MHT CET 2021 PCM Sep 23 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 2021**, 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. If m' represents the mass of each molecules of a gas and T' its absolute temperature then the root mean square speed of the gas molecule is proportional to

(A) $m^{-\frac{1}{2}}T^{\frac{1}{2}}$ (B) mT

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

2. The mass of a spherical planet is 4 times the mass of the earth, but its radius (R) is same as that of the earth. How much work is done is lifting a body of mass 5 kg through a distance of 2 m on the planet ? ($g = 10\ ms^{-2}$)

(A) 400 J (B) 200 J

(C) 800 J (D) 300 J

3. For series LCR circuit, which one of the following is a CORRECT statement?

(A) Potential difference across resistance R and that across capacitor have phase difference $\frac{\pi^c}{2}$.

(B) Applied e.m.f. and potential difference across resistance 'R' are in the same phase

(C) Applied e.m.f. and potential difference inductor coil has phase difference of $\frac{\pi^c}{2}$

(D) Potential difference across capacitor and that across inductor have phase difference of $\frac{\pi^c}{2}$.

4. Two waves

$$Y_1 = 0.25 \sin 316t$$

and

$$Y_2 = 0.25 \sin 310t$$

are propagation same direction. The number of beats produced per second are

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

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

5. In an LCR series a.c. circuit, the voltage across each of the components L, C and R is 60 V. The voltage across the LC combination is

(A) 120 V (B) 60 V

(C) zero V (D) $\frac{60}{\sqrt{3}}$ V

6. The speed of a ball of radius 2 cm in a viscous liquid is 20 cm/s. What will be the speed of a ball of radius 1 cm in same liquid?

(A) 10 cm/s (B) 4 cm/s

(C) 5 cm/s (D) 8 cm/s

7. In hydrogen atom an electron revolves around a proton (in nucleus) at a distance 'r' m. the intensity of electric field due to the proton at distance 'r' is $5 \times 10^{11} NC^{-1}$, the magnitude of force between the electron and proton is [charge on electron

$$= 1.6 \times 10^{-19} C$$

]

(A) 4×10^8 N (B) 8×10^8 N

(C) 4×10^{-8} N (D) 8×10^{-8} N

8. A particle performing S.H.M. when displacement is 'x', the potential energy and restoring force acting on it are denoted by 'E' and 'F' respectively. The relation between x, E and F is

(A) $\frac{2E}{F} - x^2 = 0$ (B) $\frac{2E}{F} + x^2 = 0$

(C) $\frac{2E}{F} + x = 0$ (D) $\frac{2E}{F} - x = 0$

9. A molecule consists of two atoms each of mass 'm' and separated by a distance 'd'. At room temperature, if the average rotational kinetic energy is 'E' then the angular frequency is

(A) $\frac{2}{d}\sqrt{\frac{E}{m}}$ (B) $\frac{d}{2}\sqrt{\frac{m}{E}}$

(C) $\sqrt{\frac{Ed}{m}}$ (D) $\sqrt{\frac{m}{Ed}}$

10. The magnifying power of a refracting type of astronomical telescope is 'm'. If focal length of eyepiece is doubled then the magnifying power will become

(A) m (B) 2 m

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

11. A wooden black of mass 'm' moves with velocity 'V' and collides with another block of mass ' 4 m', which is at rest. After collision the block of mass 'm' comes to rest. The coefficient of restitution will be

(A) 0.7 (B) 0.25

(C) 0.4 (D) 0.5

12. Two charged metallic spheres are joined by a very thin metal wire. If the radius of the larger sphere is four times that of the smaller sphere, the electric field near the larger sphere is

(A) twice that near the smaller sphere
(B) quarter of that near the smaller sphere
(C) same as that near the smaller sphere
(D) half of that near smaller sphere

13. Water rises to a height of 2 cm in a capillary tube. If cross-sectional area of the tube is reduced to

$$\frac{1}{16}^{\text{th}}$$

of initial area then water will rise to a height of

(A) 4 cm
(B) 8 cm
(C) 12 cm
(D) 16 cm

14. The radius of a planet is twice the radius of the earth. Both have almost equal average mass densities. If 'V_P' and 'V_E' are escape velocities of the planet and the earth respectively, then

(A) $V_E = 1.5\ V_P$
(B) $V_P = 1.5\ V_E$
(C) $V_P = 2V_E$
(D) $V_E = 3V_P$

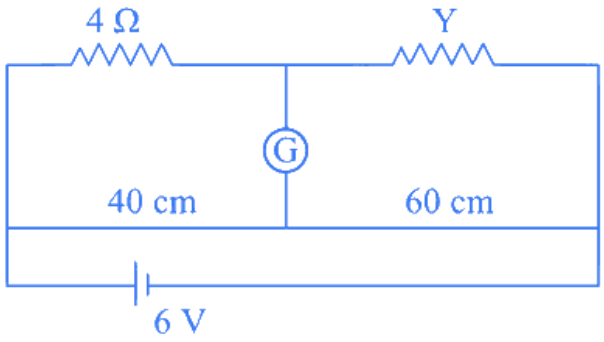
15. The shortest wavelength for Lyman series is 912

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

. The longest wavelength in Paschen series is

(A) 1216 $\overset{o}{A}$
(B) 3646 $\overset{o}{A}$
(C) 18760 $\overset{o}{A}$
(D) 8208 $\overset{o}{A}$

16. A balanced bridge is shown in the circuit diagram. The metre bridge wire has resistance $1\Omega m^{-1}$. The current drawn from the battery is (Internal resistance of battery is negligible)



(A) 0.44 A
(B) 0.66 A
(C) 0.88 A
(D) 0.22 A

17. In Young's experiment with a monochromatic source and two slits, one of the slits is covered with black opaque paper, the fringes will

(A) be darker
(B) be narrower
(C) be broader
(D) not be observed

18. A ray of light travels from air to water to glass and again from glass to air. Refractive index of water w.r.t. air is 'X', glass w.r.t. water is 'Y' and air w.r.t. glass is 'Z'. Which one of the following is correct?

(A) YZ = X
(B) XYZ = 1
(C) XY = Z
(D) XZ = Y

19. In the Bohr model, an electron moves in a circular orbit around the nucleus. Considering an orbiting electron to be a circular current loop, the magnetic moment of the hydrogen atom, when the electron is in nth excited state, is
(e = electronic charge, m_e = mass of the electron, h = Planck's constant)

(A) $(\frac{e}{m_e})\frac{nh}{2\pi}$
(B) $(\frac{e}{m_e})\frac{n^2h}{2\pi}$
(C) $(\frac{e}{2m_e})\frac{n^2h}{2\pi}$
(D) $(\frac{e}{2\,m_e})\frac{nh}{2\pi}$

20. In potentiometer experiment, cells of e.m.f. 'E_1' and 'E_2' are connected in series

$$(E_1 > E_2)$$

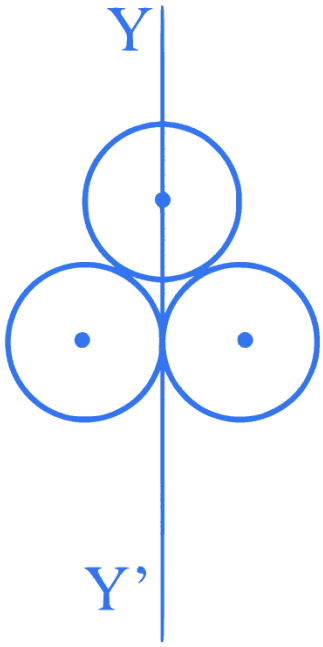
the balancing length is 64 cm of the wire. If the polarity of E_2 is reversed, the balancing length becomes 32 cm. The ratio

$$\frac{E_1}{E_2}$$

is

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

21. Three solid spheres each of mass 'M' and radius 'R' are arranged as shown in the figure. The moment of inertia of the system about YY' will be



(A) $\frac{16}{5}MR^2$ (B) $\frac{21}{5}MR^2$

(C) $\frac{7}{5}MR^2$ (D) $\frac{11}{5}MR^2$

22. A body is performing S.H.M. of amplitude 'A'. The displacement of the body from a point where kinetic energy is maximum to a point where potential energy is maximum, is

(A) zero (B) $\pm A$

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

23. Eddy currents are produced when

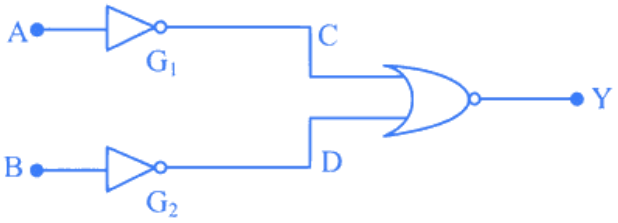
(A) a thick metal plate is kept in a steady magnetic field

(B) a circular coil is placed in a steady magnetic field

(C) a steady current is passed through a coil

(D) a thick metal plate is kept in a varying magnetic field

24. The resultant gate and its Boolean expression in the given circuit is



(A) NOR, $\overline{A+B}$ (B) AND, $A \cdot B$

(C) OR, $A+B$ (D) NAND, $\overline{A \cdot B}$

25. When wavelength of incident radiation on the metal surface is reduced from 'λ_1' to 'λ_2', the kinetic energy of emitted photoelectrons is tripled. The work function of metal [h = Plank's constant, c = velocity of light]

(A) $\frac{hc}{2}\left[\frac{3\lambda_1-\lambda_2}{\lambda_1\lambda_2}\right]$ (B) $\frac{hc}{2}\left[\frac{3\lambda_2-\lambda_1}{\lambda_1\lambda_2}\right]$

(C) $hc\left[\frac{3\lambda_1-\lambda_2}{\lambda_1\lambda_2}\right]$ (D) $hc\left[\frac{3\lambda_2-\lambda_1}{\lambda_1\lambda_2}\right]$

26. A student is throwing balls vertically upwards such that he throws the 2nd ball when the 1st ball reaches maximum height. If he throws balls at an interval of 3 second, the maximum height of the balls is $\left(g = 10\frac{m}{s^2}\right)$

(A) 45 m (B) 35 m

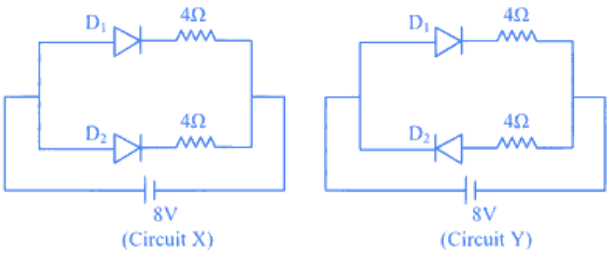
(C) 25 m (D) 30 m

27. Work done in increasing the size of a soap bubble from radius of 3 cm to 5 cm in millijoule is nearly (surface tension of soap solution $= 0.03\ Nm^{-1}$)

(A) 0.4π (B) 0.2π

(C) 4π (D) 2π

28. What are the values of the currents flowing in each of the following diode circuits X and Y respectively? (Assume that the diodes are ideal)



(A) 1 A, 2 A (B) 2 A, 1 A

(C) 4 A, 2 A (D) 2 A, 4 A

29. In the interference experiment using a biprism, the distance of the slits from the screen is increased by 25% and the separation between the slits is halved. If 'W' represents the original fringewidth, the new fringewidth is

(A) 2 W (B) 2.5 W

(C) 4 W (D) 1.5 W

30. Two waves are represented by the equation,

$$y_1 = A\sin(\omega t + kx + 0.57)m$$

and

$$y_2 = A\cos(\omega t + kx)m$$

, where x is in metre and t is in second. What is the phase difference between them?

(A) 0.57 radian (B) 1.0 radian

(C) 1.57 radian (D) 1.25 radian

31. An ideal gas at pressure 'p' is adiabatically compressed so that its density becomes twice that of the initial. If

$$\gamma = \frac{c_p}{c_v} = \frac{7}{5}$$

, then final pressure of the gas is

(A) p (B) 2p

(C) $\frac{7}{5}$p (D) 2.63p

32. In common emitter amplifier, a change of 0.2 mA in the base current causes a change of 5 mA in the collector current. If input resistance is 2 kΩ and voltage gain is 75, the load resistance used in the circuit is

(A) 8 kΩ (B) 4 kΩ

(C) 12 kΩ (D) 6 kΩ

33.

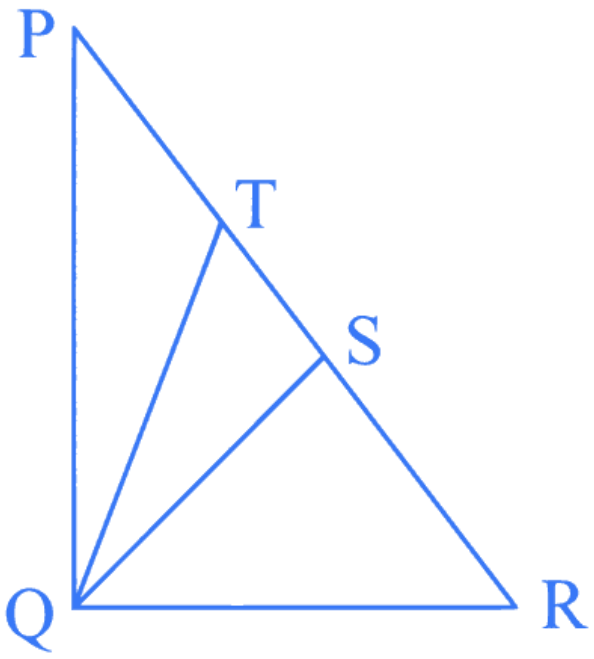


Figure shows triangular lamina which can rotate about different axes moment of inertia is maximum, about the axis

(A) PR (B) QS

(C) QR (D) PQ

34. Which one of the following statements is wrong for an isobaric process?

(A) The pressure of the system remains constant (B) There is change in volume, when work is done

(C) Temperature of the system remains constant (D) Energy exchanged is used to do work to change internal energy

35. The energy of an electron in the excited hydrogen atom is −3.4 eV. Then according to Bohr's theory, the angular momentum of the electron in that excited state is (h = Plank's constant)

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

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

36. For a perfectly black body, coefficient of emission is

(A) zero (B) infinity

(C) unity (D) less than one (non-zero)

37. Two rods of different metals have coefficients of linear expansion 'α_1' and 'α_2' respectvely. Their respective lengths are 'L_1' and 'L_2'. At all temperatures $(L_2 - L_1)$ is same. The correct relation is

(A) $L_1\alpha_1^2 = L_2\alpha_2^2$ (B) $L_1^2\alpha_1^2 = L_2^2\alpha_2^2$

(C) $L_1\alpha_2 = L_2\alpha_1$ (D) $L_1\alpha_1 = L_2\alpha_2$

38. The temperature of a black body is increased by 50%, then the percentage increase in the rate of radiation by the body is approximated

(A) 50% (B) 100%

(C) 400% (D) 150%

39. A particle excuting S.H.M starts from the mean position. Its amplitude is 'A' and time period 'T' At what displacement its speed is one-fourth of the maximum speed?

(A) $\frac{A}{\sqrt{15}}$ (B) $\frac{A}{4}$

(C) $\frac{4A}{15}$ (D) $\frac{A\sqrt{15}}{4}$

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

(A) 3 : 8 (B) 3 : 4

(C) 1 : 6 (D) 2 : 3

41. An electron is projected along the axis of circular conductor carrying current 'I' The electron will experience

(A) a force perpendicular to axis
(B) a force along the axis
(C) a force at angle 30° with the axis
(D) no force

42. A thin ring of radius 'R' meter has charge 'q' coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolution/s. The value of magnetic induction in $\mathrm{Wbm^{-2}}$ at the center of the ring is ($\mu_0 =$ Permeability of free space)

(A) $\frac{\mu_0 \mathrm{qf}}{2\pi \mathrm{R}}$
(B) $\frac{\mu_0 q}{2\pi R}$
(C) $\frac{\mu_0 q f}{2R}$
(D) $\frac{\mu_0 q}{2\pi f R}$

43. A charged spherical conductor has radius 'r'. The potential difference between its surface and 3 point at a distance '$3r$' from the centre is 'v' The electric intensity at a distance '$3r$' from the centre of the conductor is

(A) $\frac{v}{8r}$
(B) $\frac{v}{2r}$
(C) $\frac{v}{4r}$
(D) $\frac{v}{6r}$

44. In biprims experiment, the 4^{th} dark band is formed opposite to one of the slits. The wavelength of light used is (d = distance between the slits, D = distance between scource and the screen)

(A) $\frac{\mathrm{d}^2}{14\mathrm{D}}$
(B) $\frac{\mathrm{d}^2}{7\mathrm{D}}$
(C) $\frac{d^2}{9\mathrm{D}}$
(D) $\frac{d^2}{11\mathrm{D}}$

45. The magnitude of flux linked with coil varies with time as $\phi = 3t^2 + 4t + 7$. The magnitude of induced e.m.f. at $t = 2$ s is

(A) 3 V
(B) 16 V
(C) 10 V
(D) 7 V

46. At what rate a single conductor should cut the magnetic flux so that current of 1.5 mA flows through it when a resistance of 5Ω is connected across its ends?

(A) $6 \times 10^{-3} \frac{\mathrm{wb}}{\mathrm{s}}$
(B) $8 \times 10^{-3} \frac{\mathrm{wb}}{\mathrm{s}}$
(C) $4 \times 10^{-4} \frac{\mathrm{wb}}{\mathrm{s}}$
(D) $7.5 \times 10^{-3} \frac{\mathrm{wb}}{\mathrm{s}}$

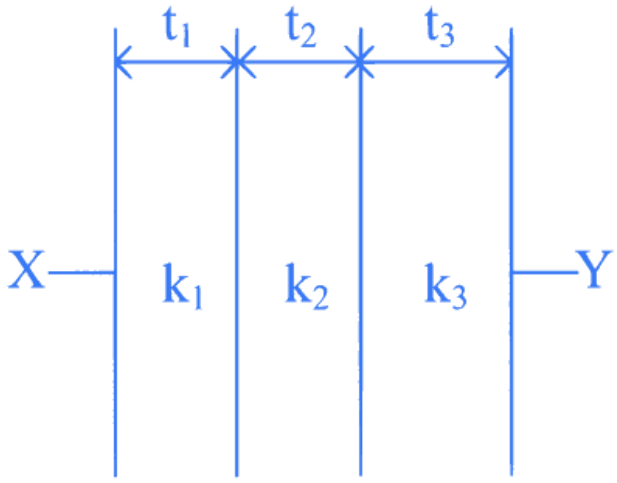
47. If we increase the frequency of an a.c. supply, then inductive reactance

(A) increases directly with the square of frequency
(B) increases as it directly proportional to frequency
(C) decreases inversely with the square of frequency
(D) decreases as it is inversely proportional to the frequency

48. An electron of mass 'm' and a photon have same energy 'E'. The ratio of de-Broglie wavelength of electron to the wavelength of photon is (c = velocity of light)

(A) $c\sqrt{\frac{E}{m}}$
(B) $\frac{1}{c}\sqrt{\frac{2m}{g}}$
(C) $\frac{1}{c}\sqrt{\frac{E}{2m}}$
(D) $c\sqrt{\frac{m}{E}}$

49. Two parallel plates with dielectric placed between the plates are as shown in figure. The resultant capacity of capacitor will be [A = area of plate. t_1, t_2 and t_3 are thickness of dielectric slabs, $\mathrm{k_1}, \mathrm{k_2}$ and $\mathrm{k_3}$ are dielectric constants.



(A) $\frac{A\epsilon_0}{[\frac{t_1+t_2+t_3}{k_1+k_2+k_3}]}$
(B) $\frac{A\epsilon_0(k_1k_2k_3)}{t_1t_2t_3}$
(C) $A\epsilon_0[\frac{k_1}{t_1} + \frac{k_2}{t_2} + \frac{k_3}{t_3}]$
(D) $\frac{A\epsilon_0}{[\frac{t_1}{k_1}+\frac{t_2}{k_2}+\frac{t_3}{k_3}]}$

50. A bar magnet has length 3 cm, cross-sectional area 2 $\mathrm{cm^2}$ and magnetic moment 3 $\mathrm{Am^2}$. The intensity of magnetisation of bar magnet is

(A) 2×10^5 A/m
(B) 3×10^5 A/m
(C) 4×10^5 A/m
(D) 5×10^5 A/m

51. What is the formal charge on 'N' atom in NH_4^+ ion?

(A) $+1$ (B) -3

(C) -1 (D) zero

52. Identify most stable free radical from following :

(A) CH_3CH_2. (B) $(CH_3)_3C$.

(C) $(CH_3)_2CH$. (D) CH_3.

53. Which among the following salt solution in water shows pH less than 7 ?

(A) $CuCl_2$ (B) CH_3COONH_4

(C) Na_2CO_3 (D) KNO_3

54. Ethoxy benzene on reaction with hot and concentrated HI forms

(A) ethyl iodide and phenol (B) ethyl iodide and iodobenzene

(C) ethyl alcohol and iodobenzene (D) ethyl alcohol and phenol

55. What is vapour pressure of solution containing 1.8 g glucose in 16.2 g water?

($P_1^0 = 24$ mmHg and Molar mass of glucose $= 180$ g mol^{-1})

(A) 18.1 mm Hg (B) 15.7 mm Hg

(C) 12.4 mm Hg (D) 23.8 mm Hg

56. The rate law equation for a reaction between A, B and C is

$$r = k[A][B][C]^2$$

, what will be ne rate of reaction if concentration of both A and B are doubled.

(A) 2r (B) 4r

(C) 6r (D) 8r

57. Identify product C in following conversion.

m - Hydroxy Benzaldehyde

$$\xrightarrow[\text{[Protection of } -\text{OH group]}]{C_6H_5CH_2Cl} \xrightarrow[\text{[O]}]{} A \xrightarrow[\text{[deprotection of } -\text{OH group]}]{} B$$

C

(A) Benzoic acid (B) m-Hydroxybenzoic acid

(C) Phenol (D) Phenyl benzoate

58. Which of the following is NOT dihydric alcohol?

(A) Catechol (B) Hydroquinone

(C) Phloroglucinol (D) Resorcinol

59. Identify the sugar containing $\alpha, \beta - 1,2$-glycosidic linkage.

(A) Sucrose (B) Maltose

(C) Lactose (D) Raffinose

60. What is the freezing point of 1 molal aqueous solution of a non volatile solute?

($K_f = 1.86$ K kg mol^{-1}) (T_f^0 for water $= 0^\circ$C)

(A) -0.93°C (B) -2.43°C

(C) -3.72°C (D) -1.86°C

61. How many particles per unit cell are present in BCC structure?

(A) 1 (B) 4

(C) 3 (D) 2

62. Identify ferromagnetic element from following.

(A) Iron (B) Vanadium

(C) Chromium (D) Manganese

63. Identify the reagent used in following conversion.

Pent -3 -enenitrile $\xrightarrow{A}$ pent -3 -enal

(A) $AlH(i-Bu)_2/H_3O^+$

(B) $K_2Cr_2O_7/H_2SO_4$

(C) $H_2/Pd.BaSO_4$

(D) $SnCl_2 \cdot HCl$

64. Which of the following complexes is diamagnetic and square planar?

(A) $[CoF_6]^{3-}$ (B) $[Co(NH_3)_6]^{3+}$

(C) $[NiCl_4]^{2-}$ (D) $[Ni(CN)_4]^{2-}$

65. What is the mass of 33.6 dm^3 of methane gas at S.T.P.?

(A) 4.8×10^{-2} kg (B) 3.3×10^{-2} kg

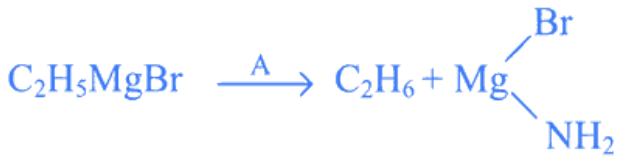
(C) 1.6×10^{-2} kg (D) 2.4×10^{-2} kg

66. An element with BCC structure has edge length of 500 pm. If it's density is 4 g cm^{-3}, find atomic mass of the element?

(A) 150 g mol^{-1} (B) 100 g mol^{-1}

(C) 125 g mol^{-1} (D) 250 g mol^{-1}

67. Identify the reagent (A) used in the following reaction.



(A) NH_3 (B) RNH_2

(C) H_2O (D) CH_3OH

68. What is the product formed when side chain chlorination of toluene is carried out followed by acid hydrolysis at 373 K ?

(A) Benzaldehyde (B) Benzal chloride

(C) Chlorobenzene (D) Benzoic acid

69. A system gives out x J of heat and does y J of work on it's surrounding. What is the internal energy change?

(A) $-x - y$ J (B) $y - x$ J

(C) $x - y$ J (D) $x + y$ J

70. Which of following reactions yields biphenyl from chlorobenzene?

(A) Swartz reaction (B) Wurtz reaction

(C) Fittig reaction (D) Finkelstein reaction

71. A system does 394 J of work on surrounding by absorbing 701 J heat. What is the change in internal energy of the system?

(A) 547 J (B) 1095 J

(C) 307 J (D) 394 J

72. How many electrons flow through the wire if a current of 1.5 ampere flow through it for 3 hours?

(A) 1.60×10^{19} (B) 1.01×10^{23}

(C) 1.01×10^{19} (D) 1.60×10^{23}

73. The conductivity of 0.3M solution of KCl at 298 K is 0.0627 S cm^{-1}. What is it's molar conductivity?

(A) 104 S cm^2 mol^{-1} (B) 188 S cm^2 mol^{-1}

(C) 209 S cm^2 mol^{-1} (D) 109 S cm^2 mol^{-1}

74. The solubility of $Ag_2C_2O_4$ is 2×10^{-4} mol L^{-1} at 298 K. What is it's solubility product?

(A) 1.6×10^{-6} (B) 3.2×10^{-11}

(C) 1.6×10^{-11} (D) 3.2×10^{-6}

75. Two electrons occupying the same orbital are distinguished by

(A) Principal quantum number (B) Azimuthal quantum number

(C) Magnetic quantum number (D) Spin quantum number

76. Which statement from following is correct for homolytic fission?

(A) In this single electron of shared pair moves to one of bonded atom and other to other atom,

(B) In this electron deficient and electron rich species are formed.

(C) In this electronegative atom pulls both electrons of shared pair.

(D) In this carbon free radical formed has sp^3 hybridisation.

77. Identify catalyst used in manufacturing of HDP.

(A) Zieglar - Natta (B) Peroxides
(C) Lindlar's (D) Magnesium oxide

78. Air is an example of a solution of

(A) gas in solid (B) liquid in gas
(C) gas in liquid (D) gas in gas

79. A gas has a volume of 3.4 L at 298 K. What is the final temperature if the volume of gas increases to 6.8 L ?

(A) 596 K (B) 412 K
(C) 298 K (D) 149 K

80. What is the atomic radius of polonium if it crystallises in a simple cubic structure with edge length of unit cell 336 pm ?

(A) 84 pm (B) 168 pm
(C) 234 pm (D) 336 pm

81. Which among the following halides has triagonal bipyramidal structure?

(A) $SeCl_2$ (B) SeF_4
(C) SF_6 (D) TeF_6

82. Which among following compounds is used as monomer in preparation of Teflon?

(A) Tetrabromoethylene (B) Tetrafluoroethylene
(C) Tetrachloroethylene (D) Tetraiodoethylene

83. Which of the following is NOT obtained when a mixture of bomomethane and bromoethane is treated with sodium in dry ether?

(A) Propane (B) Butane
(C) Methane (D) Ethane

84. Time required for 90% completion of a first order reaction is t. What is the time required for completion of 99% reaction?

(A) t (B) 2t
(C) t1/2 (D) 3t

85. A weak monobasic acid is 3.0% dissociated in it's 0.04 M solution. What is the dissociation constant of acid?

(A) 9×10^{-4} (B) 3.6×10^{-5}
(C) 3×10^{-2} (D) 4×10^{-2}

86. Which of the following alkanes is optically active?

(A) 2-Methylbutane (B) 2,3-Dimethylbutane
(C) 2,3-Dimethylpentane (D) 2-Methylpropane

87. Identify the number of unpaired electrons present and geometry respectively of $[Co(NH_3)_6]^{3+}$ complex.

(A) 0, square planar (B) 2, square planar
(C) 4, octahedral (D) 0, octahedral

88. Which among the following compounds is a weakest base?

(A) Phenymethanamine (B) N-Methylanilline
(C) Benzenamine (D) N,N-Dimethylaniline

89. In the cell represented as

$$Ni_{(s)}\left|Ni^{2\oplus}_{(IM)}\right|\left|Ag^{\oplus}_{(IM)}\right|Ag_{(s)}$$

, the reducing agent is

(A) Ag (B) $Ag^{\oplus}$
(C) Ni (D) $Ni^{2\oplus}$

90. What is the value of intercept on y-axis when

$$\log\frac{x}{m}$$

is plotted against log P in Freundlich isotherm?

(A) $\frac{1}{n}$ (B) log$k$
(C) n (D) k

91. Which from following statements is true for group 16 elements?

(A) All elements of this group form EO_2 type oxides. (B) It includes all the nonmetals.
(C) Oxides of all elements of this group are gaseous at room temperature. (D) Reducing properties of dioxides of this group element decreases form SO_2 to TeO_2.

92. Which among the following formulae is correctly represented according to stock notation?

(A) Fe (II) Cl_3 (B) Mn(II)O_2
(C) Au (III)Cl (D) Sn(IV)Cl_4

93. Identify the major product when anisole is treated with Br_2 in presence of acetic acid.

(A) m-Bromo anisole
(B) p-Bromo anisole
(C) o-Bromo anisole
(D) 2,4,6-Tribromo anisole

94. All the elements of group 2 react with water to form metal hydroxide and hydrogen, except the element

(A) Barium
(B) Calcium
(C) Magnesium
(D) Beryllium

95. Which of the following compound is obtained when glucose is treated with dilute nitric acid?

(A) Glucose oxime
(B) Gluconic acid
(C) Saccharic acid
(D) Glucose cyanohydrin

96. What is the IUPAC name of glyoxal?

(A) Propanedial
(B) Ethanedial
(C) 2-Methyl propanal
(D) Prop-2-enal

97. The order of reaction for which the units of rate constant are mol dm^{-3} s^{-1} is

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

98. Which among the following is a nonferrous alloy?

(A) Brass
(B) Nickel steel
(C) Stainless steel
(D) Chromium steel

99. Identify product 'B' in following reaction.

$$CH_3Br + AgNO_2 \longrightarrow A \xrightarrow{Sn/HCl} B$$

(A) CH_3NO_2
(B) CH_3NH_2
(C) CH_3Cl
(D) CH_3OH

100. A balloon contains 2.27 L air and has a pressure of 1.013×10^5 Nm^{-2}. The balloon rises to a certain height and expands to volume of 4540 mL. What is the final pressure of air in balloon?

(A) 2.026×10^2 Nm^{-2}
(B) 5.065×10^4 Nm^{-2}
(C) 4.540×10^4 Nm^{-2}
(D) 5.065×10^{-4} Nm^{-2}

101. If A(3, 2, −1), B(−2, 2, −3) and D(−2, 5, −4) are the vertices of a parallelogram, then the area of the parallelogram is

(A) 286 sq. units (B) $\sqrt{286}$ sq. units

(C) 300 sq. units (D) $\sqrt{300}$ sq. units

102. If $\hat{a}$ is a unit vector such that

$$(\bar{x} - \hat{a}) \cdot (\bar{x} + \hat{a}) = 8$$

, then

$$|\bar{x}| =$$

(A) ± 3 (B) $2\sqrt{2}$

(C) 3 (D) $\pm\sqrt{7}$

103. The equation of line, where length of the perpendicular segment from origin to the line is 4 and the inclination of this perpendicular segment with the positive direction of X-axis is 30°, is

(A) $x + \sqrt{3}y = 8$ (B) $x - \sqrt{3}y = 8$

(C) $\sqrt{3x} - y = 8$ (D) $\sqrt{3x} + y = 8$

104. If

$$\int \frac{\sin x}{\sin(x-\alpha)} dx = Ax + B\log\sin(x-\alpha) + c$$

, then the value of A and B are respectively (where c is a constant of integration)

(A) $\cos\alpha, \sin\alpha$ (B) $\sin\alpha, \cos\alpha$

(C) $-\cos\alpha, \sin\alpha$ (D) $-\sin\alpha, \cos\alpha$

105. The probability distribution of the number of doublets in four throws of a pair of dice is given by

(A)

X	0	1	2	3	4
P(X) :	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{1}{5}$

(B)

X	0	1	2	3
P(X) :	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

(C)

X	1	2	3	4
P(X) :	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

(D)

X	0	1	2	3	4
P(X) :	$\frac{625}{1296}$	$\frac{125}{324}$	$\frac{25}{216}$	$\frac{5}{324}$	$\frac{1}{1296}$

106. Let

$$\vec{v} = 2\hat{i} + 2\hat{j} - \hat{k}$$

and

$$\bar{w} = \hat{i} + 3\hat{k}$$

. If $\bar{u}$ is a unit vector, then the maximum value of the scalar triple product $[\bar{u}\bar{v}\bar{w}]$ is

(A) $\sqrt{6}$ (B) $\sqrt{10}$

(C) $\sqrt{13}$ (D) $\sqrt{89}$

107. S1 : If -7 is an integer, then $\sqrt{-7}$ is a complex number

S2 :

7 is not an integer or $\sqrt{-7}$ is a complex number

(A) S1 and S2 are converse statements of each other (B) S1 and S2 are negations of each other

(C) S1 and S2 are equivalent statements (D) S1 and S2 are contrapositive of each other

108. For the probability distribution given by following

x	5	6	7	8	9	10	11
P(X = x)	0.07	0.2	0.3	k	0.07	0.04	0.02

Var(X) =

(A) 2.65 (B) 2.85

(C) 1.65 (D) 3.85

109.

$$\int_0^1 |5x - 3| dx =$$

(A) $\frac{13}{10}$ (B) 1

(C) $\frac{3}{10}$ (D) $\frac{1}{2}$

110. Function

$$f(x) = e^{-1/x}$$

is strictly increasing for all x where

(A) x is only positive real number (B) x is only negative real number

(C) x is a real number (D) x is a non-zero real number

111. The distance between the parallel lines

$$\frac{x-2}{3}=\frac{y-4}{5}=\frac{z-1}{2}$$

and

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

is

(A) $\frac{1}{\sqrt{38}}$ units (B) $\sqrt{\frac{333}{38}}$ units

(C) $\sqrt{\frac{300}{37}}$ units (D) $\sqrt{\frac{300}{35}}$ units

112. The general solution of the differential equation

$$\frac{dy}{dx}+\frac{y^2+y+1}{x^2+x+1}=0$$

is

(A) $x+y+1=c(1+x+y+2xy)$

(B) $x+y+1=c(2+x+y+2xy)$

(C) $x+y+1=c(1-x-y-2xy)$

(D) $x+y+2=c(2-x-y-2xy)$

113.

$$\tan\left(\cos^{-1}\left(\frac{4}{5}\right)+\tan^{-1}\left(\frac{2}{3}\right)\right)=$$

(A) $\frac{17}{6}$ (B) $\frac{17}{3}$

(C) $\frac{18}{5}$ (D) $\frac{7}{15}$

114. The general solution of the differential equation

$$\frac{dx}{dt}=\frac{x\log x}{t}$$

is

(A) $\log x-x=c$ (B) $e^{ct}+x=0$

(C) $\log t=x+c$ (D) $e^{ct}=x$

115. If

$$3\sin\theta=2\sin 3\theta$$

and

$$0<\theta<\pi$$

, then

$$\sin\theta=$$

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

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

116. The maximum value of the objective function

$$z=2x+3y$$

subject to the constraints $x+y\leq 5, 2x+y\geq 4$ and $x\geq 0, y\geq 0$ is

(A) 15 (B) 10

(C) 20 (D) 25

117. The particular solution of differential equation

$$(x+y)dy+(x-y)dx=0$$

at

$$x=y=1$$

is

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

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

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

(D) $\log|\frac{x^2+y^2}{2}|=\frac{\pi}{4}-2\tan^{-1}(\frac{y}{x})$

118.

$$\int\frac{10^{\frac{x}{2}}}{\sqrt{10^{-x}-10^{x}}}dx=$$

(A) $2\sqrt{10^{-x}+10^{x}}+c$ (B) $\frac{2}{2\sqrt{10^{-x}+10^{x}}}+c$

(C) $\frac{1}{\log 10}\sin^{-1}(10^{x})+c$ (D) $\frac{1}{\log 10}\cos^{-1}(10^{x})+c$

119.

$$\int_0^{\pi/2}\frac{\cos x}{3\cos x+\sin x}dx=$$

(A) $\frac{3\pi}{20}-\frac{\log 3}{100}$ (B) $\frac{3\pi}{10}-\frac{\log 3}{10}$

(C) $\frac{3\pi}{20}+\frac{\log 3}{10}$ (D) $\frac{3\pi}{20}-\frac{\log 3}{10}$

120. If

$$A=\begin{bmatrix}2 & 3\\ 5 & -2\end{bmatrix}$$

and

$$A^{-1}=KA$$

, then K is

(A) 19 (B) $\frac{-1}{19}$

(C) -19 (D) $\frac{1}{19}$

121. If

$$\mathrm{A}=\begin{bmatrix}1 & 2 & 3\\ -1 & 1 & 2\\ 1 & 2 & 4\end{bmatrix}$$

, then

$$\mathrm{A}(\mathrm{adj}\,\mathrm{A})=$$

(A) $\begin{bmatrix}-1/3 & 0 & 0\\ 0 & -1/3 & 0\\ 0 & 0 & -1/3\end{bmatrix}$

(B) $\begin{bmatrix}3 & 0 & 0\\ 0 & 3 & 0\\ 0 & 0 & 3\end{bmatrix}$

(C) $\begin{bmatrix}1 & 2 & 3\\ -1 & 1 & 2\\ 1 & 2 & 4\end{bmatrix}$

(D) $\begin{bmatrix}1 & -1 & 1\\ 2 & 1 & 2\\ 3 & 2 & 4\end{bmatrix}$

122. A random variable X has the following probability distribution

x	0	1	2	3	4	5	6	7	8
$P(X=x)$	K	2K	3K	4K	4K	3K	2K	K	K

Then

$$P(3 < x \leq 6) =$$

(A) $\frac{3}{7}$ (B) $\frac{4}{7}$

(C) $\frac{13}{21}$ (D) $\frac{8}{21}$

123. If

$$x = -2$$

and

$$x = 4$$

are the extreme points of

$$y = x^3 - \alpha x^2 - \beta x + 5$$

, then

(A) $\alpha = 3, \beta = 24$ (B) $\alpha = -24, \beta = -3$

(C) $\alpha = -3, \beta = -24$ (D) $\alpha = 24, \beta = 3$

124. The coordinates of the foot of the perpendicular drawn from the origin to the plane

$$2x + y - 2z = 18$$

are

(A) $(4, 2, -4)$ (B) $(1, 2, -3)$

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

125. If a circle passes through the points $(0, 0), (x, 0)$ and $(0, y)$, then the coordinates of its centre are

(A) $(\frac{-x}{2}, \frac{y}{2})$ (B) $(\frac{x}{2}, \frac{y}{2})$

(C) $(\frac{-x}{2}, \frac{-y}{2})$ (D) $(\frac{x}{2}, \frac{-y}{2})$

126. If

$$A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & -1 & 0 \\ 3 & 3 & -4 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$

and

$$X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

such that

$$AX = B$$

, then the value of

$$x_1 + x_2 + x_3 =$$

(A) 4 (B) 5

(C) 6 (D) 3

127. If

$\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}, b = -\hat{i} + 2\hat{j} + \hat{k}, c = 3\hat{i} + \hat{j}$ and $\bar{a} + \lambda\bar{b}$ is perpendicular to $\bar{c}$, then

$$\lambda =$$

(A) 5 (B) 2

(C) 3 (D) 4

128. If two lines represented by

$$ax^2 + 2hxy + by^2 = 0$$

makes angles α and β with positive direction of X -axis, then

$$\tan(\alpha + \beta) =$$

(A) $\frac{2h}{b-a}$ (B) $\frac{2h}{a-b}$

(C) $\frac{h}{a+b}$ (D) $\frac{2h}{a+b}$

129. If

$$\tan^{-1}\left[\frac{\sqrt{1+x^2} - \sqrt{1-x^2}}{\sqrt{1+x^2} + \sqrt{1-x^2}}\right] = \alpha$$

, then the value of $\sin 2\alpha$ is

(A) x^3 (B) $\sqrt{x}$

(C) x (D) x^2

130. The general solution of the differential equation

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

is

(A) $2^x - 2^y = c$ (B) $\frac{1}{2^x} - \frac{1}{2^y} = c$

(C) $\frac{1}{2^x} + \frac{1}{2^y} = c$ (D) $2^x + 2^y = c$

131. The vector equation of the line passing through $P(1, 2, 3)$ and $Q(2, 3, 4)$ is

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

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

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

(D) $(\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + 6\hat{j} + 12\hat{k})$

132. Range of the function

$$f(x) = 3 + 2^x + 4^x$$

is

(A) $(3, \infty)$ (B) $(-\infty, \infty)$

(C) $[3, \infty)$ (D) $(-\infty, 3]$

133. The combined equation of a pair of lines passing through the origin and inclined at 60° and

$$30 =$$

respectively with x-axis is

(A) $\sqrt{3}(x^2 + y^2) = 2xy$ (B) $\sqrt{3}(x^2 + y^2) = 4xy$

(C) $4(x^2 + y^2) = \sqrt{3}xy$ (D) $2(x^2 + y^2) = \sqrt{3}xy$

134.

$$\int e^{(e^x + x)} dx =$$

(A) $e^x + x + c$ (B) $e^{(e^x)} \cdot x + c$

(C) $e^{(e^x)} + c$ (D) $e^{(e^x)}(e^x - 1) + c$

135. If
$$z = x + iy$$
satisfies the condition
$$|z + 1| = 1$$
, then z lies on the

(A) parabola with vertex $(0, 0)$
(B) circle with centre $(-1, 0)$ and radius 1
(C) circle with centre $(1, 0)$ and radius 1
(D) Y-axis

136. If $3\hat{j}, 4\hat{k}$ and $3\hat{j} + 4\hat{k}$ are the position vectors of the vertices A, B, C respectively of $\triangle ABC$, then the position vector of the point in which the bisector of $\angle$A meets BC is

(A) $\frac{5}{3}\hat{j} - 4\hat{k}$
(B) $5\hat{j} - 4\hat{k}$
(C) $5\hat{j} + 4\hat{k}$
(D) $\frac{5}{3}\hat{j} + 4\hat{k}$

137. 10 is divided into two parts such that the sum of double of the first and square of the other is minimum, then the numbers are respectively

(A) 9, 1
(B) 8, 2
(C) 6, 4
(D) 7, 3

138. In a triangle ABC, with usual notations
$$a = 2,\ b = 3, c = 5$$
, then
$$\frac{\cos A}{a} + \frac{\cos B}{b} + \frac{\cos C}{c} =$$

(A) $\frac{19}{30}$
(B) $\frac{19}{60}$
(C) $\frac{23}{60}$
(D) $\frac{38}{35}$

139. If
$$f(x) = \frac{1 - \sin x + \cos x}{1 + \sin x + \cos x}$$
, for $x \neq \pi$ is continuous at
$$x = \pi$$
, then the value of $f(\pi)$ is

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

140. 140. Given that total of 16 values is 528 and sum of the squares of deviation from 33 is 9158. The variance is

(A) 562.73
(B) 570.375
(C) 574.375
(D) 572.375

141.
$$\lim_{x \to 1}\left[\frac{\sqrt{x} - 1}{\log x}\right] =$$

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

142. If the surrounding air is kept at 25°C and a body cools from 80°C to 50°C in 30 minutes, then temperature of the body after one hour will be

(A) 31.72°C approximately
(B) 34.74°C approximately
(C) 32.36°C approximately
(D) 36.36°C approximately

143. Rooms in a hotel are numbered from 1 to 19. Rooms are allocated at random as guests arrive. The first guest to arrive is given a room which is a prime number. The probability that the second guest to arrive is given a room which is a prime number is

(A) $\frac{8}{19} \times \frac{7}{18}$
(B) $\frac{8}{19}$
(C) $\frac{8}{19} \times \frac{7}{19}$
(D) $\frac{7}{18}$

144. Negation of the statement :
$$3 + 6 > 8$$
and
$$2 + 3 < 6$$
is

(A) $3 + 6 \leq 8$ or $2 + 3 < 6$
(B) $3 + 6 < 8$ or $2 + 3 < 6$
(C) $3 + 6 \leq 8$ or $2 + 3 \geq 6$
(D) $3 + 6 > 8$ or $2 + 3 \geq 6$

145. If
$$f(x) = \text{cosec}^{-1}\left[\frac{10}{6\sin\left(2^x\right) - 8\cos\left(2^x\right)}\right]$$
, then
$$f'(x) =$$

(A) $2^x \log 2$
(B) -1
(C) $\log 2$
(D) 2^x

146. The area bounded by the parabola
$$y^2 = 4ax$$
and its latus-rectum
$$x = a$$
is

(A) $\frac{8}{3}a^2$ sq. units
(B) $\frac{2}{3}a^2$ sq. units
(C) $\frac{4}{3}a^2$ sq. units
(D) $8a^2$ sq. units

147. If

$$y = \log\sqrt{\tan x}$$

, then the value of

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

at

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

is

(A) 1 (B) -1

(C) $\frac{1}{2}$ (D) 0

148. If

$$x = a\left(t - \frac{1}{t}\right)$$

and

$$y = b\left(t + \frac{1}{t}\right)$$

, then

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

(A) $\frac{a^2x}{b^2y}$ (B) $\frac{a^2y}{b^2x}$

(C) $\frac{-b^2x}{a^2y}$ (D) $\frac{b^2x}{a^2y}$

149. Out of 7 consonants and 4 vowels, the number of words consisting of 3 consonants and 2 vowels are

(A) 3300 (B) 210

(C) 120 (D) 25200

150. Equation of planes parallel to the plane

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

which are at a distance of one unit from the point (1, 2, 3) are

(A) $x + 2y + 2z = 6, x + 2y + 2z = 0$

(B) $x - 2y + 2z = 0, x - 2y + 2z - 6 = 0$

(C) $x - 2y - 6 = 0, x - 2y + z = 6$

(D) $x + 2y + 2z = -6, x + 2y + 2z = 5$

- End of Question Paper -