
$$= \frac{1}{2} c(x_1^2 - 0) = \frac{1}{2} c\,x_1^2$$

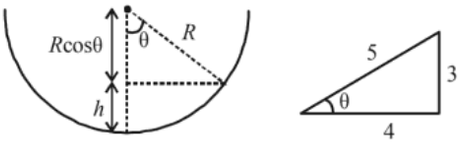
29. **(c)** Bulk modulus, $B = -\dfrac{\Delta P}{\dfrac{\Delta V}{V}} \Rightarrow \Delta P = -B\dfrac{\Delta V}{V}$

$|\Delta P| = +3 \times 10^{10} \times 0.02 = 6 \times 10^8$

30. **(a)** For balancing, $mg\sin\theta = f = \mu mg\cos\theta$

$\Rightarrow \tan\theta = \mu = \dfrac{3}{4} = 0.75$





$$h = R - R\cos\theta = R - R\left(\frac{4}{5}\right) = \frac{R}{5}$$

$\therefore h = \dfrac{R}{5} = 0.2$ m $\quad [\because$ radius, $R = 1$m$]$

31. **(a)** You precise measurement, we always take P and Q approx equal and small.

32. **(a)** Dielectric constant of conductor = ∞. So $K = \infty$

Now, $C_f = \dfrac{A\epsilon_0}{d - t + \frac{t}{k}} = \dfrac{A\epsilon_0}{d - \frac{d}{2} + \frac{d}{\infty}}$

$= \dfrac{A\epsilon_0}{\frac{d}{2}} = 2\dfrac{A\epsilon_0}{d} = 2C_i$. So, $\dfrac{C_f}{C_i} = \dfrac{2}{1}$ $\quad \left(\because C_i = \dfrac{\epsilon_0 A}{d}\right)$

33. **(b)** $\eta = 10^{-2}$ poise

$v = 18$ km/h $= \dfrac{18000}{3600} = 5$ m/s

$l = 5$ m

Strain rate $= \dfrac{v}{l}$

Coefficient of viscosity, $\eta = \dfrac{\text{shearing stress}}{\text{strain rate}}$

$\therefore$ Shearing stress = $\eta \times$ strain rate

$$= 10^{-2} \times \frac{5}{5} = 10^{-2}\,\text{Nm}^{-2}$$

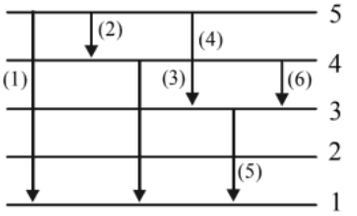
34. **(b)** When terminal velocity is reached then body moves with constant velocity hence, accelesation is zero.

35. **(c)** Velocity of efflux

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 0.2} = 2\,\text{ms}^{-1}$

PART - II (CHEMISTRY)

36. **(d)**



Total radiations are = 6

37. **(b)**

Species	Bond order
He_2^-	0.5
Be_2	0
He_2^+	0.5
O_2^{2-}	1

Be_2 does not exist due to zero bond order.

38. **(c)** For isothermal reversible expansion.

$$w = -nRT\ln\frac{V_2}{V_1}$$

39. **(b)** $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$

If CO_2 escapes, the equilibrium will shift to LHS and $[H^+]$ concentration will decrease

40. **(c)** For the reaction

$2BaO_2(s) \rightleftharpoons 2BaO(s) + O_2(g);\ \Delta H = +ve.$

At equilibrium $K_p = P_{O_2}$

Hence, the value of equilibrium constant depends only upon partial pressure of O_2. Further on increasing temperature formation of O_2 increases as this is an endothermic reaction. Hence, pressure of O_2 is dependent on temperature.

41. **(b)** $P_{total} = P_A^o \times X_A + P_B^o \times X_B$
$= 80.0 \times 0.4 + 120.0 \times 0.6 = 104$ mm Hg
The observed P_{total} is 100 mm Hg which is less than 104 mm Hg. Hence the solution shows negative deviation.

42. **(b)** $\Delta T_b = K_b \dfrac{W_B}{M_B \times W_A} \times 1000$;

$\Delta T_f = K_f \dfrac{W_B}{M_B \times W_A} \times 1000$;

$\dfrac{\Delta T_b}{\Delta T_f} = \dfrac{K_b}{K_f} = \dfrac{\Delta T_b}{-0.186} = \dfrac{0.512}{1.86} = 0.0512°C.$

43. **(b)** The oxidation potential

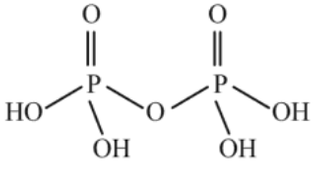
$\propto \dfrac{1}{\text{Concentration of ions}}$ and reduction potential $\propto$ concentration of ions. The cell voltage can be increased by decreasing the concentration of ions around anode or by increasing the concentration of ions around cathode

44. **(c)** We know that the activation energy of chemical reaction is given by formula $= \dfrac{k_2}{k_1} = \dfrac{E_a}{2.303R}\left[\dfrac{T_2 - T_1}{T_1 T_2}\right]$,

where k_1 is the rate constant at temperature T_1 and k_2 is the rate constant at temperature T_2 and E_a is the activation energy. Therefore activation energy of chemical reaction is determined by evaluating rate constant at two different temperatures.

45. **(d)** Enzymes are specific biological catalysts possessing well - defined active sites.

46. **(d)**

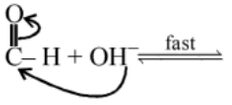


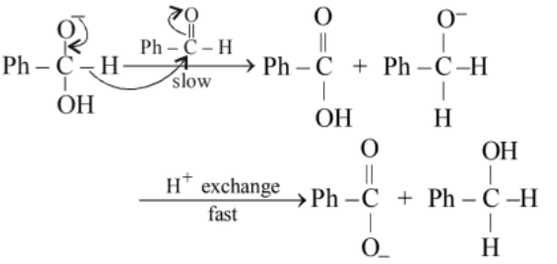
Pyrophosphoric acid ($H_4P_2O_7$)

Oxidation State :
Each P atom is bound to one oxygen = –1
2OH = –1 × 2 = – 2; 1 Oxygen = – 2
Total = –5; P = + 5.

47. **(b)** Mn^{2+} (d^5)is more stable than Mn^{3+} (d^4), thus $E^-_{Mn^{3+}/Mn^{2+}} = +ve$

48. **(a)**





49. **(c)** Inversion in configuration occurs in S_N2 reactions.

50. **(b)** The structure of CaC_2 is $Ca^{2+}[:C \equiv C:]^{2-}$
i.e, one σ and two π bonds

51. **(d)** $\Delta H = \Delta U + \Delta n_g RT$
For the reaction $\Delta n_g = 12 - 15 = -3$
$\Delta H - \Delta U = -3 \times 8.314 \times 300$
$= -7482$ J mol^{-1}

52. **(c)** The reaction (c) is Hoffmann elimination

53. **(d)** For ideal solution vapour pressure of solution
$= P_A^\circ X_A + P_B^\circ X_B$

$= 80 \times \dfrac{2}{5} + 100 \times \dfrac{3}{5} = 92$ torr

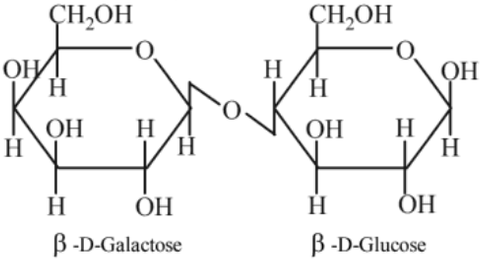
Since observed vapour pressure of solution < ideal vapour pressure, the solution shows negative deviation.

54. **(d)** $\Lambda_m = \dfrac{\kappa \times 1000}{M} = \dfrac{0.0110 \times 1000}{0.05}$
$= 220$ S cm^2 mol^{-1}

55. **(c)** Gold sol. have negative charge. So $Al_2(SO_4)_3$ is most effective for coagulation.

56. **(d)** $8MnO_4^- + 3S_2O_3^{2-} + H_2O \xrightarrow[\text{alk.solution}]{\text{neutral or}} 8MnO_2 + 6SO_4^{2-} + 2OH^-$

57. **(a)** Lactose contains β-glycosidic linkage between C_1 of galactose and C_4 of glucose.



β -D-Galactose β -D-Glucose

58. **(b)** Closed shell (Ne), half filled (P) and completely filled configuration (Mg) are the cause of higher value of I.E.

59. **(d)** de Broglie wavelength $\lambda = \dfrac{h}{mv}$

$\dfrac{\lambda_1}{\lambda_2} = \dfrac{m_2 v_2}{m_1 v_1};\ \dfrac{1}{4} = \dfrac{1}{9} \times \dfrac{v_2}{v_1}$

$\dfrac{v_2}{v_1} = \dfrac{9}{4};\ \dfrac{v_1}{v_2} = \dfrac{4}{9}$

$$KE = \frac{1}{2}mv^2$$

$$\frac{KE_1}{KE_2} = \frac{m_1}{m_2} \times \frac{v_1^2}{v_2^2} = \frac{9}{1} \times \left(\frac{4}{9}\right)^2 = \frac{16}{9}$$

60. **(c)** When $Q = K_C$, $E = 0$

61. **(c)** For Ist order reaction

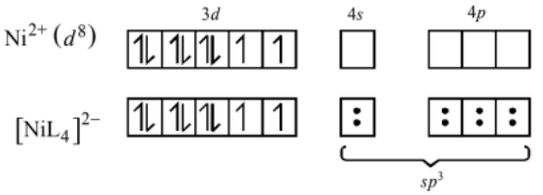
$$k = \frac{2.303}{t} \log \frac{a_o}{0.2a_o}$$

also $t_{1/2} = \frac{0.693}{k}$

$$k = \frac{0.693}{200} \Rightarrow \frac{0.693}{200} = \frac{2.303}{t} \log \frac{1}{0.2}$$

$$t = \frac{2.303}{0.693} \times 200 \log \frac{1}{0.2} = 466.675 \approx 467 \text{ sec}$$

62. **(a)** $[NiL_4]^{2-}$



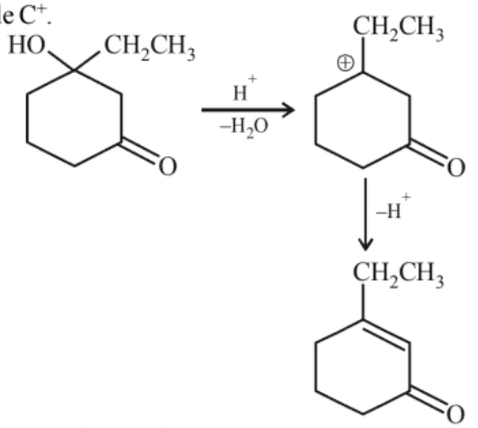
i.e, no. of unpaired electron = 2

hybridization – sp^3.

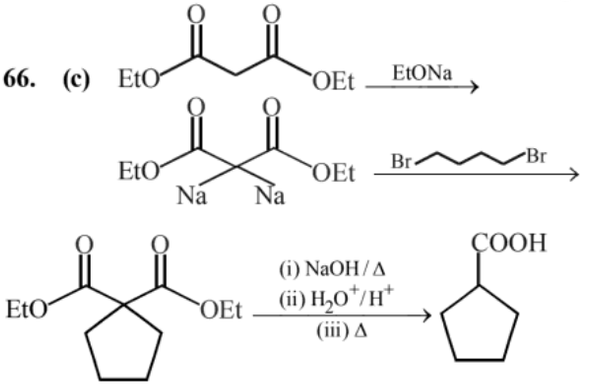
63. **(a)** Melamine plastic crockery is a copolymer of HCHO and Melamine.

64. **(d)** Unstable C^+ has general tendency to rearrange to more stable C^+.

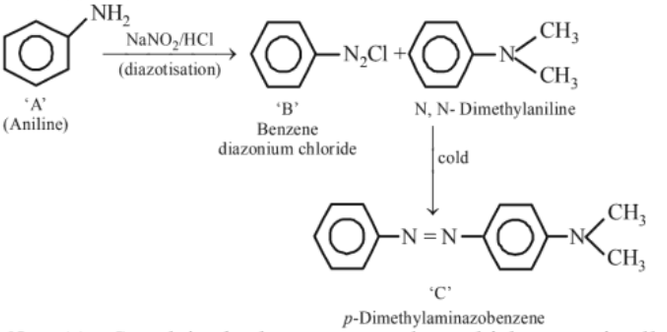
65. **(a)**



66. **(c)**

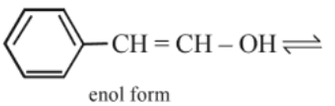


67. **(d)** The reaction can be completed as follows:

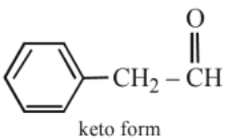


68. **(a)** Starch is also known as amylum which occurs in all green plants. A molecule of starch $(C_6H_{10}O_5)_n$ is built of a large number of α-glucose rings joined through oxygen atom.

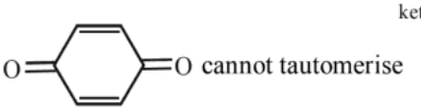
69. **(a)**

(a) 

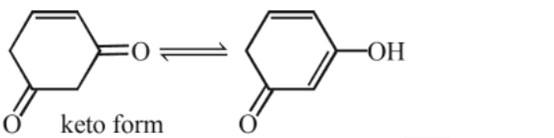
enol form

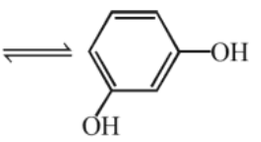


keto form

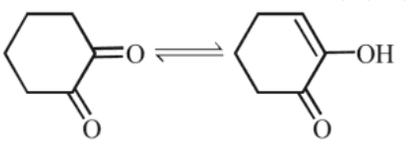
(b) 

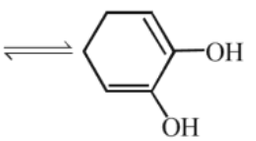
cannot tautomerise

(c) 



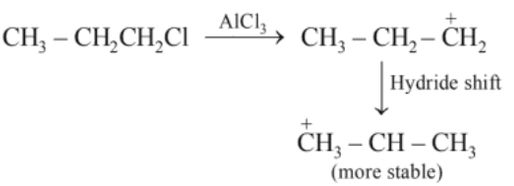
enol form

(d) 



enol forms

70. **(c)** $CH_3 - \overset{\oplus}{C}H - CH_3$ is formed in the above reaction



PART - III (MATHEMATICS)

71. **(b)** $\underset{(at\,x=0)}{\text{L.H.L}} = \lim\limits_{x\to 0^-} f(x)$

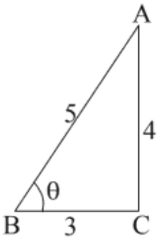
$= \lim\limits_{h\to 0} \dfrac{\sin\{(p+1)(-h)\} - \sin h}{-h}$

$= p+1+1 = p+2$

$\underset{(at\,x=0)}{\text{R.H.L}} = \lim\limits_{x\to 0^+} f(x) = \dfrac{1}{1+1} = \dfrac{1}{2}$

$f(0) = q \Rightarrow p = -\dfrac{3}{2}, q = \dfrac{1}{2}$

72. **(c)** Let $\tan^{-1}\dfrac{4}{3} = \theta \Rightarrow \tan\theta = \dfrac{4}{3}$



$\Rightarrow \cos^{-1}\left(\dfrac{3}{10}\cos\theta + \dfrac{2}{5}\sin\theta\right)$

$= \cos^{-1}\left(\dfrac{3}{10}\times\dfrac{3}{5} + \dfrac{2}{5}.\dfrac{4}{5}\right)$

$= \cos^{-1}\left(\dfrac{9}{50} + \dfrac{8}{25}\right) = \cos^{-1}\left(\dfrac{25}{50}\right) = \cos^{-1}\left(\dfrac{1}{2}\right) = \dfrac{\pi}{3}$

73. **(d)** $\underset{x\to 2}{\text{Lim}} \dfrac{2^x + 2^{3-x} - 6}{\sqrt{2^{-x}} - 2^{1-x}} = \underset{x\to 2}{\text{Lim}} \dfrac{(2^x)^2 - 6.2^x + 2^3}{\sqrt{2^x} - 2}$

[Multiplying N^r and D^r by 2^X]

$\underset{x\to 2}{\text{Lim}} \dfrac{(2^x - 4)(2^x - 2)(\sqrt{2^x} + 2)}{(\sqrt{2^x} - 2)(\sqrt{2^x} + 2)}$

$= \underset{x\to 2}{\text{Lim}} \dfrac{(2^x - 4)(2^x - 2)(\sqrt{2^x} + 2)}{(2^x - 4)}$

$= \underset{x\to 2}{\text{Lim}} (2^x - 2)(\sqrt{2^x} + 2) = (2^2 - 2)(2 + 2) = 8.$

74. **(d)** Circles

$S_1 : x^2 + y^2 - 2y - 3 = 0$ and

$S_2 : x^2 + y^2 - 8x - 18y + 93 = 0$

$C_1 \equiv (0, 1)$ and $r_1 = 2$

$C_2 \equiv (4, 9)$ and $r_2 = 2$

Since circles have same radius, centre of the smallest circle C_3 is collinear with C_1 and C_2 and mid point of C_1C_2.

$\therefore \quad C_3 \equiv (2, 5)$

75. **(b)** Given

$P(E_1) = \dfrac{2+3P}{6}, P(E_2) = \dfrac{2-P}{8}$ & $P(E_3) = \dfrac{1-P}{2}.$

According to question,

$P(E_1) + P(E_2) + P(E_3) \le 1$

$\dfrac{2+3P}{6} + \dfrac{2-P}{8} + \dfrac{1-P}{2} \le 1$

$26 - 3P \le 24 \Rightarrow 2 \le 3P \Rightarrow P \ge \dfrac{2}{3}$

So, $\dfrac{2}{3} \le P \le 1$. Then, $P_1 = 1$ and $P_2 = \dfrac{2}{3}$.

$P_1 + P_2 = \dfrac{5}{3}$

76. **(b)** Sum of elements in $A \cap B$

$= \underbrace{(2+4+6+...+200)}_{\text{Multiple of 2}} - \underbrace{(6+12+...+198}_{\text{Multiple of 2 \& 3 i.e. 6}}$

$- \underbrace{(10+20+...+200)}_{\text{Multiple of 5 \& 2 i.e. 10}} + \underbrace{(30+60+...+180}_{\text{Multiple of 2,5 \& 3 i.e. 30}} = 5264$

77. **(c)** Given, $f(x) = |x^2 - 2x - 3|.e^{|9x^2 - 12x + 1|}$

$f(x) = |(x-3)(x+1)|.e^{(3x-2)^2}$

$$f(x) = \begin{cases} (x-3)(x+1).e^{(3x-2)^2} & ; \quad x \in (3, \infty) \\ -(x-3)(x+1).e^{(3x-2)^2} & ; \quad x \in [-1, 3] \\ (x-3).(x+1).e^{(3x-2)^2} & ; \quad x \in (-\infty, -1) \end{cases}$$

Hence at $x = -1, 3$ $f(x) = 0$

Clearly, non-differentiable at $x = -1$ & $x = 3$.

78. **(a)** We have $f(x)$

$= \int e^{\log_e x^2} \log_{e^x} x\,dx = \int x^2.\dfrac{\log_e x}{x}.dx = \int x.\log_e x.dx$

$= \dfrac{x^2}{2}\log x - \int \dfrac{x^2}{2}.\dfrac{1}{x}.dx = \dfrac{x^2}{2}\log x - \dfrac{x^2}{4} + C$

Since, $f(1) = -\dfrac{1}{4}$, we get $C = 0$

$\therefore \quad f(e) = \dfrac{e^2}{2} - \dfrac{e^2}{4} = \dfrac{e^2}{4}$

79. **(d)** For unique solution $\Delta \ne 0$

$\begin{vmatrix} 1 & 1 & 1 \\ 2 & 1 & -1 \\ 3 & 2 & k \end{vmatrix} \ne 0 \Rightarrow 1(k+2) - 1(2k+3) + 1(4-3) \ne 0$

$\Rightarrow -k + 2 - 3 + 1 \ne 0 \Rightarrow k \ne 0 \therefore S = R - \{0\}$

80. **(b)** Table of values of the objective function:

Corner Point	Value of Z = 3x – 4y
(0, 0)	$3\times 0 - 4\times 0 = 0$
(5, 0)	$3\times 5 - 4\times 0 = 15$ (Maximum)
(6, 5)	$3\times 6 - 4\times 5 = -2$
(6, 8)	$3\times 6 - 4\times 8 = -14$
(4, 10)	$3\times 4 - 4\times 10 = -28$
(0, 8)	$3\times 0 - 4\times 8 = -32$ (Minimum)

Minimum of $Z = -32$ at (0, 8)

81. **(c)** $\sim (p \vee (q \wedge r)) \equiv \sim p \wedge \sim (q \wedge r) \equiv \sim p \wedge (\sim q \vee \sim r)$
[By De Morgan's Law]

$\equiv (\sim p \wedge \sim q) \vee (\sim p \wedge \sim r)$ [By Distributive Law]

82. **(d)** $f(x) = e^{(x^3 - 3x + 2)}$
Let $g(x) = x^3 - 3x + 2$;
$g'(x) = 3x^2 - 3 = 3(x^2 - 1) \geq 0$ for $x \in (-\infty, -1]$
Therefore, $f(x)$ is increasing function.
Hence, $f(x)$ is one-one
Now, the range of $f(x)$ is $(0, e^4]$.
But co-domain is $(0, e^3]$.
Hence, $f(x)$ is an into function.

83. **(a)** Given, $BA = AB^2 \Rightarrow A^{-1}(BA) = B^2$

$\Rightarrow (A^{-1}BA)^m = B^{2m} \Rightarrow A^{-1}B^m A = B^{2m}$

$\Rightarrow B^m A = AB^{2m}$

Also, $BA = AB^2 \Rightarrow A = B^{-1}AB^2$

$\Rightarrow A^n = B^{-1}A^n B^{2n}$

84. **(a)** Let, $y = \dfrac{x^2 + 2x + c}{x^2 + 4x + 3c}$

or $(y - 1)x^2 + (4y - 2)x + 3cy - c = 0$
Now, x is real. Hence,

$D = (4y - 2)^2 - 4(y - 1)(3cy - c) \geq 0, \forall y \in \mathbb{R}$

or $(2y - 1)^2 - (y - 1)(3cy - c) \geq 0, \forall y \in \mathbb{R}$

or $(4 - 3c)y^2 + (-4 + c + 3c)y + 1 - c \geq 0, \forall y \in \mathbb{R}$

or $4 - 3c > 0$ and $(4c - 4)^2 - 4(4 - 3c)(1 - c) \leq 0$

or $c < \dfrac{4}{3}$ and $4(c - 1)^2 - (4 - 3c)(1 - c) \leq 0$

or $c < \dfrac{4}{3}$ and $(c - 1) \times (4c - 4 + 4 - 3c) \leq 0$

or $c < \dfrac{4}{3}$ and $(c - 1)(c) \leq 0$

or $c < \dfrac{4}{3}$ and $0 \leq c \leq 1$

or $0 \leq c \leq 1$

85. **(c)** Here, $f(x) = \dfrac{x}{\sqrt{a^2 + x^2}} - \dfrac{d - x}{\sqrt{b^2 + (d - x)^2}}$

$\Rightarrow f'(x) = \dfrac{a^2}{(a^2 + x^2)^{3/2}} + \dfrac{b^2}{(b^2 + (d - x)^2)^{3/2}} > 0$

$\forall\, x \in \boldsymbol{R}$

$\therefore f(x)$ is an increasing function of x.

86. **(b)** $f(0) = \sin 0 = 0,\ f(0^+) \to 0^+$

$f(0^-) = \lim\limits_{x \to 0^-} \sin(x^2 - 3x) = \lim\limits_{h \to 0} \sin(h^2 + 3h) \to 0^+$

Thus, $f(0^+) > f(0)$ and $f(0^-) > f(0)$.
Hence, $x = 0$ is a point of minima.

87. **(d)** $I_1 = \int\limits_{-\frac{1}{2}}^{1} 2xf(2x(1 - 2x))\,dx$

$\Rightarrow 2x = t \Rightarrow 2dx = dt \Rightarrow I_1 = \dfrac{1}{2}\int\limits_{-1}^{2} tf(t(1 - t))\,dt$

$\Rightarrow 2I_1 = \int\limits_{-1}^{2} (1 - t) f[(1 - t)(1 - (1 - t))]\,dt$

$\Rightarrow 2I_1 = \int\limits_{-1}^{2} f(t(1 - t))\,dt - \int\limits_{-1}^{2} tf(t(1 - t))\,dt$

$\Rightarrow 2I_1 = I_2 - 2I_1 \Rightarrow 4I_1 = I_2 \Rightarrow \dfrac{I_2}{I_1} = 4.$

88. **(d)** The given differential equation is

$$(1 + e^{\frac{x}{y}})\,dx + e^{\frac{x}{y}}\left(1 - \frac{x}{y}\right)dy = 0$$

$$\frac{dx}{dy} = \frac{e^{\frac{x}{y}}\left(\frac{x}{y} - 1\right)}{\left(e^{x/y} + 1\right)} \qquad \text{...(i)}$$

$$= g\left(\frac{x}{y}\right) \quad \because \quad \frac{dx}{dy} = g\left(\frac{x}{y}\right)$$

$\therefore$ eq. (i) is the homogeneous differential equation so, put

$$\frac{x}{y} = v \text{ i.e., } x = vy \Rightarrow \frac{dx}{dy} = v + y\frac{dv}{dy}$$

Then, eq. (i) becomes

$$v + y\frac{dv}{dy} = \frac{e^v(v - 1)}{e^v + 1} \Rightarrow y\frac{dv}{dy} = \frac{e^v(v - 1)}{e^v + 1} - v$$

$$\Rightarrow \quad y\frac{dv}{dy} = \frac{ve^v - e^v - ve^v - v}{e^v + 1} - v$$

$$\Rightarrow \quad \frac{e^v + 1}{e^v + v}dv = -\frac{1}{y}dy$$

On integrating both sides, we get

$$\int \frac{e^v + 1}{e^v + v}dv = -\int \frac{1}{y}dy \qquad \text{Put } e^v + v = t$$

$$\Rightarrow \quad e^v + 1 = \frac{dt}{dv} \Rightarrow dv = \frac{dt}{e^v + 1}$$

$$\therefore \quad \int \frac{e^v + 1}{t}\frac{dt}{e^v + 1} - \log|y| + \log C$$

$\Rightarrow \log|t| + \log|y| = \log C$
$\Rightarrow \log|e^v + v| + \log|y| = \log C \qquad (\because t = e^v + v)$
$\Rightarrow \log|(e^v + v)y| = C \Rightarrow |(e^v + v)y| = C$

$\Rightarrow (e^v + v)y = C$. So, put $v = \dfrac{x}{y}$, we get

$$\left(e^{x/y} + \frac{x}{y}\right)y = C \Rightarrow ye^{x/y} + x = C$$

This is the required solution of the given differential equation.

89. **(a)** $\|A^{-1}|(AB)^{T}| = \|A^{-1}| \cdot (A \cdot \text{adj}\, A)^{T}|$

$= \left|\frac{1}{|A|} \cdot (|A| \cdot I)^{T}\right| = \left|\frac{1}{|A|} \cdot |A| \cdot I^{T}\right| = \left|I^{T}\right| = 1$

90. **(a)** $f(x) = \frac{\sqrt{6x^2 + 5x - 6}}{\sqrt{4-x} - \sqrt{x+4}}$

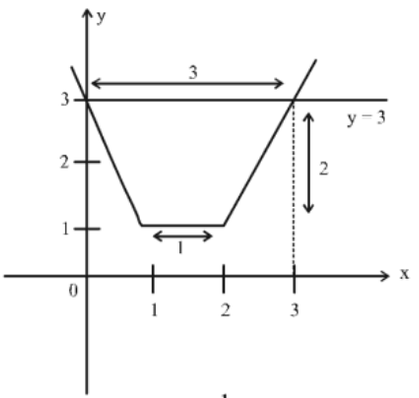
$6x^2 + 5x - 6 \geq 0 \Rightarrow x \in \left(-\infty, -\frac{3}{2}\right] \cup \left[\frac{2}{3}, \infty\right)$

for $\sqrt{4-x} - \sqrt{x+4} \Rightarrow x \in [-4, 4]$

$\Rightarrow x \in \left[-4, \frac{-3}{2}\right] \cup \left[\frac{2}{3}, 4\right]$

91. **(c)** $|z| = \frac{|1+i\sqrt{3}|\,|\cos\theta + i\sin\theta|}{2|1-i|\,|\cos\theta - i\sin\theta|} = \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$

92. **(b)** Given $y = |x-1| + |x-2|$ and $y = 3$
Since, graph of the given curves are



$\therefore$ Required area $= \frac{1}{2}(1+3) \times 2 = 4$

93. **(d)** In the expansion of $\left(\frac{x\sqrt{y}}{3} - \frac{3}{y\sqrt{x}}\right)^{12}$, n = 12 (even)

then middle term is $\frac{12}{2} + 1 = 7^{\text{th}}$ term.

$(r+1)^{\text{th}}$ term; $T_{r+1} = {}^{12}C_r \left[\frac{x\sqrt{y}}{3}\right]^{12-r} \cdot \left(-\frac{3}{y\sqrt{x}}\right)^{r}$

$\therefore\ T_7 = T_{6+1} = {}^{12}C_6 \left(\frac{x\sqrt{y}}{3}\right)^{6} \left(-\frac{3}{y\sqrt{x}}\right)^{6}$

$= {}^{12}C_6 \frac{x^6 y^3}{y^6 x^3} = {}^{12}C_6\, x^3 y^{-3} = C(12, 6) x^3 y^{-3}$

94. **(d)** Given : $5^{1+x} + 5^{1-x}, \frac{a}{2}, 5^{2x} + 5^{-2x}$ are in A.P.

$\therefore\ 2.\frac{a}{2} = 5^{1+x} + 5^{1-x} + 5^{2x} + 5^{-2x}$

$\Rightarrow a = 5.5^{x} + 5(5^{x})^{-1} + (5^{x})^{2} + (5^{x})^{-2}$

Let $5^{x} = t$ $\therefore\ a = 5t + \frac{5}{t} + t^2 + \frac{1}{t^2}$

$\Rightarrow a = t^2 + \frac{1}{t^2} + 5\left(t + \frac{1}{t}\right)$

$\Rightarrow a = \left(t + \frac{1}{t}\right)^2 - 2 + 5\left(t + \frac{1}{t}\right)$

Put $t + \frac{1}{t} = A$

$\therefore a = A^2 + 5A - 2$ [add & subtract $\left(\frac{b}{2a}\right)^2$]

$\Rightarrow a = \left[A^2 + 5A - \left(\frac{5}{2}\right)^2\right] + \left(\frac{5}{2}\right)^2 - 2$

$\Rightarrow a = \left(A - \frac{5}{2}\right)^2 + \frac{17}{4} \Rightarrow a \geq \frac{17}{4}$.

95. **(a)** Equation of parabola is $y^2 = ax = 4 \cdot \frac{a}{4} x$ ...(i)

$\therefore$ Focus of parabola is $\left(\frac{a}{4}, 0\right)$.

Focal chord of the parabola is $2x - y - 8 = 0$

$\therefore\ 2 \cdot \frac{a}{4} - 0 - 8 = 0 \Rightarrow a = 16$

Putting the value of a in (i), we get

$y^2 = 16x \Rightarrow y^2 = 4 \cdot 4x$

So, directrix is $x + 4 = 0$.

96. **(c)** $ab\sin x + b\sqrt{(1-a^2)}\cos x$

Now, $\sqrt{(ab)^2 + (b\sqrt{(1-a^2)})^2}$

$= \sqrt{a^2b^2 + b^2(1-a^2)} = b\sqrt{(a^2 + 1 - a^2)} = b$

$\Rightarrow b\{(a\sin x + \sqrt{(1-a^2)}\cos x)\}$

Let, $a = \cos\alpha$,

$\therefore \sqrt{(1-a^2)} = \sin\alpha \Rightarrow b \sin(x + a)$

$\because -1 \leq \sin(x+\alpha) \leq 1$

$\therefore c - b \leq b\sin(x+\alpha) + c \leq b + c$

$\therefore b\sin(x+\alpha) + c \in [c-b, c+b]$

97. **(c)** The equation of a line perpendicular to $3x + 2y + 5 = 0$ is $2x - 3y + \lambda = 0$ ...(i)
This passes through the point (3, 4).
$\therefore\ 3 \times 2 - 3 \times 4 + \lambda = 0 \Rightarrow \lambda = 6$
Putting $\lambda = 6$ in (i), we get $2x - 3y + 6 = 0$, which is the required equation.

98. **(d)** Let E be the event that the randomly drawn card is a spade. Let F_i be the event that i spades nre missing from the 52-card, for i can take values 0, 1, 2

$P(E) = P\left(\frac{E}{F_0}\right) P(F_0) + P\left(\frac{E}{F_1}\right) P(F_1) + P\left(\frac{E}{F_2}\right) P(F_2)$

$= \frac{13}{50}\frac{\binom{13}{0}\binom{39}{2}}{\binom{52}{2}} + \frac{12}{50}\frac{\binom{13}{1}\binom{39}{1}}{\binom{52}{2}} + \frac{11}{50}\frac{\binom{13}{2}\binom{39}{0}}{\binom{52}{2}} = \frac{1}{4}$

99. **(b)** We know that $\sum P_i = 1$

$\therefore \quad a + 4a + 3a + 7a + 8a + 10a + 6a + 9a = 1$

$\Rightarrow \quad 48a = 1 \Rightarrow a = \frac{1}{48}$

Now, $P(X < 3) = P(0) + P(1) + P(2)$

$= a + 4a + 3a = 8a = 8.\frac{1}{48} = \frac{1}{6}$

$P(X \geq 4) = P(4) + P(5) + P(6) + P(7)$

$= 8a + 10a + 6a + 9a = 33a = \frac{33}{48}$

and $P(0 < X < 5) = P(1) + P(2) + P(3) + P(4)$

$= 4a + 3a + 7a + 8a = 22a = \frac{22}{48} = \frac{11}{24}$

100. **(c)** Since, $|\vec{a}| = \sqrt{11}, |\vec{c}| = \sqrt{22}$

Now, $|\vec{a}| = |\vec{b} \times \vec{c}| = |\vec{b}||\vec{c}|\sin\theta \Rightarrow \sqrt{11} = \sqrt{50}\sqrt{22}\sin\theta$

$\Rightarrow \sin\theta = \frac{1}{10}$

$\because |\vec{b} + \vec{c}|^2 = |\vec{b}|^2 + |\vec{c}|^2 + 2\vec{b} \cdot \vec{c}$

$= |\vec{b}|^2 + |\vec{c}|^2 + 2|\vec{b}||\vec{c}|\cos\theta$

$= 50 + 22 + 2 \times \sqrt{50} \times \sqrt{22} \times \frac{\sqrt{99}}{10} \quad = 72 + 66$

$\Rightarrow \left|72 - |\vec{b} + \vec{c}|^2\right| = 66$

101. **(b)**

Marks Obtained	Number of students f_i	Mid points x_i	$f_i\, x_i$	$\lvert x_i - \bar{x} \rvert$	$f_i \lvert x_i - \bar{x} \rvert$
10-20	2	15	30	30	60
20-30	3	25	75	20	60
30-40	8	35	280	10	80
40-50	14	45	630	0	0
50-60	8	55	440	10	80
60-70	3	65	195	20	60
70-80	2	75	150	30	60
	40		**1800**		**400**

Here, $N = \sum_{i=1}^{7} f_i = 40, \sum_{i=1}^{7} f_i x_i = 1800$

Therefore, $\bar{x} = \frac{1}{N}\sum_{i=1}^{7} f_i x_i = \frac{1800}{40} = 45$

Now, $\sum_{i=1}^{7} f_i \mid x_i - \bar{x} \mid = 400$

$\therefore$ M.D. $(\bar{x}) = \frac{1}{N}\sum_{i=1}^{7} f_i \mid x_i - \bar{x} \mid = \frac{1}{40} \times 400 = 10$

102. **(c)** Centre at (0, 0), $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at point (4, –1)

$\frac{16}{a^2} + \frac{1}{b^2} = 1 \Rightarrow 16b^2 + a^2 = a^2b^2$ ...(i)

at point (–2, 2), $\frac{4}{a^2} + \frac{4}{b^2} = 1$

$\Rightarrow \quad 4b^2 + 4a^2 = a^2b^2$ ...(ii)

$\Rightarrow \quad 16b^2 + a^2 = 4a^2 + 4b^2$

From equations (i) and (ii)

$\Rightarrow \quad 3a^2 = 12b^2 \Rightarrow a^2 = 4b^2$

$b^2 = a^2(1 - e^2) \Rightarrow e^2 = \frac{3}{4} \Rightarrow e = \frac{\sqrt{3}}{2}$

103. **(a)** $S = \log_7 x^2 + \log_7 x^3 + \log_7 x^4 + ...20$ terms

$\because S = 460$

$\Rightarrow \log_7(x^2 \cdot x^3 \cdot x^4 \cdot .....x^{21}) = 460$

$\Rightarrow \log_7 x^{(2+3+4.....21)} = 460$

$\Rightarrow (2 + 3 + 4 + ... + 21)\log_7 x = 460$

$\Rightarrow \frac{20}{2}(2 + 21)\log_7 x = 460$

$\Rightarrow \log_7 x = \frac{460}{230} = 2 \Rightarrow x = 7^2 = 49$

104. **(a)** Let a, b, c, be the direction ratios of the required line. Then, equation of line passing through $(1, 2, -4)$ and having DR's (a, b, c) is

$\frac{x-1}{a} = \frac{y-2}{b} = \frac{z+4}{c}$

Now, as line (i) is perpendicular to the lines

$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and

$$\frac{x-15}{3}=\frac{y-29}{8}=\frac{z-5}{-5}$$

$\therefore\ 3a-16b+7c=0$ ...(i)

$3a+8b-5c=0$ ...(ii)

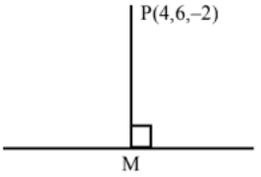
On solving (ii) and (iii), we get

$$\frac{a}{24}=\frac{b}{36}=\frac{c}{72} i.e., \frac{a}{2}=\frac{b}{3}=\frac{c}{6}$$

So, the required equation is

$$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z+4}{6}$$

105. (d)



Equation of line is $\frac{x+3}{3}=\frac{y-2}{3}=\frac{z-3}{-1}=\lambda$

$M(3\lambda-3, 3\lambda+2, 3-\lambda)$

D.R of PM $(3\lambda-7, 3\lambda-4, 5-\lambda)$

Since PM is perpendicular to line

$\Rightarrow 3(3\lambda-7)+3(3\lambda-4)-1(5-\lambda)=0$

$\Rightarrow \lambda_2=2$

Put $\lambda=2$ in cordinate M.

$\Rightarrow M(3, 8, 1) \Rightarrow PM=\sqrt{14}$

106. (a) Let Q(x, y, z) be any point which is equidistant from A(0, 2, 3) and B(2, –2, 1), then

$QA=QB$

Squaring both sides, we get $QA^2=QB^2$

$$\Rightarrow \sqrt{(x-0)^2+(y-2)^2+(z-3)^2}$$

$$=\sqrt{(x-2)^2+(y+2)^2+(z-1)^2}$$ (Using distance formula)

$\Rightarrow 4x-8y-42+4=0 \Rightarrow x-2y-2+1=0$

$\Rightarrow x-2y-1=0$

Hence, the required locus is $x-2y-1=0$

107. (d) Here, $\lim_{x\to\frac{\pi}{2}}\frac{\cos x}{(1-\sin x)^{\frac{1}{3}}}=\lim_{t\to 0}\frac{\sin t}{(1-\cos t)^{\frac{1}{3}}}$

$$=\lim_{t\to 0}\frac{2\sin\frac{t}{2}\cos\frac{t}{2}}{\left(2\sin^2\frac{t}{2}\right)^{\frac{1}{3}}}=\lim_{t\to 0}2^{\frac{2}{3}}\cos\frac{t}{2}\left(\sin\frac{t}{2}\right)^{\frac{2}{3}}=0$$

108. (c) $A=\begin{vmatrix} x^2+2 & 2x+1 & 1 \\ 2x+1 & x+2 & 1 \\ 3 & 3 & 1 \end{vmatrix}$

after expanding along R_1

$=(x-1)^2(x-3)$, which is clearly negative for $x<1$

109. (b) Let $y=\sqrt{\sec\sqrt{x}}$

Differentiating w.r.t. x, we get

$$\frac{dy}{dx}=\frac{1}{2\sqrt{\sec\sqrt{x}}}\cdot\sec\sqrt{x}\cdot\tan\sqrt{x}\cdot\frac{1}{2\sqrt{x}}$$

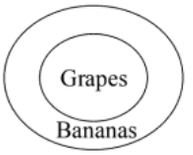
$$=\frac{1}{4\sqrt{x}}(\sec\sqrt{x})^{1/2}\frac{\sin\sqrt{x}}{\cos\sqrt{x}}=\frac{1}{4\sqrt{x}}(\sec\sqrt{x})^{3/2}\cdot\sin\sqrt{x}$$

110. (c) $f\left(x+\frac{1}{x}\right)=x^2+\frac{1}{x^2}=\left(x+\frac{1}{x}\right)^2-2$

$\therefore f(x)=x^2-2$

PART - IV (APTITUDE TEST)

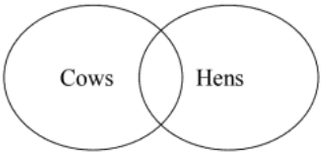
111. (c)



Conclusion I. [√] II. [×]
III. [√] IV. [×]

Hence, only I and III follow.

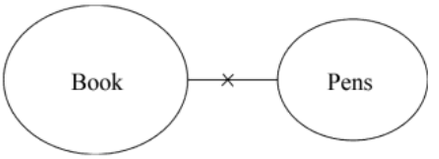
112. (a)



Conclusion I. [√] II. [×]
III. [×] IV. [×]

Hence, only I follow.

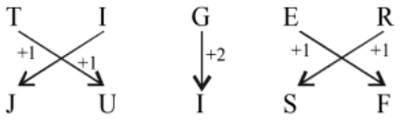
113. (c)



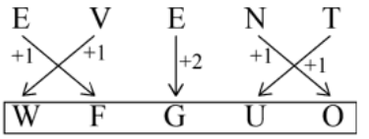
Conclusion I. [√] II. [√]
III. [√] IV. [×]

Hence, only I, II and III follow.

114. (b) As,

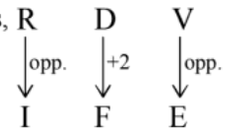


Similarly,

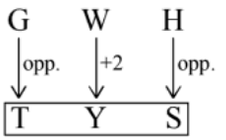


115. (a) 14. [B, C, D, F, G, J, K, L, N, P, Q, R, S and Z]

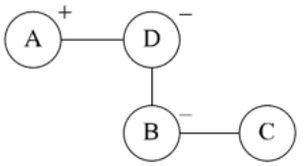
116. (c) As,



Similarly,



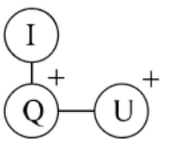
117. (b)



[+ = Male
− = Female]

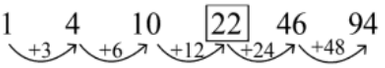
Hence, 'B' is Niece of 'A'.

118. (c) From statement (I) and (II)

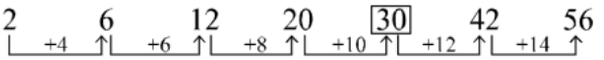


Hence, statement I and II together are sufficient to answer the question.

119. (a) The series is as follows



120. (c) The series is as follows



PART - V (ENGLISH)

121. (c) The phrase suggests overcoming the disparity between countries with advanced AI tools and those without access. The UN is urging international cooperation so that developing nations can benefit equally. Bridging this divide ensures fairness in how AI transforms societies globally.

122. (b) The mention of the expert group highlights the seriousness with which the UN is approaching AI governance. It shows a strategic effort to include multidisciplinary knowledge and global perspectives in setting fair, effective policies.

123. (d) The passage focuses on ensuring that AI is developed and used responsibly, with fairness, inclusivity, and global collaboration at its core. It emphasizes both the potential and the risks of AI and calls for policies that protect human rights while closing access gaps.

124. (a) "Inclusive" in this context means ensuring that everyone is involved or considered, much like "comprehensive," which suggests covering all elements or groups fairly. The other options suggest limiting or partial involvement.

125. (c) "Strategies" imply structured, goal-oriented actions. "Chaos" represents complete disorder or lack of planning, making it a contextual opposite.