MHT CET 2024 PCM May 9 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 gyromagnetic ratio and Bohr magneton are given respectively by [Given $\rightarrow$ e = charge on electron, m = mass of electron, h = Planck's constant]

(A) $\frac{e}{2m}, \frac{eh}{4\pi m}$
(B) $\frac{eh}{4\pi m}, \frac{e}{2m}$
(C) $\frac{2m}{e}, \frac{4\pi m}{eh}$
(D) $\frac{4\pi m}{eh}, \frac{2m}{e}$

2. Two satellites A and B having ratio of masses 3 : 1 are revolving in circular orbits of radii ' r ' and ' 4 r '. The ratio of total energy of satellites A to that of B is

(A) 1 : 3
(B) 3 : 1
(C) 3 : 4
(D) 12 : 1

3. The current amplification factor of a transistor is 50 . The input resistance when used in common emitter mode is 1kΩ. The peak value for an a.c. input voltage of 0.01 V peak is

(A) 100μ A
(B) 0.01 mA
(C) 0.25 mA
(D) 500μ A

4. Average power associated with an ideal inductor and ideal capacitor over a complete cycle of a.c. is respectively

(A) zero, one
(B) one, zero
(C) zero, zero
(D) one, one

5. A metal rod of length ' l ' rotates about one of its ends in a plane perpendicular to a magnetic field of induction ' B '. If the e.m.f. induced between the ends of the rod is ' e ', then the number of revolutions made by the rod per second is

(A) $\frac{e}{B\pi^2 l}$
(B) $\frac{e}{B\pi l^2}$
(C) $\frac{B^2}{e\pi l}$
(D) $\frac{\pi l^2}{eB}$

6. In S.H.M. the displacement of a particle at an instant is $Y = A\cos 30^\circ$, where $A = 40$ cm and kinetic energy is 200 J . If force constant is $1 \times 10^{\times}$N/m, then x will be $\left(\cos 30^\circ = \sqrt{3}/2\right)$

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

7. Two sound waves having same amplitude ' A ' and angular frequency ' ω ' but having a phase difference of $\left(\frac{\pi}{2}\right)^c$ are superimposed then the maximum amplitude of the resultant wave is

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

8. Out of the following musical instruments, which is 'NOT' a percussion instrument?

(A) Daphali
(B) Sambal
(C) Cymbals
(D) Clarinet

9. The function of dielectric in a capacitor is

(A) to reduce the effective potential on plates.
(B) to increase the effective potential on plates.
(C) to decrease the capacitance.
(D) to reduce the plate area of capacitor.

10. Three identical metal spheres (of same surface area) have red, black and white colors and they are heated up to same temperature. They are allowed to cool. Arrange them from maximum rate of cooling to minimum rate of cooling

(A) black, red, white
(B) white, red, black
(C) red, black, white
(D) red, white, black

11. In an ammeter, 4% of the main current is passing through the galvanometer, If shunt resistance is 5Ω, then resistance of galvanometer will be

(A) 60Ω
(B) 120Ω
(C) 240Ω
(D) 480Ω

12. LC series resonant circuit produces resonant frequency ' f '. If ' L ' is tripled and ' C ' is increased by $3C$, the resonant frequency will be

(A) $\frac{f}{3}$
(B) $\frac{f}{2\sqrt{3}}$
(C) 6f
(D) $\frac{f}{2\sqrt{2}}$

13. A wavefront is a surface

(A) perpendicular to the direction of propagation of light.
(B) parallel to the direction of propagation of light.
(C) without any specific orientation with direction of propagation of light.
(D) which has nothing to do with intensity of light.

14. When the tension in string is increased by 3 kgωt, the frequency of the fundamental mode increases in the ratio 2 : 3. The initial tension in the string is

(A) 1.6 kgωt
(B) 2.0 kgωt
(C) 2.4 kgωt
(D) 2.8 kgωt

15. In the system of two particles of masses ' m_1 ' and ' m_2 ', the first particle is moved by a distance 'd' towards the centre of mass. To keep the centre of mass unchanged, the second particle will have to be moved by a distance

(A) $\frac{m_2}{m_1}$ d, towards the centre of mass.
(B) $\frac{m_1}{m_2}$ d, away from the centre of mass.
(C) $\frac{m_1}{m_2}$ d, towards the centre of mass.
(D) $\frac{m_2}{m_1}$ d, away from the centre of mass.

16. The potential energy of a long spring when it is stretched by 3 cm is ' U '. If the spring is stretched by 9 cm , potential energy stored in it will be

(A) 3U
(B) 4U
(C) 5U
(D) 9U

17. A thin uniform rod of length ' L ' and mass ' M ' is swinging freely along a horizontal axis passing through its centre. Its maximum angular speed is ' ω '. Its centre of mass rises to a maximum height of [g = gravitational acceleration]

(A) $\frac{\omega^2 L^2}{12 g^2}$
(B) $\frac{\omega^2 L^2 g}{6}$
(C) $\frac{\omega^2 g}{12 L^2}$
(D) $\frac{\omega^2 L^2}{24 g}$

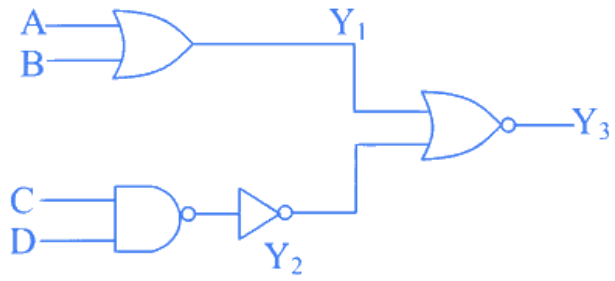
18. Three immiscible transparent liquids with uniform refractive indices $\frac{3}{2}, \frac{4}{3}$ and $\frac{6}{5}$ are arranged one on top of another. The depths of the liquids are 3 cm 4 cm and 6 cm respectively. The apparent depth of the vessel is

(A) 10 cm
(B) 9 cm
(C) 8 cm
(D) 7 cm

19. When a hydrogen atom is raised from the ground state to the excited state

(A) potential energy increases and K.E. decreases.
(B) potential energy decreases and K.E. increases.
(C) both K.E. and potential energy will increase.
(D) both K.E. and potential energy decreases.

20. In the logic circuit diagram, when all the four inputs A, B, C, D are one, the outputs Y_1, Y_2, Y_3 are respectively (1, 1, 0). When all the inputs A, B, C, D are changed to 'zero', the outputs Y_1, Y_2, Y_3 respectively change to



(A) (0, 1, 0)
(B) (0, 0, 1)
(C) (1, 1, 0)
(D) (1, 1, 1)

21. Two coils have a mutual inductance 5×10^{-3}H. The current changes in the first coil according to the equation $I_1 = I_0 \sin \omega t$ where $I_0 = 10$ A and $\omega = 100\pi$rad/s. What is the value of the maximum e.m.f. in the coil?

(A) 2π V
(B) 3π V
(C) 4π V
(D) 5π V

22. When an air bubble rises from the bottom of lake to the surface, its radius is doubled. The atmospheric pressure is equal to that of a column of water of height ' H '. The depth of the lake is

(A) H
(B) 2 H
(C) 7 H
(D) 8 H

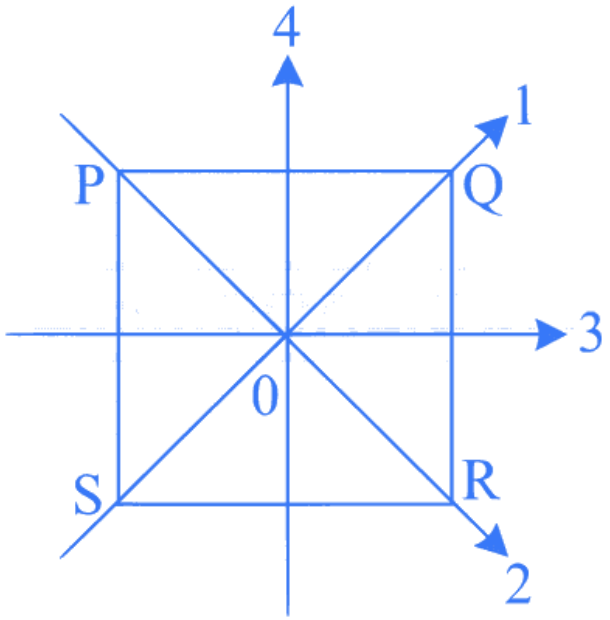
23. The period of a planet around the sun is 8 times that of earth. The ratio of radius of planet's orbit to the radius of the earth's orbit is

(A) 4
(B) 8
(C) 16
(D) 64

24. The magnetic induction due to an ideal solenoid is independent of

(A) total number of turns of the wire.
(B) length of the solenoid.
(C) radius of the wire.
(D) current carried by the wire.

25. The moment of inertia of thin square plate PQRS of uniform thickness, about an axis passing through centre ' O ' and perpendicular to the plane of the plate is $(I_1, I_2, I_3, I_4$ are respectively the moments of inertia about axis $1, 2, 3, 4$ which are in the plane of the plate as shown in figure)



(A) $I_1 + I_2 + I_3$
(B) $I_1 + I_3 + I_4$
(C) $I_1 + I_2 + I_3 + I_4$
(D) $I_1 + I_3$

26. In hydrogen atom, ratio of the shortest wavelength in the Balmer series to that in the Paschen series is

(A) 9 : 4
(B) 3 : 1
(C) 4 : 9
(D) 1 : 3

27. At certain temperature, rod A and rod B of different materials have lengths L_A and L_B respectively. Their coefficients of linear expansion are α_A and α_B respectively. It is observed that the difference between their lengths remains constant at all temperatures. The ratio $L_A : L_B$ is given by

(A) $\frac{\alpha_A}{\alpha_B}$
(B) $\frac{\alpha_B}{\alpha_A}$
(C) $\frac{\alpha_A+\alpha_B}{\alpha_A}$
(D) $\frac{\alpha_A+\alpha_B}{\alpha_B}$

28. Velocity of light in diamond is $\left(\frac{5}{12}\right)^{\text{th}}$ times that in air. Velocity of light in water is $\left(\frac{3}{4}\right)^{\text{th}}$ times that in air. The angle of incidence of ray of light travelling from water to diamond is (angle of refraction $(r) = 30°$) [Given $\rightarrow \sin 30° = \frac{1}{2}$]

(A) $\sin^{-1}(9/10)$
(B) $\sin^{-1}(3/4)$
(C) $\sin^{-1}(5/12)$
(D) $\sin^{-1}(9/5)$

29. When a capacitor is connected in series LR circuit, the alternating current flowing in the circuit

(A) is zero.
(B) increases.
(C) decreases.
(D) remain constant.

30. The internal energy of a gas will increase when it

(A) expands adiabatically.
(B) is compressed adiabatically.
(C) expands isothermally.
(D) is compressed isothermally.

31. A sonometer wire is stretched by hanging a metal bob, the fundamental frequency of the wire is ' n_1 '. When the bob is completely immersed in water, the frequency of vibration of wire becomes ' n_2 '. The relative density of the metal of the bob is

(A) $\frac{n_1-n_2}{n_1}$
(B) $\frac{n_2}{n_1-n_2}$
(C) $\frac{n_1^2}{n_1^2-n_2^2}$
(D) $\frac{n_2^2}{n_1^2-n_2^2}$

32. The magnetic field intensity inside current carrying solenoid is $H = 2.4 \times 10^3$ A/m. If length and number of turns of a solenoid is 15 cm and 60 turns respectively. The current flowing in the solenoid is

(A) 4 A
(B) 6 A
(C) 0.6 A
(D) 60 A

33. If the electric flux entering and leaving an enclosed surface is ϕ_1 and ϕ_2 then charge enclosed in the surface is (ε_0 = permittivity of free space)

(A) $\frac{\varrho_2-\varrho_1}{\epsilon_0}$
(B) $\frac{\varrho_2+\varrho_1}{\epsilon_0}$
(C) $\frac{\varrho_1-\varrho_2}{\epsilon_0}$
(D) $\epsilon_0(\varrho_2 - \varrho_1)$

34. A gas is contained in closed vessel. The initial temperature of the gas is 100°C. If the pressure of the gas is increased by 4%, the increase in the temperature of the gas is

(A) 2°C (B) 3°C

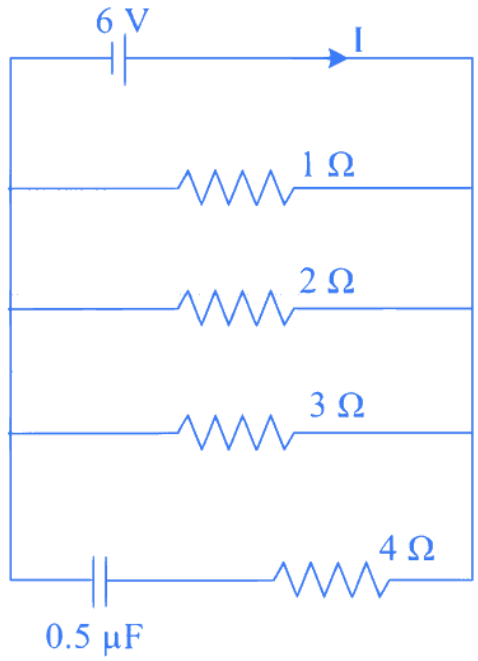
(C) 4°C (D) 5°C

35. According to Bohr's theory of hydrogen atom, the ratio of the maximum and minimum wavelength of Lyman series will be

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

(C) 2 : 5 (D) 5 : 2

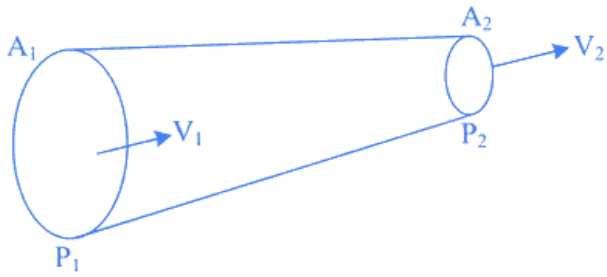
36. In the given circuit diagram, in the steady state the current through the battery and the charge on the capacitor respectively are



(A) 2 A and $3\mu C$ (B) $\frac{6}{11}$ A and $\frac{12}{7}\mu C$

(C) 11 A and $3\mu C$ (D) zero ampere and $3\mu C$

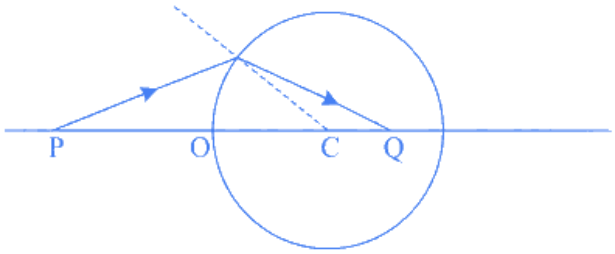
37. Water is flowing in a conical tube as shown in figure. Velocity of water at area ' A_2 ' is 60 cm/s . The value of ' A_1 ' and ' A_2 ' is 10 cm^2 and 5 cm^2 respectively. The pressure difference at both the cross-section is



(A) 230 N/m^2 (B) 200 N/m^2

(C) 135 N/m^2 (D) 105 N/m^2

38. A point object kept at P in front of a glass sphere of radius ' R ' has its image formed at Q such that PO = QO. The refractive index of material of glass sphere is 1.4. The distance PO is equal to



(A) $\frac{R}{2}$ (B) 2R

(C) 5R (D) 6R

39. The magnetic flux through a coil of resistance ' R ' changes by an amount ' $\Delta\phi$ ' in time ' Δt '. The amount of induced current and induced charge in the coil are respectively

(A) $(\frac{\Delta\varrho}{\Delta t})R$ and $\frac{R}{\Delta\varrho}$ (B) $\frac{\Delta\varrho}{R}$ and $R(\frac{\Delta t}{\Delta\varrho})$

(C) $\frac{\Delta\varrho}{R} + R$ and $\frac{\Delta\varrho}{\Delta t}$ (D) $(\frac{\Delta\varrho}{\Delta t}) \times \frac{1}{R}$ and $\frac{\Delta\varrho}{R}$

40. A circular disc of radius ' R ' and thickness $\frac{R}{8}$ has moment of inertia 'I' about an axis passing through its centre and perpendicular to its plane. It is melted and recasted into a solid sphere then moment of inertia of sphere about an axis passing through diameter is

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

(C) $\frac{I}{5}$ (D) $\frac{I}{10}$

41. When the two known resistance ' R ' and ' S ' are connected in the left and right gaps of a meter bridge respectively, the null point is found at a distance ' l_1 ' from the zero end of a meter bridge wire. An unknown resistance ' X ' is now connected in parallel with ' S ' and null point is found at a distance ' l_2 ' form zero end of meter bridge wire. The unknown resistance ' X ' is

(A) $\frac{Sl_1(100-l_2)}{100(l_2-l_1)}$ (B) $\frac{Sl_2(100-l_1)}{100(l_1-l_2)}$

(C) $\frac{100(l_2-l_1)}{Sl_1(100-l_2)}$ (D) $\frac{100(l_2-l_1)}{Sl_2(100-l_1)}$

42. For an ideal gas, in an isobaric process, the ratio of heat supplied ' Q ' to the work done ' w ' by the system is (γ = ratio of specific heat at constant pressure to that at constant volume)

(A) $\frac{1}{\gamma}$ (B) $\frac{1}{\gamma-1}$

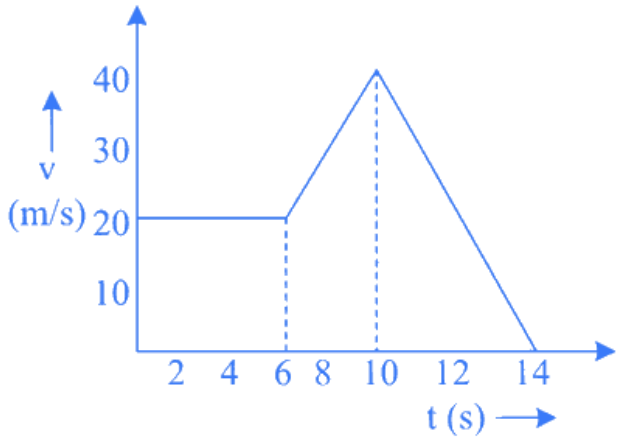
(C) $\frac{\gamma}{\gamma-1}$ (D) $\frac{\gamma-1}{\gamma}$

43. A particle is performing S.H.M. with an amplitude 4 cm . At the mean position the velocity of the particle is 12 cm/s. When the speed of the particle becomes 6 cm/s, the distance of the particle from mean position is

(A) $\sqrt{3}$ cm (B) $\sqrt{6}$ cm

(C) $2\sqrt{3}$ cm (D) $2\sqrt{6}$ cm

44. A velocity - time graph of a body is shown below. The distance covered by the body from 6 second to 9 second is



(A) 22.5 m (B) 90.0 m

(C) 82.5 m (D) 120.0 m

45. Two identical photocathodes receive light of frequencies ' n_1 ' and ' n_2 '. If the velocities of the emitted photoelectrons of mass ' m ' are ' V_1 ' and ' V , respectively, then (h = Planck's constant)

(A) $V_1 + V_2 = [\frac{2h}{m}(n_1 + n_2)]^{1/2}$

(B) $V_1 - V_2 = [\frac{2h}{m}(n_1 - n_2)]^{1/2}$

(C) $V_1^2 + V_2^2 = \frac{2h}{m}(n_1 + n_2)$

(D) $V_1^2 - V_2^2 = \frac{2h}{m}(n_1 - n_2)$

46. The temperature of a gas is $-80°C$. To what temperature the gas should be heated so that the r.m.s. speed is increased by 2 times?

(A) 499°C (B) 772°C

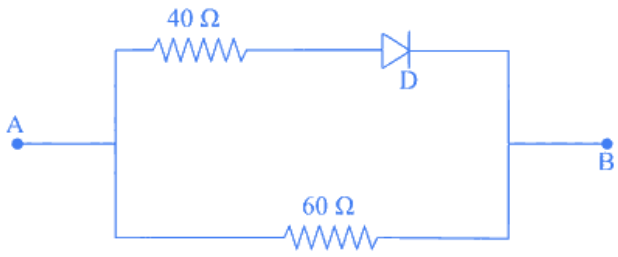
(C) 1464°C (D) 1737°C

47. Two wavelength 590 nm and 596 nm of sodium light are used one after other, to study the diffraction taking place at a single slit of aperture 2.4 mm . The distance between the slit and screen is 2 m . The separation between the positions of first secondary maximum of the diffraction pattern obtained in the two cases is

(A) 7.5×10^{-6} m (B) 7.5×10^{-9} m

(C) 2.5×10^{-6} m (D) 5.0×10^{-6} m

48. For the diagram shown, the resistance between points A and B when the ideal diode ' D ' is forward biased is ' R_1 ' and that when reverse biased is ' R_2 '. The ratio $\frac{R_1}{R_2}$ is



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

(C) $\frac{3}{2}$ (D) $\frac{5}{2}$

49. A parallel plate capacitor of capacitance ' C ' is connected to a battery and charged to a potential difference ' V '. Another capacitor of capacitance 3 C is similarly charged to a potential difference 3 V . The charging battery is then disconnected and capacitors are connected in parallel to each other in such a way that positive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is

(A) $\frac{3}{2}$ CV^2

(B) 8 CV^2

(C) $\frac{13}{2}$ CV^2

(D) 18 CV^2

50. A tuning fork of frequency 340 Hz is vibrated just above a tube of 120 cm height. Water is slowly poured in the tube. What is the minimum height of water necessary for resonance?

(A) 45 cm

(B) 30 cm

(C) 35 cm

(D) 25 cm

51. Identify fibrous protein from following.

(A) Legumelin
(B) Serum albumin
(C) Myosin
(D) Insulin

52. For the reaction,
$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$
at constant temperature, $\Delta H - \Delta U$ is

(A) $-2RT$
(B) RT
(C) $-3RT$
(D) $3RT$

53. Which from following reactions is not possible for benzene due to reversible nature?

(A) Hydrogenation
(B) Chlorination
(C) Bromination
(D) Iodination

54. Calculate the volume of unit cell when metal having density $1\ g\ cm^{-3}$ and molar mass $23\ g\ mol^{-1}$ crystallises to form bec structure.

(A) $6.0 \times 10^{-23}\ cm^3$
(B) $8.6 \times 10^{-23}\ cm^3$
(C) $9.5 \times 10^{-23}\ cm^3$
(D) $7.6 \times 10^{-23}\ cm^3$

55. Which polymer is obtained from monomers using



(A) Polycarbonate
(B) Polyacrylamide
(C) Buna-N
(D) Acrylic glass

56. Which from following elements belongs to the actinoids?

(A) Cm
(B) Pm
(C) Tm
(D) Sm

57. Which of the following rules states that it is impossible to determine simultaneously the exact position and exact momentum of an electron?

(A) Aufbau's principle
(B) de Broglie's hypothesis
(C) Heisenberg uncertainty principle
(D) Pauli's exclusion principle

58. Calculate the cryoscopic constant of solvent when 2.5 gram solute is dissolved in 35 gram solvent lowers its freezing point by 3 K. (molar mass of solute is $117\ g\ mol^{-1}$)

(A) $3.11\ K\ kg\ mol^{-1}$
(B) $3.56\ K\ kg\ mol^{-1}$
(C) $5.52\ K\ kg\ mol^{-1}$
(D) $4.91\ K\ kg\ mol^{-1}$

59. Which of the following solvents reduces the environmental pollution?

(A) Water
(B) Dichloromethane
(C) Trichloromethane
(D) Tetrachloromethane

60. What is the number of electrons present in d-subshell if its atomic number is 27 and oxidation state is $+2$?

(A) 8
(B) 7
(C) 6
(D) 5

61. What is the volume occupied by 1 molecule of water, if its density is $1\ g\ cm^{-3}$?

(A) $9.0 \times 10^{-23}\ cm^3$
(B) $2.98 \times 10^{-23}\ cm^3$
(C) $6.023 \times 10^{-23}\ cm^3$
(D) $5.50 \times 10^{-23}\ cm^3$

62. Identify the reason for the solubility of polar solute in polar solvent from the following.

(A) solute - solute interactions, solute solvent interactions and solvent - solvent interactions are of similar magnitude.
(B) solute - solute interactions > solute solvent interactions > solvent - solvent interactions .
(C) solvent- solvent interactions > solute solvent interactions > solute - solute interactions.
(D) solute - solvent interactions > solute solute interactions > solvent - solvent interactions.

63. Identify biodegradable polymer from following.

(A) Teflon
(B) PHBV
(C) LDP
(D) Polyacrylonitrile

64. What is the pOH of millimolar solution of $Ca(OH)_2$?

(A) 2.7
(B) 10.3
(C) 12.3
(D) 11.3

65. Which from following pairs is an example of isotones?

(A) ${}^{12}_{6}C;{}^{14}_{6}C$ (B) ${}^{12}_{6}C;{}^{11}_{5}B$

(C) ${}^{14}_{6}C;{}^{14}_{7}N$ (D) ${}^{13}_{6}C;{}^{11}_{5}B$

66. What is change in internal energy of the system when work done by the system is 150 J and system release 300 J of heat?

(A) $+450$ J (B) -450 J

(C) $+300$ J (D) -150 J

67. Which from following coordinate complexes is a heteroleptic complex?

(A) Pentacarbonyliron(0)

(B) Triamminetrinitrocobalt(III)

(C) Tetraamminecopper(II) ion

(D) Tetracyanonickelate(II) ion

68. Identify glycosidic linkage present in maltose.

(A) $\alpha, \beta - 1,2$ glycosidic (B) $\alpha - 1,4$ glycosidic

(C) $\beta - 1,4$ glycosidic (D) $\alpha - 1,6$ glycosidic

69. What is the number of moles of Cl atoms and N atoms respectively present in n moles of tear gas?

(A) 3 nCl and nN (B) 2 nCl and 2 nN

(C) nCl and nN (D) nCl and 2 nN

70. What is bond angle $F - B - F$ in BF_3 ?

(A) 107° (B) 104.5°

(C) 120° (D) 109.5°

71. Which from the following statements about $[Co(NH_3)_6]^{3+}$ complex is NOT correct?

(A) Prior to hybridization Co^{3+} possesses four unpaired electrons. (B) This complex has all electrons paired.

(C) It is a high spin complex. (D) It is a diamagnetic complex.

72. What is the relation between edge length and total volume occupied by atoms in bec unit cell?

(A) $V = \frac{\pi a^3}{6}$ (B) $V = \frac{\sqrt{3}\pi a^3}{8}$

(C) $V = \frac{\pi a^3}{3\sqrt{2}}$ (D) $V = \frac{\pi a^3}{16}$

73. What is the value of x and y in order to balance following redox reaction?

$$xCuO + yNH_3 \longrightarrow xCu + N_2 + xH_2O$$

(A) $x = 3, y = 2$ (B) $x = 1, y = 2$

(C) $x = 2, y = 3$ (D) $x = 2, y = 3$

74. Molar conductivity of 0.02 M weak acid is $7.92\Omega^{-1}\,cm^2\,mol^{-1}$ and its molar conductivity at infinite dilution is $232.7\Omega^{-1}\,cm^2\,mol^{-1}$. Calculate degree of dissociation of weak acid.

(A) 0.0112 (B) 0.0341

(C) 0.0694 (D) 0.292

75. Which from following compounds is most covalent?

(A) $SbCl_3$ (B) $PbCl_2$

(C) $SnCl_4$ (D) $SnCl_2$

76. What is the total number of atoms present in fcc unit cell?

(A) 2 (B) 4

(C) 6 (D) 1

77. For which electrolyte the molar conductivity at infinite dilution can not be obtained graphically?

(A) HNO_3 (B) H_2SO_4

(C) CH_3COOH (D) KCl

78. The major product formed in carbylamine reaction is

(A) Alkyl halide (B) Alkyl cyanide

(C) Nitroalkane (D) Alkyl isocyanide

79. Which among the following elements has highest electronegativity?

(A) K (B) Na

(C) Li (D) Cs

80. Consider the reaction $3I^- + S_2O_8^{2-} \longrightarrow I_3^- + 2SO_4^{2-}$, at a particular time t , $\frac{d[SO_4^{2-}]}{dt}$ is $2.2 \times 10^{-2}\,moldm^{-3}\,s^{-1}$. What is the value of $\frac{d[S_2O_8^{2-}]}{dt}$?

(A) $1.1 \times 10^{-2}\,mol\,dm^{-3}\,s^{-1}$

(B) $2.2 \times 10^{-2}\,mol\,dm^{-3}\,s^{-1}$

(C) $3.3 \times 10^{-2}\,mol\,dm^{-3}\,s^{-1}$

(D) $6.6 \times 10^{-2}\,mol\,dm^{-3}\,s^{-1}$

81. For the reaction, $NO_{2(g)} + CO_{(g)} \longrightarrow NO_{(g)} + CO_{2(g)}$ rate of reaction is proportional to square of $[NO_2]$ and independent of [CO]. What is the rate law equation?

(A) $r = k\frac{[NO_2]^{\frac{1}{2}}}{[CO]}$ (B) $r = k[NO_2]^2[CO]^0$

(C) $r = \frac{1}{2}k[NO_2][CO]$ (D) $r = k[NO_2]^2[CO]$

82. Which among the following compounds does not correctly match with its formula?

(A) Hydrazine: $NH_2 - NH_2$

(B) Semicarbazide: $NH_2 - NH - CO - NH_2$

(C) Phenylhydrazine: $C_6H_5 - NH - NH - C_6H_5$

(D) Hydroxylamine: $NH_2 - OH$

83. Which among the following forces of attraction is developed between polar and non polar molecules?

(A) Dipole-induced dipole interaction (B) Ion-dipole interaction

(C) Dipole-dipole interaction (D) van der Waals forces

84. Which among the following is correct conjugate acid base pair for the equation stated below?

$$HCl + NH_3 \rightleftharpoons NH_4^+ + Cl^-$$

(A) Cl^- and NH_4^+ (B) HCl and NH_3

(C) NH_4^+ and NH_3 (D) NH_4^+ and HCl

85. Which among the following compounds is NOT a tertiary amine?

(A) N, N-Dimethyl aniline (B) N-Methyl-N-Phenyl aniline

(C) Butan-1-amine (D) N, N-Dimethyl-1-butanamine

86. Which among the following reactions is used for the preparation of alkyl fluorides?

(A) Finkelstein reaction (B) Swartz reaction

(C) Fittig reaction (D) Wurtz reaction

87. What type of colloid is milk?

(A) Solid in liquid (B) Liquid in solid

(C) Liquid in Liquid (D) Gas in liquid

88. What is the osmotic pressure of solution prepared by dissolving 3 gram solute in $2dm^3$ water at 300 K . (Molar mass of solute $= 60\ g\ mol^{-1}$, $R = 0.0821 dm^3\ atm\ K\ mol^{-1}$)

(A) 0.76 atm (B) 0.62 atm

(C) 0.51 atm (D) 0.84 atm

89. Which among the following is the method for the preparation of ethers?

(A) By the action of moist Ag_2O an alkyl halide (B) By the action of aq. KOH on alkyl halide.

(C) By the action of alc. Sodium hydroxide on alkyl halide. (D) By the action of sodium alkoxide on alkyl halide.

90. Identify the bond line formula for propan-1-ol

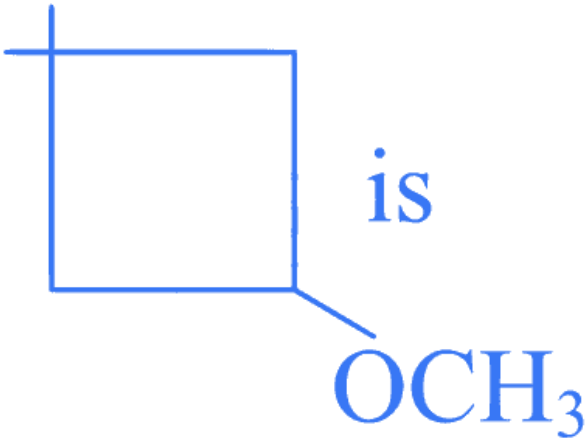
(A) 

(B) 

(C) 

(D) 

91. IUPAC name of the compound



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

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

(C) 3-Methoxy-1,1-dimethylbutane

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

92. Dissociation constant and degree of dissociation of weak acid are 1.8×10^{-5} and 0.03 respectively. What will be the concentration of solution of weak acid?

(A) 0.2 M (B) 0.02 M

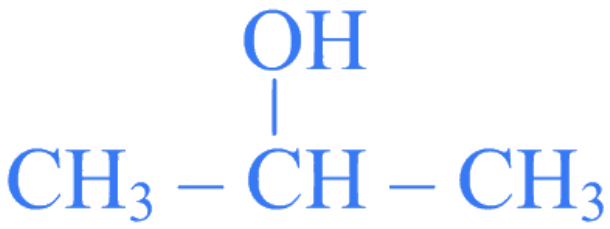
(C) 0.5 M (D) 0.05 M

93. The decreasing order of reactivity of following alcohols with halo acid is

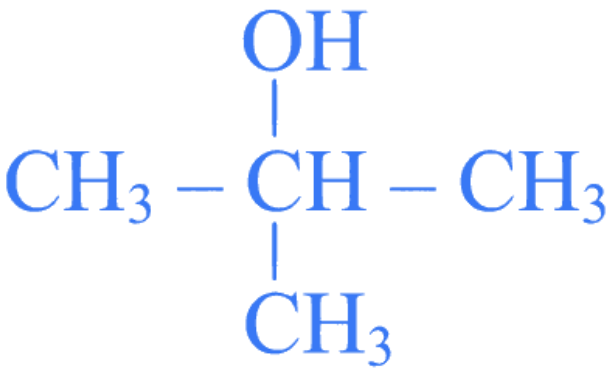
(I) CH_3OH

(II) CH_3CH_2OH

(III)



(IV)



(A) (IV) > (III) > (II) > (I) (B) (I) > (II) > (III) > (IV)

(C) (II) > (I) > (IV) > (III) (D) (IV) > (II) > (III) > (I)

94. What is the product obtained in the reaction?

$CH_3 - CH = CH - CH_2 - CHO \xrightarrow[(i)\ H_3O^+]{(i)\ LAH_4}$ product

(A) $CH_3 - CH = CH - CH_2 - CH_2 - OH$

(B) $CH_3 - CH = CH - CH_2 - COOH$

(C) $CH_3 - CH_2 - CH_2 - CH_2 - CHO$

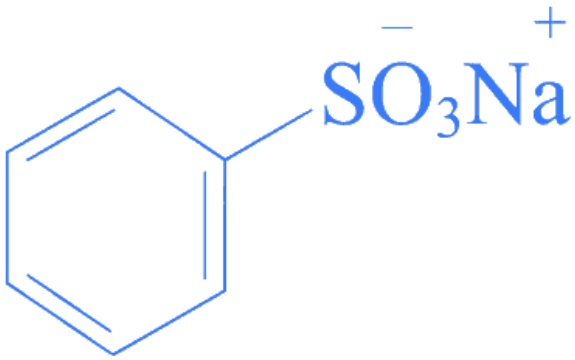
(D) $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$

95. Two moles of an ideal gas is expanded isothermally from a volume of 300 cm^3 to 2.5 dm^3 at 298 K against a constant pressure at 1.9 bar. Calculate the work done in joules.

(A) −418 J (B) −565 J

(C) −918 J (D) −950 J

96. Identify name of



from following.

(A) Benzene sulphonic acid
(B) Sodium benzene sulphonate
(C) Sodium phenoxide
(D) Benzene diazonium sulphate

97. Which of the following compounds is used to convert acetaldehyde into acetaldehyde cynanohydrin?

(A) $FeCl_3$ (neutral)
(B) H_2SO_4 (dil.)
(C) HCN
(D) $NaHSO_3$

98. What volume of chlorine gas (molar mass 71) is evolved at STP during electrolysis of fused NaCl by passage of 1 amp current for 965 second? (At STP, V = 22.4 dm^3)

(A) 0.112 L
(B) 0.224 L
(C) 1.12 L
(D) 2.24 L

99. Identify the test from following so that aldehyde when boiled with ammoniacal silver nitrate solution deposts silver.

(A) Schiff's test
(B) Tollen's test
(C) Fehling test
(D) Iodoform test

100. Find the percentage of unreacted reactant for zero order reaction in 90 second having rate constant 1 mol dm^{-3} s^{-1}.

(A) 5%
(B) 10%
(C) 15%
(D) 20%

101. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & 3 \\ 3 & 2 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 0 & b \\ 7 & -1 & -2 \\ c & 1 & 1 \end{bmatrix}$ and if matrix B is the inverse of matrix A, then value of $4a + 2b - c$ is

(A) 6 (B) -14

(C) 14 (D) -6

102. If $\int f(x)dx = \psi(x)$, then $\int x^5 f\left(x^3\right) dx$ is equal to

(A) $\frac{1}{3}x^3\psi(x^3) - 3\int x^3\psi(x^3)dx + c$, (where c is a constant of integration)

(B) $\frac{1}{3}(x^3\psi(x^3) - \int x^3\psi(x^3)dx) + c$, (where c is a constant of integration)

(C) $\frac{1}{3}x^3\psi(x^3) - \int x^2\psi(x^3)dx + c$, (where c is a constant of integration)

(D) $\frac{1}{3}(x^3\psi(x^3) - \int x^2\psi(x^3)dx) + c$, (where c is a constant of integration)

103. The population of a town increases at a rate proportional to the population at that time. If the population increases from 40 thousand to 80 thousand in 40 years, then the population in another 40 years will be

(A) 180000 (B) 128000

(C) 160000 (D) 256000

104. If X is a random variable with distribution given below

$X = x_i$:	**0**	**1**	**2**	**3**
$P(X = x_i)$:	k	3k	3k	k

Then the value of k and its variance are respectively given by

(A) $\frac{1}{8}, \frac{22}{27}$ (B) $\frac{1}{8}, \frac{23}{27}$

(C) $\frac{1}{8}, \frac{8}{9}$ (D) $\frac{1}{8}, \frac{3}{4}$

105. An urn contains nine balls of which three are red, four are blue and two are green. Three balls are drawn at random without replacement from the urn. The probability, that the three balls have different colours, is

(A) $\frac{1}{3}$ (B) $\frac{2}{7}$

(C) $\frac{1}{21}$ (D) $\frac{2}{23}$

106. The area (in sq. units) bounded by the curves $y = (x+1)^2, y = (x-1)^2$ and the line $y = \frac{1}{4}$ is

(A) $\frac{2}{3}$ (B) $\frac{1}{6}$

(C) $\frac{1}{3}$ (D) $\frac{1}{4}$

107. If $\int \frac{dx}{\sqrt[3]{\sin^{11} x \cos x}} = -\left(\frac{3}{8}f(x) + \frac{3}{2}g(x)\right) + c$ then

(A) $f(x) = \tan^{\frac{-8}{3}} x$, $g(x) = \tan^{\frac{-2}{3}} x$, (where c is a constant of integration)

(B) $f(x) = \tan^{\frac{8}{3}} x$, $g(x) = \tan^{\frac{-2}{3}} x$, (where c is a constant of integration)

(C) $f(x) = \tan^{\frac{-8}{3}} x$, $g(x) = \tan^{\frac{2}{3}} x$, (where c is a constant of integration)

(D) $f(x) = \tan^{\frac{8}{3}} x$, $g(x) = \tan^{\frac{2}{3}} x$, (where c is a constant of integration)

108. A random variable X takes values $-1, 0, 1, 2$ with probabilities $\frac{1+3p}{4}, \frac{1-p}{4}, \frac{1+2p}{4}, \frac{1-4p}{4}$ respectively, where p varies over $\mathbb{R}$. Then the minimum and maximum values of the mean of X are respectively.

(A) $-\frac{7}{4}$ and $\frac{1}{2}$ (B) $-\frac{1}{16}$ and $\frac{5}{16}$

(C) $-\frac{7}{4}$ and $\frac{5}{16}$ (D) $-\frac{1}{16}$ and $\frac{5}{4}$

109. Let C be a curve given by $y(x) = 1 + \sqrt{4x-3}$, $x > \frac{3}{4}$. If P is a point on C , such that the tangent at P has slope $\frac{2}{3}$, then a point through which the normal at P passes, is

(A) $(1, 7)$ (B) $(4, -3)$

(C) $(3, -4)$ (D) $(2, 3)$

110. The equation of the circle, the end points of whose diameter are the centres of the circles $x^2+y^2+6x-14y+5=0$ and $x^2+y^2-4x+10y-4=0$ is

(A) $x^2+y^2-x-2y+41=0$

(B) $x^2+y^2+x-2y+41=0$

(C) $x^2+y^2+x-2y-41=0$

(D) $x^2+y^2-x+2y-41=0$

111. The equation of the plane, passing through the point $(1,1,1)$ and perpendicular to the planes $2x+y-2z=5$ and $3x-6y-2z=7$, is

(A) $14x+2y-15z=1$

(B) $14x-2y+15z=27$

(C) $14x+2y+15z=31$

(D) $-14x+2y+15z=3$

112. If for $x\in\left(0,\frac{1}{4}\right)$, the derivative of $\tan^{-1}\left(\frac{6x\sqrt{x}}{1-9x^3}\right)$ is $\sqrt{x}\cdot g(x)$, then $g(x)$ equals

(A) $\frac{3x\sqrt{x}}{1-9x^3}$ (B) $\frac{3x}{1-9x^3}$

(C) $\frac{3}{1+9x^3}$ (D) $\frac{9}{1+9x^3}$

113. If the vectors $a\hat{i}+\hat{j}+\hat{k},\hat{i}+b\hat{j}+\hat{k},\hat{i}+\hat{j}+c\hat{k}$ $(a\neq b,c\neq 1)$ are coplanar, then $\frac{1}{1-a}+\frac{1}{1-b}+\frac{1}{1-c}$ has the value _____.

(A) 1 (B) -1

(C) -2 (D) 5

114. The sides of a triangle are $\sin\theta,\cos\theta$ and $\sqrt{1+\sin\theta\cos\theta}$ for some $0<\theta<\frac{\pi}{2}$, then the greatest angle of a triangle is

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

(C) $\frac{\pi}{6}$ (D) $\frac{5\pi}{6}$

115. If $\lim\limits_{x\to\infty}\left(\frac{x^2+x+1}{x+1}-ax-b\right)=4$ then

(A) a $=1$, b $=4$ (B) a $=1$, b $=-4$

(C) a $=2$, b $=-3$ (D) a $=2$, b $=3$

116. If $y=y(x)$ is the solution of the differential equation $x\frac{dy}{dx}+2y=x^2$ satisfying $y(1)=1$, then the value of $y\left(\frac{1}{2}\right)$ is

(A) $\frac{7}{64}$ (B) $\frac{1}{4}$

(C) $\frac{13}{6}$ (D) $\frac{49}{16}$

117. The value of $\cos^{-1}\left\{\frac{1}{\sqrt{2}}\left(\cos\frac{9\pi}{10}-\sin\frac{9\pi}{10}\right)\right\}$ is

(A) $\frac{7\pi}{20}$ (B) $\frac{13\pi}{20}$

(C) $\frac{17\pi}{20}$ (D) $\frac{21\pi}{20}$

118. Consider the statements given by following :

(A) If $3+3=7$, then $4+3=8$.

(B) If $5+3=8$, then earth is flat.

(C) If both (A) and (B) are true, then $5+6=17$.

Then which of the following statements is correct?

(A) (A) is true while (B) and (C) are false.

(B) (A) and (C) are true while (B) is false.

(C) (A) and (B) are false, while (C) is true.

(D) (A) is false but (B) and (C) are true.

119. If $\alpha+\beta=\frac{\pi}{2}$ and $\beta+\gamma=\alpha$, then $\tan\alpha$ equals

(A) $2(\tan\beta+\tan\gamma)$ (B) $\tan\beta+\tan\gamma$

(C) $\tan\beta+2\tan\gamma$ (D) $2\tan\beta+\tan\gamma$

120. If $f(x)=\frac{\log x}{x}(x>0)$, then it is increasing in

(A) $(0,e)$ (B) (e,∞)

(C) $(0,\infty)$ (D) $(-\infty,\infty)$

121. If $\bar{a},\bar{b}$ and $\bar{c}$ are three non-coplanar vectors, then $(\bar{a}+\bar{b}+\bar{c})\cdot[(\bar{a}+\bar{b})\times(\bar{a}+\bar{c})]$ equals

(A) 0 (B) $[\bar{a}\bar{b}\bar{c}]$

(C) $2[\bar{a}\bar{b}\bar{c}]$ (D) $-[\bar{a}\bar{b}\bar{c}]$

122. In a class of 300 students, every student reads 5 news papers and every news paper is read by 60 students. Then the number of newspapers is

(A) at least 30 (B) at most 20

(C) exactly 25 (D) exactly 10

123. The maximum value of $\frac{\log x}{x}$ is

(A) e (B) 2e

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

124. Derivative of e^x w.r.t. $\sqrt{x}$ is

(A) $\sqrt{x}e^x$ (B) $-2\sqrt{x}$

(C) $2\sqrt{x}e^x$ (D) $\frac{1}{2}\sqrt{x}e^x$

125. The curve satisfying the differential equation $y\,dx - (x + 3y^2)\,dy = 0$ and passing through the point $(1, 1)$ also passes through the point

(A) $(\frac{1}{4}, \frac{1}{2})$ (B) $(\frac{1}{4}, -\frac{1}{2})$
(C) $(\frac{1}{3}, -\frac{1}{3})$ (D) $(-\frac{1}{3}, \frac{1}{3})$

126. The maximum value of $z = x + y$, subjected to $x + y \leq 10, 5x + 3y \geq 15, x \leq 6, x, y \geq 0$

(A) occurs only at unique point. (B) occurs only at two distinct points.
(C) occurs at infinitely many points. (D) does not exist.

127. The distance of the point $(1, 3, -7)$ from the plane passing through the point $(1, -1, -1)$ having normal perpendicular to both the lines $\frac{x-1}{1} = \frac{y+2}{-2} = \frac{z-4}{3}$ and $\frac{x-2}{2} = \frac{y+1}{-1} = \frac{z+7}{-1}$ is

(A) $\frac{10}{\sqrt{83}}$ units. (B) $\frac{5}{\sqrt{83}}$ units.
(C) $\frac{10}{\sqrt{74}}$ units. (D) $\frac{20}{\sqrt{74}}$ units.

128. Domain of definition of the real valued function $f(x) = \sqrt{\sin^{-1}(2x) + \frac{\pi}{6}}$ is

(A) $[-\frac{1}{4}, \frac{1}{2}]$ (B) $[\frac{-3}{2}, \frac{1}{2}]$
(C) $[\frac{-3}{2}, \frac{1}{9}]$ (D) $[-\frac{1}{4}, \frac{3}{4}]$

129. The value of m , such that $\frac{x-4}{1} = \frac{y-2}{1} = \frac{z-m}{2}$ lies in the plane $2x - 4y + z = 7$, is

(A) 7 (B) -7
(C) no real value (D) 4

130. Suppose that $\bar{p}, \bar{q}$ and $\bar{r}$ are three non-coplanar vectors in $\mathbb{R}^3$. Let the components of a vector $\bar{s}$ along $\bar{p}, \bar{q}$ and $\bar{r}$ be 4,3 and 5 respectively. If the components of this vector $\bar{s}$ along $(-\bar{p} + \bar{q} + \bar{r}), (\bar{p} - \bar{q} + \bar{r})$ and $(-\bar{p} - \bar{q} + \bar{r})$ are x, y and z respectively, then the value of $2x + y + z$ is

(A) 10 (B) 6
(C) 9 (D) 8

131. $\int \frac{x^4+x^2+1}{x^2-x+1} dx$ is equal to

(A) $\frac{x^3}{3} - \frac{x^2}{2} + x + c$, (where c is a constant of integration) (B) $\frac{x^3}{3} + \frac{x^2}{2} + x + c$, (where c is a constant of integration)
(C) $\frac{x^3}{3} - \frac{x^2}{2} - x + c$, (where c is a constant of integration) (D) $\frac{x^3}{3} + \frac{x^2}{2} - x + c$, (where c is a constant of integration)

132. If the curves $y^2 = 6x, 9x^2 + by^2 = 16$ intersect each other at right angles, then the value of b is

(A) $\frac{9}{2}$ (B) 6
(C) 7 (D) $\frac{7}{2}$

133. Let $\bar{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\bar{b} = \hat{i} + \hat{j}$ If $\bar{c}$ is a vector such that $\bar{a} \cdot \bar{c} = |\bar{c}|$, $|\bar{c} - \bar{a}| = 2\sqrt{2}$ and the angle between $(\bar{a} \times \bar{b})$ and $\bar{c}$ is $60°$, then the value of $|(\bar{a} \times \bar{b}) \times \bar{c}|$ is

(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{3\sqrt{3}}{2}$
(C) $\frac{5\sqrt{3}}{2}$ (D) $\frac{\sqrt{3}}{4}$

134. The mean and the standard deviation of 10 observations are 20 and 2 respectively. Each of these 10 observations is multiplied by p and then reduced by q, where $p \neq 0$ and $q \neq 0$. If the new mean and new standard deviation (s.d.) become half of the original values, then q is equal to

(A) -20 (B) -5
(C) 10 (D) -10

135. If Mean value theorem holds for the function $f(x) = (x - 1)(x - 2)(x - 3), x \in [0, 4]$ then the values of c as per the theorem are

(A) $2 \pm \frac{4}{\sqrt{3}}$ (B) $2 \pm \frac{2}{\sqrt{3}}$
(C) $2 \pm \sqrt{2}$ (D) $2 \pm \sqrt{3}$

136. The value of $I = I = \int_{\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{x^2 \cos x}{1+e^{-x}} dx$ is equal to

(A) $\frac{\pi^2}{4} - 2$ (B) $\frac{\pi^2}{4} + 2$
(C) $\pi^2 - e^{\frac{\pi}{2}}$ (D) $\pi^2 + e^{\frac{\pi}{2}}$

137. If $\bar{a} = \hat{i} + \hat{j} + \hat{k}, \bar{a} \cdot \bar{b} = 1$ and $\bar{a} \times \bar{b} = \hat{j} - \hat{k}$, then $\bar{b}$ is

(A) $\hat{i} - \hat{j} + \hat{k}$ (B) $2\hat{j} - \hat{k}$
(C) $\hat{i}$ (D) $2\hat{i}$

138. If the mean and the variance of Binomial variate X are 2 and 1 respectively, then the probability that X takes a value greater than or equal to one is

(A) $\frac{1}{16}$ (B) $\frac{9}{16}$
(C) $\frac{3}{4}$ (D) $\frac{15}{16}$

139. The value of $I = \int \frac{(x-1)e^x}{(x+1)^3} dx$ is

(A) $\frac{-e^x}{(x+1)^2} + C$, (where C is a constant of integration)

(B) $\frac{-xe^x}{(x+1)^2} + C$, (where C is a constant of integration)

(C) $\frac{xe^x}{(x+1)^2} + C$, (where C is a constant of integration)

(D) $\frac{e^x}{(x+1)^2} + C$, (where C is a constant of integration)

140. If $Z = \frac{-2}{1+\sqrt{3}i}, i = \sqrt{-1}$, then the value of $\arg Z$ is

(A) $\frac{2\pi}{3}$

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

(C) $-\frac{\pi}{3}$

(D) $\frac{4\pi}{3}$

141. In $(0, 2\pi)$, the number of solutions of $\tan\theta + \sec\theta = 2\cos\theta$ are

(A) 0

(B) 1

(C) 2

(D) 3

142. If the area of the parallelogram with $\bar{a}$ and $\bar{b}$ as two adjacent sides is 15 square units, then the area (in square units) of the parallelogram, having $3\bar{a} + 2\bar{b}$ and $\bar{a} + 3\bar{b}$ as two adjacent sides, is

(A) 45

(B) 75

(C) 105

(D) 120

143. If an equation $hxy + gx + fy + c = 0$ represents a pair of lines, then

(A) $fg = ch$

(B) $gh = cf$

(C) $fh = cg$

(D) $hf = -cg$

144. The general solution of $\sin x - 3\sin 2x + \sin 3x = \cos x - 3\cos 2x + \cos 3x$ is

(A) $x = n\pi + \frac{\pi}{4}, n \in \mathbb{Z}$

(B) $x = 2n\pi + \frac{\pi}{4}, n \in \mathbb{Z}$

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

(D) $x = \frac{n\pi}{2} + \frac{\pi}{8}, n \in \mathbb{Z}$

145. The length of the perpendicular from the point $A(1, -2, -3)$ on the line $\frac{x-1}{2} = \frac{y+3}{-1} = \frac{z+1}{-2}$ is

(A) 6 units

(B) 3 units

(C) 2 units

(D) 4 units

146. The straight line, $2x - 3y + 17 = 0$ is perpendicular to the line passing through the points $(7, 17)$ and $(15, \beta)$, then β equals

(A) 5

(B) $\frac{35}{3}$

(C) $-\frac{35}{3}$

(D) -5

147. If $f(x) = \frac{x^2-x}{x^2+2x}$ then $\frac{d}{dx}\left(f^{-1}(x)\right)$ at $x = 2$ is

(A) -3

(B) 3

(C) -1

(D) 1

148. For the triangle ABC , with usual notations, if the angles A, B, C are in A.P. and $m\angle A = 30°, c = 3$, then the values of a and b are respectively

(A) $\frac{\sqrt{3}}{2}, \frac{3}{2}$

(B) $\frac{3}{2}, \frac{3\sqrt{3}}{2}$

(C) $\frac{3\sqrt{3}}{2}, \frac{3}{2}$

(D) $\frac{3}{2}, \frac{\sqrt{3}}{2}$

149. Let p, q, r be three statements such that the truth value of $(p \wedge q) \to (\sim q \vee r)$ is F. Then the truth values of p, q, r are respectively

(A) T, F, T.

(B) T, T, T.

(C) F, T, F.

(D) T, T, F.

150. Let k be a non-zero real number. If $f(x) = \begin{cases} \frac{(e^x-1)^2}{\sin\left(\frac{x}{k}\right)\log\left(1+\frac{x}{4}\right)} & , x \neq 0 \\ 12 & , x = 0 \end{cases}$ is a continuous function, then the value of k is

(A) 1

(B) 2

(C) 4

(D) 3

- End of Question Paper -