MHT CET 2023 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 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. A rubber ball filled with water, having a small hole is used as the bob of a simple pendulum. The time period of such a pendulum

(A) is a constant.
(B) decreases with time.
(C) increases with time.
(D) first increases and then decreases, finally having same value as at the beginning.

2. The ratio of wavelengths for transition of electrons from 2^{nd} orbit to 1^{st} orbit of Helium (He^{++}) and Lithium (Li^{++1}) is (Atomic number of Helium $= 2$, Atomic number of Lithium $= 3$)

(A) 9 : 4
(B) 9 : 36
(C) 4 : 9
(D) 2 : 3

3. For an intrinsic semiconductor (n_h and n_e are the number of holes per unit volume and number of electrons per unit volume respectively)

(A) $n_h < n_e$
(B) $n_h = n_e$
(C) $n_h = \frac{n_e}{2}$
(D) $n_h > n_e$

4. A 5.0 V stabilized power supply is required to be designed using a 12 V DC power supply as input source. The maximum power rating of zener diode is 2.0 W. The minimum value of resistance R_s in Ω connected in series with zener diode will be

(A) 16.5
(B) 17.5
(C) 18.5
(D) 15.5

5. A jar 'P' is filled with gas having pressure, volume and temperature P, V, T respectively. Another gas jar Q filled with a gas having pressure 2P, volume $\frac{V}{4}$ and temperature 2 T. The ratio of the number of molecules in jar P to those in jar Q is

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

6. The magnetic flux through a loop of resistance 10 Ω varying according to the relation $\phi = 6t^2 + 7t + 1$, where ϕ is in milliweber, time is in second at time $t = 1$ s the induced e.m.f. is

(A) 12 mV
(B) 7 mV
(C) 19 mV
(D) 19 V

7. A thin rod of length 'L' is bent in the form of a circle. Its mass is 'M'. What force will act on mass 'm' placed at the centre of this circle? (G = constant of gravitation)

(A) zero
(B) $\frac{GMm}{4L^2\pi^2}$
(C) $\frac{4\pi^2 GMm}{L}$
(D) $\frac{2GMm}{L^2}$

8. The coil of an a.c. generator has 100 turns, each of cross-sectional area 2 m^2. It is rotating at constant angular speed 30 rad/s, in a uniform magnetic field of 2×10^{-2} T. If the total resistance of the circuit is 600 Ω then maximum power dissipated in the circuit is

(A) 6 W
(B) 9 W
(C) 12 W
(D) 24 W

9. A beam of unpolarized light passes through a tourmaline crystal A and then it passes through a second tourmaline crystal B oriented so that its principal plane is parallel to that of A. The intensity of emergent light is I_0. Now B is rotated by 45° about the ray. The emergent light will have intensity $\left(\cos 45° = \frac{1}{\sqrt{2}}\right)$

(A) $\frac{I_0}{2}$
(B) $\frac{I_0}{\sqrt{2}}$
(C) $\frac{\sqrt{2}}{I_0}$
(D) $\frac{2}{I_0}$

10. The materials suitable for making electromagnets should have

(A) high retentivity and high coercivity
(B) low retentivity and low coercivity
(C) high retentivity and low coercivity
(D) low retentivity and high coercivity

11. A body falls on a surface of coefficient of restitution 0.6 from a height of 1 m. Then the body rebounds to a height of

(A) 1 m (B) 0.36 m

(C) 0.4 m (D) 0.6 m

12. In a diffraction pattern due to single slit of width 'a', the first minimum is observed at an angle of 30° when the light of wavelength $5400\ \text{Å}$ is incident on the slit. The first secondary maximum is observed at an angle of $\left(\sin 30^\circ = \frac{1}{2}\right)$

(A) $\sin^{-1}(\frac{3}{4})$ (B) $\sin^{-1}(\frac{2}{3})$

(C) $\sin^{-1}(\frac{1}{2})$ (D) $\sin^{-1}(\frac{1}{4})$

13. A stone is projected vertically upwards with speed 'v'. Another stone of same mass is projected at an angle of 60° with the vertical with the same speed 'v'. The ratio of their potential energies at the highest points of their journey is $[\sin 30^\circ = \cos 60^\circ = 0.5, \cos 30^\circ = \sin 60^\circ = \frac{\sqrt{3}}{2}]$

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

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

14. An electron (mass m) is accelerated through a potential difference of 'V' and then it enters in a magnetic field of induction 'B' normal to the lines. The radius of the circular path is ($e =$ electronic charge)

(A) $\sqrt{\frac{2eV}{m}}$ (B) $\sqrt{\frac{2Vm}{eB^2}}$

(C) $\sqrt{\frac{2Vm}{eB}}$ (D) $\sqrt{\frac{2Vm}{e^2 B}}$

15. A capacitor, an inductor and an electric bulb are connected in series to an a.c. supply of variable frequency. As the frequency of the supply is increased gradually, then the electric bulb is found to

(A) increase in brightness.

(B) decrease in brightness.

(C) increase, reach a maximum and then decrease in brightness.

(D) show no change in brightness.

16. When both source and listener are approaching each other the observed frequency of sound is given by (V_L and V_S is the velocity of listener and source respectively, $n_0 =$ radiated frequency)

(A) $n = n_0[\frac{V+V_L}{V-V_s}]$ (B) $n = n_0[\frac{V-V_L}{V+V_s}]$

(C) $n = n_0[\frac{V-V_L}{V-V_s}]$ (D) $n = n_0[\frac{V+V_L}{V+V_s}]$

17. Water is flowing through a horizontal pipe in stream line flow. At the narrowest part of the pipe

(A) velocity is maximum and pressure minimum.

(B) pressure is maximum and velocity minimum.

(C) both pressure and velocity are minimum.

(D) both pressure and velocity are maximum.

18. The angle of prism is A and one of its refracting surface is silvered. Light rays falling at an angle of incidence '2A' on the first surface return back through the same path after suffering reflection at the silvered surface. The refractive index of the material of the prism is

(A) $2\sin(\frac{A}{2})$ (B) 2tanA

(C) 2cosA (D) 2sinA

19. The maximum velocity of a particle performing S.H.M. is 'V'. If the periodic time is made $\left(\frac{1}{3}\right)^d$ and the amplitude is doubled, then the new maximum velocity of the particle will be

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

(C) 3 V (D) 6 V

20. A conducting wire of length 2500 m is kept in east-west direction, at a height of 10 m from the ground. If it falls freely on the ground then the current induced in the wire is (Resistance of wire $= 25\sqrt{2}\ \Omega$, acceleration due to gravity $g = 10\ \text{m/s}^2$, $B_H = 2\times10^{-5}\ \text{T}$)

(A) 0.2 A (B) 0.02 A

(C) 0.01 A (D) 2 A

21. For an electron moving in the n^{th} Bohr orbit the deBroglie wavelength of an electron is

(A) $n\pi r$ (B) $\frac{\pi r}{n}$

(C) $\frac{nr}{2\pi}$ (D) $\frac{2\pi r}{n}$

22. A square lamina of side 'b' has same mass as a disc of radius 'R' the moment of inertia of the two objects about an axis perpendicular to the plane and passing through the centre is equal. The ratio

$$\frac{b}{R}$$

is

(A) $1:1$ (B) $\sqrt{3}:1$

(C) $\sqrt{6}:1$ (D) $1:\sqrt{3}$

23. A body weighs 300 N on the surface of the earth. How much will it weigh at a distance

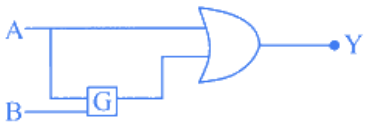
$$\frac{R}{2}$$

below the surface of earth? ($R \rightarrow$ Radius of earth)

(A) 300 N (B) 250 N

(C) 200 N (D) 150 N

24. To get the truth table shown, from the following logic circuit, the Gate G should be



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

(A) OR (B) AND

(C) NOR (D) NAND

25. For a gas having 'X' degrees of freedom, 'γ' is ($\gamma =$ ratio of specific heats $= C_P/C_V$)

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

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

26. A galvanometer of resistance G is shunted with a resistance of 10% of G. The part of the total current that flows through the galvanometer is

(A) $\frac{1}{11}$I (B) $\frac{2}{11}$I

(C) $\frac{1}{10}$I (D) $\frac{1}{5}$I

27. If an electron in a hydrogen atom jumps from an orbit of level $n=3$ to orbit of level $n=2$, then the emitted radiation frequency is (where R = Rydberg's constant, C = Velocity of light)

(A) $\frac{3RC}{27}$ (B) $\frac{RC}{25}$

(C) $\frac{8RC}{9}$ (D) $\frac{5RC}{36}$

28. Self inductance of solenoid is

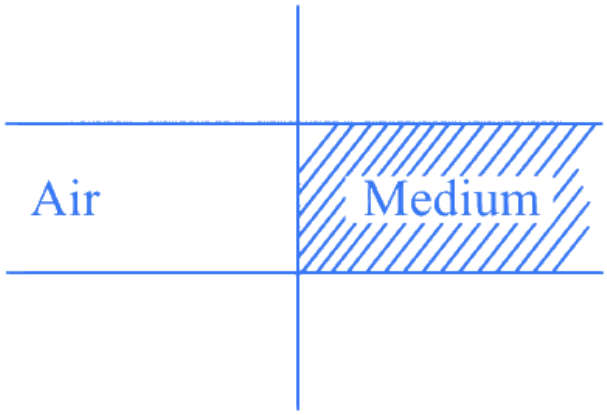
(A) directly proportional to current flowing through the coil.

(B) directly proportional to the length.

(C) directly proportional to its area of cross-section.

(D) inversely proportional to the area of cross-section.

29. The capacitance of a parallel plate capacitor is 2.5 μF. When it is half filled with a dielectric as shown in figure, its capacitance becomes 5 μF. The dielectric constant of the dielectric is



(A) 7.5 (B) 3

(C) 4 (D) 5

30. Equation of simple harmonic progressive wave is given by

$$y=\frac{1}{\sqrt{a}}\sin\omega t \pm \frac{1}{\sqrt{b}}\cos\omega t$$

then the resultant amplitude of the wave is ($\cos 90^\circ = 0$)

(A) $\frac{a\pm b}{ab}$ (B) $\frac{\sqrt{a}\pm\sqrt{b}}{ab}$

(C) $\frac{\sqrt{a}\pm\sqrt{b}}{\sqrt{ab}}$ (D) $\sqrt{\frac{a+b}{ab}}$

31. Two uniform brass rods A and B of length 'l' and '$2l$' and their radii '$2r$' and 'r' respectively are heated to same temperature. The ratio of the increase in the volume of rod A to that of rod B is

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

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

32. In a single slit experiment, the width of the slit is doubled. Which one of the following statements is correct?

(A) The intensity and width of the central maximum are unaffected.

(B) The intensity remains same and angular width becomes half.

(C) The intensity and angular width both are doubled.

(D) The intensity increases by a factor 4 and the angular width decreases by a factor of $\frac{1}{2}$.

33. A gas at N.T.P. is suddenly compressed to $\left(\frac{1}{4}\right)^{\text{th}}$ of its original volume. The final pressure in (Given $\gamma =$ ratio of sp. heats $= \frac{3}{2}$) atmosphere is ($P =$ original pressure)

(A) 4P (B) $\frac{3}{2}$P

(C) 8P (D) $\frac{1}{4}$P

34. The excess of pressure in a first soap bubble is three times that of other soap bubble. Then the ratio of the volume of first bubble to other is

(A) 1 : 3 (B) 27 : 1

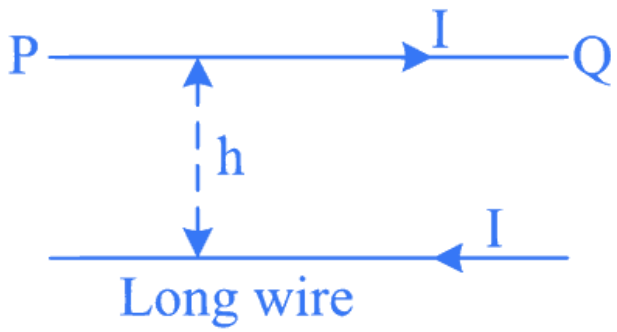
(C) 1 : 9 (D) 1 : 27

35. In a meter bridge experiment null point is obtained at l cm from the left end. If the meter bridge wire is replaced by a wire of same material but twice the area of across-section, then the null point is obtained at a distance

(A) $2l$ cm from left end. (B) l cm from left end.

(C) $l/2$ cm from left end. (D) $l/4$ cm from left end.

36. A long straight wire carrying a current of 25 A rests on the table. Another wire PQ of length 1 m and mass 2.5 g carries the same current but in the opposite direction. The wire PQ is free to slide up and down. To what height will wire PQ rise? ($\mu_0 = 4\pi \times 10^{-7}$ SI unit)



(A) 3 mm (B) 4 mm

(C) 5 mm (D) 8 mm

37. In a thermodynamic process, there is no exchange of heat between the system and surroundings. Then the thermodynamic process is

(A) isothermal (B) isobaric

(C) isochoric (D) adiabatic

38. According to kinetic theory of gases, which one of the following statements is wrong?

(A) All the molecules of a gas are identical.

(B) Collisions between the molecules of a gas and that of the molecules with the walls of the container are perfectly elastic.

(C) The molecules do not exert appreciable force on one another except during collision.

(D) The pressure exerted by a gas is due to the collision between the molecules of the gas.

39. The radii of two soap bubbles are r_1 and r_2. In isothermal condition they combine with each other to form a single bubble. The radius of resultant bubble is

(A) $R = \frac{r_1+r_2}{2}$ (B) $R = r_1(r_1r_2 + r_2)$

(C) $R = \sqrt{r_1^2 + r_2^2}$ (D) $R = r_1 + r_2$

40. The rays of different colours fail to converge at a point after passing through a thick converging lens. This defect is called

(A) spherical aberration (B) distortion
(C) coma (D) chromatic aberration

41. The ratio of potential difference that must be applied across parallel and series combination of two capacitors C_1 and C_2 with their capacitance in the ratio $1:2$ so that energy stored in these two cases becomes same is

(A) $3:\sqrt{2}$ (B) $\sqrt{2}:3$
(C) $2:9$ (D) $9:2$

42. The potential energy of charged parallel plate capacitor is v_0. If a slab of dielectric constant K is inserted between the plates, then the new potential energy will be

(A) $\frac{v_0}{\mathrm{K}}$ (B) $v_0\ \mathrm{K}^2$
(C) $\frac{v_0}{\mathrm{K}^2}$ (D) v_0^2

43. A solid sphere rolls without slipping on an inclined plane at an angle θ. The ratio of total kinetic energy to its rotational kinetic energy is

(A) $\frac{7}{2}$ (B) $\frac{5}{2}$
(C) $\frac{7}{3}$ (D) $\frac{5}{4}$

44. Two discs of same mass and same thickness (t) are made from two different materials of densities 'd_1' and 'd_2' respectively. The ratio of the moment of inertia I_1 to I_2 of two discs about an axis passing through the centre and perpendicular to the plane of disc is

(A) $\mathrm{d}_1:\mathrm{d}_2$ (B) $\mathrm{d}_2:\mathrm{d}_1$
(C) $1:d_1d_2$ (D) $1:\mathrm{d}_1^2\,\mathrm{d}_2$

45. When a string of length 'l' is divided into three segments of length l_1, l_2 and l_3. The fundamental frequencies of three segments are $\mathrm{n}_1, \mathrm{n}_2$ and n_3 respectively. The original fundamental frequency 'n' of the string is

(A) $\mathrm{n} = \mathrm{n}_1 + \mathrm{n}_2 + \mathrm{n}_3$
(B) $\sqrt{\mathrm{n}} = \sqrt{\mathrm{n}_1} + \sqrt{\mathrm{n}_2} + \sqrt{\mathrm{n}_3}$
(C) $\frac{1}{\mathrm{n}} = \frac{1}{\mathrm{n}_1} + \frac{1}{\mathrm{n}_2} + \frac{1}{\mathrm{n}_3}$
(D) $\frac{1}{\sqrt{\mathrm{n}}} = \frac{1}{\sqrt{\mathrm{n}_1}} + \frac{1}{\sqrt{\mathrm{n}_2}} + \frac{1}{\sqrt{\mathrm{n}_3}}$

46. A seconds pendulum is placed in a space laboratory orbiting round the earth at a height '3R' from the earth's surface. The time period of the pendulum will be ($R =$ radius of earth)

(A) zero (B) $\frac{2}{3}$ s
(C) 4 s (D) infinite

47. A solid metallic sphere has a charge $+3Q$. Concentric with this sphere is a conducting spherical shell having charge $-\mathrm{Q}$. The radius of the sphere is 'A' and that of the spherical shell is 'B'. $(B > A)$. The electric field at a distance 'R' $(\mathrm{A} < \mathrm{R} < \mathrm{B})$ from the centre is ($\varepsilon_0 =$ permittivity of vacuum)

(A) $\frac{\mathrm{Q}}{2\pi\epsilon_0\mathrm{R}}$ (B) $\frac{3Q}{2\pi\epsilon_0 R}$
(C) $\frac{3\mathrm{Q}}{4\pi\epsilon_0\mathrm{R}^2}$ (D) $\frac{4Q}{2\pi\epsilon_0 R^2}$

48. A closed organ pipe of length 'L_1' and an open organ pipe contain diatomic gases of densities 'ρ_1' and 'ρ_2' respectively. The compressibilities of the gases are same in both pipes, which are vibrating in their first overtone with same frequency. The length of the open organ pipe is (Neglect end correction)

(A) $\frac{4\,\mathrm{L}_1}{3}$ (B) $\frac{4L_1}{3}\sqrt{\frac{\rho_1}{\rho_2}}$
(C) $\frac{4L_1}{3}\sqrt{\frac{\rho_2}{\rho_1}}$ (D) $\frac{3}{4L_1}\sqrt{\frac{\rho_1}{\rho_2}}$

49. From a metallic surface photoelectric emission is observed for frequencies v_1 and $v_2 (v_1 > v_2)$ of the incident light. The maximum values of the kinetic energy of the photoelectrons emitted in the two cases are in the ratio $1:\mathrm{x}$. Hence the threshold frequency of the metallic surface is

(A) $\frac{v_1 - v_2}{x}$ (B) $\frac{v_1 - v_2}{x-1}$
(C) $\frac{xv_1 - v_2}{x-1}$ (D) $\frac{xv_2 - v_1}{x-1}$

50. In an AC circuit, the current is

$$\mathrm{i} = 5\sin\left(100\mathrm{t} - \frac{\pi}{2}\right)\mathrm{A}$$

and voltage is

$$\mathrm{e} = 200\sin(100\mathrm{t})$$

volt. Power consumption in the circuit is $(\cos 90^\circ = 0)$

(A) 200 W (B) 0 W
(C) 40 W (D) 1000 W

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51. Which of the following molecules has no lone pair of electrons on central atom?

(A) SO_2 (B) SF_6

(C) NH_3 (D) SF_4

52. Calculate ΔG° for the cell:

$$Sn_{(s)}\left|Sn^{2+}_{(1M)}\right|\left|Ag^{+}_{(1M)}\right|Ag_{(s)}$$

at

$$25^\circ C\left(E^\circ_{cell} = 0.90\ V\right)$$

(A) -173.7 kJ (B) -225.3 kJ

(C) -100.2 kJ (D) -290.8 kJ

53. Which from following statements is NOT correct?

(A) All alkali metals are silvery white.

(B) Density of potassium is less than sodium.

(C) Compounds of group-1 elements are diamagnetic.

(D) Melting point of group-1 elements increase down the group.

54. A compound made of elements A and B form fcc structure. Atoms of A are at the corners and atoms of B are present at the centres of faces of cube. What is the formula of the compound?

(A) AB (B) AB_2

(C) AB_3 (D) A_2B

55. What are different possible oxidation states exhibited by scandium?

(A) $+4$ (B) $+5$

(C) $+4, +5$ (D) $+2, +3$

56. Which from following is the slope of the graph of rate versus concentration of the reactant for first order reaction?

(A) $-k$ (B) k

(C) $\frac{k}{2.303}$ (D) $\frac{-k}{2.303}$

57. What is the packing efficiency of silver metal in its unit cell?

(A) 52.4% (B) 68.0%

(C) 32.0% (D) 74.0%

58. Which from following polymers is obtained from C_2F_4 ?

(A) PVC (B) Polyisobutylene

(C) Polyacrylonitrile (D) Teflon

59. Calculate current in ampere required to deposit 4.8 g Cu from it's salt solution in 30 minutes. [Molar mass of

$$Cu = 63.5\ g\ mol^{-1}$$

]

(A) 8.1 ampere (B) 6.4 ampere

(C) 10.5 ampere (D) 12.3 ampere

60. Identify number of moles of donor atoms in 2n mole of SCN^-.

(A) 3n (B) 6n

(C) 4n (D) n

61. 0.2 M aqueous solution of glucose has osmotic pressure 4.9 atm at 300 K. What is the concentration of glucose if it has osmotic pressure 1.5 atm at same temperature?

(A) 0.03 M (B) 0.04 M

(C) 0.05 M (D) 0.06 M

62. Identify the product when phenol is heated with zinc dust.

(A) Benzoquinone (B) Cyclohexane

(C) Benzene (D) Cyclohexanol

63. Identify the product 'B' in the following reaction.

Dry ice

$$\xrightarrow[\text{Dry ether}]{CH_3MgBr}$$

A

$$\xrightarrow[\text{dil. HCl}]{H_2O}$$

B

(A) Methanoic acid (B) Ethanoic acid

(C) Methanol (D) Ethanol

64. Which among the following reactions exhibits

$$\Delta H = \Delta U$$

?

(A) $H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$

(B) $2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

(C) $PCl_{5(g)} \rightarrow PCl_{3(g)} + Cl_{2(g)}$

(D) $C_{(s)} + 2H_2O_{(g)} \rightarrow 2H_{2(g)} + CO_{2(g)}$

65. A buffer solution is prepared by mixing 0.2 M sodium acetate and 0.1 M acetic acid. If pK_a for acetic acid is 4.7, find the pH.

(A) 3.0 (B) 4.0

(C) 5.0 (D) 2.0

66. A solution of nonvolatile solute is obtained by dissolving 3.5 g in 100 g solvent has boiling point elevation 0.35 K. Calculate the molar mass of solute.
(Molal elevation constant $= 2.5 \text{ K kg mol}^{-1}$)

(A) 270 g mol^{-1} (B) 260 g mol^{-1}

(C) 250 g mol^{-1} (D) 240 g mol^{-1}

67. At 0°C a gas occupies 22.4 liters. What is the temperature in Kelvin to reach the volume of 224 liters?

(A) 546 K (B) 273 K

(C) 2730 K (D) 5460 K

68. Which from following rule / principle states that "No two electrons in an atom can have the same set of four quantum numbers"?

(A) Pauli's exclusion principle (B) Hund's rule

(C) Aufbau rule (D) Heisenberg uncertainty principle

69. Which from following molecules exhibits highest acidic nature?

(A) H_2O (B) H_2S

(C) H_2Se (D) H_2Te

70. What is the number of moles of sp^2 hybrid carbon atoms in one mole of hexa-1,4-diyne?

(A) 5 (B) 3

(C) 4 (D) Zero

71. Which of the following is NOT obtained when a mixture of methyl chloride and n-propyl chloride is treated with sodium metal in dry ether?

(A) Ethane (B) Butane

(C) Propane (D) Hexane

72. Which carbon atoms (numbered from C_1 to C_6) are involved in the formation of ring structure of glucose?

(A) C_2 and C_5 (B) C_1 and C_3

(C) C_1 and C_4 (D) C_1 and C_5

73. Calculate the amount of reactant in percent that remains after 60 minutes involved in first order reaction.
($k = 0.02303$ minute $^{-1}$)

(A) 25% (B) 75%

(C) 50% (D) 12.5%

74. Which salt from following forms aqueous solution having pH less than 7 ?

(A) CH_3COONa (B) Na_2SO_4

(C) $CuSO_4$ (D) Na_2CO_3

75. Identify neutral ligand from following

(A) Ammine (B) Nitrato

(C) Cyano (D) Chloro

76. Identify the product 'B' in following reaction.
Ethyl phenyl ketone

$$\xrightarrow{H_2N-NH_2}$$

A

$$\xrightarrow[\Delta]{KOH,\, HO-(CH_2)_2-OH}$$

(A) Phenylhydrazone (B) Ethyl benzene

(C) n-Propyl benzene (D) Isopropyl benzene

77. Which of the following amines undergoes acylation reaction?

(A) Ethyldimethylamine

(B) N-Methylaniline

(C) N,N-Dimethylmethanamine

(D) N,N-Dimethylaniline

78. What is the IUPAC name of following compound?



(A) 1-Methylbut-2-en-1-amine
(B) Pent-3-en-2-amine
(C) Pent-2-en-4-amine
(D) 4-Methylbut-2-en-4-amine

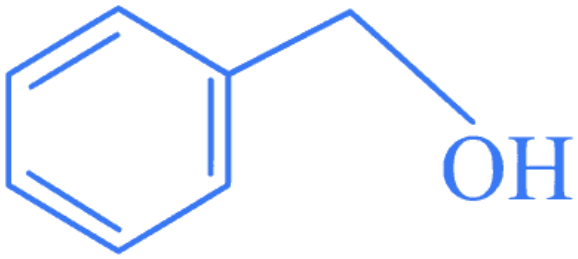
79. What is the number of unit cells when one mole atom of a metal that forms simple cubic structure?

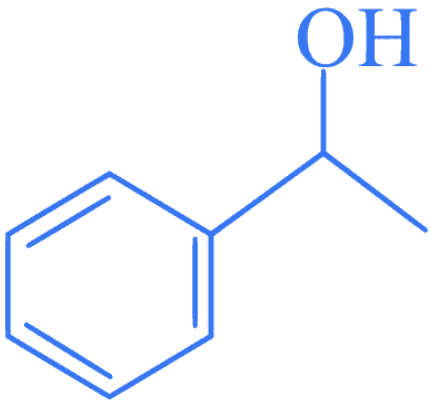
(A) 6.022×10^{23}
(B) 1.204×10^{24}
(C) 9.033×10^{23}
(D) 3.011×10^{23}

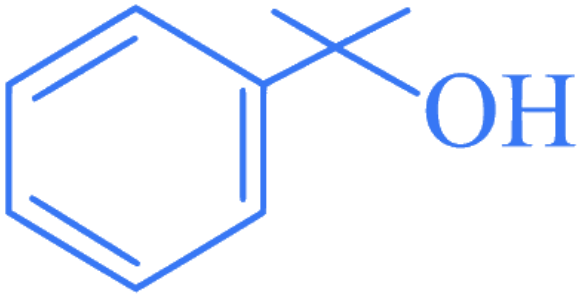
80. Identify the gas produced due to reduction of NH_4^+ ions at cathode during working of dry cell.

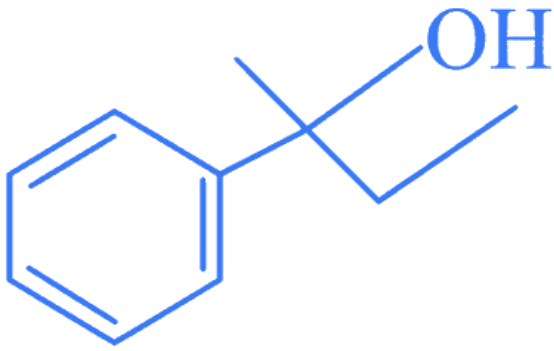
(A) Ammonia
(B) Hydrogen
(C) Hydrogen chloride
(D) Chlorine

81. Which of the following is secondary benzylic alcohol?

(A)


(B)


(C)


(D)


82. Find the value of spin only magnetic moment for chromium cation in +2 state.

(A) 3.87 BM
(B) 4.90 BM
(C) 2.84 BM
(D) 1.73 BM

83. An ideal gas expands by performing 200 J of work, during this internal energy increases by 432 J. What is enthalpy change?

(A) 200 J
(B) 232 J
(C) 432 J
(D) 632 J

84. Calculate the wavenumber of the photon emitted during transition from the orbit of $n = 2$ to $n = 1$ in hydrogen atom. $\left[R_H = 109677\ \text{cm}^{-1}\right]$

(A) 27419.3 cm^{-} (B) 109677.0 cm^{-1}

(C) 12064.5 cm^{-1} (D) 82257.8 cm^{-1}

85. Calculate the value of ΔG for following reaction at 300 K.

$$H_2O_{(s)} \longrightarrow H_2O_{(l)}$$

$$\left(\Delta H = 7\ \text{kJ}, \Delta S = 24.8\ \text{J K}^{-1}\right)$$

(A) 0.74 kJ mol^{-1} (B) -0.82 kJ mol^{-1}

(C) 0.21 kJ mol^{-1} (D) -0.44 kJ mol^{-1}

86. What is the oxidation state of carbon in CaC_2 and $K_2C_2O_4$ respectively?

(A) -2 and $+6$ (B) -1 and $+3$

(C) $+2$ and $+2$ (D) -2 and $+3$

87. What is the number of moles of water molecules required to prepare n moles of methane from n moles of methyl magnesium iodide?

(A) n (B) 2n

(C) 0.5n (D) 0.1n

88. Which of the following metals is used as catalyst in manufacture of sulphuric acid by contact process?

(A) Iron (B) Platinum

(C) Nickel (D) Cobalt

89. The rate for reaction $A + B \rightarrow$ product, is 1.8×10^{-2} mol dm^{-3} s^{-1}. Calculate the rate constant if the reaction is second order in A and first order in B. ($[A] = 0.2M; [B] = 0.1M$)

(A) 9.0 mol^{-2} dm^6 s^{-1} (B) 18.0 mol^{-2} dm^6 s^{-1}

(C) 4.5 mol^{-2} dm^6 s^{-1} (D) 16.0 mol^{-2} dm^6 s^{-1}

90. Which of the following concentration terms depends on temperature?

(A) Molality (B) Molarity

(C) Mole fraction (D) Percent by mass

91. What type of reaction is the formation of aldol from aldehyde?

(A) Condensation reaction (B) Addition reaction

(C) Substitution reaction (D) Elimination reaction

92. Identify homopolymer from following.

(A) Polyacrylonitrile (B) Glyptal

(C) Polycarbonate (D) Buna-S

93. Identify the chiral molecule from following.

(A) 2-Bromopropane (B) 2-Bromo-2-methylbutane

(C) 2-Bromo-3-methylbutane (D) 3-Bromopentane

94. What is the mass in gram of 1 atom of an element if its atomic mass is 10 u ?

(A) 2.06056×10^{-22} g (B) 1.66056×10^{-23} g

(C) 1.06056×10^{-24} g (D) 3.66056×10^{-25} g

95. Solubility of a salt A_2B_3 is 1×10^{-3} mol dm^{-3}. What is the value of its solubility product?

(A) 1.08×10^{-13} (B) 8.1×10^{-15}

(C) 2.7×10^{-15} (D) 2.0×10^{-13}

96. Identify the element having general electronic configuration ns^2np^4 from following.

(A) Se (B) Br

(C) Xe (D) Kr

97. Identify the product A obtained in the following reaction.

Phenol + Conc. Nitric acid $\xrightarrow{\text{conc, } H_2SO_4}$ A

(A) o-Nitrophenol (B) p-Nitrophenol

(C) 2,4,6-Trinitrophenol (D) Mixture of ortho and para-nitrophenol

98. What is the value of specific rotation exhibited by glucose molecule?

(A) $+52.7^\circ$ (B) -92.4°

(C) $+66.5^\circ$ (D) $+40.3^\circ$

99. What type of information is collected using scanning electron microscopy?

(A) Structure of material surface
(B) Crystal structure
(C) Binding nature
(D) Particle size

100. Identify the reagent A in the following conversion.

Alkyl halide $\xrightarrow{A}$ Alkyl nitrite

(A) KNO_3
(B) $NaNO_3$
(C) $AgNO_2$
(D) KNO_2

101. If two vertices of a triangle are $A(3,1,4)$ and $B(-4,5,-3)$ and the centroid of the triangle is $G(-1,2,1)$, then the third vertex C of the triangle is

(A) $(2,0,2)$ (B) $(-2,0,2)$

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

102. In a Binomial distribution with

$$n = 4$$

, if

$$2P(X = 3) = 3P(X = 2)$$

, then the variance is

(A) $\frac{36}{169}$ (B) $\frac{144}{169}$

(C) $\frac{9}{169}$ (D) $\frac{16}{169}$

103. Let two non-collinear vectors $\hat{a}$ and $\hat{b}$ form an acute angle. A point P moves, so that at any time t the position vector $\overline{OP}$, where O is origin, is given by $\hat{a}\sin t + \hat{b}\cos t$, when P is farthest from origin O, let M be the length of $\overline{OP}$ and $\hat{u}$ be the unit vector along $\overline{OP}$, then

(A) $\hat{u} = \frac{\hat{a}+\hat{b}}{|\hat{a}+\hat{b}|}$ and $M = (1+\hat{a}\cdot\hat{b})^{\frac{1}{2}}$

(B) $\hat{u} = \frac{\hat{a}-\hat{b}}{|\hat{a}-\hat{b}|}$ and $M = (1+\hat{a}\cdot\hat{b})^{\frac{1}{2}}$

(C) $\hat{u} = \frac{\hat{a}+\hat{b}}{|\hat{a}+\hat{b}|}$ and $M = (1+2\hat{a}\cdot\hat{b})^{\frac{1}{2}}$

(D) $\hat{u} = \frac{\hat{a}-\hat{b}}{|\hat{a}-\hat{b}|}$ and $M = (1-2\hat{a}\cdot\hat{b})^{\frac{1}{2}}$

104. The number of solutions in $[0,2\pi]$ of the equation

$$16^{\sin^2 x} + 16^{\cos^2 x} = 10$$

is

(A) 2 (B) 4

(C) 6 (D) 8

105. The differential equation of all parabolas, whose axes are parallel to Y-axis, is

(A) $y_3 = 1$ (B) $y_3 = 0$

(C) $y_3 = -1$ (D) $yy_3 + y_1 = 0$

106. The value of c of Lagrange's mean value theorem for

$$f(x) = \sqrt{25 - x^2}$$

on $[1,5]$ is

(A) $\sqrt{15}$ (B) 5

(C) $\sqrt{10}$ (D) 1

107.

$$\int \frac{x+1}{x(1+xe^x)^2}\,dx =$$

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

(B) $\log\left|\frac{xe^x}{1+xe^x}\right| - \frac{1}{1+xe^x} + c$, where c is a constant of integration.

(C) $\log|1+xe^x| + \frac{1}{1+xe^x} + c$, where c is constant of integration.

(D) $\log\left|\frac{xe^x}{1+xe^x}\right| + \frac{1}{1+xe^x} + c$, where c is constant of integration.

108. If

$$Z_1 = 4i^{40} - 5i^{35} + 6i^{17} + 2, Z_2 = -1 + i$$

, where

$$i = \sqrt{-1}$$

, then

$$|Z_1 + Z_2| =$$

(A) 5 (B) 13

(C) 12 (D) 15

109. The approximate value of $\log_{10} 998$ is (given that

$$\log_{10} e = 0.4343$$

)

(A) 3.0008686 (B) 1.9991314

(C) 2.0008686 (D) 2.9991314

110. If

$$\sin^{-1} x + \cos^{-1} y = \frac{3\pi}{10}$$

, then the value of $\cos^{-1} x + \sin^{-1} y$ is

(A) $\frac{\pi}{10}$ (B) $\frac{7\pi}{10}$

(C) $\frac{9\pi}{10}$ (D) $\frac{3\pi}{10}$

111. The area (in sq. units) of the region

$$A = \left\{(x,y)/\frac{y^2}{2} \le x \le y+4\right\}$$

is

(A) 30 (B) $\frac{53}{3}$

(C) 16 (D) 18

112. A, B, C are three events, one of which must and only one can happen. The odds in favor of A are 4 : 6, the odds against B are 7 : 3. Thus, odds against C are

(A) 7 : 3 (B) 4 : 6

(C) 6 : 4 (D) 3 : 7

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

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

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

114. Two sides of a triangle are $\sqrt{3}+1$ and $\sqrt{3}-1$ and the included angle is 60°, then the difference of the remaining angles is

(A) 30° (B) 45°

(C) 60° (D) 90°

115. The standard deviation of the following distribution

C.I.	0 - 6	6 - 12	12 - 18
f_i	2	4	6

is

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

(C) $2\sqrt{5}$ (D) 20

116. The maximum value of xy when $x + 2y = 8$ is

(A) 20 (B) 16

(C) 24 (D) 8

117. If truth values of statements p, q are true, and r, s are false, then the truth values of the following statement patterns are respectively

$$a :\sim (p \wedge \sim r) \vee (\sim q \vee s)$$
$$b : (\sim q \wedge \sim r) \leftrightarrow (p \vee s)$$
$$c : (\sim p \vee q) \rightarrow (r \wedge \sim s)$$

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

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

118. The rate of change of $\sqrt{x^2+16}$ with respect to

$$\frac{x}{x-1}$$

at

$$x = 5$$

is

(A) $\frac{-80}{\sqrt{41}}$ (B) $\frac{80}{\sqrt{41}}$

(C) $\frac{12}{5}$ (D) $\frac{-12}{5}$

119. If

$$x^2 + y^2 = t + \frac{1}{t}$$

and

$$x^4 + y^4 = t^2 + \frac{1}{t^2}$$

, then

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

is equal to

(A) $\frac{y}{x}$ (B) $\frac{-y}{x}$

(C) $\frac{x}{y}$ (D) $\frac{-x}{y}$

120. Two tangents to the circle

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

at the points A and B meet at the point $P(-4, 0)$. Then the area of the quadrilateral PAOB, O being the origin, is

(A) $2\sqrt{3}$ sq. units (B) $8\sqrt{3}$ sq. units

(C) $4\sqrt{3}$ sq. units (D) $6\sqrt{3}$ sq. units

121.

$$f : \mathbb{R} - \left(-\frac{3}{5}\right) \rightarrow \mathbb{R}$$

is defined by

$$f(x) = \frac{3x-2}{5x+3}$$

, then $f \circ f(1)$ is

(A) 1 (B) $\frac{-13}{29}$

(C) $\frac{13}{29}$ (D) -1

122. The value of

$$\cot\left(\sum_{n=1}^{23} \cot^{-1}\left(1 + \sum_{k=1}^{n} 2k\right)\right)$$

is

(A) $\frac{23}{25}$ (B) $\frac{25}{23}$

(C) $\frac{23}{24}$ (D) $\frac{24}{23}$

123. An object is moving in the clockwise direction around the unit circle

$$x^2 + y^2 = 1$$

. As it passes through the point

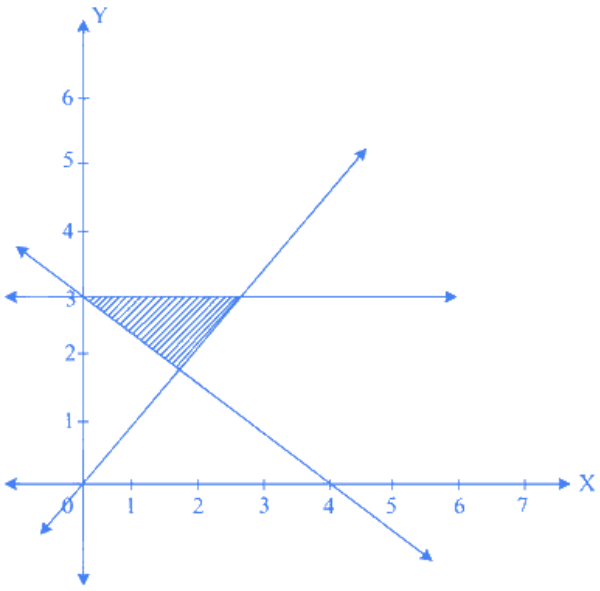
$$\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$$

, its y-co-ordinate is decreasing at the rate of 3 units per sec. The rate at which the x-co-ordinate changes at this point is

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

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

124. If feasible region is as shown in the figure, then the related inequalities are



(A) $3x + 4y \geq 12, y - x \geq 0, y \leq 3, x, y \geq 0$

(B) $3x + 4y \leq 12, y - x \leq 0, y \geq 3, x, y \geq 0$

(C) $3x + 4y \leq 12, y - x \geq 0, y \leq 3, x, y \geq 0$

(D) $3x + 4y \geq 12, y - x \leq 0, y \geq 3, x, y \geq 0$

125.

$$\int \frac{e^{\tan^{-1}x}}{1+x^2}\left[\left(\sec^{-1}\sqrt{1+x^2}\right)^2 + \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right] dx, x > 0 =$$

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

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

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

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

126. If $f(x)$ is a function satisfying

$$f'(x) = f(x)$$

with

$$f(0) = 1$$

and $g(x)$ is a function that satisfies

$$f(x) + g(x) = x^2$$

. Then the value of the integral

$$\int_0^1 f(x)g(x)dx$$

is

(A) $e - \frac{e^2}{2} - \frac{5}{2}$ (B) $e + \frac{e^2}{2} - \frac{3}{2}$

(C) $e - \frac{e^2}{2} - \frac{3}{2}$ (D) $e + \frac{e^2}{2} + \frac{5}{2}$

127. The foot of the perpendicular drawn from the origin to the plane is $(4, -2, 5)$, then the Cartesian equation of the plane is

(A) $4x - 2y + 5z = 45$

(B) $-4x + 2y + 5z = 45$

(C) $4x - 2y + 5z + 45 = 0$

(D) $4x + 2y - 5z + 45 = 0$

128.

$$\lim_{x \to \frac{\pi}{2}} \frac{\cot x - \cos x}{(\pi - 2x)^3}$$

equals

(A) $\frac{1}{24}$ (B) $\frac{1}{16}$

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

129. If the distance between the parallel lines given by the equation

$$x^2 + 4xy + py^2 + 3x + qy - 4 = 0$$

is λ, then

$$\lambda^2 =$$

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

(C) 25 (D) $\frac{9}{5}$

130. The particular solution of the differential equation

$$(1 + y^2)dx - xy\,dy = 0$$

at

$$x = 1, y = 0$$

, represents

(A) circle (B) pair of straight lines

(C) hyperbola (D) ellipse

131. If at the end of certain meeting, everyone had shaken hands with everyone else, it was found that 45 handshakes were exchanged, then the number of members present at the meeting, are

(A) 10 (B) 15

(C) 20 (D) 21

132. If

$$\sin 18^\circ = \frac{\sqrt{5}\ -1}{4}$$

, then $\cos^2 48^\circ - \sin^2 12^\circ$ has the value

(A) $\frac{-\sqrt{5}+1}{8}$ (B) $\frac{\sqrt{5}-1}{8}$

(C) $\frac{\sqrt{5}+1}{8}$ (D) $\frac{-1-\sqrt{5}}{8}$

133. If

$$A = \begin{bmatrix} 2 & -1 \\ -1 & 3 \end{bmatrix}$$

, then the inverse of $\left(2A^2 + 5A\right)$ is

(A) $\frac{1}{95}\begin{bmatrix} 7 & 3 \\ 3 & 4 \end{bmatrix}$ (B) $\frac{1}{95}\begin{bmatrix} -7 & 3 \\ 3 & -4 \end{bmatrix}$

(C) $\frac{1}{95}\begin{bmatrix} -7 & -3 \\ 3 & 4 \end{bmatrix}$ (D) $\frac{1}{95}\begin{bmatrix} 4 & 3 \\ 3 & 7 \end{bmatrix}$

134. If

$$I = \int \frac{\sin x + \sin^3 x}{\cos 2x} dx = P\cos x + Q \log\left|\frac{\sqrt{2}\ \cos x - 1}{\sqrt{2}\ \cos x + 1}\right|$$

(where c is a constant of integration), then values of P and Q are respectively

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

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

135. The negation of the statement $(p \wedge q) \rightarrow (\sim p \vee r)$ is

(A) $p \vee q \vee \sim r$ (B) p ∧ q ∧ ∼ r

(C) $\sim p \vee q \wedge r$ (D) $\sim p \vee \sim q \vee \sim r$

136. The probability mass function of random variable X is given by

$$P[X = r] = \begin{cases} \frac{{}^nC_r}{32}, & n, r \in \mathbb{N} \\ 0, & \text{otherwise} \end{cases}$$

, then $P[X \leq 2]$ =

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

(C) $\frac{1}{4}$ (D) $\frac{1}{5}$

137. The distance of a point $(2, 5)$ from the line $3x + y + 4 = 0$ measured along the line L_1 and L_1 are same. If slope of line L_1 is $\frac{3}{4}$, then slope of the line L_2 is

(A) $-\frac{3}{4}$ (B) $\frac{1}{3}$

(C) $\frac{1}{4}$ (D) 0

138. The distance of the point having position vector $\hat{i} - 2\hat{j} - 6\hat{k}$, from the straight line passing through the point $(2, -3, -4)$ and parallel to the vector $6\hat{i} + 3\hat{j} - 4\hat{k}$ is units.

(A) $\sqrt{\frac{340}{61}}$ (B) $\frac{341}{61}$

(C) $\frac{\sqrt{341}}{61}$ (D) $\sqrt{\frac{341}{61}}$

139. A vector $\overrightarrow{n}$ is inclined to X-axis at 45°, Y-axis at 60° and at an acute angle to Z-axis If $\overrightarrow{n}$ is normal to a plane passing through the point $(-\sqrt{2}, 1, 1)$, then equation of the plane is

(A) $\sqrt{2}x + y + z = 0$

(B) $x + \sqrt{2}y + z = 1$

(C) $-\sqrt{2}\ x + y + 2z = 5$

(D) $x + y + \sqrt{2}z = 1$

140. If

$$\cos^{-1} x - \cos^{-1} \frac{y}{3} = \alpha$$

, where

$$-1 \leq x \leq 1, -3 \leq y \leq 3, x \leq \frac{y}{3}$$

, then for all $x, y\ 9x^2 - 6xy\cos\alpha + y^2$ is equal to

(A) $\sin^2\alpha$ (B) $3\sin^2\alpha$

(C) $9\sin^2\alpha$ (D) $\frac{4}{9}\sin^2\alpha$

141. 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) 19

(C) 23 (D) 33

142. Three fair coins numbered 1 and 0 are tossed simultaneously. Then variance Var (X) of the probability distribution of random variable X, where X is the sum of numbers on the uppermost faces, is

(A) 0.7 (B) 0.75

(C) 0.65 (D) 0.62

143.

$$\int \frac{1}{\sin(x-a)\sin x}dx =$$

(A) $\sin a(\log(\sin(x-\text{a})\cdot \text{cosec}x)) + \text{c}$, where c is a constant of integration.

(B) $\text{cosec}a(\log(\sin(x-a)\cdot \text{cosec}x)) + c$, where c is a constant of integration.

(C) $-\sin a(\log(\sin(x-\text{a})\cdot \sin x)) + \text{c}$, where c is a constant of integration.

(D) $-\text{cosec}a(\log(\sin(x-\text{a})\cdot \sin x)) + \text{c}$, where c is a constant of integration.

144. The derivative of $\text{f}(\sec x)$ with respect to $g(\tan x)$ at

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

, where

$$f'(\sqrt{2}\,) = 4$$

and

$$g'(1) = 2$$

, is

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

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

145. The scalar product of the vector $\hat{\text{i}}+\hat{\text{j}}+\hat{\text{k}}$ with a unit vector along the sum of the vectors $2\hat{i}+4\hat{j}-5\hat{k}$ and $\lambda\hat{i}+2\hat{j}+3\hat{k}$ is equal to 1 , then value of λ is

(A) 1 (B) 2

(C) 3 (D) 4

146. The number of discontinuities of the greatest integer function

$$\text{f}(x) = [x], x \in \left(-\frac{7}{2}, 100\right)$$

(A) 104 (B) 100

(C) 102 (D) 103

147. If

$$[(\bar{a}+2\bar{b}+3\bar{c})\times(\bar{b}+2\bar{c}+3\bar{a})]\cdot(\bar{c}+2\bar{a}+3\bar{b}) = 54$$

then the value of

$$\left[\bar{a} \quad \bar{b} \quad \bar{c}\right]$$

is

(A) 0 (B) 1

(C) 3 (D) 2

148. A spherical raindrop evaporates at a rate proportional to its surface area. If originally its radius is 3 mm and 1 hour later it reduces to 2 mm, then the expression for the radius R of the raindrop at any time t is

(A) $6\text{R} = \text{t} + 2$ (B) $\text{R}(\text{t}+2) = 6$

(C) $\text{R} = 6(\text{t}+2)$ (D) $6\text{R} = \text{t}$

149. If the Cartesian equation of a line is

$$6x-2 = 3y+1 = 2z-2$$

, then the vector equation of the line is

(A) $\bar{\text{r}} = (\frac{1}{3}\hat{\text{i}} - \frac{1}{3}\hat{\text{j}} + \hat{\text{k}}) + \lambda(\hat{\text{i}} + 2\hat{\text{j}} + 3\hat{\text{k}})$

(B) $\bar{\text{r}} = (\hat{\text{i}} + \hat{\text{j}} + \hat{\text{k}}) + \lambda(\hat{\text{i}} + 2\hat{\text{j}} + 3\hat{\text{k}})$

(C) $\bar{\text{r}} = (\frac{-1}{3}\hat{\text{i}} + \frac{1}{3}\hat{\text{j}} + \hat{\text{k}}) + \lambda(\hat{\text{i}} - 2\hat{\text{j}} + 3\hat{\text{k}})$

(D) $\bar{\text{r}} = (\frac{1}{3}\hat{\text{i}} - \frac{1}{3}\hat{\text{j}} - \hat{\text{k}}) + \lambda(\hat{\text{i}} - \hat{\text{j}} + \hat{\text{k}})$

150. The volume of parallelopiped, whose coterminous edges are given by

$$\text{u} = \hat{\text{i}} + \hat{\text{j}} + \lambda\hat{\text{k}}, \vec{v} = \hat{i} + \hat{j} + 3\hat{k}, \bar{w} = 2\hat{i} + \hat{j} + \hat{k}$$

is 1 cu. units. If θ is the angle between $\bar{u}$ and $\bar{w}$, then the value of $\cos\theta$ is

(A) $\frac{3}{4}$ (B) $\frac{5}{6}$

(C) $\frac{1}{5}$ (D) $\frac{1}{6}$

- End of Question Paper -