MHT CET 2023 PCM May 10 Shift 2 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 2023**, 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. Two trains, each 30 m long are travelling in opposite directions with velocities 5 m/s and 10 m/s. They will cross after

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

2. The fundamental frequency of air column in pipe 'A' closed at one end is in unison with second overtone of an air column in pipe 'B' open at both ends. The ratio of length of air column in pipe 'A' to that of air column in pipe 'B' is

(A) 1 : 6 (B) 3 : 8
(C) 2 : 3 (D) 3 : 4

3. In Young's double slit experiment, the two slits are 'd' distance apart. Interference pattern is observed on a screen at a distance 'D' from the slits. A dark fringe is observed on a screen directly opposite to one of the slits. The wavelength of light is

(A) $\frac{D^2}{2\,d}$ (B) $\frac{d^2}{2D}$
(C) $\frac{D^2}{d}$ (D) $\frac{d^2}{D}$

4. A black body radiates maximum energy at wavelength 'λ' and its emissive power is 'E' Now due to change in temperature of that body, it radiates maximum energy at wavelength

$$\frac{2\lambda}{3}$$

. At that temperature emissive power is

(A) $\frac{81}{16}$ (B) $\frac{27}{32}$
(C) $\frac{18}{10}$ (D) $\frac{9}{4}$

5. In meter bridge experiment, null point was obtained at a distance 'l' from left end. The values of resistances in the left and right gap are doubled and then interchanged. The new position of the null point is

(A) $(100 - l)$ (B) $(100 - 2l)$
(C) $(100 - 3l)$ (D) $(100 - \frac{l}{2})$

6. The magnetic field at the centre of a circular coil of radius 'R', carrying current $2A$ is 'B_1'. The magnetic field at the centre of another coil of radius '$3R$' carrying current $4A$ is 'B_2'. The ratio $B_1 : B_2$ is

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

7. If a capacitor of capacity 900 μF is charged to 100 V and its total energy is transferred to a capacitor of capacity 100 μF, then its potential will be

(A) 30 V (B) 200 V
(C) 300 V (D) 400 V

8. The equation of wave is

$$Y = 6\sin\left(12\pi t - 0.02\pi x + \frac{\pi}{3}\right)$$

where 'x' is in m and 't' in s. The velocity of the wave is

(A) 200 m/s (B) 300 m/s
(C) 400 m/s (D) 600 m/s

9. With an alternating voltage source of frequency 'f', inductor 'L', capacitor 'C' and resistance 'R' are connected in series. The voltage leads the current by 45°. The value of 'L' is

$(\tan 45^\circ = 1)$

(A) $(\frac{1+2\pi fCR}{4\pi^2 f^2 C})$ (B) $(\frac{1-2\pi fCR}{4\pi^2 f^2 C})$
(C) $(\frac{4\pi^2 f^2 C}{1+2\pi fCR})$ (D) $(\frac{4\pi^2 f^2 C}{1-2\pi fCR})$

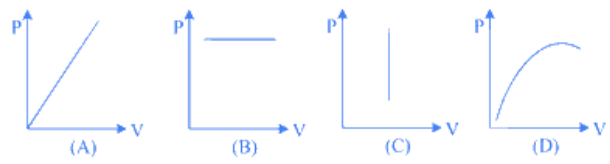
10. A pure Si crystal has 4×10^{28} atoms per m^3. It is doped by 1 ppm concentration of antimony. The number of free electrons available will be

(A) 4×10^{34} m^{-3} (B) 4×10^{28} m^{-3}
(C) 4×10^{22} m^{-3} (D) 4×10^{20} m^{-3}

11. A mass 'M' moving with velocity 'V' along X-axis collides and sticks to another mass 2M which is moving along Y-axis with velocity '3 V'. The velocity of the combination after collision is

(A) $\frac{V}{3}\hat{i} + 2V\hat{j}$ (B) $\frac{V}{2}\hat{i} + V\hat{j}$
(C) $\frac{V}{3}\hat{i} - 2V\hat{j}$ (D) $\frac{V}{2}\hat{i} - V\hat{j}$

12. Which of the following graphs between pressure (P) and volume (V) correctly shows isochoric changes?



(A) D (B) B
(C) C (D) A

13. A galvanometer has resistance 'G' and range 'V_g'. How much resistance is required to read voltage upto 'V' volt?

(A) $G(\frac{V}{V_g} - 1)$ (B) $G(\frac{V+V_g}{V})$

(C) $G(\frac{V-V_g}{V})$ (D) GV_g

14. 'n' number of liquid drops each of radius 'r' coalesce to form a single drop of radius 'R'. The energy released in the process is converted into the kinetic energy of the big drop so formed. The speed of the big drop is [T = surface tension of liquid, ρ = density of liquid.]

(A) $\sqrt{\frac{T}{\rho}[\frac{1}{r} - \frac{1}{R}]}$ (B) $\sqrt{\frac{2T}{\rho}[\frac{1}{r} - \frac{1}{R}]}$

(C) $\sqrt{\frac{4T}{\rho}[\frac{1}{r} - \frac{1}{R}]}$ (D) $\sqrt{\frac{6T}{\rho}[\frac{1}{r} - \frac{1}{R}]}$

15. What is the moment of inertia of the electron moving in second Bohr orbit of hydrogen atom? [h = Planck's constant, m = mass of electron, ε_0 = permittivity of free space, e = charge on electron]

(A) $\frac{4\epsilon_0^2 h^4}{\pi^2 me^4}$ (B) $\frac{8m\epsilon_0^2 h^4}{\pi^2 e^4}$

(C) $\frac{16\epsilon_0^2 h^4}{\pi^2 me^4}$ (D) $\frac{\epsilon_0^2 h^4}{16\pi^2 me^4}$

16. At critical temperature, the surface tension of liquid is

(A) zero (B) infinity

(C) unity (D) same as that at any other temperature

17. Two wires 2 mm apart supply current to a 100 V, 1 kW heater. The force per metre between the wires is ($\mu_0 = 4\pi \times 10^{-27}$ SI unit)

(A) 2×10^{-2} N (B) 4×10^{-3} N

(C) 2×10^{2} N (D) 10^{-2} N

18. A solenoid of 500 turns/m is carrying a current of 3 A. Its core is made of iron which has relative permeability 5001. The magnitude of magnetization is

(A) 4.5×10^{6} Am^{-1} (B) 6.0×10^{-6} Am^{-1}

(C) 7.5×10^{6} Am^{-1} (D) 9.0×10^{6} Am^{-1}

19. The ratio of the velocity of the electron in the first Bohr orbit to that in the second Bohr orbit of hydrogen atom is

(A) 8 : 1 (B) 2 : 1

(C) 4 : 1 (D) 1 : 4

20. The capacitive reactance of a capacitor 'C' is XΩ. Both, the frequency of a.c. supply and capacitance of the above capacitor are doubled. The new capacitive reactance will be

(A) $\frac{X}{4}\Omega$ (B) $\frac{X}{2}\Omega$

(C) 2XΩ (D) 4XΩ

21. A 100 mH coil carries a current of 1 A. Energy stored in the form of magnetic field is

(A) 0.025 J (B) 0.050 J

(C) 0.075 J (D) 0.100 J

22. A metal rod 2 m long increases in length by 1.6 mm, when heated from 0°C to 60°C. The coefficient of linear expansion of metal rod is

(A) $1.33 \times 10^{-5}/°C$ (B) $1.66 \times 10^{-5}/°C$

(C) $1.33 \times 10^{-3}/°C$ (D) $1.66 \times 10^{-3}/°C$

23. Assume that an electric field $E = 30x^2\hat{i}$ exists in space. If 'V_0' is the potential at the origin and 'V_A' is the potential at $x = 2$ m, then the potential difference $(V_A - V_0)$ is

(A) -80 J (B) -120 J

(C) 80 J (D) 120 J

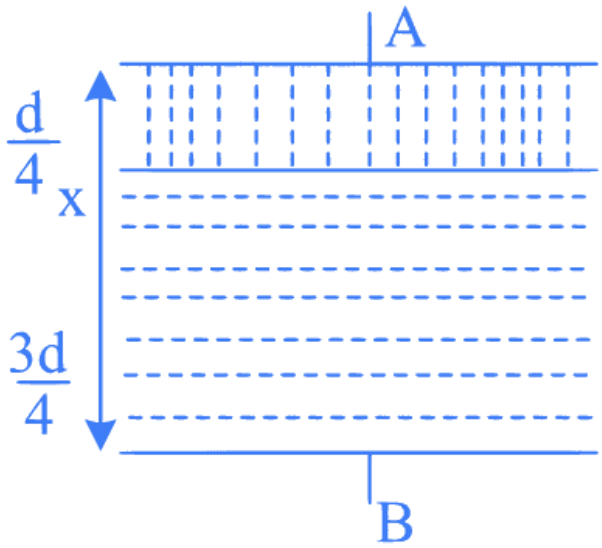
24. Two dielectric slabs having dielectric constant 'K_1' and 'K_2' of thickness

$$\frac{d}{4}$$

and

$$\frac{3\,d}{4}$$

are inserted between the plates as shown in figure. The net capacitance between A and B is [ε_0 is permittivity of free space]



(A) $\frac{2\,A\epsilon_0}{d}\left[\frac{K_1\,K_2}{3\,K_1+K_2}\right]$ (B) $\frac{3\,A\epsilon_0}{d}\left[\frac{K_1+K_2}{K_1\,K_2}\right]$

(C) $\frac{3\,A_0}{2\,d}\left[\frac{K_1+K_2}{K_1\,K_2}\right]$ (D) $\frac{4A\epsilon_0}{d}\left[\frac{K_1K_2}{3K_1+K_2}\right]$

25. The output of an 'OR' gate is connected to both the inputs of a 'NAND' gate. The combination will serve as

(A) OR gate (B) NOT gate

(C) NOR gate (D) AND gate

26. Which one of the operations of $n-p-n$ transistor differs from that of $p-n-p$ transistor?

(A) The emitter-base junction is reversed biased in $n-p-n$ transistor.

(B) The emitter injects minority carriers into the base region of the $p-n-p$ transistor.

(C) The emitter injects holes into the base of the $p-n-p$ transistor and electrons into the base region of $n-p-n$ transistor.

(D) The emitter injects holes into the base of $n-p-n$ transistor.

27. A hollow metal pipe is held vertically and bar magnet is dropped through it with its length along the axis of the pipe. The acceleration of the falling magnet is (g = acceleration due to gravity)

(A) equal to g. (B) less than g.

(C) more than g. (D) zero.

28. A metal sphere of mass 'm' and density 'σ_1' falls with terminal velocity through a container containing liquid. The density of liquid is 'σ_2'. The viscous force acting on the sphere is

(A) $mg(1+\frac{\sigma_2}{\sigma_1})$ (B) $mg(1-\frac{\sigma_1}{\sigma_2})$

(C) $mg(1-\frac{\sigma_2}{\sigma_1})$ (D) $mg(1+\frac{\sigma_1}{\sigma_2})$

29. Two uniform wires of same material are vibrating under the same tension. If the first overtone of first wire is equal to the 2^{nd} overtone of 2^{nd} wire and radius of the first wire is twice the radius of the 2^{nd} wire then the ratio of length of first wire to 2^{nd} wire is

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

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

30. A body is projected vertically from earth's surface with velocity equal to half the escape velocity. The maximum height reached by the satellite is (R = radius of earth)

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

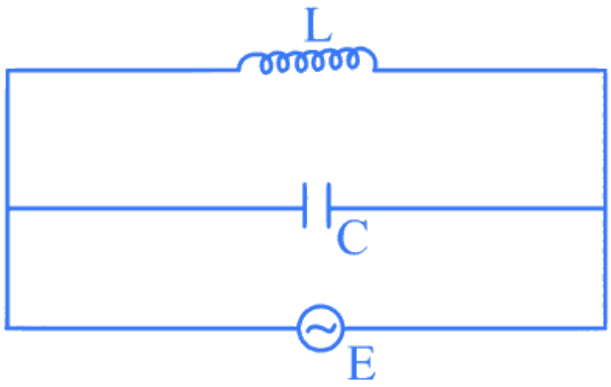
(C) $\frac{R}{3}$ (D) $\frac{R}{4}$

31. A ball of mass 'm' is dropped from a height 's' on a horizontal platform fixed at the top of a vertical spring. The platform is depressed by a distance 'h'. The spring constant is (g = acceleration due to gravity)

(A) $\frac{2mg(s-h)}{h^2}$ (B) $\frac{2mg(s+h)}{h^2}$

(C) $\frac{mg(s-h)}{h}$ (D) $\frac{mg(s+h)}{h}$

32. In the circuit given below, the current through inductor is 0.9 A and through the capacitor is 0.6 A. The current drawn from the a.c. source is



(A) 1.5 A
(B) 0.9 A
(C) 0.6 A
(D) 0.3 A

33. A body is executing a linear S.H.M. Its potential energies at the displacement 'x' and 'y' are 'E_1' and 'E_2' respectively. Its potential energy at displacement $(x + y)$ will be

(A) $E_1 + E_2$
(B) $(\sqrt{E_1} + \sqrt{E_2})^2$
(C) $E_1 - E_2$
(D) $(\sqrt{E_2} - \sqrt{E_1})^2$

34. We have a jar filled with gas characterized by parameters P, V, T and another jar B filled with gas having parameters

$$2P, \frac{V}{4}, 2T$$

, where symbols have their usual meaning. The ratio of number of molecules in jar A to those in jar B is

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

35. Two spheres each of mass 'M' and radius

$$\frac{R}{2}$$

are connected at the ends of massless rod of length '$2R$'. What will be the moment of inertia of the system about an axis passing through centre of one of the spheres and perpendicular to the rod?

(A) $\frac{2}{3}MR^2$
(B) $\frac{5}{2}MR^2$
(C) $\frac{5}{21}MR^2$
(D) $\frac{21}{5}MR^2$

36. If the potential difference used to accelerate electrons is doubled, by what factor does the de-Broglie wavelength associated with electrons change?

(A) Wavelength is increased to $\frac{1}{\sqrt{2}}$ times.
(B) Wavelength is increased to $\frac{1}{2}$ times.
(C) Wavelength is decreased to $\frac{1}{\sqrt{2}}$ times.
(D) Wavelength is decreased to $\frac{1}{2}$ times.

37. A simple harmonic progressive wave is represented by

$$y = A\sin(100\pi t + 3x)$$

. The distance between two points on the wave at a phase difference of

$$\frac{\pi}{3}$$

radian is

(A) $\frac{\pi}{8}$ m
(B) $\frac{\pi}{9}$ m
(C) $\frac{\pi}{6}$ m
(D) $\frac{\pi}{3}$ m

38. An insulated container contains a monoatomic gas of molar mass 'm'. The container is moving with velocity 'V'. If it is stopped suddenly, the change in temperature of a gas is [R is gas constant]

(A) $\frac{MV^2}{R}$
(B) $\frac{MV^2}{2R}$
(C) $\frac{MV^2}{3R}$
(D) $\frac{3MV^2}{2R}$

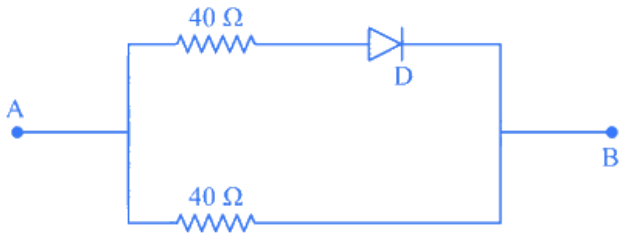
39. To get three images of a single object, the angle between the two plane mirrors should be

(A) 50°
(B) 60°
(C) 72°
(D) 90°

40. A parallel beam of monochromatic light falls normally on a single narrow slit. The angular width of the central maximum in the resulting diffraction pattern

(A) increases with increase of slit width.
(B) decreases with increase of slit width.
(C) decreases with decrease of slit width.
(D) may increase or decrease with decrease of slit width.

41. For the diagram shown, the resistances between points A and B when ideal diode D is forward biased is 'R_1' and that when reverse biased is 'R_2'. The ratio $R_1 : R_2$ is



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

(C) 1 : 2 (D) 1 : 4

42. The maximum kinetic energy of the photoelectrons varies

(A) inversely with the intensity of incident radiation and is independent of its frequency.

(B) inversely with the frequency of incident radiation and is independent of its intensity.

(C) linearly with the frequency of incident radiation and depends on its intensity

(D) linearly with the frequency of incident radiation and is independent of its intensity.

43. Light waves from two coherent sources arrive at two points on a screen with path difference of zero and

$$\frac{\lambda'}{2}$$

. The ratio of intensities at the points is

$$(\cos 0^\circ = 1, \cos \pi = -1)$$

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

(C) 1 : 2 (D) ∞ : 1

44. A uniform rope of length 'L' and mass 'm_1' hangs vertically from a rigid support. A block of mass 'm_2' is attached to the free end of the rope. A transverse wave of wavelength 'λ_1' is produced at the lower end of the rope. The wavelength of the wave when it reaches the top of the rope is 'λ_2'. The ratio

$$\frac{\lambda_1}{\lambda_2}$$

is

(A) $\left[\frac{m_2}{m_1+m_2}\right]^{\frac{1}{2}}$ (B) $\left[\frac{m_1+m_2}{m_2}\right]^{\frac{1}{2}}$

(C) $\left[\frac{m_1}{m_1+m_2}\right]^{\frac{1}{2}}$ (D) $\left[\frac{m_2}{m_1-m_2}\right]^{\frac{1}{2}}$

45. In a vessel, the ideal gas is at a pressure P. If the mass of all the molecules is halved and their speed is doubled, then resultant pressure of the gas will be

(A) 4P (B) 2P

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

46. Two concentric circular coils having radii r_1 and

$$r_2 (r_2 << r_1)$$

are placed co-axially with centres coinciding. The mutual induction of the arrangement is (Both coils have single turn,

$$\mu_0 =$$

permeability of free space)

(A) $\frac{\mu_0 \pi r_2^2}{2r_1}$ (B) $\frac{\mu_0 \pi r_2}{2r_1}$

(C) $\frac{\mu_0 \pi r_2^2}{r_1^2}$ (D) $\frac{\mu_0 \pi r_2}{r_1}$

47. A system consists of three particles each of mass 'm_1' placed at the corners of an equilateral triangle of side '

$$\frac{L}{3}$$

', A particle of mass 'm_2' is placed at the mid point of any one side of the triangle. Due to the system of particles, the force acting on m_2 is

(A) $\frac{3Gm_1 m_2}{L^2}$ (B) $\frac{6Gm_1 m_2}{L^2}$

(C) $\frac{9Gm_1 m_2}{L^2}$ (D) $\frac{12Gm_1 m_2}{L^2}$

48. The moment of inertia of a uniform square plate about an axis perpendicular to its plane and passing through the centre is

$$\frac{Ma^2}{6}$$

, where 'M' is the mass and 'a' is the side of square plate. Moment of inertia of this plate about an axis perpendicular to its plane and passing through one of its corners is

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

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

49. Two lenses of power -15D and $+5$D are in contact with each other. The focal length of the combination is

(A) -0.1 cm (B) -10 cm

(C) -20 cm (D) $+10$ cm

50. A particle performing uniform circular motion of radius

$$\frac{\pi}{2}\,\text{m}$$

makes 'x' revolutions in time 't'. Its tangential velocity is

(A) $\frac{\pi x}{t}$ (B) $\frac{\pi x^2}{t}$

(C) $\frac{\pi^2 x^2}{t}$ (D) $\frac{\pi^2 x}{t}$

51. What is the calculated value of spin only magnetic moment in terms of BM if only one unpaired electron is present in a species?

(A) 2.76 (B) 2.84
(C) 2.2 (D) 1.73

52. Which of the following is tertiary allylic alcohol?

(A) Prop-2-en-1-ol (B) But-3-en-2-ol
(C) 2-Methylprop-2-en-ol (D) 2-Methylbut-3-en-2-ol

53. Identify the solvent used in bromination of phenol to obtain 2,4,6-tribromophenol.

(A) Chloroform (B) Water
(C) Carbon tetrachloride (D) Carbon disulphide

54. How many moles of nitrogen atoms are present in 8 g of ammonium nitrate?
(Molar mass of ammonium nitrate $= 80$
)

(A) 0.1 mol (B) 0.2 mol
(C) 0.4 mol (D) 0.8 mol

55. Identify the elements undergoing reduction and oxidation respectively in the following redox reaction.

$$3H_3AsO_{3(aq)} + BrO^-_{3(aq)} \rightarrow Br^-_{(aq)} + 3H_3AsO_4$$

(A) As and O (B) Br and As
(C) As and Br (D) Br and O

56. Which of the following is tricarboxylic acid?

(A) Propionic acid (B) Oxalic acid
(C) Malonia acid (D) Citric acid

57. Find the radius of an atom in fcc unit cell having edge length 393pm.

(A) 196.51 pm (B) 170.22 pm
(C) 78.63 pm (D) 138.93 pm

58. Which from following is a CORRECT decreasing order of ionization enthalpies of different elements?

(A) S > Se > Te > Po (B) Te > Po > S > Se
(C) S > Te > Po > Se (D) Te > Po > Se > S

59. A gas absorbs 200 J heat and expands by 500 cm^3 against a constant external pressure 2×10^5 N m^{-2}. What is the change in internal energy?

(A) 800 J (B) −750 J
(C) 100 J (D) −150 J

60. Identify a copolymer from following.

(A) Natural rubber (B) Polypropene
(C) PVC (D) Terylene

61. Find the average rate of formation of $NO_{2(g)}$, in following reaction.

$$2\,N_2O_{5(g)} \rightarrow 4NO_{2(g)} + O_{2(g)}$$

$$\left[-\frac{\Delta[N_2O_5]}{\Delta t}\right] = x \text{ mol dm}^{-3}\text{ s}^{-1}$$

(A) x mol dm^{-3} s^{-1} (B) $\frac{x}{2}$ mol dm^{-3} s^{-1}
(C) $2x$ mol dm^{-3} s^{-1} (D) $4x$ mol dm^{-3} s^{-1}

62. Calculate the rate constant for the first order reaction, $A \rightarrow B$ if the rate of reaction is 5.4×10^{-6} mol dm^{-3} s^{-1} and
$[A] = 0.3M$
.

(A) 1.8×10^{-5} s^{-1} (B) 1.5×10^{-5} s^{-1}
(C) 2.1×10^{-5} s^{-1} (D) 2.4×10^{-5} s^{-1}

63. Identify the product obtained when benzonitrile is reduced by stannous chloride in presence of hydrochloric acid followed by acid hydrolysis.

(A) Benzal chloride (B) Benzoyl chloride
(C) Benzophenone (D) Benzaldehyde

64. Find solubility in terms of mol L^{-1} if solubility product of silver bromide is 6.4×10^{-13}.

(A) 4.0×10^{-5} mol L^{-1} (B) 8.0×10^{-7} mol L^{-1}
(C) 7.5×10^{-5} mol L^{-1} (D) 6.4×10^{-4} mol L^{-1}

65. What happens when solution of an electrolyte is diluted?

(A) Both $\wedge$ and k increases (B) Both $\wedge$ and k decreases
(C) $\wedge$ increases and k decreases (D) $\wedge$ decreases and k increases

66. The solubility of a gas in a liquid is directly proportional to the pressure of the gas over the solution. Identify the law for this statement.

(A) Henry's law
(B) Raoult's law
(C) Dalton's law
(D) Avogadro's law

67. Weak acid HX has dissociation constant 1×10^{-5}. Calculate the percent dissociation in its 0.1M solution.

(A) 2.2%
(B) 3.5%
(C) 4.2%
(D) 1.0%

68. Calculate the pH of a buffer solution containing 0.01 M salt and 0.004 M weak acid.

$\left(pK_a = 4.762\right)$

(A) 4.36
(B) 4.76
(C) 5.16
(D) 5.36

69. Which among the following is vinylic halide?

(A) $CH_2 = CH - CH_2 - X$
(B) $CH_3 - CH = CH - X$
(C) $CH_3 - C \equiv C - X$
(D) $C_6H_5 - CH_2 - X$

70. Which from following compounds is obtained when carbon dioxide gas bubbled through slaked lime solution?

(A) $CaCO_{3\,(s)}$
(B) $CaCl_{2\,(aq)}$
(C) $CaSO_{4(s)}$
(D) $NaCl_{(aq)}$

71. Calculate the number of atoms present in unit cell of an element having molar mass 190 g mol^{-1} and density 20 g cm^{-3}.

$\left[a^3 \cdot N_A = 38\ cm^3\ mol^{-1}\right]$

(A) 1
(B) 2
(C) 6
(D) 4

72. What is the solubility of a gas in water at 25°C if partial pressure is 0.18 atm ?

$\left(K_H = 0.16\ moldm^{-3}\ atm^{-1}\right)$

(A) 0.029 mol dm^{-3}
(B) 0.022 mol dm^{-3}
(C) 0.032 mol dm^{-3}
(D) 0.038 mol dm^{-3}

73. What is the radius of fourth orbit of Be^{+++} ?

(A) 211.6 pm
(B) 158.7 pm
(C) 52.9 pm
(D) 13.2 pm

74. What is the number of unpaired electrons in NO molecule?

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

75. Identify the glycosidic linkage present in lactose.

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

76. Which from following statements is TRUE about $CH_3CH\,(NH_2)\,CH_2COOH$ molecule?

(A) It is an example of amino acids.
(B) Its IUPAC name is 3-carboxy-2-amine.
(C) The amino group is located at C − 2.
(D) $-NH_2$ group is considered as principal functional group for IUPAC naming.

77. Which of the following is obtained as product when ethylene reacts with oxygen in presence of Pd/Al_2O_3 ?

(A) Acetaldehyde
(B) Acetic acid
(C) Methane
(D) Methyl alcohol

78. What is the position of transition elements from Sc to Zn in long form of periodic table?

(A) Group 4 to 13, period-3
(B) Group 3 to 12, period-4
(C) Group 5 to 14, period-4
(D) Group 3 to 12, period-5

79. Which from following elements is most abundant on earth?

(A) N
(B) C
(C) O
(D) H

80. What is the volume of 1 mole real gas at STP

$\left(V_0 = 22.4\ dm^3\right)$

, if compressibility factor of real gas is 1.1 at STP?

(A) 22.40 dm^3
(B) 23.64 dm^3
(C) 24.64 dm^3
(D) 23.50 dm^3

81. Identify the product obtained when isopropyl bromide is reacted with metallic sodium in dry ether.

(A) Isobutane
(B) Isohexane
(C) 2,3-Dimethylbutane
(D) 2,3-Dimethylhexane

82. Which of the following is general representation of Grignard reagent?

(A) $R - O - Na$ (B) $R - COO - Ag$

(C) $R - Mg - X$ (D) $R - COOK$

83. Which among the following statements is NOT true about high density polythene?

(A) It is obtained from ethene.

(B) It needs high pressure (1000-2000 atm) for synthesis.

(C) Polymerization occurs in presence of Zieglar-Natta catalyst.

(D) Melting point is higher than LDP.

84. What is osmotic pressure of solution of 1.7 g $CaCl_2$ in 1.25 dm^3 water at 300 K if van't Hoff factor and molar mass of $CaCl_2$, are 2.47 and 111 g mol^{-1} respectively?

$$\left[R = 0.082\ dm^3\ atm\ mol^{-1}\ K^{-1}\right]$$

(A) 0.625 atm (B) 0.744 atm

(C) 0.827 atm (D) 0.936 atm

85. Which among the following pair of properties is intensive?

(A) Mass and heat capacity

(B) Heat capacity and pressure

(C) Specific heat and pressure

(D) Internal energy and boiling point

86. Identify the molecular formula of an alkane that exhibits only two different structural isomers.

(A) C_2H_6 (B) C_3H_8

(C) C_4H_{10} (D) C_6H_{12}

87. An organic compound 'A' on reaction with PCl_3 gives an alkyl chloride having formula C_3H_7Cl. 'A' on oxidation with PCC forms an aldehyde having formula C_3H_6O. Identify 'A'.

(A) Propan-1-ol (B) Propan-2-ol

(C) Propanoic acid (D) Propanone

88. Identify tetrasaccharide from following.

(A) Glycogen (B) Cellulose

(C) Ribose (D) Stachyose

89. What type of ligand does the ethylenediamine is?

(A) Monodentate (B) Bidentate

(C) Tetradentate (D) Hexadentate

90. What is angular momentum of an electron in fourth orbit of hydrogen atom?

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

(C) $\frac{2h}{\pi}$ (D) $\frac{3h}{\pi}$

91. Which from following complexes is heteroleptic?

(A) $K_3[Al(C_2O_4)_3]$ (B) $[Co(C_2O_4)_3]^{3-}$

(C) $Na_3[AlF_6]$ (D) $[Co(H_2O)(NH_3)_5]_3$

92. Calculate E°_{cell} in which following reaction occurs.

$$Mg_{(s)} + 2Ag^+_{(IM)} \rightarrow Mg^+_{(1M)} + 2Ag_{(s)}$$

if

$$E^\circ_{Ag} = 0.8\ V$$

and

$$E^\circ_{Mg} = -2.37\ V$$

(A) -3.17 V (B) 3.17 V

(C) -1.57 V (D) 1.57 V

93. Identify CORRECT decreasing order of solubilities of alcohols, alkanes and amines in water having comparable molar mass.

(A) Alcohol > amine > alkane

(B) Alkane > amine > alcohol

(C) Amine > alcohol > alkane

(D) Alkane > alcohol > amine

94. Which of the following characteristic properties is NOT true for crystalline solid?

(A) These substances have sharp melting point,

(B) These have different values of refractive index in different directions.

(C) The constituent particles are orderly arranged.

(D) These are isotropic.

95. Time required for 90% completion of a first order reaction is 'x' minute. Calculate the time required to complete 99.9% of the reaction at same temperature.

(A) x minute (B) $2x$ minute

(C) $3x$ minute (D) $\frac{x}{2}$ minute

96. Identify 'A' in the following reaction:

A

$$\xrightarrow[\text{ether}]{\text{LiAlH}_4}$$

Ethanamine

(A) C_2H_5CN (B) CH_3CONH_2

(C) $C_2H_5CONH_2$ (D) CH_3NO_2

97. Which of the following reagents is used in Gatterman-Koch formylation of arene?

(A) CrO_3

(B) $CO, HCl/AlCl_3$ (anhydr.)

(C) CrO_2Cl_2, CS_2

(D) Cl_2 $h\nu, H_3O^+$

98. Identify the last step in wet chemical synthesis of nanomaterial.

(A) Formation of oxide or alcohol-bridged network (B) Dehydration

(C) Aging of the gel (D) Drying of the gel

99. Calculate the conductivity of 0.02 M electrolyte solution if its molar conductivity $407.2\Omega^{-1}$ cm^2 mol^{-1} ?

(A) $8.144 \times 10^{-3}\Omega^{-1}$ cm^{-1}

(B) $4.072 \times 10^{-3}\Omega^{-1}$ cm^{-1}

(C) $7.15 \times 10^{-3}\Omega^{-1}$ cm^{-1}

(D) $6.055 \times 10^{-3}\Omega^{-1}$ cm^{-1}

100. If 8.84 kJ heat is liberated for formation of 3 g ethane, calculate its $\triangle_f H^\circ$.

(A) -8.00 kJ (B) 15.0 kJ

(C) 30.0 kJ (D) -88.4 kJ

101. The value of c for the function
$$f(x) = \log x$$
on [1, e] if LMVT can be applied, is

(A) $e - 2$ (B) $e + 1$

(C) $e - 1$ (D) e

102. The three ships namely A, B and C sail from India to Africa. If the odds in favour of the ships reaching safely are $2:5, 3:7$ and $6:11$ respectively, then probability of all of them arriving safely is

(A) $\frac{18}{595}$ (B) $\frac{11}{34}$

(C) $\frac{196}{217}$ (D) $\frac{1}{595}$

103. If p and q are true statements and r and s are false statements, then the truth values of the statement patterns $(p \wedge q) \vee r$ and $(p \vee s) \leftrightarrow (q \wedge r)$ are respectively

(A) F, T (B) T, T

(C) F, F (D) T, F

104. If the sum of mean and variance of a Binomial Distribution is
$$\frac{15}{2}$$
for 10 trials, then the variance is

(A) 1.5 (B) 2.5

(C) 4.5 (D) 3.5

105. If
$$(\bar{a} \times \bar{b}) \times \bar{c} = -5\bar{a} + 4\bar{b}$$
and
$$\bar{a} \cdot \bar{b} = 3$$
, then the value of $\bar{a} \times (\bar{b} \times \bar{c})$ is

(A) $3\bar{b} - 4\bar{c}$ (B) $4\bar{a} - 3\bar{b}$

(C) $4\bar{b} - 3\bar{c}$ (D) $3\bar{a} - 4\bar{c}$

106. The plane through the intersection of planes
$$x + y + z = 1$$
and
$$2x + 3y - z + 4 = 0$$
and parallel to Y-axis also passes through the point

(A) $(3, 3, -1)$ (B) $(-3, 0, 1)$

(C) $(3, 2, 1)$ (D) $(-3, 0, -1)$

107. Let
$$f(x) = e^x - x$$
and
$$g(x) = x^2 - x, \forall x \in R$$
, then the set of all $x \in R$, where the function
$$h(x) = (fog)(x)$$
is increasing is

(A) $[0, \frac{1}{2}] \cup [1, \infty)$ (B) $[-1, -\frac{1}{2}] \cup [\frac{1}{2}, \infty)$

(C) $[0, \infty)$ (D) $[-\frac{1}{2}, 0] \cup [1, \infty)$

108. Let f be a differentiable function such that
$$f(1) = 2$$
and
$$f'(x) = f(x)$$
, for all $x \in R$. If
$$h(x) = f(f(x))$$
, then $h'(1)$ is equal to

(A) $4e^2$ (B) $4e$

(C) $2e$ (D) $2e^2$

109. The joint equation of a pair of lines passing through the origin and making an angle of
$$\frac{\pi}{4}$$
with the line
$$3x + 2y - 8 = 0$$
is

(A) $5x^2 + 24xy - 5y^2 = 0$

(B) $5x^2 - 24xy + 5y^2 = 0$

(C) $5x^2 - 24xy - 5y^2 = 0$

(D) $5x^2 + 24xy + 5y^2 = 0$

110. Two sides of a square are along the lines
$$5x - 12y + 39 = 0$$
and
$$5x - 12y + 78 = 0$$
, then area of the square is

(A) 9 sq. units. (B) $\frac{1}{3}$ sq. units.

(C) 18 sq. units. (D) 3 sq. units.

111. The value of

$$\int \frac{dx}{x^2(x^4+1)^{\frac{3}{4}}}$$

is

(A) $(\frac{x^4+1}{x^4})^{\frac{1}{4}} + c$, where c is a constant of integration.

(B) $(x^4+1)^{\frac{1}{4}} + c$, where c is a constant of integration.

(C) $-(x^4+1)^{\frac{1}{4}} + c$, where c is a constant of integration.

(D) $-(\frac{x^4+1}{x^4})^{\frac{1}{4}} + c$, where c is a constant of integration.

112.

$\int \frac{5\tan x}{\tan x - 2}\,dx = x + a\log|\sin x - 2\cos x| + c$, (where c is a constant of integration), then the value of a is

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

(C) 2 (D) 3

113. Let

$S = \{t \in R/f(x) = |x-\pi|\left(e^{|x|}-1\right)\sin|x|$ is not differentiable at t$\}$, then S is

(A) $\varnothing$ (an empty set) (B) $\{0\}$

(C) $\{\pi\}$ (D) $\{0, \pi\}$

114. The domain of the function

$$f(x) = \sin^{-1}\left(\frac{|x|+5}{x^2+1}\right)$$

is $(-\infty, -a] \cup [a, \infty)$. Then a is equal to

(A) $\frac{\sqrt{17}}{2} + 1$ (B) $\frac{\sqrt{17}-1}{2}$

(C) $\frac{1+\sqrt{17}}{2}$ (D) $\frac{\sqrt{17}}{2} - 1$

115. The perpendicular distance of the origin from the plane

$$x - 3y + 4z - 6 = 0$$

is

(A) 6 (B) $\frac{6}{\sqrt{26}}$

(C) $\frac{1}{\sqrt{26}}$ (D) $\frac{3}{\sqrt{26}}$

116. The area bounded by the X-axis and the curve

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

is

(A) $\frac{37}{12}$ sq. units (B) $\frac{27}{12}$ sq. units

(C) $\frac{37}{4}$ sq. units (D) $\frac{27}{13}$ sq. units

117. Let $f : R \to R$ and $g : R \to R$ be continuous functions. Then the value of the integral

$$\int_{\frac{-\pi}{2}}^{\frac{\pi}{2}} [f(x) + f(-x)][g(x) - g(-x)]dx$$

is

(A) π (B) 1

(C) -1 (D) 0

118. If

$$\bar{p} = \hat{i} + \hat{j} + \hat{k}$$

and

$$\bar{q} = \hat{i} - 2\hat{j} + \hat{k}$$

. Then a vector of magnitude $5\sqrt{3}$ units perpendicular to the vector $\bar{q}$ and coplanar with $\bar{p}$ and $\bar{q}$ is

(A) $5(\hat{i} - \hat{j} + \hat{k})$ (B) $5(\hat{i} + \hat{j} - \hat{k})$

(C) $5(\hat{i} - \hat{j} - \hat{k})$ (D) $5(\hat{i} + \hat{j} + \hat{k})$

119. The value of

$$\frac{^{10}C_r}{^{11}C_r}$$

, when both the numerator and denominator are at their greatest values, is

(A) $\frac{6}{11}$ (B) $\frac{1}{11}$

(C) $\frac{4}{11}$ (D) $\frac{3}{11}$

120. The general solution of the differential equation

$$\frac{dy}{dx} + \left(\frac{3x^2}{1+x^3}\right)y = \frac{1}{x^3+1}$$

is

(A) $y(1+x^3) = x^3 + c$, where c is a constant of integration.

(B) $y(1+x^3) = x + c$, where c is a constant of integration.

(C) $y(1+x^3) = x^2 + c$, where c is a constant of integration.

(D) $y(1+x^3) = 2x + c$, where c is a constant of integration.

121. If y is a function of x and

$$\log(x+y) = 2xy$$

, then

$$\frac{dy}{dx}$$

at

$$x = 0$$

is

(A) 0 (B) -1

(C) 1 (D) 2

122. The displacement 'S' of a moving particle at a time t is given by

$$S = 5 + \frac{48}{t} + t^3$$

. Then its acceleration when the velocity is zero, is

(A) 12 (B) 20

(C) 16 (D) 24

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

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$

(C) $\frac{\pi}{4}$ (D) $\frac{2\pi}{3}$

124. The value of

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

is

(A) $\frac{5\pi}{6}$ (B) $\frac{\pi}{2}$

(C) $\frac{2\pi}{3}$ (D) $\frac{3\pi}{4}$

125.

$$\int_0^{\pi} \frac{x \tan x}{\sec x + \cos x} dx =$$

(A) $\frac{\pi}{8}$ (B) $-\frac{\pi^2}{8}$

(C) $\frac{\pi^2}{4}$ (D) $-\frac{\pi^2}{4}$

126. If

$$\tan^{-1} a + \tan^{-1} b + \tan^{-1} c = \pi$$

, then which of the following statement is true?

(A) $a + b - c = abc$ (B) $a + b + c = 2abc$

(C) abc $= 1$ (D) $a + b + c = abc$

127. If

$$f(x) = \frac{4}{x^4}\left[1 - \cos\frac{x}{2} - \cos\frac{x}{4} + \cos\frac{x}{2} \cdot \cos\frac{x}{4}\right]$$

is continuous at

$$x = 0$$

, then $f(0)$ is

(A) $\frac{1}{32}$ (B) $\frac{1}{16}$

(C) $\frac{1}{8}$ (D) $\frac{1}{64}$

128. Two lines

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

and

$$\frac{x+5}{7} = \frac{y-2}{-6} = \frac{z-3}{4}$$

intersect at the point R. Then reflection of R in the xy-plane has co-ordinates

(A) $(2, -4, -7)$ (B) $(2, -4, 7)$

(C) $(-2, 4, 7)$ (D) $(2, 4, 7)$

129. The value of

$$\int \frac{(x^2 - 1)dx}{x^3\sqrt{2x^4 - 2x^2 + 1}}$$

is

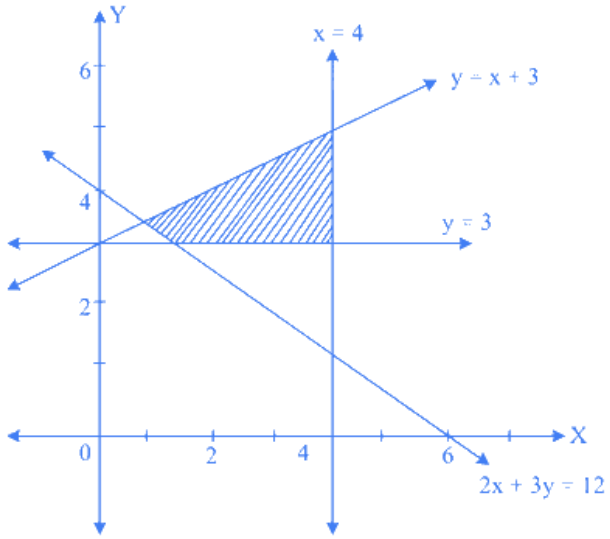
(A) $2\sqrt{2 - \frac{2}{x^2} + \frac{1}{x^4}} + c$, where c is a constant of integration.

(B) $2\sqrt{2 + \frac{2}{x^2} + \frac{1}{x^4}} + c$, where c is a constant of integration.

(C) $\frac{1}{2}\sqrt{2 - \frac{2}{x^2} + \frac{1}{x^4}} + c$, where c is a constant of integration.

(D) $2\sqrt{2 - \frac{2}{x^2} - \frac{1}{x^4}} + c$, where c is a constant of integration.

130. The shaded area in the figure given below is a solution set of a system of inequations. The minimum value of objective function $3x + 5y$, subject to the linear constraints given by this system of inequations is



(A) 19.5 (B) 21

(C) 15 (D) 19.8

131. If

$$a = mb + nc$$

, where

$$a = 4\hat{i} + 13\hat{j} - 18\hat{k}, b = \hat{i} - 2\hat{j} + 3\hat{k},$$

$$c = 2\hat{i} + 3\hat{j} - 4\hat{k}$$

, then

$$m + n =$$

(A) 1 (B) 2

(C) 3 (D) -1

132. In a game, 3 coins are tossed. A person is paid ₹ 7 /-, if he gets all heads or all tails; and he is supposed to pay ₹ 3 /-, if he gets one head or two heads. The amount he can expect to win on an average per game is ₹

(A) -0.5 (B) 0.5

(C) 1 (D) -1

133.

$$\int e^x\left(1-\cot x+\cot^2 x\right)dx =$$

(A) $e^x \cdot \cot x + c$, where c is a constant of integration.

(B) $e^x \cdot \operatorname{cosec} x + c$, where c is a constant of integration.

(C) $-e^x \cdot \cot x + c$, where c is a constant of integration.

(D) $-e^x \cdot \operatorname{cosec} x + c$, where c is a constant of integration.

134. The parametric equations of the circle

$$x^2+y^2+2x-4y-4=0$$

are

(A) $x=-1+3\cos\theta, y=2+3\sin\theta$

(B) $x=1+3\cos\theta, y=-2+3\sin\theta$

(C) $x=-1+3\sin\theta, y=-2+3\cos\theta$

(D) $x=1+3\sin\theta, y=-2+3\cos\theta$

135. In a triangle ABC, with usual notations, if

$$c = 4$$

, then value of

$$(a-b)^2\cos^2\frac{C}{2}+(a+b)^2\sin^2\frac{C}{2}$$

is

(A) 4 (B) 16

(C) 9 (D) 25

136.

$$\lim_{x\to a}\frac{\sqrt{a+2x}-\sqrt{3x}}{\sqrt{3a+x}-2\sqrt{x}} =$$

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

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

137. If

$$B=\begin{bmatrix}3 & \alpha & -1\\ 1 & 3 & 1\\ -1 & 1 & 3\end{bmatrix}$$

is the adjoint of a 3×3 matrix A and

$$|A| = 4$$

, then α is equal to

(A) 1 (B) 0

(C) -1 (D) -2

138. If

$$x = 3\tan t$$

and

$$y = 3\sec t$$

, then the value of

$$\frac{d^2y}{dx^2}$$

at

$$t=\frac{\pi}{4}$$

is

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

(C) $\frac{1}{3\sqrt{2}}$ (D) $\frac{3}{2\sqrt{2}}$

139. A fair die is tossed twice in succession. If X denotes the number of sixes in two tosses, then the probability distribution of X is given by

(A)

X = x	0	1	2
P(X = x)	$\frac{25}{36}$	$\frac{1}{36}$	$\frac{5}{18}$

(B)

X = x	0	1	2
P(X = x)	$\frac{5}{18}$	$\frac{1}{36}$	$\frac{25}{36}$

(C)

X = x	0	1	2
P(X = x)	$\frac{25}{36}$	$\frac{5}{18}$	$\frac{1}{36}$

(D)

X = x	0	1	2
P(X = x)	$\frac{5}{18}$	$\frac{25}{36}$	$\frac{1}{36}$

140. The negation of the statement pattern $\sim s \vee (\sim r \wedge s)$ is equivalent to

(A) $s \wedge r$ (B) $s \wedge (r \wedge \sim s)$

(C) $s \wedge \sim r$ (D) $s \vee (r \vee \sim s)$

141. If the volume of tetrahedron, whose vertices are with position vectors $\hat{i}-6\hat{j}+10\hat{k}, -\hat{i}-3\hat{j}+7\hat{k}, 5\hat{i}-\hat{j}+\lambda\hat{k}$ and $7\hat{i}-4\hat{j}+7\hat{k}$ is 11 cubic units, then value of λ is

(A) 4 (B) 5

(C) 7 (D) 6

142. The argument of

$$\frac{1+i\sqrt{3}}{\sqrt{3}+i}, i=\sqrt{-1}$$

is

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

(C) $\frac{\pi}{6}$ (D) $\frac{\pi}{2}$

143. If

$$y=\tan^{-1}\left(\frac{\log\left(\frac{e}{x^2}\right)}{\log(ex^2)}\right)+\tan^{-1}\left(\frac{4+2\log x}{1-8\log x}\right)$$

, then

$$\frac{dy}{dx}$$

is

(A) 0 (B) $\frac{1}{2}$

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

144. If the surface area of a spherical balloon of radius 6 cm is increasing at the rate $2\ cm^2/sec$, then the rate of increase in its volume in cm^3/sec is

(A) 16 (B) 6

(C) 12 (D) 8

145. The value of α, so that the volume of parallelopiped formed by $\hat{i}+\alpha\hat{j}+\hat{k}, \hat{j}+\alpha\hat{k}$ and $\alpha\hat{i}+\hat{k}$ becomes minimum, is

(A) -3 (B) 3

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

146. In a certain culture of bacteria, the rate of increase is proportional to the number of bacteria present at that instant. It is found that there are 10,000 bacteria at the end of 3 hours and 40,000 bacteria at the end of 5 hours, then the number of bacteria present in the beginning are

(A) 1250 (B) 1200

(C) 1350 (D) 1300

147. If x, y, z are in A.P. and $\tan^{-1}x, \tan^{-1}y$ and $\tan^{-1}z$ are also in A.P., then

(A) $x=y=z$ (B) $2x=3y=6z$

(C) $6x=3y=2z$ (D) $6x=4y=3z$

148. Mean and variance of six observations are 8 and 16 respectively. If each observation is multiplied by 3, then new variance of the resulting observations is

(A) 16 (B) 48

(C) 24 (D) 144

149. The differential equation of all circles, passing through the origin and having their centres on the X-axis, is

(A) $y^2=x^2+xy\frac{dy}{dx}$ (B) $x^2=y^2+2xy\frac{dy}{dx}$

(C) $y^2=x^2+2xy\frac{dy}{dx}$ (D) $x^2=y^2-xy\frac{dy}{dx}$

150.

$$\int_0^1 \cos^{-1}x\,dx=$$

(A) -1 (B) 0

(C) 1 (D) 2

- End of Question Paper -