MHT CET 2023 PCM May 10 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**.

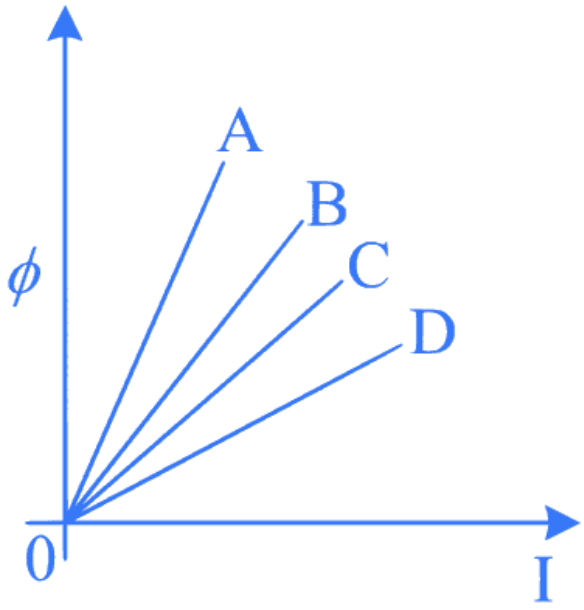
(vi) There is **no negative marking**. Unanswered questions score zero.

1. An open organ pipe having fundamental frequency (n) is in unison with a vibrating string. If the tube is dipped in water so that 75% of the length of the tube is inside the water then the ratio of fundamental frequency of the air column of dipped tube with that of string will be (Neglect end corrections)

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

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

2. A graph of magnetic flux (ϕ) versus current (I) is plotted for four inductors A, B, C, D. Larger value of self inductance is for inductor



(A) A (B) B

(C) C (D) D

3. An electron accelerated through a potential difference 'V_1' has a de-Broglie wavelength 'λ'. When the potential is changed to 'V_2' its de-Broglie wavelength increases by 50%. The value of

$$\left(\frac{V_1}{V_2}\right)$$

is

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

(C) 3 : 2 (D) 4 : 1

4. In case of a stationary wave pattern which of the following statement is CORRECT?

(A) The distance between the consecutive nodes is equal to the wavelength.

(B) In a pipe at both ends only even harmonics are present in an air column.

(C) In a pipe closed at one end, all harmonics are present in an air column.

(D) In case of a stretched string when vibrated, frequency of first overtone is same as second harmonic.

5. If 'I' is moment of inertia of a thin circular disc about an axis passing through the tangent of the disc and in the plane of disc. The moment of inertia of same circular disc about an axis perpendicular to plane and passing through its centre is

(A) $\frac{4I}{5}$ (B) $\frac{2I}{5}$

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

6. A parallel plate capacitor has plate area 'A' and separation between plates is 'd'. It is charged to a potential difference of V_0 volt. The charging battery is then disconnected and plates are pulled apart three times the initial distance. The work done to increase the distance between the plates is

(ε_0 = permittivity of free space)

(A) $\frac{3\epsilon_0 A V_0^2}{d}$ (B) $\frac{\epsilon_0 A V_0^2}{2d}$

(C) $\frac{\epsilon_0 A V_0^2}{3d}$ (D) $\frac{\epsilon_0 A V_0^2}{d}$

7. The shortest wavelength in the Balmer series of hydrogen atom is equal to the shortest wavelength in the Brackett series of a hydrogen like atom of atomic number z. The value of z is

(A) 2 (B) 3

(C) 4 (D) 6

8. If the length of stretched string is reduced by 40% and tension is increased by 44% then the ratio of final to initial frequencies of stretched string is

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

(C) 3 : 4 (D) 1 : 3

9. A square loop of area 25 cm^2 has a resistance of 10Ω. This loop is placed in a uniform magnetic field of magnitude 40 T. The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in one second, will be

(A) 1×10^{-4} J (B) 1.0×10^{-3} J

(C) 5×10^{-3} J (D) 2.5×10^{-3} J

10. Two capacitors

$$C_1 = 3\mu F$$

and

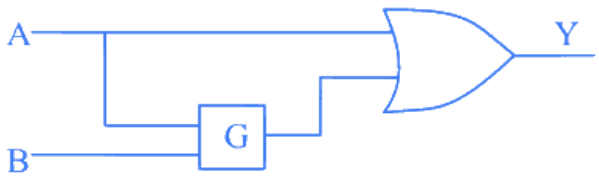
$$C_2 = 2\mu F$$

are connected in series across d.c. source of 100 V . The ratio of the potential across C_2 to C_1 is

(A) 2 : 3 (B) 3 : 2

(C) 6 : 5 (D) 5 : 6

11. To obtain the truth-table shown, from the following logic circuit, the gate G should be



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

(A) AND (B) NAND

(C) OR (D) NOR

12. An electric dipole consisting of two opposite charges of 2×10^{-6}C separated by a distance of 3 cm placed in an electric field of 2×10^5 N/C then the maximum torque acting on dipole is

(A) 12×10^{-1} N − m (B) 24×10^{-3} N − m

(C) 12×10^{-3} N − m (D) 24×10^{-1} N − m

13. In insulators

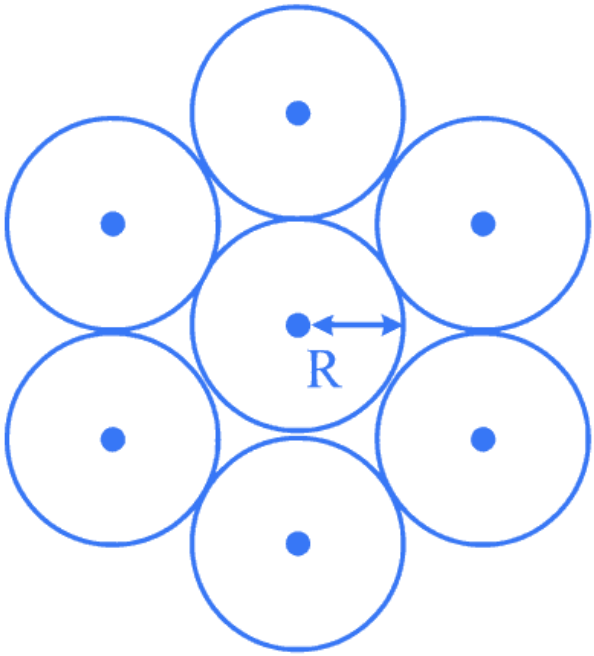
(A) valence band is empty and conduction band is filled with electrons.

(B) conduction band is empty and valence band is completely filled with electrons.

(C) valence band is partially filled.

(D) conduction band is partially filled with electrons.

14. Seven identical discs each of mass M and radius R are arranged in a hexagonal plane pattern so as to touch each neighbour disc as shown in the figure. The moment of inertia of the system of seven discs about an axis passing through the centre of central disc and normal to the plane of all discs is



(A) $\frac{7}{2}$ MR^2 (B) $\frac{13}{2}$ MR^2

(C) $\frac{29}{2}$ MR^2 (D) $\frac{55}{2}$ MR^2

15. A satellite moves in a stable circular orbit round the earth if (where V_H, V_c and V_e are the horizontal velocity, critical velocity and escape velocity respectively)

(A) $V_H < V_c$ (B) $V_H = V_e$

(C) $V_H = V_c$ (D) $V_H > V_e$

16. The mean electrical energy density between plates of a charged air capacitor is (where q = charge on capacitor, A = Area of capacitor plate)

(A) $\frac{q^2}{2\epsilon_0 A^2}$ (B) $\frac{q}{2\epsilon_0 A^2}$

(C) $\frac{q^2}{2\epsilon_0 A}$ (D) $\frac{\epsilon_0 A}{q^2}$

17. A person is observing a bacteria through a compound microscope. For better observation and to improve its resolving power he should

(A) increase the wavelength of light.

(B) increase the refractive index of the medium between the object and objective lens.

(C) decrease the focal length of the eyepiece.

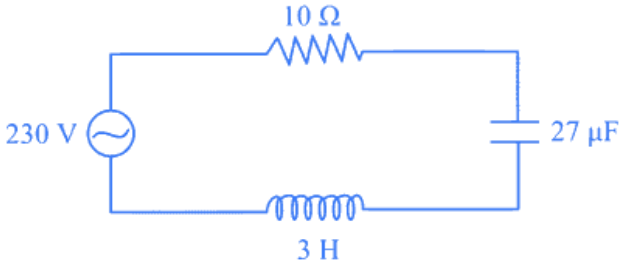
(D) decrease the diameter of the objective lens.

18. The inductive reactance of a coil is 'X_L'. If the inductance of a coil is tripled and frequency of a.c. supply is doubled, then the new inductive reactance will be

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

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

19. In the circuit shown the ratio of quality factor and the bandwidth is



(A) 10 s (B) 8 s

(C) 6 s (D) 4 s

20. Water flows through a horizontal pipe at a speed 'V'. Internal diameter of the pipe is 'd'. If the water is coming out at a speed 'V_1' then the diameter of the nozzle is

(A) $d\sqrt{\frac{V_1}{V}}$ (B) $d\sqrt{\frac{V}{V_1}}$

(C) $\frac{dV}{V_1}$ (D) $\frac{V_1}{dV}$

21. In Young's double slit experiment the separation between the slits is doubled without changing other setting of the experiment to obtain same fringe width, the distance 'D' of the screen from slit should be made

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

(C) 2D (D) 4D

22. A body is released from the top of a tower 'H' metre high. It takes t second to reach the ground. The height of the body $\frac{t}{2}$ second after release is

(A) $\frac{H}{2}$ metre from ground (B) $\frac{H}{4}$ metre from ground

(C) $\frac{3H}{4}$ metre from ground (D) $\frac{H}{6}$ metre from ground

23. There is a second's pendulum on the surface of earth. It is taken to the surface of planet whose mass and radius are twice that of earth. The period of oscillation of second's pendulum on the planet will be

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

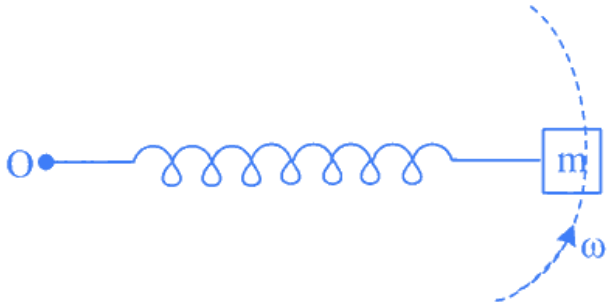
(C) $\frac{1}{\sqrt{2}}$ s (D) $\frac{1}{2}$ s

24. Two long parallel wires carrying currents 8 A and 15 A in opposite directions are placed at a distance of 7 cm from each other. A point 'P' is at equidistant from both the wires such that the lines joining the point to the wires are perpendicular to each other. The magnitude of magnetic field at point 'P' is $(\sqrt{2} = 1.4)(\mu_0 = 4\pi \times 10^{-7}$ SI units)

(A) 68×10^{-6} T (B) 48×10^{-6} T

(C) 32×10^{-6} T (D) 16×10^{-6} T

25. A body of mass 200 gram is tied to a spring of spring constant 12.5 N/m, while other end of spring is fixed at point 'O'. If the body moves about 'O' in a circular path on a smooth horizontal surface with constant angular speed 5 rad/s then the ratio of extension in the spring to its natural length will be



(A) 1 : 2 (B) 1 : 1
(C) 2 : 3 (D) 2 : 5

26. Which of the following is NOT involved in the formation of secondary rainbow?

(A) Refraction (B) Angular dispersion
(C) Interference (D) Total internal reflection

27. For a satellite orbiting around the earth in a circular orbit, the ratio of potential energy to kinetic energy at same height is

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

28. Maximum kinetic energy of photon is 'E' when wavelength of incident radiation is 'λ'. If wavelength of incident radiations is reduced to

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

then energy of photon becomes four times. Then work function of the metal is

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

29. Consider the Doppler effect in two cases. In the first case, an observer moves towards a stationary source of sound with a speed of 50 m/s. In the second case, the observer is at rest and the source moves towards the observer with the same speed of 50 m/s. Then the frequency heard by the observer will be
[velocity of sound in air = 330 m/s .]

(A) same in both the cases. (B) more in the second case than in the first case.
(C) less in the second case than in the first case. (D) less than the actual frequency in both the cases.

30. According to Curie's law in magnetism, the correct relation is (M = magnetization in paramagnetic sample, B = applied magnetic field, T = absolute temperature of the material, C = curie's constant)

(A) $M = \frac{T}{CB}$ (B) $M = \frac{CB}{T}$
(C) $C = \frac{MB}{T}$ (D) $C = \frac{T^2}{MB}$

31. A double convex air bubble in water behaves as

(A) convergent lens (B) divergent lens
(C) plane slab (D) concave mirror

32. Three liquids have same surface tension and densities ρ_1, ρ_2, and $\rho_3 (\rho_1 > \rho_2 > \rho_3)$. In three identical capillaries rise of liquid is same. The corresponding angles of contact θ_1, θ_2 and θ_3 are related as

(A) $\theta_1 > \theta_2 > \theta_3$ (B) $\theta_1 > \theta_3 > \theta_2$
(C) $\theta_1 < \theta_2 < \theta_3$ (D) $\theta_1 = \theta_2 = \theta_3$

33. If a lighter body of mass 'M_1' and velocity 'V_1' and a heavy body (mass M_2 and velocity V_2) have the same kinetic energy then

(A) $M_2V_2 < M_1 V_1$ (B) $M_2V_2 = M_1V_1$
(C) $M_2V_1 < M_1V_2$ (D) $M_2V_2 > M_1V_1$

34. Electron of mass 'm' and charge 'q' is travelling with speed 'v' along a circular path of radius 'R', at right angles to a uniform magnetic field of intensity 'B'. If the speed of the electron is halved and the magnetic field is doubled, the resulting path would have radius

(A) 4R (B) 2R

(C) $\frac{R}{2}$ (D) $\frac{R}{4}$

35. In a series LR circuit,

$$X_L = R$$

, power factor is P_1. If a capacitor of capacitance C with

$$X_C = X_L$$

is added to the circuit the power factor becomes P_2. The ratio of P_1 to P_2 will be

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

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

36. If only 1% of total current is passed through a galvanometer of resistance 'G' then the resistance of the shunt is

(A) $\frac{G}{25}\Omega$ (B) $\frac{G}{49}\Omega$

(C) $\frac{G}{2}\Omega$ (D) $\frac{G}{99}\Omega$

37. A voltmeter of resistance 150Ω connected across a cell of e.m.f. 3 V reads 2.5 V. What is the internal resistance of the cell?

(A) 10Ω (B) 15Ω

(C) 20Ω (D) 30Ω

38. Two conducting circular loops of radii 'R_1' and 'R_2' are placed in the same plane with their centres coinciding. If

$$R_1 > R_2$$

, the mutual inductance M between them will be directly proportional to

(A) $\frac{R_1}{R_2}$ (B) $\frac{R_2}{R_1}$

(C) $\frac{R_1^2}{R_2}$ (D) $\frac{R_2^2}{R_1}$

39. The average force applied on the walls of a closed container depends on T^x where T is the temperature of an ideal gas. The value of 'x' is

(A) 4 (B) 3

(C) 2 (D) 1

40. 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) $\frac{51E}{8}$ (B) $\frac{81E}{16}$

(C) $\frac{61E}{27}$ (D) $\frac{71E}{19}$

41. A Carnot engine with efficiency 50% takes heat from a source at 600 K. To increase the efficiency to 70%, keeping the temperature of the sink same, the new temperature of the source will be

(A) 360 K (B) 1000 K

(C) 900 K (D) 300 K

42. The amplitude of a particle executing S.H.M. is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is

(A) 1 cm (B) 2 cm

(C) 3 cm (D) 4 cm

43. A piece of metal at 850 K is dropped in to 1 kg water at 300 K. If the equilibrium temperature of water is 350 K then the heat capacity of the metal, expressed in JK^{-1} is

(1 cal = 4.2 J)

(A) 420 (B) 240

(C) 100 (D) No Solution

44. Heat energy is incident on the surface at the rate of X J/min . If 'a' and 'r' represent coefficient of absorption and reflection respectively then the heat energy transmitted by the surface in 't' minutes is

(A) $(a+r)xt$ (B) $\frac{(a+r)}{xt}$

(C) $-(a+r)xt$ (D) $\frac{xt}{(a+r)}$

45. Identify the mismatch out of the following.

(A) Zener diode - voltage regulator. (B) Photodiode- optocouplers.

(C) Solar cell - Electrical energy into light. (D) Light emitting diode - optical communication.

46. Two sources of light 0.6 mm apart and screen is placed at a distance of 1.2 m from them. A light of wavelength

$$6000\ \overset{o}{\text{A}}$$

used. Then the phase difference between the two light waves interfering on the screen at a point at a distance 3 mm from central bright band is

(A) 6π radian (B) 3π radian

(C) 4π radian (D) 5π radian

47. The ratio of longest to shortest wavelength emitted in Paschen series of hydrogen atom is

(A) $\frac{144}{63}$ (B) $\frac{25}{9}$

(C) $\frac{9}{25}$ (D) $\frac{63}{144}$

48. The height of liquid column raised in a capillary tube of certain radius when dipped in liquid 'A' vertically is 5 cm. If the tube is dipped in a similar manner in another liquid 'B' of surface tension and density double the values of liquid 'A', the height of liquid column raised in liquid 'B' would be (Assume angle of contact same)

(A) 0.20 m (B) 0.5 m

(C) 0.05 m (D) 0.10 m

49. A particle of mass 'm' is rotating along a circular path of radius 'r' having angular momentum 'L'. The centripetal force acting on the particle is given by

(A) $\frac{L^2}{mr}$ (B) $\frac{L^2}{mr^2}$

(C) $\frac{mL^2}{r}$ (D) $\frac{L^2}{mr^3}$

50. A sample of gas at temperature T is adiabatically expanded to double its volume. The work done by the gas in the process is

$$\left(\frac{C_P}{C_V} = \gamma = \frac{3}{2}\right) \quad (R =$$

gas constant)

(A) $TR(\sqrt{2} - 2)$ (B) $\frac{T}{R}(\sqrt{2} - 2)$

(C) $\frac{R}{T}(2 - \sqrt{2})$ (D) $RT(2 - \sqrt{2})$

51. Identify the compound with highest acidic strength from following.

(A) Ethanol (B) t-Butyl alcohol
(C) Phenol (D) p-Nitrophenol

52. Which of the following species is NOT iso-electronic with neon?

(A) O^{2-} (B) Na
(C) Mg^{2+} (D) Al^{3+}

53. Conductivity of a solution is $1.26 \times 10^{-2}\Omega^{-1}\ cm^{-1}$ Calculate molar conductivity for 0.01 M solution.

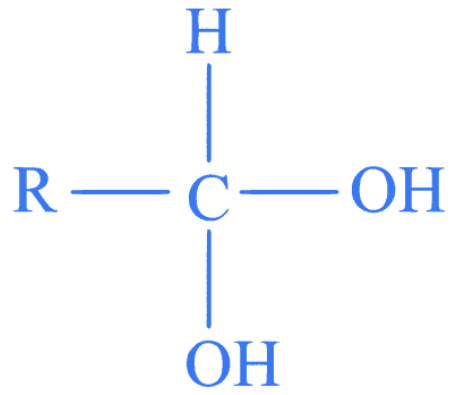
(A) $1.26 \times 10^{3}\Omega^{-1}\ cm^{2}\ mol^{-1}$
(B) $2.52 \times 10^{3}\Omega^{-1}\ cm^{2}\ mol^{-1}$
(C) $4.82 \times 10^{3}\Omega^{-1}\ cm^{2}\ mol^{-1}$
(D) $6.30 \times 10^{3}\Omega^{-1}\ cm^{2}\ mol^{-1}$

54. Identify the molecule from following that does NOT involve sp^3 hybridisation.

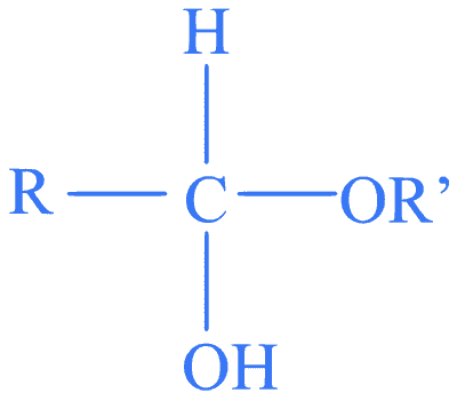
(A) CH_4 (B) C_2H_2
(C) H_2O (D) NH_3

55. Which among the following compounds is hemiacetal?

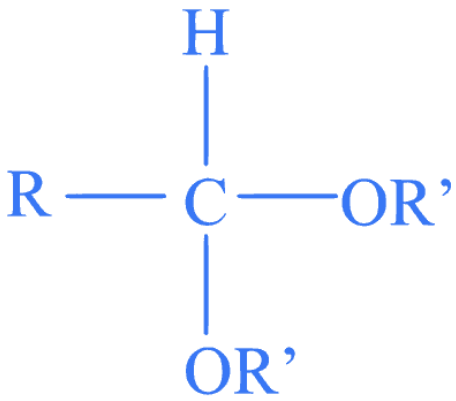
(A)



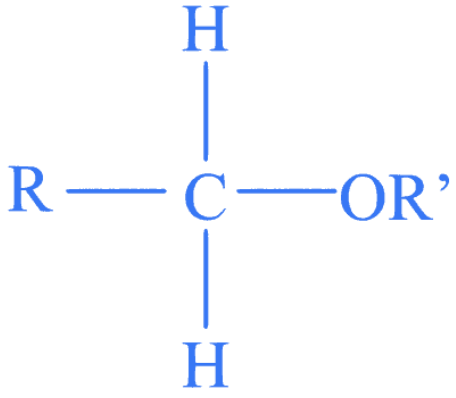
(B)



(C)



(D)



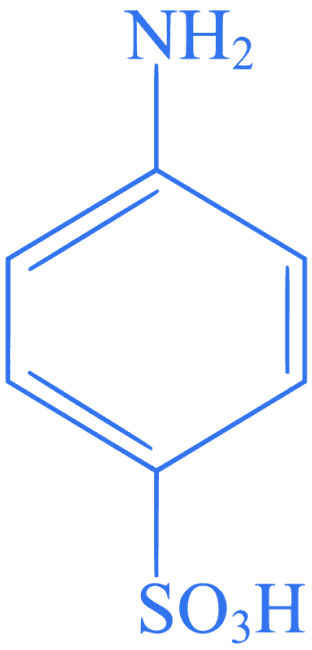
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56. Calculate the concentration of H^+ ions in a solution if pOH is 11.

(A) 10^{-11} M (B) 10^{-8} M

(C) 10^{-6} M (D) 10^{-3} M

57. Identify the name of compound



from following.

(A) Sulphanilic acid (B) Sulphonic acid

(C) Benzene sulphonic acid (D) Amino benzoic acid

58. Identify the physical quantity that is measured in Candela.

(A) Energy (B) Work

(C) Force (D) Luminous intensity

59. Calculate the edge length of unit cell of metal which crystallises to bcc structure.
(Radius of metal atom = 173 pm
)

(A) 5.01×10^{-8} cm (B) 4.00×10^{-8} cm

(C) 4.5×10^{-8} cm (D) 5.5×10^{-8} cm

60. What is new temperature of a gas when its initial volume 3 dm^3 at 300 K is doubled at constant pressure?

(A) 450 K (B) 600 K

(C) 750 K (D) 900 K

61. Which among the following phenols does NOT correctly match with their IUPAC names?

(A) Catechol: Benzene-1,2-diol (B) Resorcinol : Benzene-1,3-diol

(C) o-Cresol : Benzene-1,2,3-triol (D) Quinol: Benzene-1,4-diol

62. Which among following statements is NOT true according to principles of green chemistry?

(A) In a chemical synthesis the waste product should be zero or minimum. (B) Good atom economy means very few atoms of reactants are incorporated in the product.

(C) Only small amounts of unwanted by products are formed. (D) Use of lindane is better than DDT.

63. What is the value of effective atomic number of cobalt in $[Co(NH_3)_6]^{3+}$ complex if Co(Z = 27)
?

(A) 30 (B) 32

(C) 35 (D) 36

64. For the reaction, $3I + S_2O_8^{2-} \rightarrow I_3^- + 2SO_4^{2-}$, at a particular time t, $\frac{d[SO_4^{2-}]}{dt}$ is 2.2×10^{-2} mol dm^{-3} s^{-1}. What is the value of $-\frac{d[I^-]}{dt}$
?

(A) 1.1×10^{-2} mol dm^{-3} s^{-1}

(B) 3.3×10^{-2} mol dm^{-3} s^{-1}

(C) 4.4×10^{-2} mol dm^{-3} s^{-1}

(D) 6.6×10^{-2} mol dm^{-3} s^{-1}

65. What is the total number of Bravais lattices present for different crystal systems?

(A) 14 (B) 7

(C) 4 (D) 3

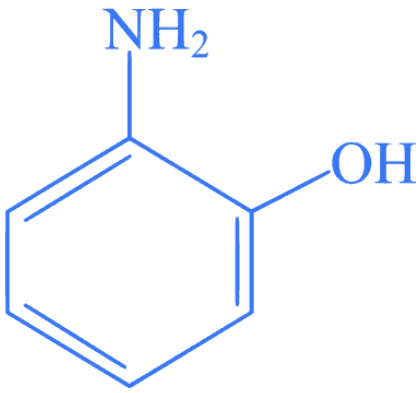
66. Identify compound Y in the following reaction.

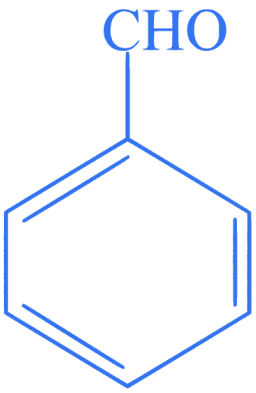
$$C_2H_5Cl + Y \xrightarrow{\Delta} C_2H_5CN$$

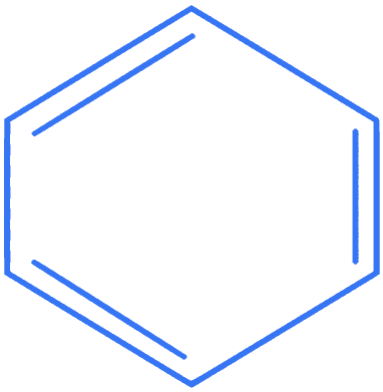
(A) NH_3 (B) HNO_3

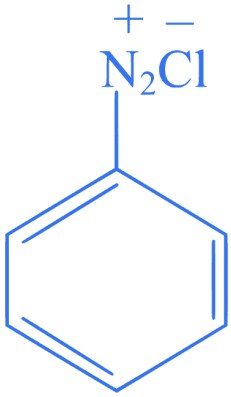
(C) KCN (alc) (D) AgCN (alc)

67. Aniline is treated with $NaNO_2 + HCl$ at low temperature to form:

(A) 

(B) 

(C) 

(D) 

68. Which of the following is NOT a difficulty in setting SHE?

(A) To obtain pure hydrogen gas
(B) To obtain dry hydrogen gas
(C) To maintain exactly 1 atm pressure
(D) To bring the reaction in reverse direction

69. Lewis acid is a substance that :

(A) gives H^+ ions aqueous solution
(B) accepts a proton
(C) accepts electron pair
(D) donates a proton

70. Which among the following α-amino acids does NOT have chiral carbon atom?

(A) Histidine
(B) Glutamic acid
(C) Serine
(D) Glycine

71. The difference between ΔH and ΔU is usually significant for systems consisting of :

(A) only solids
(B) only gases
(C) only liquids
(D) both solids and liquids

72. Which of the following elements is doped with to obtain fibre amplifiers for optical fibre communication system?

(A) Zn
(B) Cu
(C) Er
(D) La

73. What is the half life of a first order reaction if rate constant is 4.2×10^{-2} per day?

(A) 5.0 day
(B) 16.5 day
(C) 28.0 day
(D) 9.0 day

74. What type of solution is the ethyl alcohol in water?

(A) Liquid in solid
(B) Solid in liquid
(C) Liquid in liquid
(D) Gas in liquid

75. Which among the following colours is obtained in Schiff test of aldehydes?

(A) Blue
(B) Green
(C) Magenta
(D) Black

76. Which from following monomers is used to prepare thermocol?

(A) Bisphenol and acrylamide
(B) Acrylamide
(C) Butadiene
(D) Styrene

77. Which of the following is character of lyophilic colloid?

(A) Particles of dispersed phase have no affinity for dispersion medium.

(B) Particles easily detected under ultramicroscope.

(C) Addition of large amount of electrolyte causes precipitation.

(D) These are irreversible colloids.

78. Find the depression in freezing point of solution when 3.2 gram non volatile solute with molar mass 128 gram mol^{-1} is dissolved in 80 gram solvent if cryoscopic constant of solvent is 4.8 K kg mol^{-1}.

(A) 3.0 K

(B) 1.5 K

(C) 2.0 K

(D) 2.5 K

79. What is the value of x in order to balance following redox reaction?

$$Mn^{2+}_{(aq)} + xClO^{-}_{3(aq)} \rightarrow MnO_{2(s)} + xClO_{2(aq)}$$

(A) $x = 1$

(B) $x = 2$

(C) $x = 3$

(D) $x = 4$

80. The reaction, $3ClO^{-} \rightarrow ClO^{-}_{3} + 2Cl^{-}$ occurs in two steps:

i. $2ClO^{-} \rightarrow ClO^{-}_{2} + Cl^{-}$

ii. $ClO^{-}_{2} + ClO^{-} \rightarrow ClO^{-}_{3} + Cl^{-}$,

the reaction intermediate is:

(A) Cl^{-}

(B) ClO^{-}_{2}

(C) ClO^{-}_{3}

(D) ClO^{-}

81. Acetic acid dissociated to 1.20% in its 0.01 M solution. What is the value of its dissociation constant?

(A) 2.20×10^{-2}

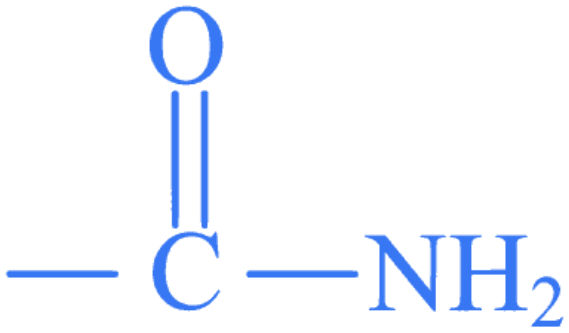
(B) 1.60×10^{-4}

(C) 1.44×10^{-6}

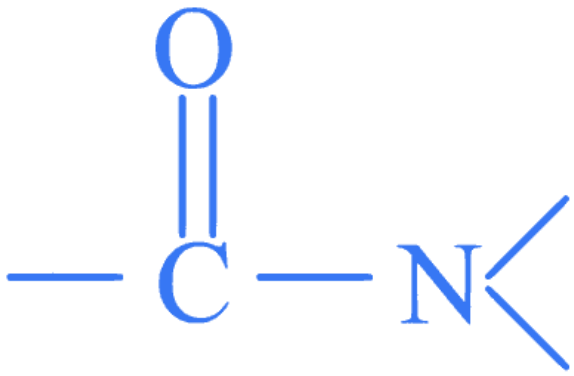
(D) 2.40×10^{-4}

82. The structure of functional group of secondary amide is :

(A) $-NH-$

(B) 

(C) 

(D) 

83. Which of the following solutions exhibits lowest value of boiling point elevation assuming complete dissociation?

(A) 0.1 m $AlCl_3$

(B) 0.01 m $MgCl_2$

(C) 1 m KCl

(D) 0.5 m NaCl

84. Identify heteroleptic complex from following.

(A) Tetraamminediaquacobalt (III) chloride

(B) Hexaamminecobalt (III) bromide

(C) Potassium tetrahydroxozincate (II)

(D) Tetracarbonyl nickel (0)

85. Which among the following statements of group-1 elements is NOT true?

(A) Unipositive ions have inert gas configuration.

(B) Compounds of unipositive ions are paramagnetic.

(C) These form colourless compounds in $+1$ state.

(D) These have high negative values of standard reduction potential.

86. Identify glycosidic linkage present in lactose.

(A) $\beta - 1, 2$

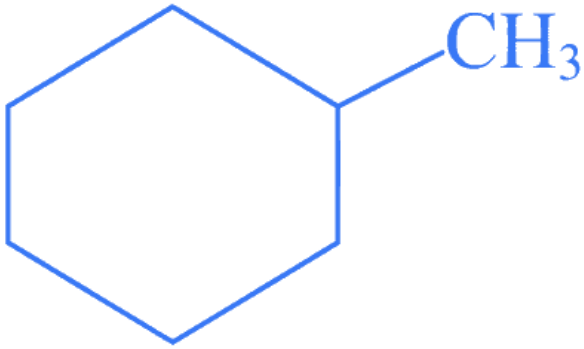
(B) $\alpha - 1, 4$

(C) $\beta - 1, 4$

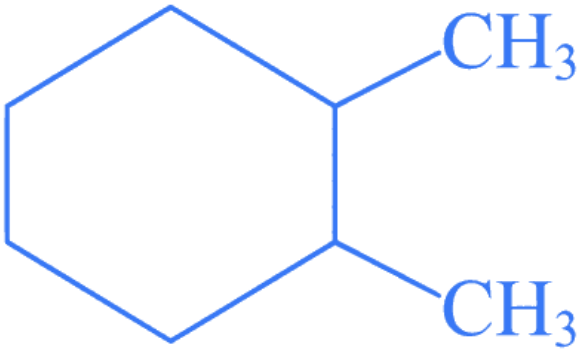
(D) $\beta - 1, 6$

87. Which of the following compounds reacts with HBr to form 1-Bromo-1-methylcyclohexane?

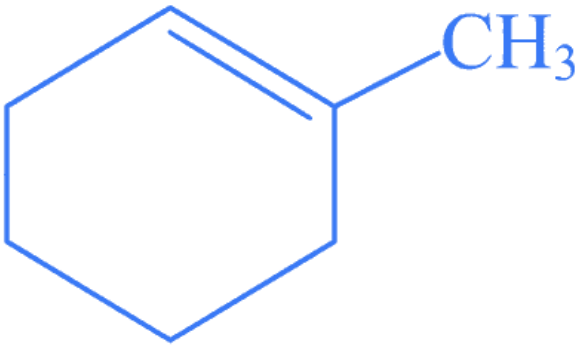
(A)



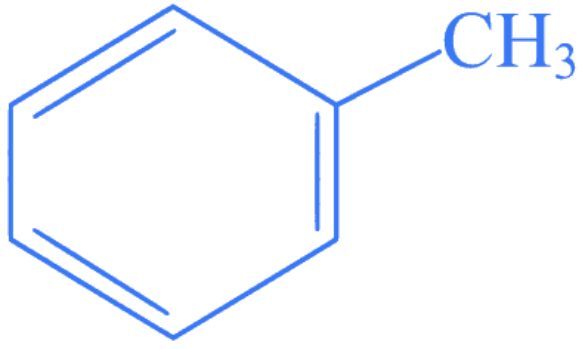
(B)



(C)



(D)



88. Identify degenerate orbitals from following for hydrogen atom.

(A) 1s and 2s

(B) 1s and 2p

(C) 2s and 2p

(D) 3s and 2p

89. Identify the product P obtained in following reaction.

Benzene + ozone (excess) $\xrightarrow{CCl_4}$ Benzene triozonide $\xrightarrow{Zn/H_2O}$ $P + H_2O_2$

(A) Benzoic acid (B) Benzaldehyde

(C) Phenol (D) Glyoxal

90. Identify strongest oxoacid of halogen from following.

(A) Hypochlorous acid (B) Chlorous acid

(C) Chloric acid (D) Perchloric acid

91. Identify the reagent R used in the reaction stated below.

Benzene diazonium chloride $+R \rightarrow$ Benzene

(A) HCl (B) H_3PO_2/H_2O

(C) H_2O/HCl (D) $CH_3 - CH_2 - OH$

92. Identify lanthanoid element from following.

(A) Eu (B) Cm

(C) Am (D) Np

93. What is change in internal energy when system releases 8 kJ of heat and performs 660 J of work on the surrounding?

(A) -7340 J (B) -5400 J

(C) -8660 J (D) -1212 J

94. Identify the method used to obtain SO_2 gas in industry.

(A) By burning sulphur in air

(B) By treating sodium sulphite with dil. sulphuric acid

(C) By treating sodium sulphite with dil. hydrochloric acid

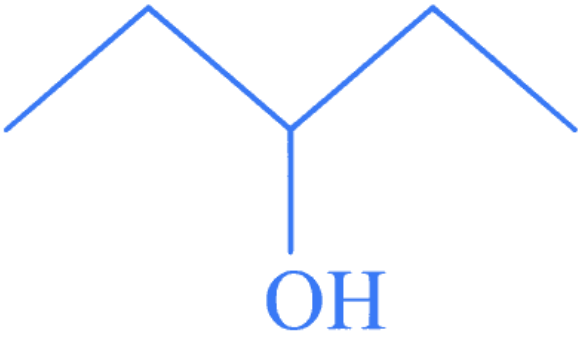
(D) By roasting zinc sulphide and iron pyrites

95. Which among the following compounds reacts fastly with HBr ?

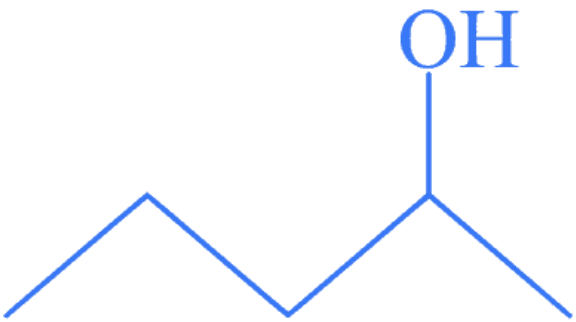
(A)



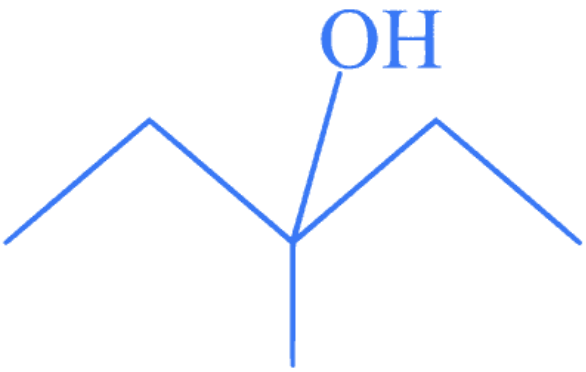
(B)



(C)



(D)



96. Identify biodegradable polymer from following.

(A) Nylon 2-nylon 6 (B) Terylene

(C) Nylon 6 (D) Nylon 6,6

97. What mass of Mg is produced during electrolysis of molten $MgCl_2$ by passing 2 amp current for 482.5 second?

(Molar mass $Mg = 24\ g\ mol^{-1}$)

(A) 0.12 g (B) 0.24 g

(C) 1.2 g (D) 0.4 g

98. Calculate the final volume when 2 moles of an ideal gas expand from 3 dm^3 at constant external pressure 1.6 bar and the work done in the process is 800 J.

(A) 2.66 dm^3 (B) 4.8 dm^3

(C) 5.0 dm^3 (D) 8.0 dm^3

99. Calculate the molar mass of an element with density 2.7 g cm^{-3} that forms fcc structure.

$$\left[a^3 \cdot N_A = 40\ cm^3\ mol^{-1}\right]$$

(A) 112 g mol^{-1} (B) 54 g mol^{-1}

(C) 27 g mol^{-1} (D) 78 g mol^{-1}

100. Identify ketone from the following.

(A) Ethyl ethanoate (B) Acetophenone

(C) N-Methylphthalimide (D) Methyl salicylate

101. A group consists of 8 boys and 5 girls, then the number of committees of 5 persons that can be formed, if committee consists of at least 2 girls and at most 2 boys, are

(A) 300 (B) 320
(C) 321 (D) 322

102. Scalar projection of the line segment joining the points $A(-2,0,3), B(1,4,2)$ on the line whose direction ratios are $6,-2,3$ is

(A) $\frac{23}{7}$ (B) 1
(C) 7 (D) $\frac{1}{7}$

103. For a binomial variate X with

$$n = 6$$

if

$$P(X=4) = \frac{135}{2^{12}}$$

, then its variance is

(A) $\frac{8}{9}$ (B) $\frac{1}{4}$
(C) 4 (D) $\frac{9}{8}$

104. If

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

and

$$c = \hat{i} + 3\hat{j}$$

are such that $(\bar{a} + \lambda\bar{b})$ is perpendicular to $\bar{c}$, then the value of λ is

(A) $\frac{5}{11}$ (B) $\frac{11}{5}$
(C) $\frac{-11}{5}$ (D) $\frac{-5}{11}$

105. The number of integral values of p in the domain $[-5,5]$, such that the equation

$$2x^2 + 4xy - py^2 + 4x + qy + 1 = 0$$

represents pair of lines, are

(A) 3 (B) 4
(C) 7 (D) 8

106. An open metallic tank is to be constructed, with a square base and vertical sides, having volume 500 cubic meter. Then the dimensions of the tank, for minimum area of the sheet metal used in its construction, are

(A) 5 m, 5 m, 10 m (B) 10 m, 10 m, 5 m
(C) 2 m, 2 m, 8 m (D) 15 m, 15 m, 5 m

107. The p.d.f. of a discrete random variable is defined as

$$f(x) = \begin{cases} kx^2, 0 \le x \le 6 \\ 0, \text{ otherwise} \end{cases}$$

Then the value of $F(4)$ (c.d.f) is

(A) $\frac{30}{91}$ (B) $\frac{30}{97}$
(C) $\frac{15}{47}$ (D) $\frac{15}{97}$

108. The variance, for first six prime numbers greater than 5, is

(A) 27 (B) 28
(C) 15 (D) 20

109. The value of

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

is

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

110. The points $(1,3),(5,1)$ are opposite vertices of a diagonal of a rectangle. If the other two vertices lie on the line

$$y = 2x + c$$

, then one of the vertex on the other diagonal is

(A) $(1,-2)$ (B) $(0,-4)$
(C) $(2,0)$ (D) $(3,2)$

111. Considering only the principal values of an inverse function, the set

$$A = \left\{ x \ge 0 / \tan^{-1} x + \tan^{-1} 6x = \frac{\pi}{4} \right\}$$

(A) is an empty set. (B) is a singleton set.
(C) contains more than two elements. (D) contains two elements.

112. The line

$$\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$$

lies in the plane

$$x + 3y - \alpha z + \beta = 0$$

, then the value of $\alpha^2 + \alpha\beta + \beta^2$ is

(A) 127 (B) 43
(C) 109 (D) 61

113. The vector projection of $\overline{AB}$ on $\overline{CD}$, where $A \equiv (2,-3,0), B \equiv (1,-4,-2), C \equiv (4,6,8)$ and D $\equiv (7,0,10)$, is

(A) $\frac{1}{49}(3\hat{i}-6\hat{j}+2\hat{k})$ (B) $\frac{1}{6}(-\hat{i}-\hat{j}-2\hat{k})$

(C) $-\frac{1}{49}(3\hat{i}-6\hat{j}+2\hat{k})$ (D) $-\frac{1}{6}(-\hat{i}-\hat{j}-2\hat{k})$

114. If the circles

$$x^2+y^2=9$$

and

$$x^2+y^2+2\alpha x+2y+1=0$$

touch each other internally, then the value of α^3 is

(A) $\frac{27}{64}$ (B) $\frac{125}{27}$

(C) $\frac{27}{125}$ (D) $\frac{64}{27}$

115. If

$$y=\cos^{-1}\left(\frac{a^2}{\sqrt{x^4+a^4}}\right)$$

, then

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

is

(A) $\frac{2a^2x}{x^4+a^4}$ (B) $\frac{2a^2x^2}{\sqrt{x^4+a^4}}$

(C) $\frac{a^4x^4}{x^4+a^4}$ (D) $\frac{a^4x^2}{2\sqrt{x^4+a^4}}$

116. The population

$$P=P(t)$$

at time t of certain species follows the differential equation

$$\frac{dP}{dt}=0.5P-450$$

. If

$$P(0)=850$$

, then the time at which population becomes zero is

(A) 2log18 (B) log9

(C) $\frac{1}{2}$log18 (D) log18

117. The vertices of the feasible region for the constraints

$x+y\le 4, x\le 2, y\le 1, x+y\ge 1, x, y\ge 0$ are

(A) $(1,0),(2,0),(2,1),(0,4)$

(B) $(0,1),(4,0),(0,4),(1,0)$

(C) $(1,0),(2,0),(2,1),(0,1)$

(D) $(1,0),(4,0),(2,1),(0,4)$

118. The value of

$$\tan\frac{\pi}{8}$$

is

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

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

119. If

$$B=\begin{bmatrix}1 & \alpha & 2\\ 1 & 2 & 2\\ 2 & 3 & 3\end{bmatrix}$$

is the adjoint of a 3×3 matrix A and

$$|A|=5$$

, then α is equal to

(A) 25 (B) 27

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

120. The logical statement $[\sim(\sim p\vee q)\vee(p\wedge r)]\wedge(\sim q\wedge r)$ is equivalent to

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

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

121. If

$$w=\frac{z}{z-\frac{1}{3}i}$$

and

$$|w|=1, i=\sqrt{-1}$$

, then z lies on

(A) circle. (B) line.

(C) parabola. (D) ellipse.

122. If one side of a triangle is double the other and the angles opposite to these sides differ by 60°, then the triangle is

(A) obtuse angled (B) right angled

(C) acute angled (D) isosceles

123. If

$$\int\sqrt{\frac{x-7}{x-9}}dx=A\sqrt{x^2-16x+63}+\log\left|(x-8)+\sqrt{x^2-16x+63}\right|+c,$$

(where c is a constant of integration) then A is

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

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

124. A player tosses 2 fair coins. He wins ₹5 if 2 heads appear, ₹ 2 if one head appears and ₹ 1 if no head appears. Then the variance of his winning amount in ₹ is :

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

(C) $\frac{9}{4}$ (D) $\frac{17}{2}$

125. Area of the region bounded by the curve

$$y = \sqrt{49 - x^2}$$

and X-axis is

(A) 49π sq. units (B) $\frac{49\pi}{2}$ sq. units

(C) $\frac{49\pi}{4}$ sq. units (D) 98π sq. units

126. The solution of the equation

$$\tan^{-1}(1+x) + \tan^{-1}(1-x) = \frac{\pi}{2}$$

is

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

(C) $x = -1$ (D) $x = \pi$

127. The differential equation

$$\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$$

determines a family of circles with

(A) variable radii and fixed centre at $(0, 1)$. (B) variable radii and fixed centre at $(0, -1)$.

(C) fixed radius of 1 unit and variable centre along the Y-axis. (D) fixed radius of 1 unit and variable centre along the X-axis.

128. A square plate is contracting at the uniform rate 4 cm^2/sec, then the rate at which the perimeter is decreasing, when side of the square is 20 cm , is

(A) $\frac{1}{5}$ cm/sec. (B) 4 cm/sec.

(C) 2 cm/sec. (D) $\frac{2}{5}$ cm/sec.

129. If the function $f(x)$ is continuous in $0 \le x \le \pi$, then the value of $2a + 3b$ is where

$$f(x) = \begin{cases} x + a\sqrt{2}\sin x & \text{if } 0 \le x < \frac{\pi}{4} \\ 2x\cot x + b & \text{if } \frac{\pi}{4} \le x \le \frac{\pi}{2} \\ a\cos 2x - b\sin x & \text{if } \frac{\pi}{2} < x \le \pi \end{cases}$$

(A) $\frac{\pi}{12}$ (B) $\frac{\pi}{6}$

(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{10}$

130. For

$$x > 1$$

, if

$$(2x)^{2y} = 4e^{2x-2y}$$

, then

$$(1 + \log 2x)^2 \frac{dy}{dx}$$

is equal to

(A) $\frac{x\log 2x + \log 2}{x}$ (B) $\frac{x\log 2x - \log 2}{x}$

(C) $x\log 2x$ (D) $\log 2x$

131. The vectors are

$$\bar{a} = 2\hat{i} + \hat{j} - 2\hat{k}, \bar{b} = \hat{i} + \hat{j}$$

. If $\bar{c}$ is a vector such that

$$\bar{a} \cdot \bar{c} = |\bar{c}|$$

and

$$|\bar{c} - \bar{a}| = 2\sqrt{2}$$

, angle between $\bar{a} \times \bar{b}$ and $\bar{c}$ is

$$\frac{\pi}{4}$$

, then $|(\bar{a} \times \bar{b}) \times \bar{c}|$ is

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

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

132.

$$\int \frac{1}{7 - 6x - x^2} dx =$$

(A) $\frac{1}{4}\log(\frac{7+x}{1-x}) + c$, where c is a constant of integration. (B) $\frac{1}{8}\log(\frac{7+x}{1-x}) + c$, where c is a constant of integration.

(C) $\frac{1}{16}\log(\frac{7+x}{1-x}) + c$, where c is a constant of integration. (D) $\frac{1}{32}\log(\frac{7+x}{1-x}) + c$, where c is a constant of integration.

133.

$$\int \frac{dx}{\sin x + \cos x} =$$

(A) $\sqrt{2}\log\tan(x + \frac{\pi}{4}) + c$, where c is a constant of integration.

(B) $\frac{1}{\sqrt{2}}\log\tan(\frac{x}{2} + \frac{\pi}{8}) + c$, where c is a constant of integration.

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

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

134. A ladder of length 17 m rests with one end against a vertical wall and the other on the level ground. If the lower end slips away at the rate of 1 m/sec., then when it is 8 m away from the wall, its upper end is coming down at the rate of

(A) $\frac{5}{8}$ m/sec. (B) $\frac{8}{15}$ m/sec.

(C) $\frac{-8}{15}$ m/sec. (D) $\frac{15}{8}$ m/sec.

135. Let P be a plane passing through the points $(2, 1, 0), (4, 1, 1)$ and $(5, 0, 1)$ and R be the point $(2, 1, 6)$. Then image of R in the plane P is

(A) $(6, 5, 2)$ (B) $(4, 3, 2)$

(C) $(6, 5, -2)$ (D) $(3, 4, -2)$

136. The co-ordinates of the point, where the line through $A(3,4,1)$ and $B(5,1,6)$ crosses the XZ-plane, are

(A) $(\frac{11}{3},0,\frac{21}{3})$ (B) $(\frac{17}{3},0,\frac{23}{3})$

(C) $(\frac{-11}{3},0,\frac{21}{3})$ (D) $(\frac{17}{3},0,\frac{-23}{3})$

137. The number of possible solutions of
$$\sin\theta+\sin 4\theta+\sin 7\theta=0, \theta\in(0,\pi)$$
are

(A) 3 (B) 4

(C) 6 (D) 8

138. If
$$I=\int\frac{dx}{x^2(x^4+1)^{\frac{3}{4}}}$$
, then I is

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

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

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

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

139. If
$$\bar{a}=\hat{i}+2\hat{j}+\hat{k},\bar{b}=\hat{i}-\hat{j}+\hat{k},\bar{c}=\hat{i}+\hat{j}-\hat{k}$$
, then a vector in the plane of $\bar{a}$ and $\bar{b}$, whose projection on $\bar{c}$ is
$$\frac{1}{\sqrt{3}}$$
, is

(A) $\hat{i}+\hat{j}-2\hat{k}$ (B) $3\hat{i}+\hat{j}-3\hat{k}$

(C) $4\hat{i}-\hat{j}+4\hat{k}$ (D) $2\hat{i}+3\hat{j}-\hat{k}$

140. The number of solutions of
$$\tan x+\sec x=2\cos x$$
in $[0,2\pi]$ are

(A) 6 (B) 4

(C) 3 (D) 2

141. If
$$\int_0^{\frac{1}{2}}\frac{x^2}{(1-x^2)^{\frac{3}{2}}}dx=\frac{k}{6}$$
, then the value of k is

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

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

142. General solution of the differential equation
$$\cos x(1+\cos y)dx-\sin y(1+\sin x)dy=0$$
is

(A) $(1+\cos x)(1+\sin y)=c$

(B) $1+\sin x+\cos y=c$

(C) $(1+\sin x)(1+\cos y)=c$

(D) $1+\sin x\cdot\cos y=c$

143. If the line
$$ax+by+c=0$$
is a normal to the curve
$$xy=1$$
, then

(A) $a>0,b>0$ (B) $a>0,b<0$

(C) $a<0,b<0$ (D) $a=0,\ b=0$

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

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

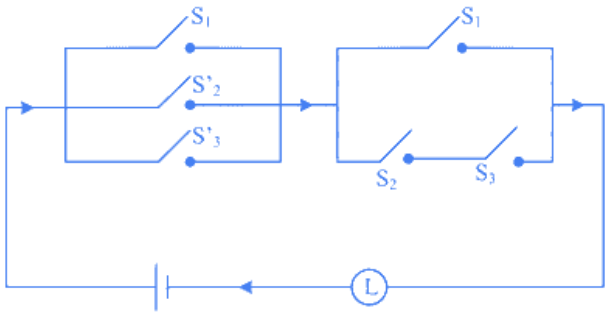
(C) $\frac{\sqrt{2}}{3}$ (D) $\sqrt{\frac{2}{3}}$

145. If
$$f(x)=e^x,\ g(x)=\sin^{-1}x$$
and
$$h(x)=f(g(x))$$
, then
$$\frac{h'(x)}{h(x)}$$
is

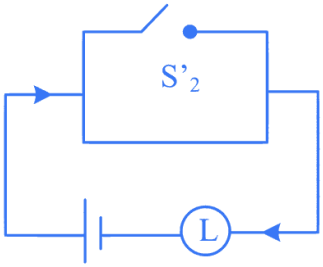
(A) $e^{\sin^{-1}x}$ (B) $\frac{1}{\sqrt{1-x^2}}$

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

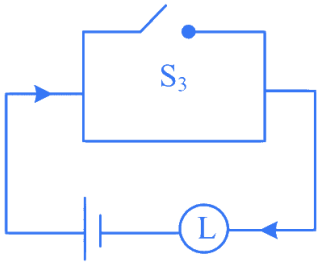
146. The given circuit is equivalent to



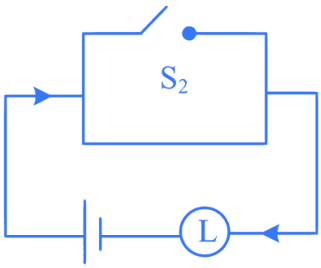
(A)



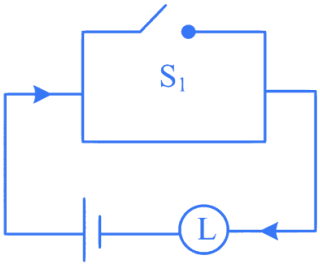
(B)



(C)



(D)



147. A kite is 120 m high and 130 m of string is out. If the kite is moving away horizontally at the rate of 39 m/sec, then the rate at which the string is being out, is

(A) 12 m/sec. (B) 15 m/sec.

(C) 18 m/sec. (D) 20 m/sec.

148. ABC is a triangle in a plane with vertices $A(2,3,5), B(-1,3,2)$ and $C(\lambda,5,\mu)$. If median through A is equally inclined to the co-ordinate axes, then value of $\lambda+\mu$ is

(A) 17 (B) 10

(C) 7 (D) 3

149. Three critics review a book. For the three critics the odds in favor of the book are $2:5, 3:4$ and $4:3$ respectively. The probability that the majority is in favor of the book, is given by

(A) $\frac{183}{343}$ (B) $\frac{160}{343}$

(C) $\frac{209}{343}$ (D) $\frac{134}{343}$

150. $f: R \to R; g: R \to R$ are two functions such that

$$f(x) = 2x - 3,\ g(x) = x^3 + 5$$

, then $(fog)^{-1}(-9)$ is

(A) -2 (B) 2

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

- End of Question Paper -