MHT CET 2024 PCM May 16 Shift 1 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

Time Allowed: 180 Minutes **Total Questions: 150** **Maximum Marks: 200**

General Instructions

(i) This **PCM** paper is from **MHT CET 2024**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

(ii) Answer all **150 multiple choice questions**: **50 Physics**, **50 Chemistry** and **50 Mathematics**.

(iii) Each question offers **four choices**, with **one correct answer**.

(iv) Allow **90 minutes for Physics and Chemistry together**, followed by **90 minutes for Mathematics**. The first group closes before the second opens.

(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

(vi) There is **no negative marking**. Unanswered questions score zero.

1. The materials having negative magnetic susceptibility are

(A) both paramagnetic and ferromagnetic.
(B) paramagnetic.
(C) diamagnetic.
(D) ferromagnetic.

2. In most liquids, with rise in temperature, surface tension of a liquid

(A) first decreases and then increases.
(B) increases.
(C) decreases.
(D) remains unchanged.

3. Two identical capacitors A and B are connected in series to a battery of E.M.F., 'E'. Capacitor B contains a slab of dielectric constant K.Q_A and Q_B are the charges stored in A and B . When the dielectric slab is removed, the corresponding charges are Q'_A and Q'_B. Then

(A) $\frac{Q'_A}{Q_A} = \frac{K}{2}$
(B) $\frac{Q'_B}{Q_B} = \frac{K+1}{2}$
(C) $\frac{Q'_A}{Q_A} = \frac{K+1}{K}$
(D) $\frac{Q'_B}{Q_B} = \frac{K+1}{2K}$

4. In M_O is the mass of an oxygen isotope ${}_8O^{17}$ and M_p and M_N are the mass of proton and mass of neutron respectively, then the nucleus binding energy of the isotope is

(A) M_oC^2
(B) $(M_o - 8M_P)C^2$
(C) $(M_o - 17M_N)C^2$
(D) $(M_o - 8M_P - 9M_N)C^2$

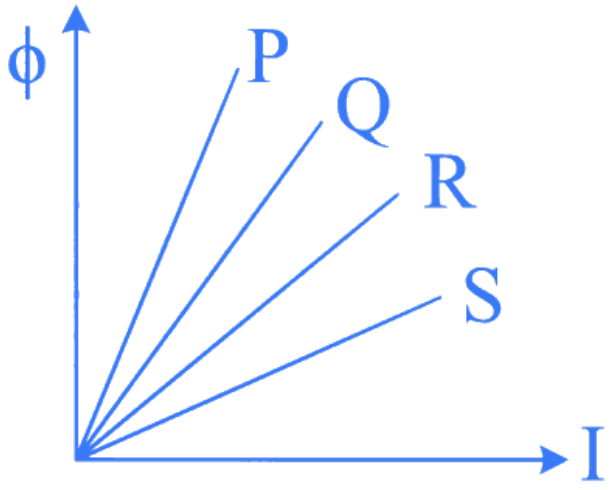
5. Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The location of a point on the x-axis from the origin, at which the net electric field due to these two point charges is zero is

(A) $\frac{L}{4}$
(B) 4L
(C) 8L
(D) 2L

6. When an electron orbiting in hydrogen atom in its ground state jumps to higher excited state, the de-Broglie wavelength associated with it

(A) will become zero.
(B) will remain same.
(C) will decrease.
(D) will increase.

7. A graph of magnetic flux (ϕ) versus current (I) is shown for 4 different inductors P, Q, R, S. Minimum value of inductance is for inductor



(A) P
(B) Q
(C) R
(D) S

8. The magnetic induction along the axis of a toroidal solenoid is independent of

(A) number of turns per unit length.
(B) current passing through it.
(C) radius of the toroidal solenoid.
(D) permeability

9. Optical path of a particular ray of light has travelled a distance of 3 cm in flint glass is same as that on travelling a distance ' x ' cm through another medium. The value of ' x ' is [refractive index of flint glass $= 1 \cdot 6$, refractive index of another medium $= 1.25$]

(A) 3.84 cm
(B) 2.84 cm
(C) 1.84 cm
(D) 4.84 cm

10. A string is under tension of 180 N and mass per unit length 2×10^{-3}Kg/m. It produces two consecutive resonant frequencies with a tuning fork, which are 375 Hz and 450 Hz . The mass of the string is

(A) 1 gram
(B) 2 gram
(C) 3 gram
(D) 4 gram

11. Two spheres of equal masses, one of which is a thin spherical shell and the other solid sphere, have the same moment of inertia about their respective diameters. The ratio of their radii is

(A) $3:5$ (B) $\sqrt{3}:\sqrt{5}$

(C) $\sqrt{3}:\sqrt{7}$ (D) $5:7$

12. Assuming the expression for the pressure exerted by the gas, it can be shown that pressure is

(A) $(\frac{3}{4})^{\text{th}}$ of kinetic energy per unit volume of a gas. (B) $(\frac{2}{3})^{\text{rd}}$ of kinetic energy per unit volume of a gas.

(C) $(\frac{1}{3})^{\text{rd}}$ of kinetic energy per unit volume of a gas. (D) $(\frac{3}{2})^{\text{rd}}$ of kinetic energy per unit volume of a gas.

13. A particle executing S.H.M. has velocities ' V_1 ' and ' V_2 ' at distances ' x_1 ' and ' x_2 ' respectively, from the mean position. Its frequency is

(A) $\frac{1}{2\pi}\sqrt{\frac{V_1^2-V_2^2}{x_1^2-x_2^2}}$ (B) $2\pi\sqrt{\frac{x_1^2-x_2^2}{v_1^2-V_2^2}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{V_2^2-V_1^2}{x_1^2-x_2^2}}$ (D) $2\pi\sqrt{\frac{x_1^2-x_2^2}{V_2^2-V_1^2}}$

14. The angle of incidence is found to be twice the angle of refraction when ray of light passes from vacuum into a medium of refractive index ' μ '. The angle of incidence will be

(A) $\cos^{-1}(\frac{\mu}{2})$ (B) $2\cos^{-1}(\frac{\mu}{2})$

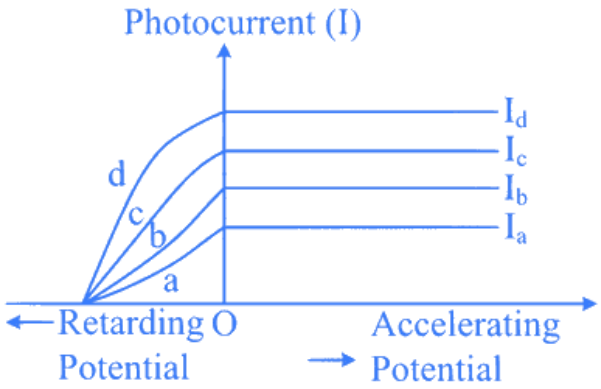
(C) $\sin^{-1}(\frac{\mu}{2})$ (D) $2\sin^{-1}(\frac{\mu}{2})$

15. The input signal given to C.E. amplifier having a voltage gain of 126 is $V_i = 2\cos\left(12t + \frac{\pi}{3}\right)$. The corresponding output signal will be

(A) $252\cos(12t + \frac{4\pi}{3})$ (B) $252\cos(12t + \frac{\pi}{3})$

(C) $63\cos(12t + \frac{2\pi}{3})$ (D) $2\cos(12t + \frac{5\pi}{3})$

16. The figure shows the variation of photocurrent with anode potential for four different radiations. Let I_a, I_b, I_c and I_d be the intensities for the curves a, b, c and d respectively [f_a, f_b, f_c and f_d are frequencies respectively]



(A) $f_a = f_b > f_c > f_d$ and $I_a = I_b > I_c > I_d$ (B) $f_a < f_b > f_c = f_d$ and $I_a = I_b > I_c > I_d$

(C) $f_a = f_b = f_c = f_d$ and $I_a < I_b < I_c < I_d$ (D) $f_a > f_b > f_c > f_d$ and $I_a = I_b = I_c = I_d$

17. When a resistance of 100Ω is connected in series with a galvanometer of resistance G , its range is V . To double its range a resistance of 1000Ω is connected in series. The value of G is

(A) 800Ω (B) 300Ω

(C) 200Ω (D) 100Ω

18. The angular separation of the central maximum in the Fraunhofer diffraction pattern is measured. The slit is illuminated by the light of wavelength 6000 $\overset{o}{A}$. If the slit is illuminated by light of another wavelength, the angular separation decreases by 20%. The wavelength of light used is

(A) $6400\overset{o}{A}$ (B) $5600\overset{o}{A}$

(C) $4800\overset{o}{A}$ (D) $4400\overset{o}{A}$

19. A particle starting from rest moves along the circumference of a circle of radius ' r ' with angular acceleration ' α '. The magnitude of the average velocity in time it completes the small angular displacement ' θ ' is

(A) $\frac{r^2}{2\alpha\theta}$ (B) $\frac{r}{2\alpha\theta}$

(C) $\frac{r\alpha\theta}{2}$ (D) $\frac{r}{\sqrt{2}}\sqrt{\alpha\theta}$

20. If heat energy ΔQ is supplied to an ideal diatomic gas, the increase in internal energy is ΔU and the amount of work done by the gas is ΔW. The ratio $\Delta W : \Delta U : \Delta Q$ is

(A) 2 : 3 : 5 (B) 2 : 5 : 7

(C) 7 : 5 : 9 (D) 1 : 2 : 5

21. How many times more intense is a 60 dB sound that a 30 dB sound?

(A) 2 (B) 4

(C) 1000 (D) 10000

22. Two loops P and Q of radii R_1 and R_2 are made from uniform metal wire of same material. I_p and I_Q be the moment of inertia of loop P and Q respectively then ratio R_1/R_2 is (Given $I_P/I_Q = 27$)

(A) 4 : 1 (B) 3 : 1

(C) 9 : 1 (D) 6 : 1

23. The power radiated by a black body is P and it radiates maximum energy around the wavelength λ_0. Now the temperature of the black body is changed so that it radiates maximum energy around wavelength $\left(\frac{\lambda_0}{2}\right)$. The power radiated by it will now increase by a factor of

(A) 2 (B) 8

(C) 16 (D) 32

24. Two coils P and Q each of radius R carry currents I and $\sqrt{8}$I respectively in same direction. Those coils are lying in perpendicular planes such that they have a common centre. The magnitude of the magnetic field at the common centre of the two coils is (μ_0 = permeability of free space)

(A) $\frac{\mu_0 I}{2R}$ (B) $\frac{3\mu_0 I}{2R}$

(C) $\frac{5\mu_0 I}{2R}$ (D) $\frac{7\mu_0 \mathrm{I}}{2\mathrm{R}}$

25. In Young's double slit experiment, intensity at a point is $\left(\frac{1}{4}\right)$ of the maximum intensity. The angular position of this point is

(A) $\sin^{-1}\left(\frac{\lambda}{D}\right)$ (B) $\sin^{-1}\left(\frac{\lambda}{2d}\right)$

(C) $\sin^{-1}\left(\frac{\lambda}{3\,\mathrm{d}}\right)$ (D) $\sin^{-1}\left(\frac{\lambda}{4d}\right)$

26. The mutual inductance of two coils is 45 mH . The self-inductance of the coils are $\mathrm{L}_1 = 75\mathrm{mH}$ and $\mathrm{L}_2 = 48\mathrm{mH}$. The coefficient of coupling between the two coils is

(A) 0.3 (B) 0.4

(C) 0.75 (D) 1.0

27. Frequency of the series limit of Balmer series of hydrogen atom of Rydberg's constant ' R ' and velocity of light ' C ' is

(A) $\frac{\mathrm{RC}}{4}$ (B) RC

(C) $\frac{4}{\mathrm{RC}}$ (D) 4 RC

28. The co-ordinates of a moving particle at any time ' t ' are given by $x = \alpha t^3$ and $y = \beta t^3$ where α and β are constants. The speed of the particle at time ' t ' is given by

(A) $t\sqrt{\alpha^2 + \beta^2}$ (B) $3t\sqrt{\alpha^2 + \beta^2}$

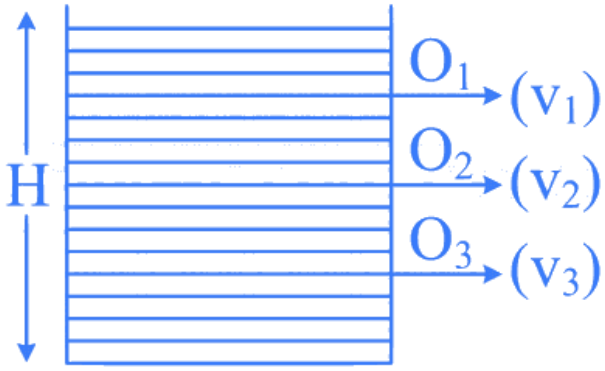
(C) $t^2\sqrt{\alpha^2 + \beta^2}$ (D) $3t^2\sqrt{\alpha^2 + \beta^2}$

29. A bucket full of hot water is kept in a room. If it cools from 75°C to 70°C in t_1 minutes, from 70°C to 65°C in t_2 minutes and 65°C to 60°C in t_3 minutes, then

(A) $t_1 < t_2 < t_3$ (B) $t_1 > t_2 > t_3$

(C) $t_1 = t_2 = t_3$ (D) $t_1 < t_2 = t_3$

30. A cylinder contains water upto a height ' H '. It has three orifices O_1, O_2, O_3 as shown in the figure. Let V_1, V_2, V_3 be the speed of efflux of water from the three orifices. Then



(A) $V_1 = V_2 = V_3$ (B) $V_1 < V_2 < V_3$

(C) $V_1 > V_2 > V_3$ (D) $V_1 = V_3 > V_2$

31. In LCR series circuit, an alternating e.m.f. 'e' and current ' i ' are given by equations $\mathrm{e} = 160\sin(100\mathrm{t})$ Volt and $\mathrm{i} = 250\sin\left(100\mathrm{t} + \frac{\pi}{3}\right)$ mA. The average power dissipated in the circuit is

(A) 2.5 W (B) 4.0 W

(C) 10 W (D) 100 W

32. The power (P) is supplied to a rotating body having moment of inertia ' I ' and angular acceleration ' α '. Its instantaneous angular velocity ' ω ' is

(A) $P(I\alpha)^{-1}$ (B) $P^{-1}(I\alpha)^{-1}$

(C) $P\alpha^{-1}I$ (D) PIa

33. When the dielectric is placed in an external electric field, the electric field inside the dielectric is

(A) less than the external electric field. (B) larger than the external electric field.

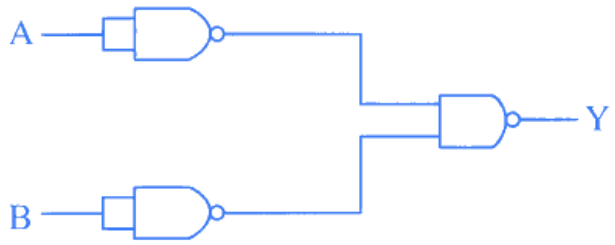
(C) equal to the external electric field. (D) equal to or greater than external electric field.

34. A satellite is orbiting just above the surface of the planet of density ' ρ ' with periodic time ' T '. The quantity $T^2\rho$ is equal to (G = universal gravitational constant)

(A) $\frac{4\pi^2}{G}$ (B) $\frac{3\pi^2}{G}$

(C) $\frac{3\pi}{G}$ (D) $\frac{\pi}{G}$

35. The truth table of the following circuit is



(A)

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

(B)

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	1

(C)

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

(D)

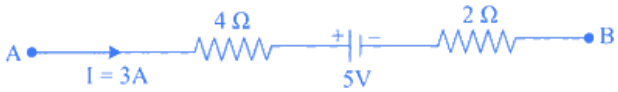
A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

36. Two sound waves each of wavelength ' λ ' and having the same amplitude ' A ' from two source ' S_1 ' and ' S_2 ' interfere at a point P . If the path difference, $S_2P - S_1P = \lambda/3$ then the amplitude of resultant wave at point ' P ' will be $[\cos(120^\circ) = -0.5]$

(A) A (B) 2A

(C) $\frac{A}{2}$ (D) $\frac{3A}{2}$

37. The potential difference $(V_A - V_B)$ between the points A and B in the given part of the circuit



(A) $-13V$ (B) 13V

(C) $-23V$ (D) 23V

38. An ideal diatomic gas is heated at constant pressure. What is the fraction of total energy applied, which increases the internal energy for the gas?

(A) $\frac{2}{5}$ (B) $\frac{5}{7}$

(C) $\frac{3}{7}$ (D) $\frac{3}{5}$

39. An electric lamp connected in series with a capacitor and an a.c. source is glowing with certain brightness. On increasing the value of capacitance the brightness of the lamp

(A) is increased. (B) is decreased.

(C) remains the same. (D) becomes zero.

40. A series combination of n_1 capacitors, each of value C_1 is charged by a source of potential difference 6 V . Another parallel combination of n_2 capacitors, each of value C_2 is charged by a source of potential difference 2 V . Total energy of both the combinations is same. The value of C_2 in terms of C_1 is

(A) $\frac{3C_1}{n_1n_2}$ (B) $\frac{9n_2}{n_1}C_1$

(C) $\frac{3n_2}{n_1}C_1$ (D) $\frac{9C_1}{n_1n_2}$

41. The speed with which the earth would have to rotate about its axis so that a person on the equator would weigh $\frac{3}{5}$ th as much as at present weight is (g = gravitational acceleration, R = equatorial radius of the earth)

(A) $\sqrt{\frac{2g}{5R}}$ (B) $\sqrt{\frac{3g}{5R}}$

(C) $\sqrt{\frac{5R}{3g}}$ (D) $\sqrt{\frac{3}{5}gR}$

42. A simple pendulum has a periodic time ' T_1 ' when it is on the surface of earth of radius ' R '. Its periodic time is ' T_2 ' when it is taken to a height ' R ' above the earth's surface. The value of $\frac{T_2}{T_1}$ is

(A) $\sqrt{2}$ (B) 1

(C) 2 (D) $\frac{1}{2}$

43. A coil of resistance 250Ω is placed in a magnetic field. If the magnetic flux (ϕ) linked with the coil varies with time $t(\mathrm{~s})$ as $\phi = 50\mathrm{t}^2 + 7$. The current in the coil at $t = 4$ s is

(A) 1.3 A (B) 1.4 A

(C) 1.5 A (D) 1.6 A

44. If the $\mathrm{p} - \mathrm{n}$ junction diode is unbiased,

(A) n-type side has lower potential than p-type side.

(B) n-type side has same potential as p-type side.

(C) An electric field is established at the junction such that n side is at positive voltage relative to p -side.

(D) The potential across the junction is such that p -side is at positive voltage relative to n-side

45. When capillary is dipped vertically in water, rise of water in capillary is ' h '. The angle of contact is zero. Now the tube is depressed so that its length above the water surface is $\frac{\mathrm{h}}{3}$. The new apparent angle of contact is $(\cos 0^\circ = 1)$

(A) $\cos^{-1}(\frac{1}{2})$ (B) $\cos^{-1}(\frac{1}{3})$

(C) $\cos^{-1}(\frac{1}{4})$ (D) $\cos^{-1}(\frac{1}{6})$

46. The alternating voltage is given by $\mathrm{v} = \mathrm{v}_0 \sin\left(\omega \mathrm{t} + \frac{\pi}{3}\right)$ when will be the voltage maximum for first time?

(A) $\frac{\mathrm{T}}{6}$ (B) $\frac{\mathrm{T}}{3}$

(C) $\frac{T}{2}$ (D) $\frac{\mathrm{T}}{12}$

47. In case of system of two-particles of different masses, the centre of mass lies

(A) at the mid-point of line joining the two particles.

(B) on the line joining the two particles.

(C) at one end of the line joining the two particles.

(D) on the line perpendicular to the line joining the two particles.

48. A simple pendulum of length L has mass m and it oscillates freely with amplitude A. At extreme position, its potential energy is (g = acceleration due to gravity)

(A) $\frac{\mathrm{mgA}}{2\,\mathrm{L}}$ (B) $\frac{\mathrm{mgA}^2}{\mathrm{L}}$

(C) $\frac{\mathrm{mgA}}{\mathrm{L}}$ (D) $\frac{\mathrm{mgA}^2}{2\,\mathrm{L}}$

49. A glass slab of thickness 4.8 cm is placed on the piece of paper on which an ink dot is marked. By how much distance would an ink dot appear to be raised? (The refractive index of glass = 1.5)

(A) 1.6 cm (B) 2.4 cm

(C) 3.2 cm (D) 4.8 cm

50. In ideal gas of 27°C is compressed adiabatically to $(8/27)$ of its original volume. If $\gamma = \frac{5}{3}$, the rise in temperature of a gas is

(A) 300 K (B) 375 K

(C) 400 K (D) 450 K

51. Identify the angle $O-S-O$ in SO_2 molecule.

(A) 119.5° (B) 180°

(C) 109° (D) 107.5°

52. Calculate the number of unit cells in 0.9 g metal if it forms bec structure. $[\rho \times a^3 = 3 \times 10^{-22}$ gram$]$

(A) 1.0×10^{21} (B) 2.0×10^{21}

(C) 3.0×10^{21} (D) 4.0×10^{21}

53. Which of the following polymers need $HO-CH_2-CH_2-OH$ as one of the monomers for its preparation?

(A) Nylon 6,6 (B) Dacron

(C) Polyacrylamide (D) Buna- N

54. What is the EAN of Zn in $[Zn(NH_3)_4]^{2+}$?

(A) 32 (B) 28

(C) 30 (D) 36

55. What is molecular formula of undecane?

(A) $C_{11}H_{24}$ (B) C_9H_{18}

(C) $C_{12}H_{26}$ (D) $C_{20}H_{42}$

56. Which from following elements has completely filled 4 f orbital at expected ground state configuration?

(A) W (B) Yb

(C) Eu (D) Cd

57. Which from following compounds is NOT in gaseous phase at $25^\circ C$?

(A) ClF (B) BrF

(C) IF_3 (D) ClF_3

58. Calculate the pH of 0.01 M sulphuric acid.

(A) 1.699 (B) 2.00

(C) 0.699 (D) 3.398

59. Identify the correct statement from following properties.

(A) The osmosis is a colligative property.

(B) The vapour pressure of solution containing nonvolatile solute is lower than that of pure solvent at any given temperature.

(C) The osmotic pressure of 0.1 M NaCl solution is lower than 0.1 M sucrose solution.

(D) The boiling point of solution containing nonvolatile solute is lower than that of pure solvent.

60. Which of the following is true for a reaction as per coliision theory?

(A) Every collision between reactants leads to chemical reaction.

(B) It may be expected that rate of reaction is equal to rate of collision.

(C) For gas phase reactions, the number of collisions is far less compared to observed rate.

(D) The colliding molecules do not need proper orientation.

61. What is the IUPAC name of following compound?



(A) 1-Bromo -1,2-dimethylbut-2-ene

(B) 4-Bromo-3-methylpent-2-ene

(C) 4-Bromo-3, 4-dimethylbut-2-ene

(D) 2-Bromo-3-methylpent-3-ene

62. What is wavenumber of a radiation having wavelength 0.25μ m ?

(A) 2.5×10^6 m^{-1} (B) 4.0×10^6 m^{-1}

(C) 6.5×10^6 m^{-1} (D) 8.0×10^6 m^{-1}

63. What is the product of Hydroborationoxidation of but-1-ene?

(A) Butanal (B) Butanone

(C) Butan-1-ol (D) Butan-2-ol

64. Identify the class of $(C_6H_5)_3$ N ?

(A) 3° aliphatic simple amine (B) 3° aromatic mixed amine

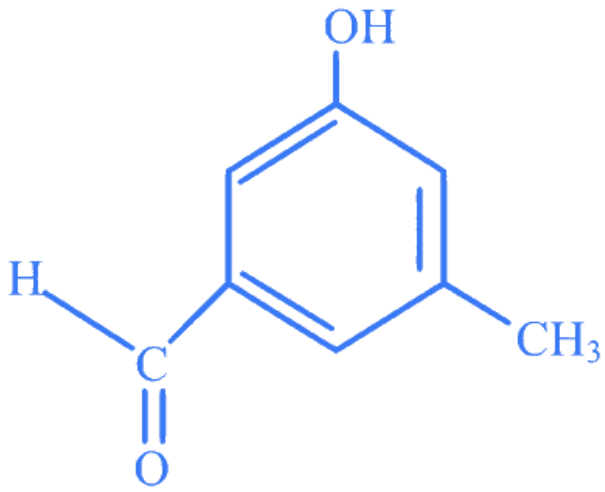
(C) 3° aromatic simple amine (D) 3° aliphatic mixed amine

65. What is the conductivity of 0.05 M NaOH solution having resistance 31.5 ohm and cell constant 0.315 cm^{-1} ?

(A) 100 ohm^{-1} cm^{-1} (B) 0.02 ohm^{-1} cm^{-1}

(C) 0.09 ohm^{-1} cm^{-1} (D) 0.01 ohm^{-1} cm^{-1}

66. What is IUPAC name of the following compound?



(A) 3-formyl-5-methylphenol

(B) 5-formyl-3-methylphenol

(C) 3-hydroxy-5-methylbenzaldehyde

(D) 5-hydroxy-3-methylbenzaldehyde

67. The enthalpy of vaporisation of a liquid is 30 kJ mol^{-1} and entropy of vaporisation is 75JK^{-1} mol^{-1}. Calculate boiling point of liquid at 1 atm .

(A) 250 K (B) 400 K

(C) 450 K (D) 600 K

68. Which from following polymers is used as substitute for wool?

(A) Teflon (B) LDP

(C) Dacron (D) Polyacrylonitrile

69. Which from following complexes is having ambidentate ligand in it?

(A) Triamminetrinitrocobalt (III)

(B) Pentacarbonyliron (0)

(C) Tetraaminecopper (II) ion

(D) Trioxalatocobaltate (III) ion

70. What is the number of moles of oxygen and number of moles of N atoms respectively present in one mole thymine?

(A) 2 and 2 (B) 1 and 5

(C) 1 and 3 (D) 2 and 3

71. Identify one dimensional nanostructure from following.

(A) Nanowires (B) Nanoparticles

(C) Thin films (D) Quantum dots

72. What is the general formula of lanthanoid hydroxide? (Consider Ln as any lanthanoid element)

(A) $Ln(OH)$ (B) $Ln(OH)_2$

(C) $Ln(OH)_3$ (D) $Ln(OH)_4$

73. Find the void volume of fcc unit cell in cm^3 if the volume of fcc unit cell 1.25×10^{-22} cm^3.

(A) 3.25×10^{-23} (B) 2.16×10^{-23}

(C) 1.34×10^{-23} (D) 4.20×10^{-23}

74. Find work done on 2 mole of an ideal gas at 27°C if it is compressed reversibly and isothermally from $5.05 \times 10^6 Nm^{-2}$ to $1.01 \times 10^5 Nm^{-2}$ pressure.

(A) 19.52 kJ (B) 1.95 kJ

(C) 39.04 kJ (D) 3.904 kJ

75. Rate of reaction, $A + B \rightarrow$ product, is $7.2 \times 10^{-2} moldm^{-3}\ s^{-1}$ at $[A] = 0.4\ moldm^{-3}$ and $[B] = 0.1\ moldm^{-3}$. The reaction is first order in A and second order in B. Calculate rate constant.

(A) 14 $mol^{-2}dm^6\ s^{-1}$ (B) 12 $mol^{-2}dm^6\ s^{-1}$

(C) 18 $mol^{-2}dm^6\ s^{-1}$ (D) 20 $mol^{-2}dm^6\ s^{-1}$

76. Identify the product obtained when alkenes react with cold and dilute alkaline potassium permanganate.

(A) Alkanols (B) Glycols

(C) Glycerols (D) Alkanoic acids

77. Which among the following has the highest melting point?

(A) Phenol (B) p-Cresol

(C) p-Nitrophenol (D) o-Nitrophenol

78. What is the oxidation state of phosphorus in phosphate ion?

(A) -5 (B) $+3$

(C) $+5$ (D) $+6$

79. Which from the following concentrations of a weak electrolyte solution exhibits maximum molar conductivity?

(A) 0.004 M (B) 0.002 M

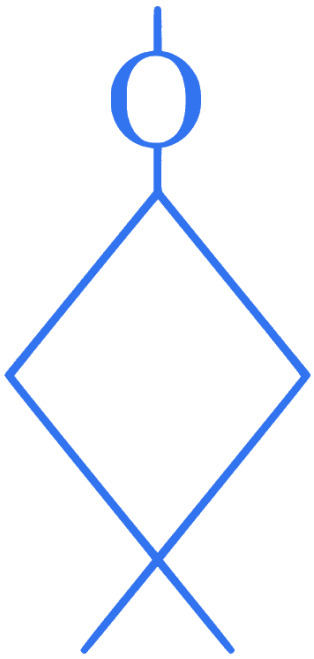
(C) 0.005 M (D) 0.001 M

80. Which among the following is NOT dicarboxylic acid?

(A) Adipic acid (B) Valeric acid

(C) Glutaric acid (D) Malonic acid

81. What is IUPAC name of following compound?



(A) 1-Methoxy-3,3-dimethylcyclobutane

(B) 3-Methoxy-1,1-dimethylcyclobutane

(C) 3,3-dimethylcyclobutoxymethane

(D) 1-Methoxy-3-isopropylbutane

82. Consider the following cell E° cell $= 1.007$ V and E° calomel $= 0.242$ V What is the standard potential of Zn ?

(A) -0.765 V (B) 0.765 V

(C) -1.247 V (D) 1.247 V

83. Identify the substrate ' A ' in the following conversion.

$$A \xrightarrow[H_3O^+]{AlH(i-Bu)_2} \text{Pent-3-enal}$$

(A) Pentanenitrile (B) Pent-3-enenitrile

(C) Pent-3-en-1-amine (D) Pent-3-ynenitrile

84. Find the number of moles of sodium atoms in 6.9×10^{-2} kg (Atomic mass $= 23$ g mol^{-1})

(A) 1.5 (B) 0.3

(C) 3.0 (D) 2.3

85. Identify the product ' B ' in the following sequence of recations.

$$CH_3Br \xrightarrow{KCN} A \xrightarrow{Na_2/C_2H_5OH} B$$

(A) Methyl cyanide (B) Methyl amine

(C) Ethyl amine (D) Ethyl cyanide

86. Which of the following elements belongs to second group and fifth period of periodic table?

(A) Rubidium (B) Strontium

(C) Caesium (D) Barium

87. Which among the following has lowest boiling point?

(A) Chloromethane (B) Fluoromethane

(C) Bromomethane (D) Iodomethane

88. Which of the following species contain 20 electrons?

(A) K^+ (B) Ca

(C) Mg (D) Cl

89. A zero order reaction has half life time of 0.2 minute. If initial concentration of reactant is 0.2 moldm^{-3}. Find rate constant.

(A) 0.2 mol dm^{-3} min^{-1}

(B) 0.5 mol dm^{-3} min^{-1}

(C) 1.4 mol dm^{-3} min^{-1}

(D) 6.0 mol dm^{-3} min^{-1}

90. Which of the following is NOT optically active compound?

(A) 1,2-Diiodobutane (B) 1,3-Diiodobutane
(C) 1,4-Diiodobutane (D) 2,3-Diiodobutane

91. What is the numerical value of gas constant R in terms of $\mathrm{LatmK^{-1}\ mol^{-1}}$?

(A) 0.085 (B) 0.082
(C) 8.314 (D) 1.987

92. What type of solid is the silica?

(A) Ionic (B) Molecular
(C) Covalent (D) Metallic

93. Which from following mixtures in water acts as a buffer?

(A) Acetic acid and sodium acetate (B) Acetic acid and ammonium chloride
(C) Ammonium hydroxide and sodium chloride (D) Formic acid and acetic acid

94. Calculate van't Hoff factor of 0.15 M solution of electrolyte if it freezes at -0.5 K.

$$\left[\mathrm{K_f = 1.86\ K\ kg\ mol^{-1}}\right]$$

(A) 1.12 (B) 1.25
(C) 1.45 (D) 1.79

95. Calculate the solubility in $\mathrm{moldm^{-3}}$ of sparingly soluble salt BA if its solubility product 4.9×10^{-13} at same temperature.

(A) 7.0×10^{-7} (B) 7.5×10^{-7}
(C) 8.0×10^{-7} (D) 4.9×10^{-7}

96. Which of the following equations gives combined relationship of Boyle's law and Charle's law?

(A) $\frac{P_1V_2}{T_1} = \frac{P_2V_1}{T_2}$ (B) $\mathrm{n = \frac{RT}{PV}}$
(C) $\frac{\mathrm{P_1V_1}}{\mathrm{T_1}} = \frac{\mathrm{P_2V_2}}{\mathrm{T_2}}$ (D) $\mathrm{p = \frac{RT}{nV}}$

97. What is the value of slope in Freundlich adsorption isotherm $\log \frac{x}{m}$ against $\log C$?

(A) $\frac{1}{n}$ (B) n
(C) K (D) logK

98. What is the total number of electrons present in bonding orbitals of O_2 molecule according to molecular orbital theory?

(A) 16 (B) 06
(C) 10 (D) 04

99. Calculate the relative lowering of vapour pressure of solution containing 46 g of non volatile solute in 162 g of water at 20°C. [Molar mass of nonvolatile solute $= 46\ \mathrm{g\ mol^{-1}}$]

(A) 0.89 (B) 0.045
(C) 0.11 (D) 0.06

100. Identify acidic amino acid from following (represented by using three letter symbols)

(A) Glu (B) Gly
(C) Gln (D) Arg

101. Let $A = \begin{bmatrix} x & 1 \\ 1 & 0 \end{bmatrix}, x \in \mathbb{R}^+$ and $A^4 = [a_{ij}]_2$. If $a_{11} = 109$, then $\left(A^4\right)^{-1} =$

(A) $\begin{bmatrix} 109 & 33 \\ 33 & 10 \end{bmatrix}$ (B) $\begin{bmatrix} 10 & 33 \\ 33 & 10 \end{bmatrix}$

(C) $\begin{bmatrix} 10 & 33 \\ 33 & 109 \end{bmatrix}$ (D) $\begin{bmatrix} 10 & -33 \\ -33 & 109 \end{bmatrix}$

102. The proposition $(\sim p) \vee (p \wedge \sim q)$ is equivalent to

(A) $p \wedge (\sim q)$ (B) $p \vee (q)$

(C) $p \rightarrow (\sim q)$ (D) $q \rightarrow p$

103. In a triangle ABC , with usual notations, $2ac \sin\left(\frac{A-B+C}{2}\right)$ is equal to

(A) $a^2 + b^2 - c^2$ (B) $c^2 + a^2 - b^2$

(C) $b^2 - a^2 + c^2$ (D) $a^2 - b^2 - c^2$

104. If $\frac{x^2}{a} + \frac{2xy}{h} + \frac{y^2}{b} = 0$ represents a pair of straight lines and slope of one of the lines is twice that of the other, then $ab : h^2$ is

(A) 1 : 2 (B) 2 : 1

(C) 9 : 8 (D) 8 : 9

105. If $\bar{a}, \bar{b}$ and $\bar{c}$ are unit coplanar vectors, then the scalar triple product $\left[\begin{array}{ccc} 2\bar{a}-\bar{b} & 2\bar{b}-\bar{c} & 2\bar{c}-\bar{a} \end{array}\right]$ has the value

(A) 0 (B) 1

(C) $-\sqrt{3}$ (D) $\sqrt{3}$

106. If a random variable X has the following probability distribution values

X	0	1	2	3	4	5	6	7
P(X) :	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

Then $P(X \geq 6)$ has the value

(A) $\frac{19}{100}$ (B) $\frac{81}{100}$

(C) $\frac{9}{100}$ (D) $\frac{91}{100}$

107. Let the vectors $\bar{a}, \bar{b}, \bar{c}$ be such that $|\bar{a}| = 2, |\bar{b}| = 4$ and $|\bar{c}| = 4$. If the projection of $\bar{b}$ on $\bar{a}$ is equal to the projection of $\bar{c}$ on $\bar{a}$ and $\bar{b}$ is perpendicular to $\bar{c}$, then the value of $|\vec{a} + \bar{b} - \bar{c}|$ is

(A) $2\sqrt{5}$ (B) 6

(C) 4 (D) $4\sqrt{2}$

108. If the sum of the deviations of 50 observations from 30 is 50 , then the mean of these observations is

(A) 30 (B) 50

(C) 51 (D) 31

109. The general solution of the equation $\sqrt{3}\cos\theta + \sin\theta = \sqrt{2}$ is

(A) $n\pi + (-1)^n \frac{\pi}{2} + \frac{\pi}{6}, n \in \mathbb{Z}$

(B) $n\pi + (-1)^n \frac{\pi}{2} - \frac{\pi}{6}, n \in \mathbb{Z}$

(C) $n\pi + (-1)^n \frac{\pi}{4} - \frac{\pi}{3}, n \in \mathbb{Z}$

(D) $n\pi + (-1)^n \frac{\pi}{4} + \frac{\pi}{3}, n \in \mathbb{Z}$

110. If $\sin^{-1}\left(\frac{x}{5}\right) + \text{cosec}^{-1}\left(\frac{5}{4}\right) = \frac{\pi}{2}$, then the value of x is

(A) 4 (B) 5

(C) 1 (D) 3

111. A random variable X takes the values $0, 1, 2, 3$ and its mean is 1.3 . If $P(X = 3) = 2P(X = 1)$ and $P(X = 2) = 0.3$, then $P(X = 0)$ is

(A) 0.2 (B) 0.1

(C) 0.3 (D) 0.4

112. Let $\bar{a}, \bar{b}$ and $\bar{c}$ be three non-zero vectors such that no two of them are collinear and $(\bar{a} \times \bar{b}) \times \bar{c} = \frac{1}{3}|\bar{b}||c|\bar{a}$. If θ is the angle between vectors $\bar{b}$ and $\bar{c}$, then the value of $\sin\theta$ is

(A) $\frac{2}{3}$ (B) $\frac{-2\sqrt{2}}{3}$

(C) $\frac{2\sqrt{2}}{3}$ (D) $\frac{-\sqrt{2}}{3}$

113. The equation of the plane, passing through the intersection of the planes $x + y + z = 1$ and $2x + 3y - z + 4 = 0$ and parallel to Y-axis is

(A) $x + 4z - 1 = 0$ (B) $x + 4z - 7 = 0$

(C) $x - 4z + 7 = 0$ (D) $x - 4z + 1 = 0$

114. If $f(1) = 1, f'(1) = 3$, then the derivative of $f(f(f(x))) + (f(x))^2$ at $x = 1$ is

(A) 12 (B) 9

(C) 15 (D) 33

115. If $\left[\ \bar{a}\times\bar{b}\quad \bar{b}\times\bar{c}\quad \bar{c}\times\bar{a}\ \right]=\lambda\left[\ \bar{a}\quad \bar{b}\quad \bar{c}\ \right]^2$, then λ is equal to

(A) 3 (B) 0
(C) 1 (D) 2

116. The value of $\lim\limits_{x\to 0}\left((\sin x)^{\frac{1}{x}}+\left(\frac{1}{x}\right)^{\sin x}\right)$, where $x>0$ is

(A) 0 (B) -1
(C) 1 (D) 2

117. If θ denotes the acute angle between the curves $y=10-x^2$ and $y=2+x^2$, at a point of the intersection, then $|\tan\theta|$ is equal to

(A) $\frac{8}{15}$ (B) $\frac{8}{17}$
(C) $\frac{4}{9}$ (D) $\frac{7}{17}$

118. If $y=a\log x+bx^2+x$ has its extremum values at $x=-1$ and $x=2$, then

(A) $a=2,\ b=-1$ (B) $a=2,\ b=-\frac{1}{2}$
(C) $a=-2,\ b=\frac{1}{2}$ (D) $a=2,\ b=\frac{1}{2}$

119. Let $P=\{\theta/\sin\theta-\cos\theta=\sqrt{2}\cos\theta\}$ and $Q=\{\theta/\sin\theta+\cos\theta=\sqrt{2}\sin\theta\}$ be two sets, then

(A) $P\subset Q$ and $Q-P\neq\varnothing$ (B) $Q\not\subset P$
(C) $P\not\subset Q$ (D) $P=Q$

120. A line with positive direction cosines passes through the point $P(2,-1,2)$ and makes equal angles with co-ordinate axes. The line meets the plane $2x+y+z=9$ at point Q. Then the length of the line segment PQ equals

(A) 1 units (B) $\sqrt{2}$ units
(C) $\sqrt{3}$ units (D) 2 units

121. Let $f(x)=\frac{1-\tan x}{4x-\pi},x\neq\frac{\pi}{4},x\in\left[0,\frac{\pi}{2}\right]$. $f(x)$ is continuous in $\left[0,\frac{\pi}{2}\right]$, then $f\left(\frac{\pi}{4}\right)$ is

(A) $-\frac{1}{2}$ (B) $\frac{1}{2}$
(C) 1 (D) -1

122. The value of $\int\limits_{-\frac{\pi}{2}}^{\frac{\pi}{2}}\frac{\sin^2 x}{1+2^x}dx$ is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{8}$
(C) $\frac{\pi}{2}$ (D) 4π

123. The area (in sq. units) of the region described by $\{(x,y)/y^2\le 2x$ and $y\ge(4x-1)\}$ is

(A) $\frac{15}{64}$ (B) $\frac{9}{32}$
(C) $\frac{7}{32}$ (D) $\frac{5}{64}$

124. Let $y=y(x)$ be the solution of the differential equation $(x\log x)\frac{dy}{dx}+y=2x\log x(x\ge 1)$ then $y(e)$ is equal to

(A) 2 (B) 2e
(C) e (D) 1

125. The set of all points, for which $f(x)=x^2e^{-x}$ strictly increases, is

(A) $(0,2)$ (B) $(2,\infty)$
(C) $(-2,0)$ (D) $(-\infty,\infty)$

126. Range of the function $f(x)=\frac{x^2+x+2}{x^2+x+1},x\in\mathbb{R}$ is

(A) $(1,\frac{7}{3})$ (B) $[1,\frac{7}{3})$
(C) $(1,\frac{7}{3}]$ (D) $[1,\frac{7}{3}]$

127. Let S be a non-empty subset of $\mathbb{R}$. Consider the following statement:
p : There is a rational number $x\in S$ such that $x>0$.
Which of the following statements is the negation of the statement p?

(A) There is a rational number $x\in S$ such that $x\le 0$. (B) There is no rational number $x\in S$ such that $x\le 0$.
(C) Every rational number $x\in S$ satisfies $x\le 0$. (D) $x\in S$ and $x\le 0\Rightarrow x$ is not a rational number.

128. The number of values of x in the interval $(0,5\pi)$ satisfying the equation $3\sin^2 x-7\sin x+2=0$

(A) 0 (B) 5
(C) 6 (D) 10

129. If the vectors $\overrightarrow{AB}=3\hat{i}+4\hat{k}$ and $\overrightarrow{AC}=5\hat{i}-2\hat{j}+4\hat{k}$ are the sides of the triangle ABC, then the length of the median, through A, is

(A) $\sqrt{45}$ units. (B) $\sqrt{18}$ units.
(C) $\sqrt{72}$ units. (D) $\sqrt{33}$ units

130. The equation of the circle, concentric with the circle $2x^2 + 2y^2 - 6x + 8y + 1 = 0$ and double of its area is

(A) $2x^2 + 2y^2 - 6x + 8y + 11 = 0$

(B) $2x^2 + 2y^2 - 6x + 8y - 11 = 0$

(C) $4x^2 + 4y^2 - 12x + 16y - 21 = 0$

(D) $4x^2 + 4y^2 - 12x + 16y + 21 = 0$

131. If $y = \sec\left(\tan^{-1} x\right)$, then $\frac{dy}{dx}$ at $x = 1$ is equal to

(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$

(C) $\sqrt{2}$ (D) 1

132. Eight chairs are numbered 1 to 8 . Two women and three men wish to occupy one chair each. First the women choose chairs from amongst the chairs marked 1 to 4 , and then the men select the chairs from amongst the remaining. The number of possible arrangements is

(A) ${}^6\mathrm{C}_3 \times {}^4\mathrm{C}_2$ (B) ${}^4\mathrm{P}_2 \times {}^6\mathrm{P}_3$

(C) ${}^4C_2 + {}^4P_3$ (D) ${}^4\mathrm{P}_2 + {}^6\mathrm{P}_3$

133. If the distance between the plane Ax-2y+z = d and the plane containing the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-2}{3} = \frac{y-3}{4} = \frac{z-4}{5}$ is $\sqrt{6}$ units, then $|d|$ is

(A) 1 (B) $\sqrt{6}$

(C) 2 (D) 6

134. Maximum value of $Z = 100x + 70y$ Subject to $2x \geq 4, y \leq 3, x + y \leq 8, x, y \geq 0$ is

(A) 800 (B) 940

(C) 400 (D) 710

135. Three persons P, Q and R independently try to hit a target. If the probabilities of their hitting the target are $\frac{3}{4}, \frac{1}{2}$ and $\frac{5}{8}$ respectively, then the probability that the target is hit by P or Q but not by R, is

(A) $\frac{15}{64}$ (B) $\frac{21}{64}$

(C) $\frac{39}{64}$ (D) $\frac{9}{64}$

136. If $\bar{a}$ and $\bar{b}$ are two unit vectors such that $\bar{a} + 2\bar{b}$ and $5\overline{\mathrm{a}} - 4\,\overline{\mathrm{b}}$ are perpendicular to each other, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{3}$

(C) $\cos^{-1}(\frac{1}{3})$ (D) $\cos^{-1}(\frac{3}{7})$

137. Let the function $g : (-\infty, \infty) \to \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ be given by $g(u) = 2\tan^{-1}(e^u) - \frac{\pi}{2}$. Then g is

(A) even and is strictly increasing in $(0, \infty)$.

(B) odd and is strictly decreasing in $(-\infty, \infty)$.

(C) odd and is strictly increasing in $(-\infty, \infty)$.

(D) neither even nor odd, but is strictly increasing in $(-\infty, \infty)$.

138. The length of the projection of the line segment joining the points $(5, -1, 4)$ and $(4, -1, 3)$ on the plane $x + y + z = 7$ is

(A) $\sqrt{\frac{2}{3}}$ units (B) $\frac{2}{\sqrt{3}}$ units

(C) $\frac{2}{3}$ units (D) $\frac{\sqrt{2}}{3}$ units

139. If $f(x) = \frac{\sin^2 \pi x}{1+\pi^x}$, then $\int (f(x) + f(-x))dx$ is equal to

(A) $\frac{x}{2} - \frac{\sin \pi x}{2\pi} + \mathrm{c}$, (where c is a constant of integration)

(B) $\frac{1}{2}x - \frac{\sin 2\pi x}{4\pi} + \mathrm{c}$, (where c is a constant of integration)

(C) $\frac{x}{2} - \frac{\cos \pi x}{2\pi} + \mathrm{c}$, (where c is a constant of integration)

(D) $\frac{1}{1+\pi^x} + \frac{\cos^2 \pi x}{2\pi} + \mathrm{c}$, (where c is a constant of integration)

140. Suppose that the points $(h, k), (1, 2)$ and $(-3, 4)$ lie on the line l_1. If a line l_2 passing through the points (h, k) and $(4, 3)$ is perpendicular to l_1, then $\left(\frac{k}{h}\right)$ equals

(A) $\frac{1}{3}$ (B) 0

(C) 3 (D) $-\frac{1}{7}$

141. If $\int \frac{dx}{\cos^3 x\sqrt{2}\sin 2x} = (\tan x)^A + C(\tan x)^B + \mathrm{k}$ where k is a constant of integration, then $A + B + C$ equals

(A) $\frac{27}{10}$ (B) $\frac{16}{5}$

(C) $\frac{27}{5}$ (D) $\frac{21}{5}$

142. The maximum value of $(\cos \alpha_1) \cdot (\cos \alpha_2) \ldots . (\cos \alpha_n)$ under the constraints $0 \leq \alpha_1, \alpha_2, \ldots ., \alpha_n \leq \frac{\pi}{2}$ and $(\cot \alpha_1) \cdot (\cot \alpha_2) \ldots (\cot \alpha_n) = 1$ is

(A) $\frac{1}{2^{(\frac{n}{2})}}$ (B) $\frac{1}{2^n}$

(C) 2^n (D) $2^{\frac{n}{2}}$

143. If $\frac{dy}{dx} = y + 3, y + 3 > 0$ and $y(0) = 2$, then $y(\log 2)$ is equal to

(A) 13 (B) -2

(C) 7 (D) 5

144. The assets of a person are reduced in his business such that the rate of reduction is proportional to the square root of the existing assets. If the assets were initially ₹10, 00, 000 and due to loss they reduce to ₹10, 000 after 3 years, then the number of years required for the person to go bankrupt will be

(A) $\frac{10}{3}$ (B) $\frac{10}{9}$

(C) $\frac{20}{9}$ (D) $\frac{20}{3}$

145. If $f(1) = 1, f'(1) = 5$, then the derivative of $f(f(f(x))) + (f(x))^2$ at $x = 1$ is

(A) 125 (B) 1250

(C) 135 (D) 35

146. The abscissa of the point on the curve $y = a\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}}\right)$ where the tangent is parallel to the X -axis is

(A) 0 (B) a

(C) 2a (D) $-2a$

147. The integral $\int \frac{2x^3-1}{x^4+x}\,dx$ is equal to

(A) $\log\frac{|x^3+1|}{x^2} + c$, (where c is a constant of integration)

(B) $\frac{1}{2}\log\frac{(x^3+1)^2}{|x^3|} + c$, (where c is a constant of integration)

(C) $\log\left|\frac{x^3+1}{x}\right| + c$, (where c is a constant of integration)

(D) $\frac{1}{2}\log\frac{|x^3+1|}{x^2} + c$, (where c is a constant of integration)

148. Let $z = x + iy$ be a complex number, where x and y are integers and $i = \sqrt{-1}$. Then the area of the rectangle whose vertices are the roots of the equation $\overline{z}z^3 + \overline{z}z^3 = 350$ is

(A) 48 (B) 32

(C) 40 (D) 80

149. If $\int \frac{\log\left(t+\sqrt{1+t^2}\right)}{\sqrt{1+t^2}}dt = \frac{1}{2}(g(t))^2 + c$ where c is a constant of integration, then $g(2)$ is equal to

(A) $2\log(2 + \sqrt{5})$ (B) $\log(2 + \sqrt{5})$

(C) $\frac{1}{\sqrt{5}}\log(2 + \sqrt{5})$ (D) $\frac{1}{2}\log(2 + \sqrt{5})$

150. A box contains 15 green and 10 yellow balls. If 10 balls are randomly drawn, one by one, with replacement, then the variance of the number of green balls drawn is

(A) 6 (B) 4

(C) $\frac{6}{25}$ (D) $\frac{12}{5}$

- End of Question Paper -