MHT CET 2024 PCM May 11 Shift 2 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

Time Allowed: 180 Minutes **Total Questions: 150** **Maximum Marks: 200**

General Instructions

(i) This **PCM** paper is from **MHT CET 2024**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

(ii) Answer all **150 multiple choice questions**: **50 Physics**, **50 Chemistry** and **50 Mathematics**.

(iii) Each question offers **four choices**, with **one correct answer**.

(iv) Allow **90 minutes for Physics and Chemistry together**, followed by **90 minutes for Mathematics**. The first group closes before the second opens.

(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

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

1. An electric dipole will have minimum potential energy when it subtends an angle

$$\begin{bmatrix}\cos 0^\circ = 1 \\ \sin 0^\circ = 0\end{bmatrix}\begin{bmatrix}\cos 90^\circ = 0 \\ \cos \pi = -1\end{bmatrix}$$

(A) π with direction of field.
(B) $\frac{\pi}{2}$ with direction of field.
(C) $\frac{3\pi}{2}$ with direction of field.
(D) zero with direction of field.

2. A particle is performing S.H.M. about its mean position with an amplitude ' a ' and periodic time ' T '. The speed of the particle when its displacement from mean position is $\frac{a}{3}$ will be

(A) $\frac{2\pi a}{T}$
(B) $\frac{4\sqrt{2}\pi a}{3\,T}$
(C) $\frac{4\pi^2 a}{3\,T}$
(D) $\frac{\sqrt{3}\pi^2 a}{2\,T}$

3. In case of photoelectric effect, the graph of measured stopping potential (V_0) against frequency ' v ' of incident light is a straight line. The slope of this line multiplied by the charge of electron (e) gives

(A) the work function of the metal.
(B) the Planck's constant.
(C) the maximum kinetic energy of the ejected electrons.
(D) the threshold frequency for photoejection from the metal.

4. Critical angle of light passing from glass to air is minimum for wavelength of

(A) red colour
(B) yellow colour
(C) green colour
(D) blue colour

5. What is the pressure of hydrogen in a cylinder of volume 10 litre if its total energy of translation is 7.5×10^3 J ?

(A) $5 \times 10^5 \mathrm{Nm}^{-2}$
(B) $10^6 \mathrm{Nm}^{-2}$
(C) $0.5 \times 10^5 \mathrm{Nm}^{-2}$
(D) $5 \times 10^6 \mathrm{Nm}^{-2}$

6. A particle ' A ' has charge ' $+q$ ' and a particle ' B ' has charge ' $+4q$ '. Each has same mass ' m '. When they are allowed to fall from rest through the same potential, the ratio of their speeds will become (particle A to particle B)

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

7. When 100 V d.c. is applied across a solenoid, a current of 1 A flows in it. When 100 a.c. is applied across it, the current drops to 0.5 A. If the frequency is 50 Hz , the impedance and inductance is

(A) $200\Omega, \sqrt{3}/\pi \mathrm{H}$
(B) $100\Omega, \sqrt{3}\mathrm{H}$
(C) $200\Omega, 1\mathrm{H}$
(D) $100\Omega, 1\mathrm{H}$

8. When n-p-n junction transistor is used as an amplifier in common emitter mode,

(A) the input impedance is high and the output impedance is low.
(B) the base emitter junction is reverse biased.
(C) input signal is applied between the base and emitter and output is obtained between collector and emitter.
(D) the input voltage and output voltage are in phase.

9. An infinitely long straight conductor carrying current 'I' is bent in a shape as shown in figure. The radius of the circular part of loop is 'r'. The magnetic induction at the centre 'C' is (μ = permeability of free space)



(A) Zero
(B) $\frac{\mu_0}{4\pi}\frac{2I}{r}(1+\pi)$
(C) $\frac{\mu_0}{4\pi}\frac{\mathrm{I}}{\mathrm{r}}(1+\pi)$
(D) $\frac{\mu_0}{4\pi}\frac{2I}{r}(\pi-1)$

10. A piece of wood has length, breadth and height, ' a ', ' b ' and ' c ' respectively. Its relative density, is ' d '. It is floating in water such that the side ' a ' is vertical. It is pushed down a little and released. The time period of S.H.M. executed by it is (g = acceleration due to gravity)

(A) $2\pi\sqrt{\frac{abc}{g}}$ (B) $2\pi\sqrt{\frac{\mathrm{bc}}{\mathrm{dg}}}$

(C) $2\pi\sqrt{\frac{g}{da}}$ (D) $2\pi\sqrt{\frac{\mathrm{ad}}{\mathrm{g}}}$

11. Assuming that junction diode is ideal, the current in arrangement shown in figure



(A) 2 mA (B) 20 mA

(C) 30 mA (D) 10 mA

12. Four thin metal rods each of mass ' M ' and length ' L ', are welded end to end to form a square. The moment of inertia of the system about an axis passing through the centre of the square and perpendicular to its plane is

(A) $\frac{\mathrm{ML}^2}{3}$ (B) $\frac{2\mathrm{ML}^2}{3}$

(C) $\frac{2\mathrm{ML}^2}{9}$ (D) $\frac{4\mathrm{ML}^2}{3}$

13. Considering interference between two sources of intensities ' I ' and ' 4 I ', the intensity at a point where the phase difference is π is $(\cos\pi = -1)$

(A) I (B) 4I

(C) 5I (D) 3I

14. If number of turns per unit length in a solenoid is tripled, the self inductance of solenoid will

(A) remain constant (B) be halved

(C) become 9 times (D) become $\frac{1}{9}$ times

15. A sphere ' A ' of radius ' R ' has a charge ' Q ' on it. The field at point B outside the sphere is ' E '. Now another sphere of radius ' $2R$ ' having a charge ' $-2Q$ ' is placed at B. The total field at the point midway between A and B due to both the spheres is

(A) E (B) 3E

(C) 12E (D) 15E

16. Two rain drops of same radius are falling through air each with a steady speed of 5 cm/s. If the drops coalesce, the new steady velocity of big drop will be

(A) 5 cm/s (B) $5\sqrt{2}$ cm/s

(C) $5 \times 2^{1/3}$ cm/s (D) $5 \times (4)^{1/3}$ cm/s

17. Which of the following statements is NOT true?

(A) Sound wave travels in a straight line. (B) Sound is propagated as waves.

(C) Sound can travel through vacuum. (D) Sound is a form of energy.

18. In a hydrogen atom in its ground state, the first Bohr orbit has radius r_1. The electron's orbital speed becomes one-third when the atom is raised to one of its excited states. The radius of the orbit in that excited state is

(A) $3r_1$ (B) $4r_1$

(C) $9r_1$ (D) $16\mathrm{r}_1$

19. ' N ' molecules of gas A, each having mass ' m ' and ' 2 N ' molecules of gas B , each of mass ' 2 m ' are contained in the same vessel which is at constant temperature ' T '. The mean square velocity of B is V^2 and mean square of x -component of A is ω^2. The value of $\frac{\omega^2}{\mathrm{V}^2}$ is

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

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

20. For a satellite moving in an orbit around the earth at height ' h ' the ratio of kinetic energy to potential energy is

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

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

21. The number of turns in the primary of a transformer are 1000 and in secondary 3000. If 80 V a.c. is applied to the primary, the potential difference per turn of the secondary coil is

(A) 0.02 V (B) 0.04 V

(C) 0.08 V (D) 0.16 V

22. A current carrying circular loop of radius ' R ' and current carrying long straight wire are placed in the same plane. The current through circular loop and long straight wire are ' I_c ' and ' I_w ' respectively. The perpendicular distance between centre of the circular loop and wire is ' d '. The magnetic field at the centre of the loop will be zero when separation ' d ' is equal to

(A) $\frac{RI_w}{\pi I_c}$ (B) $\frac{RI_c}{\pi I_w}$

(C) $\frac{\pi I_c}{RI_w}$ (D) $\frac{\pi I_w}{RI_c}$

23. All the springs in fig. (a), (b) and (c) are identical, each having force constant K . Mass attached to each system is ' m '. If T_a, T_b and T_c are the time periods of oscillations of the three systems respectively, then

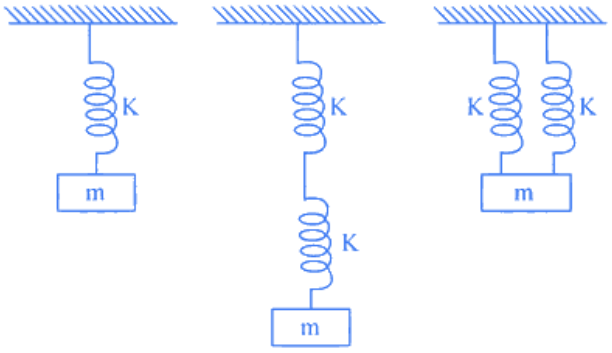
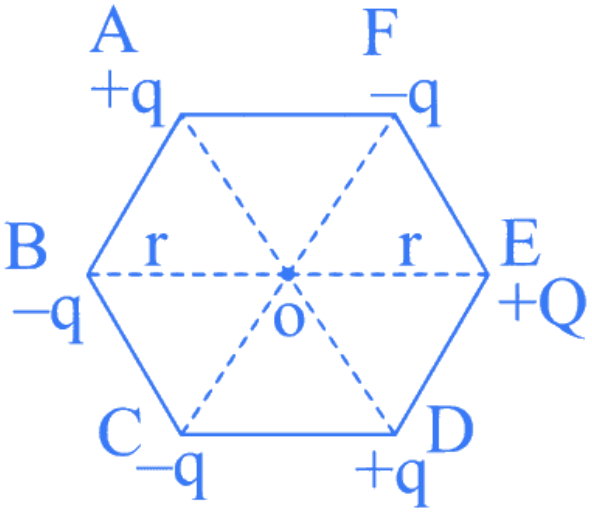


fig. (a) fig. (b) fig. (c)

(A) $T_a = \sqrt{2}\, T_b$ (B) $T_a = \frac{T_c}{\sqrt{2}}$

(C) $T_b = 2T_a$ (D) $T_b = 2T_c$

24. The point charges $+q, -q, -q, +q, +Q$ and -q are placed at the vertices of a regular hexagon ABCDEF as shown in figure. The electric field at the centre of hexagon ' O ' due to the five charges at A, B, C, D and F is thrice the electric field at centre ' O ' due to charge $+Q$ at E alone. The value of Q is



(A) $\frac{+q}{3}$ (B) $\frac{+q}{5}$

(C) $\frac{+q}{6}$ (D) $+6q$

25. A 1μ F capacitor is charged to 50 V and is then discharged through 10 mH inductor of negligible resistance. The maximum current in the inductor is

(A) 0.5 A (B) 1.5 A

(C) 1 A (D) 0.15 A

26. The phase difference between two waves giving rise to dark fringe in Young's double slit experiment is (n is the integer)

(A) zero (B) $(4n+1)\frac{\pi}{2}$

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

27. A capillary tube stands with its lower end dipped into liquid for which the angle of contact is 90°. The liquid will

(A) neither rise nor fall. (B) get depressed only.

(C) rise only. (D) rise upto the top of the tube.

28. A body is projected in vertically upward direction from the surface of the earth of radius ' R ' into space with velocity ' nV_e ' (n < 1). The maximum height from the surface of earth to which a body can reach is

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

(C) $\frac{nR^2}{(1+n^2)}$ (D) $\frac{n^2R^2}{(1+n)}$

29. The angular momentum of the electron in the third Bohr orbit of hydrogen atom is ' l '. Its angular momentum in the fourth Bohr orbit is

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

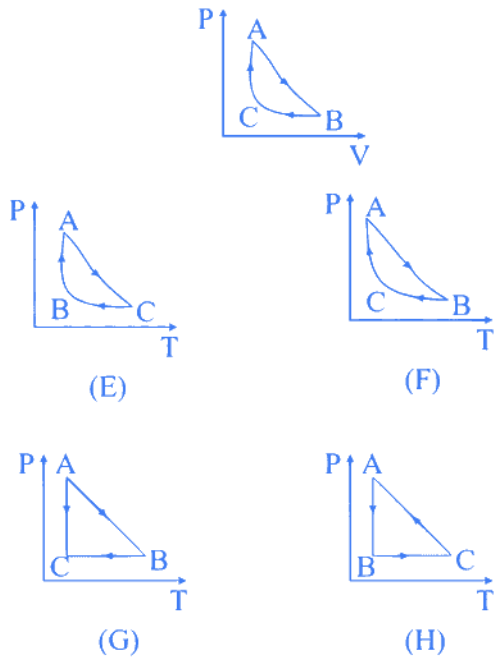
(C) $\frac{5}{4}l$ (D) $\frac{3}{2}l$

30. A battery of 6 V is connected to the ends of uniform wire 3 m long and of resistance 100Ω. The difference of potential between two points 50 cm apart on the wire is

(A) 1 V (B) 1.5 V

(C) 2 V (D) 3 V

31. The p – V diagram for a fixed mass of an ideal gas undergoing cyclic process is as shown in figure. AB represents isothermal process and CA represents adiabatic process. Which one of the following graphs represents the p-T diagram of this cyclic process?



(A) (G) (B) (F)

(C) (H) (D) (E)

32. A vessel is filled with two different liquids which do not mix. One is 40 cm deep and has refractive index 1.6 and other is 30 cm deep and has refractive index $1 \cdot 5$. The apparent depth of vessel when viewed normally is

(A) 37.5 cm (B) 50 cm

(C) 45 cm (D) 40 cm

33. In LCR resonant circuit, the current and voltage have phase difference

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$

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

34. How is the interference pattern affected when violet light replaces sodium light?

(A) The fringes become brighter. (B) The fringes become faint.

(C) Fringewidth decreases. (D) Fringewidth increases.

35. A lead sphere of mass ' m ' falls in viscous liquid with terminal velocity V_0. Another lead sphere of mass ' 8 m ' but of same material will fall through the same liquid with terminal velocity

(A) V_0 (B) $8V_0$

(C) $4V_0$ (D) 64 V_0

36. Two cylinders A and B fitted with piston contain equal amount of an ideal diatomic as at temperature ' T ' K . The piston of cylinder A is free to move while that of B is held fixed. The same amount of heat is given to the gas in each cylinder. If the rise temperature of the gas in A is ' dT_A ', then the rise in temperature of the gas in cylinder B is $\left(\gamma = \frac{C_p}{C_v}\right)$

(A) $2dt_A$ (B) $\frac{dT_A}{2}$

(C) γdT_A (D) $\frac{dT_A}{\gamma}$

37. A photoelectric surface is illuminated successively by monochromatic light of Wavelength λ and $(\lambda/3)$. If the maximum kinetic energy of the emitted photoelectrons in the second case is 4 times that in the first case, the work function of the surface of the material is (h = Planck's constant, c = speed of light)

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

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

38. A metal rod having coefficient of linear expansion $2 \times 10^{-5}/^{\circ}C$ is 0.75 m long at 45°C. When the temperature rises to 65°C, the increase in length of the rod will be

(A) 3.0 mm (B) 0.75 mm
(C) 0.30 mm (D) 0.15 mm

39. If the two waves of same amplitude, having frequencies 340 Hz and 335 Hz , are moving in same direction, then the time interval between two successive maxima formed (in second) is

(A) 0.1 (B) 0.2
(C) 0.3 (D) 0.5

40. A closely wound coil of 100 turns and of crosssection 1 cm^2 has coefficient of self inductance 1 mH . The magnetic induction at the centre of the core of a coil when a current of 2 A flows in it, will be (in Wb/m^2)

(A) 0.2 (B) 0.4
(C) 0.8 (D) 1

41. A particle of mass ' m ' is performing uniform circular motion along a circular path of radius ' r '. Its angular momentum about the axis passing through the centre and perpendicular to the plane is ' L '. The kinetic energy of the particle is

(A) $\frac{L^2}{2Mr^2}$ (B) $\frac{2\,L^2}{mr^2}$
(C) $\frac{L^2}{mr^2}$ (D) $\frac{2\,L^2}{3mr^2}$

42. Kirchhoff's second law is based on the law of conservation of

(A) charge (B) energy
(C) momentum (D) inter conversion of mass into energy

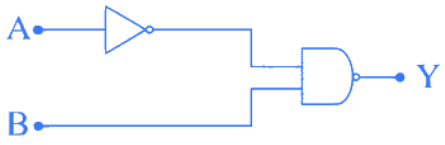
43. A moving body with mass ' m_1 ' strikes a stationary mass ' m_2 '. What should be the ratio $\frac{m_1}{m_2}$ so as to decrease the velocity of first by (1.5) times the velocity after the collision?

(A) 1 : 25 (B) 1 : 5
(C) 5 : 1 (D) 25 : 1

44. The frequency of the third overtone of a pipe of length ' L_c ', closed at one end is same as the frequency of the sixth overtone of a pipe of length ' L_0 ', open at both ends. Then the ratio $L_c : L_0$ is

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

45. For the following digital logic circuit, the correct truth-table is



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

(P)

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

(Q)

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

(R)

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

(S)

(A) Q (B) P
(C) S (D) R

46. The ratio of the velocity of sound in hydrogen gas $\left(\gamma = \frac{7}{5}\right)$ to that in helium gas $\left(\gamma = \frac{5}{3}\right)$ at the same temperature is

(A) 1 : 1 (B) 7 : 3
(C) 21 : 25 (D) $\sqrt{42}$: 5

47. Moment of inertia of a disc about an axis passing through its centre and perpendicular to its plane is 'I'. The ratio of moment of inertia about a parallel axis tangential to its rim to passing through a point midway between the centre and the rim is

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

48. Two cars start from a point at the same time in a straight line and their positions are represented by $x_1(t) = at + bt^2$ and $x_2(t) = Ft - t^2$. At what time do the cars have the same velocity?

(A) $\frac{a+F}{2(b-1)}$ (B) $\frac{a-F}{1+b}$
(C) $\frac{a+F}{2(1+b)}$ (D) $\frac{F-a}{2(1+b)}$

49. Magnetic field at the centre of a circular loop of area ' A ' is ' B '. The magnetic moment of the loop will be

(A) $\frac{BA^2}{\mu_0\pi}$

(B) $\frac{2BA^{3/2}}{\mu_0\pi}$

(C) $\frac{BA^{1/2}}{\mu_0\pi^{1/2}}$

(D) $\frac{2BA^{3/2}}{\mu_0\pi^{1/2}}$

50. A wire of length ' L ' and linear density ' m ' is stretched between two rigid supports with tension ' T '. It is observed that wire resonates in the P^{th} harmonic at a frequency of 320 Hz and resonates again at next higher frequency of 400 Hz . The value of ' p ' is

(A) 2

(B) 4

(C) 8

(D) 10

51. If instantaneous rate of reaction is given as $-\frac{1}{a}\frac{d[A]}{dt} = -\frac{1}{b}\frac{d[B]}{dt} = \frac{1}{c]}\frac{d[C]}{} = \frac{1}{d]}\frac{d[D]}{}$ the reaction is represented as

(A) $A + B \longrightarrow C + D$

(B) $aA + B \longrightarrow cC + dD$

(C) $aA + bB \longrightarrow cC + dD$

(D) $aA + bB \longrightarrow C + D$

52. Which among the following is a correct decreasing order of thermodynamic stability of the complexes?

(A) $[Co(NH_3)_6]^{3+} > [Ag(CN)_2]^- > [Cu(CN)_4]^{2-}$

(B) $[Co(NH_3)_6]^{3+} > [Cu(CN)_4]^{2-} > [Ag(CN)_2]^-$

(C) $[Ag(CN)_2]^- > [Co(NH_3)_6]^{3+} > [Cu(CN)_4]^{2-}$

(D) $[Cu(CN)_4]^{2-} > [Ag(CN)_2]^- > [Co(NH_3)_6]^{3+}$

53. Identify the process from following such that volume of system remains constant.

(A) adiabatic process
(B) isochoric process
(C) isothermal process
(D) isobaric process

54. Identify the instrument used to find crystal structure from following :

(A) X-ray diffractometer
(B) UV-Visible spectrophotometer
(C) Scanning electron microscope
(D) Transmission electron microscope

55. In a solution, mole fraction of solute is 0.2 , when lowering in vapour pressure is 10 mm Hg . To get lowering of vapour pressure of 20 mm Hg , mole fraction of solute in solution is

(A) 0.2
(B) 0.4
(C) 0.6
(D) 0.8

56. Which among the following is an example of one dimensional nanostructure?

(A) Nano rings
(B) Nano tubes
(C) Layers and coatings
(D) Quantum dots

57. Which among the following is an example of emulsion?

(A) Foam rubber
(B) Froth
(C) Gelatin
(D) Hair cream

58. Which of the following solutions will not show flow of solvent in either direction when separated by semipermeable membrane?

(A) 6 g urea dm^{-3} and 85.5 g sucrose dm^{-3}
(B) 15 g urea dm^{-3} and 34.2 g sucrose dm^{-3}
(C) 6 g urea dm^{-3} and 34.2 g sucrose dm^{-3}
(D) 15 g urea dm^{-3} and 171 g sucrose dm^{-3}

59. Identify the correct stability order of following alkenes.
I) $(CH_3)_2C = C(CH_3)_2$
II) $(CH_3)_2C = CH_2$
III) $(CH_3)_2C = CHCH_3$

(A) III > II > I
(B) I > III > II
(C) II > I > III
(D) I > II > III

60. Which of the following element in +1 oxidation state has largest ionic radius?

(A) Rb
(B) K
(C) Na
(D) Li

61. Identify the product in following reaction. Pent -3-enenitrile $\xrightarrow[H_3O^+]{AlH(B-B)_2}$ product

(A) Pent-3-en-1-amine
(B) Pentanal
(C) Pent-3-enal
(D) Pent-3-en-1-ol

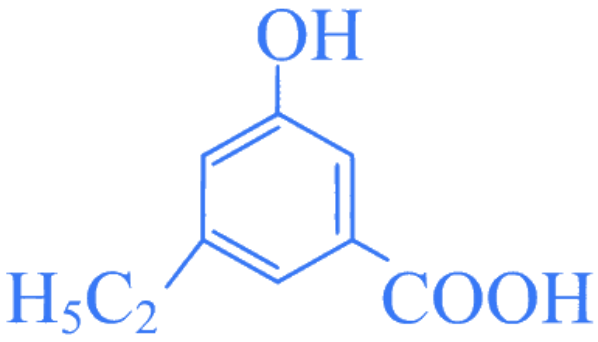
62. Which of the following molecules has zero dipole moment?

(A) HF
(B) NH_3
(C) BF_3
(D) $CHCl_3$

63. What is the concentration of an electrolyte solution to have molar conductivity of $101\Omega^{-1}\ cm^2\ mol^{-1}$ and conductivity of $1.01 \times 10^{-2}\Omega^{-1}\ cm^{-1}$ at 298 K?

(A) 0.05 M
(B) 0.1 M
(C) 0.15 M
(D) 0.2 M

64. What is IUPAC name of following compound?



(A) 3-Carboxy-5-ethyl phenol
(B) 5-Carboxy-3-ethyl phenol
(C) 3-Ethyl-5-hydroxy benzoic acid
(D) 5-Ethyl-3-hydroxy benzoic acid

65. Which element from following is the last element of 5d-transition series?

(A) Hg
(B) Cd
(C) In
(D) Ag

66. The solubility of $CaCO_3$ is 7×10^{-5} moldm^{-3} at 25°C. What is its solubility product at same temperature?

(A) 6.7×10^{-9}
(B) 9.0×10^{-9}
(C) 1.12×10^{-9}
(D) 4.9×10^{-9}

67. Which of the following compounds is NOT obtained at any stage of Gabriel phthalimide synthesis?

(A) Potassium salt of phthalimide
(B) N -alkyl phthalimide
(C) Phthalic acid
(D) Primary amine

68. The solution containing 18 gdm^{-3} glucose (molar mass 180) in water and another containing 6 gdm^{-3} of solute A in water boils at same temperature. What is molar mass of A ?

(A) 54 g mol^{-1}
(B) 90 g mol^{-1}
(C) 120 g mol^{-1}
(D) 60 g mol^{-1}

69. Which among following polymers is used to manufacture water pipes?

(A) Polycarbonate
(B) PVC
(C) Buna-N
(D) Polyacrylamide

70. Identify the correct pair of molecule and the heteroatom present in it respectively from following:

(A) Furan-S
(B) Pyrrole-N
(C) Thiophene-O
(D) Piperidine-S

71. What type of unit cell from following is common to all seven types of crystal systems?

(A) Simple
(B) Body-centred
(C) Face-centred
(D) Base-centred

72. If P_1 partial pressure of a gas and x_1 is its mole fraction in a mixture, then correct relation between P_1 and x_1 is

(A) $P_{total} = P_1 x_1$
(B) $x_1 = \frac{P_1}{P_{total}}$
(C) $P_{total} = 1 - P_1 x_1$
(D) $P_{total} = P_1(1 - x_1)$

73. Which among the following is benzylic halide?

(A) Bromobenzene
(B) Bromophenyl methane
(C) 4-Bromotoluene
(D) 1-Bromo-2-phenylethane

74. Which from following statements is NOT correct regarding Bohr model?

(A) It failed to account for finer details of hydrogen spectrum.
(B) It is unable to explain atomic spectrum other than hydrogen.
(C) It explains Zeeman effect.
(D) It failed to explain ability of atoms to form molecules by chemical bonds.

75. Cell constant of a conductivity cell is 0.9 cm^{-1} and resistance shown by $AgNO_3$ solution is 6530 ohm. What is the conductivity of $AgNO_3$ solution?

(A) $725\Omega^{-1}$ cm^{-1}
(B) $5870\Omega^{-1}$ cm^{-1}
(C) $1.38 \times 10^{-4}\Omega^{-1}$ cm^{-1}
(D) $4.72 \times 10^{-4}\Omega^{-1}$ cm^{-1}

76. Which among the following minerals contains radioactive element in it?

(A) Cleveite
(B) Carnallite
(C) Chile salt petre
(D) Baryte

77. The common name of Benzene-1, 2, 3-triol is

(A) Phloroglucinol (B) Pyrogallol

(C) Quinol (D) Catechol

78. Rate law for a reaction is $r = k[A]^2[B]$. If rate constant is 6.25 $mol^{-2}dm^6\ s^{-1}$, what is the rate of reaction when $[A] = 1\ moldm^{-3}$ and $[B] = 0.2\ moldm^{-3}$?

(A) 1.250 mol $dm^{-3}sec^{-1}$

(B) 2.125 mol $dm^{-3}sec^{-1}$

(C) 3.105 mol $dm^{-3}sec^{-1}$

(D) 2.0×10^{-2} mol $dm^{-3}sec^{-1}$

79. Which element from following is NOT considered as transition element on the basis of electronic configuration?

(A) Ti (B) V

(C) Hg (D) Ag

80. Two moles of an ideal gas are compressed isothermally and reversibly from 40 L to 20 L at 300 K . What is the work done? $\left(R = 8.314\ J\ K^{-1}\ mol^{-1}\right)$

(A) 3.46 kJ (B) 4.16 kJ

(C) 2.08 kJ (D) 6.12 kJ

81. Identify the product ' A ' obtained in following reaction.

N -alkyl phthalimide $\xrightarrow{N_2OH_{(aq)}}$ sodium phthalate + A

(A) Primary amine (B) Amide

(C) Phenol (D) Benzoic acid

82. Which among the following is the conjugate base of $HClO_4$?

(A) ClO_4^{2-} (B) ClO_4

(C) HCl (D) ClO_4^-

83. Which from following polymers contain - CO - NH - linkage in it?

(A) Urea formaldehyde resin (B) Glyptal

(C) Polycarbonate (D) Thermacol

84. Identify the product of ozonolysis of but-2-ene from following:

(A) Acetone and formaldehyde (B) Acetaldehyde and formaldehyde

(C) Acetone (D) Acetaldehyde

85. What is atomic radius of an element if it crystallises in BCC structure with edge length of unit cell 287 pm?

(A) 124 pm (B) 131 pm

(C) 137 pm (D) 174 pm

86. Identify the product ' B ' in the following reaction sequence.

$$C_2H_5 - Br \xrightarrow[\text{Dry ether}]{Mg} A \xrightarrow{CH_3OH} B$$

(A) $H_3C - CH_2 - CH_3$ (B) $C_2H_5 - O - CH_3$

(C) C_2H_6 (D) $C_2H_5 - OH$

87. Identify the correct statement for following reaction.

$$3Mg + N_2 \longrightarrow Mg_3\ N_2$$

(A) Mg is reduced (B) Mg is oxidised

(C) N_2 is oxidised (D) oxidation state of Mg changes from +2 to zero

88. Which of the following cannot be used as standard solution for determination of cell constant of conductivity cell?

(A) 1 M KCl (B) 0.1 M KCl

(C) 0.01 M KCl (D) Saturated KCl

89. Which from following reagents is used in the conversion of phenol to picric acid?

(A) dil. Nitric acid (B) conc. Nitrous acid

(C) conc. Sulphuric acid (D) conc. HNO_3+ conc. H_2SO_4

90. Which element from following has largest atomic size as compared to other three?

(A) S (B) Se

(C) Cl (D) Br

91. Calculate the enthalpy change when 12 g carbon react with sufficient hydrogen to form methane. If enthalpy of formation of methane is $-75\ kJ\ mol^{-1}$.

(A) -45 kJ (B) -60 kJ

(C) -75 kJ (D) -90 kJ

92. What type of ligand is the oxalate ion?

(A) Monodentate (B) Bidentate

(C) Ambidentate (D) Hexadentate

93. What is pH of a centimolar solution of H_2SO_4 ?

(A) 1.7 (B) 2.0

(C) 3.2 (D) 4.5

94. What is the time needed to reduce the initial concentration of reactant to 10% in a first order reaction if its half life time is 10 minutes?

(A) 15 minute (B) 20 minute

(C) 25 minute (D) 33 minute

95. Which from following proteins acts as an enzyme to break protein to α-amino acid?

(A) Trypsine (B) Pepsin

(C) Myosine (D) Keratine

96. Identify the orbital having highest energy from following:

(A) 2p (B) 3s

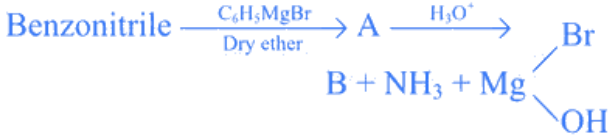
(C) 3d (D) 4p

97. A metal crystallises in bcc structure with edge length 4×10^{-8}. If density of unit cell is 10 g cm^{-3}. What is its molar mass?

(A) 60 g mol^{-1} (B) 120 g mol^{-1}

(C) 152 g mol^{-1} (D) 193 g mol^{-1}

98. Identify product 'B' in following reaction



(A) Benzophenone (B) Benzaldehyde

(C) Benzyl alcohol (D) Benzoic acid

99. How many molecules of carbon dioxide are formed when 0.6 g carbon is burnt in air?

(A) 3.01×10^{22} (B) 2.01×10^{23}

(C) 6.02×10^{22} (D) 5.02×10^{23}

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

Sodium phenoxide $\xrightarrow[6\ atm]{CO_2, 398\ K}$ A $\xrightarrow{H_3O^+}$ B

(A) Picric acid (B) Sulphonic acid

(C) Salicylic acid (D) Salicylaldehyde

101. The number of arrangements, of the letters of the word MANAMA in which two M's do not appear adjacent, is

(A) 40 (B) 60
(C) 80 (D) 100

102. A random variable X has the following probability distribution

$X = x$	1	2	3	4	5	6	7	8
$P(X = x)$	0.15	0.23	0.10	0.12	0.20	0.08	0.07	0.05

For the event $E = \{X \text{ is a prime number }\}$, $F = \{X < 4\}$, then $P(E \cup F)$ is

(A) 0.5 (B) 0.77
(C) 0.35 (D) 0.75

103.

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

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

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

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

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

104. An ice ball melts at the rate which is proportional to the amount of ice at that instant. Half of the quantity of ice melts in 15 minutes. x_0 is the initial quantity of ice. If after 30 minutes the amount of ice left is kx_0, then the value of k is

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$
(C) $\frac{1}{4}$ (D) $\frac{1}{8}$

105. Contrapositive of the statement 'If two numbers are not equal, then their squares are not equal', is

(A) If the squares of two numbers are not equal, then the numbers are equal.
(B) If the squares of two numbers are equal, then the numbers are not equal.
(C) If the squares of two numbers are equal, then the numbers are equal.
(D) If the squares of two numbers are not equal, then the numbers are not equal.

106. If $f : [1, \infty) \to [2, \infty)$ is given by $f(x) = x + \frac{1}{x}$ then $f^{-1}(x)$ equals

(A) $\frac{x+\sqrt{x^2-4}}{2}$ (B) $\frac{2}{1+x^2}$
(C) $\frac{x-\sqrt{x^2-4}}{2}$ (D) $1 + \sqrt{x^2-4}$

107. The angles of a triangle are in the ratio $5 : 1 : 6$, then ratio of the smallest side to the greatest side is

(A) $\sqrt{3}+1 : 2\sqrt{2}$ (B) $2\sqrt{2} : \sqrt{3}+1$
(C) $2\sqrt{2} : \sqrt{3}-1$ (D) $\sqrt{3}-1 : 2\sqrt{2}$

108. Let $y = y(x)$ be the solution of the differential equation $x\frac{dy}{dx} + y = x\log x, (x > 1)$ If $2(y(2)) = \log 4 - 1$ then the value of $y(e)$ is

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

109. The area (in sq. units) of the region bounded by $y - x = 2$ and $x^2 = y$ is equal to

(A) $\frac{2}{3}$ (B) $\frac{4}{3}$
(C) $\frac{9}{2}$ (D) $\frac{16}{3}$

110. Let $\bar{a}, \bar{b}$ and $\bar{c}$ be three unit vectors such that $\bar{a} \times (\bar{b} \times \bar{c}) = \frac{\sqrt{3}}{2}(\bar{b} + \bar{c})$. If $\bar{b}$ is not parallel to $\bar{c}$, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{3\pi}{4}$ (B) $\frac{\pi}{2}$
(C) $\frac{2\pi}{3}$ (D) $\frac{5\pi}{6}$

111. $\lim_{x\to 0} \frac{x\tan 2x - 2x\tan x}{(1-\cos 2x)^2}$ is

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

112. If $y = a\log x + bx^2 + x$ has its extreme values at $x = -1$ and $x = 2$, then the value of $\left(\frac{a}{b} + \frac{b}{a}\right)$ is

(A) $-\frac{7}{4}$ (B) $-\frac{15}{4}$

(C) $-\frac{17}{4}$ (D) $-\frac{5}{4}$

113. If $\hat{a} = \frac{1}{\sqrt{10}}(3\hat{i} + \hat{k})$ and $\hat{b} = \frac{1}{7}(2\hat{i} + 3\hat{j} - 6\hat{k})$, then the value of $(2\hat{a} - \hat{b}) \cdot [(\hat{a} \times \hat{b}) \times (\hat{a} + 2\hat{b})]$ is

(A) 5 (B) 3

(C) -5 (D) -3

114. If $f(x) = \log_{x^2}(\log x)$, then at $x = e, f'(x)$ has the value

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

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

115. If $I = \int_0^{\frac{\pi}{4}} \log(1 + \tan x)dx$, then value of I is

(A) $\frac{\pi}{16}\log 2$ (B) $\frac{\pi}{2}\log 2$

(C) $\frac{\pi}{8}\log 2$ (D) $\frac{\pi}{4}\log 2$

116. The parametric equations of the circle $x^2 + y^2 - ax - by = 0$ are

(A) $x = \frac{a}{2} + \frac{\sqrt{a^2+b^2}}{2}\cos\theta, y = \frac{b}{2} + \frac{\sqrt{a^2+b^2}}{2}\sin\theta$

(B) $x = \frac{-a}{2} + \frac{\sqrt{a^2+b^2}}{4}\sin\theta, y = \frac{-b}{2} + \frac{\sqrt{a^2+b^2}}{4}\cos\theta$

(C) $x = \frac{a}{2} + \sqrt{\frac{a^2+b^2}{2}}\sin\theta, y = \frac{b}{2} + \sqrt{\frac{a^2+b^2}{2}}\cos\theta$

(D) $x = \frac{a}{2} + \frac{\sqrt{a^2+b^2}}{4}\cos\theta, y = \frac{b}{2} + \frac{\sqrt{a^2+b^2}}{4}\sin\theta$

117. The curve $y = ax^3 + bx^2 + cx + 5$ touches the X - axis at $(-2, 0)$ and cuts the Y -axis at a point Q where its gradient is 3 , then values of a, b, c respectively, are

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

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

118. A variable plane passes through the fixed point $(3, 2, 1)$ and meets X, Y and Z axes at points A, B and C respectively. A plane is drawn parallel to YZ - plane through A , a second plane is drawn parallel to ZX -plan through B , a third plane is drawn parallel to XY - plane through C . Then locus of the point of intersection of these three planes, is

(A) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = \frac{11}{6}$ (B) $\frac{x}{3} + \frac{y}{2} + \frac{z}{1} = 1$

(C) $\frac{3}{x} + \frac{2}{y} + \frac{1}{z} = 1$ (D) $x + y + z = 6$

119. The value of $\sin\left(\cos^{-1}\left(-\frac{1}{3}\right) - \sin^{-1}\left(\frac{1}{3}\right)\right)$ is

(A) 1 (B) 2

(C) 3 (D) 4

120. Let $\bar{a}, \bar{b}$, and $\bar{c}$ be three non-zero vectors such that no two of these are collinear. If the vector $\bar{a} + 2\bar{b}$ is collinear with $\bar{c}$ and $\bar{b} + 3\bar{c}$ is collinear with $\bar{a}$, then $\bar{a} + 2\bar{b} + 6\bar{c}$ equals

(A) $\lambda\bar{c}$(λ being some non-zero scalar)

(B) $\bar{b}$(λ being some non-zero scalar)

(C) $\lambda\bar{a}$ (λ being some non-zero scalar)

(D) $\bar{0}$ (λ being some non-zero scalar)

121. Let A, B and C be three events, which are pairwise independent and $\bar{E}$ denote the complement of an event E . If $P(A \cap B \cap C) = 0$ and $P(C) > 0$, then $P((\bar{A} \cap \bar{B})/C)$ is equal to

(A) $P(A) + P(\bar{B})$ (B) $P(\bar{A}) - P(\bar{B})$

(C) $P(\bar{A}) - P(B)$ (D) $P(\bar{A}) + P(\bar{B})$

122. A production unit makes special type of metal chips by combining copper and brass. The standard weight of the chip must be at least 5 gms. The basic ingredients i.e. copper and brass cost ₹8 and ₹ 5 per gm. The durability considerations dictate that the metal chip must no contain more than 4 gms of brass and should contain minimum 2 gms of copper. Then the minimum cost of the metal chip satisfying the above conditions is

(A) Rs.36 (B) Rs.31

(C) Rs.30 (D) Rs.40

123. The distance of the point $(1, -5, 9)$ from the plane $x - y + z = 5$ measured along the line $x = y = z$ is _____ units.

(A) $3\sqrt{10}$ (B) $10\sqrt{3}$

(C) $\frac{10}{\sqrt{3}}$ (D) $\frac{20}{3}$

124. If $f(x) = 1 + x; g(x) = \log x$, then $\int g(f(x))dx$ is equal to

(A) $(1 + x)\log(1 + x) - x + c$, (where c is a constant of integration)

(B) $(1 + x)\log x - x + c$, (where c is a constant of integration)

(C) $x\log(1 + x) + c$, (where c is a constant of integration)

(D) $(1 + x)\log(1 + x) + x + c$, (where c is a constant of integration)

125. The general solution of $\sin x + \cos x = 1$ is

(A) $x = 2n\pi, n \in \mathbb{Z}$

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

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

(D) not existing

126. In a $\triangle PQR, m\angle R = \frac{\pi}{2}$. If $\tan\left(\frac{P}{2}\right)$ and $\tan\left(\frac{Q}{2}\right)$ are the roots of the equation $ax^2 + bx + c = 0 (a \neq 0)$, then

(A) $a + b = c$ (B) $b + c = a$

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

127. If for some $\alpha \in \mathbb{R}$, the lines $L_1 : \frac{x+1}{2} = \frac{y-2}{-1} = \frac{z-1}{1}$ and $L_2 : \frac{x+2}{\alpha} = \frac{y+1}{5-\alpha} = \frac{z+1}{1}$ are coplanar, then the line L_2 passes through the point

(A) $(10, 2, 2)$ (B) $(2, -10, -2)$

(C) $(10, -2, -2)$ (D) $(-2, 10, 2)$

128.

$$\int \cos(\log x) dx =$$

(A) $\frac{x}{2}(\sin(\log x) - \cos(\log x)) + c$, (where c is a constant of integration)

(B) $x(\cos(\log x) - \sin(\log x)) + c$, (where c is a constant of integration)

(C) $\frac{x}{2}(\cos(\log x) + \sin(\log x)) + c$, (where c is a constant of integration)

(D) $x(\cos(\log x) + \sin(\log x)) + c$, (where c is a constant of integration)

129. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar unit vectors such that $\bar{a} \times (\bar{b} \times \bar{c}) = \frac{(\bar{b}+\bar{c})}{\sqrt{2}}$ then the angle between $\bar{a}$ and $\bar{b}$ is

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

(C) $\frac{\pi}{2}$ (D) π

130. The joint equation of pair of lines through the origin, each of which makes an angle of 30° with Y -axis, is

(A) $3x^2 - y^2 = 0$ (B) $x^2 - 3y^2 = 0$

(C) $3x^2 + y^2 = 0$ (D) $x^2 + 3y^2 = 0$

131. Let $f(x) = \begin{cases} \frac{1-\cos 4x}{x^2} & , x < 0 \\ a & , x = 0 \\ \frac{\sqrt{2}}{\sqrt{16+\sqrt{x}-4}} & , x > 0 \end{cases}$ If $f(x)$ is continuous at $x = 0$, then the value of a is

(A) 8 (B) 4

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

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

(A) 2 (B) 3

(C) 0 (D) 1

133. The maximum value of the function $f(x) = 2x^3 - 15x^2 + 36x - 48$ on the set $A = \{x / x^2 + 20 \leq 9x\}$ is

(A) -16 (B) -7

(C) 16 (D) 7

134. The number of unit vectors perpendicular to $\bar{a} = (1, 1, 0)$ and $\bar{b} = (0, 1, 1)$ is

(A) one. (B) two.

(C) three. (D) infinite.

135. If the normal to the curve $y = f(x)$ at the point $(3, 4)$ makes an angle of $\left(\frac{3\pi}{4}\right)$ with the positive X-axis, then the value of $f'(3)$ is

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

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

136.

$$\int \frac{2x+5}{\sqrt{7-6x-x^2}} dx = A\sqrt{7-6x-x^2} + B \sin^{-1}\left(\frac{x+3}{4}\right) + c$$

(where c is a constant of integration) then the value of $A + B$ is

(A) -3 (B) 1

(C) -1 (D) 3

137. A straight line L through the point $(3, -2)$ is inclined at an angle of 60° to the line $\sqrt{3}x + y = 1$. If L also intersects the X -axis, then the equation of L is

(A) $y + \sqrt{3}\ x + 2 - 3\sqrt{3}\ = 0$

(B) $y - \sqrt{3}x + 2 + 3\sqrt{3} = 0$

(C) $\sqrt{3}y - x + 3 + 2\sqrt{3} = 0$

(D) $\sqrt{3}y + x - 3 + 2\sqrt{3} = 0$

138. If $y(x)$ is the solution of the differential equation $(x+2)\frac{dy}{dx} = x^2+4x-9, x \neq -2$ and $y(0)=0$, then $y(-4)$ is equal to

(A) 0 (B) 1

(C) -1 (D) 2

139. If the sides of a triangle a, b, c are in A.P., then with usual notations, a $\cos^2\frac{C}{2} + c\cos^2\frac{A}{2}$ is

(A) $\frac{3a}{2}$ (B) $\frac{3c}{2}$

(C) $\frac{3b}{2}$ (D) $\frac{a+c}{2}$

140. A random variable x takes the values $0, 1, 2, 3, \ldots$ with probability $P(X=x) = k(x+1)\left(\frac{1}{5}\right)^x$, where k is a constant, then $P(X=0)$ is

(A) $\frac{16}{25}$ (B) $\frac{7}{25}$

(C) $\frac{19}{25}$ (D) $\frac{18}{25}$

141. If $A\begin{bmatrix} 2 & 1 \\ 7 & 4 \end{bmatrix}$ then $\left(A^2-5A\right)^{-1}$ is

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

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

142. The following statement $(p \to q) \to ((\sim p \to q) \to q)$ is

(A) a fallacy. (B) equivalent to $(\sim p) \to q$.

(C) equivalent to $p \to (\sim q)$. (D) a tautology.

143. Let $\omega = -\frac{1}{2} + i\frac{\sqrt{3}}{2}, i = \sqrt{-1}$, then the value of $\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1-\omega^2 & \omega^2 \\ 1 & \omega^2 & \omega^4 \end{vmatrix}$ is

(A) 3ω (B) $3\omega(\omega-1)$

(C) $3\omega^2$ (D) $3\omega(1-\omega)$

144. Let f be twice differentiable function such that $f''(x) = -f(x), f'(x) = g(x)$ and $h(x) = (f(x))^2 + (g(x))^2$. If $h(5) = 1$, then the value of $h(10)$ is

(A) 2 (B) 1

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

145. Let $P(3,2,6)$ be a point in space and Q be a point on the line $\bar{r} = \hat{i} - \hat{j} + 2\hat{k} + \mu(-3\hat{i} + \hat{j} + 5\hat{k})$. Then the value of μ for which the vector $\overline{PQ}$ is parallel to the plane $x - 4y + 3z = 1$ is

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

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

146. Let $f(x) = \frac{x}{\sqrt{a^2+x^2}} - \frac{d-x}{\sqrt{b^2+(d-x)^2}}, x \in \mathbb{R}$ where a, b, d are non-zero real constants. Then

(A) f' is not a continuous function of x. (B) f is neither increasing nor decreasing function of x.

(C) f is an increasing function of x. (D) f is a decreasing function of x.

147. If the vectors $\bar{a} = \hat{i} - \hat{j} + 2\hat{k}, \bar{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\bar{c} = \lambda\hat{i} + \hat{j} + \mu\hat{k}$ are mutually orthogonal, then $(\lambda, \mu) \equiv$

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

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

148. If $y = (\sin x)^{\tan x}$, then $\frac{dy}{dx}$ is equal to

(A) $(\sin x)^{\tan x}(1 + \sec^2 x \log(\sin x))$

(B) $\tan x(\sin x)^{\tan x - 1}\cos x$

(C) $(\sin x)^{\tan x}\sec^2 x \log \sin x$

(D) $\tan x(\sin x)^{\tan x - 1}$

149. If for some $x \in \mathbb{R}^+ \cup \{0\}$, the frequency distribution of the marks obtained by 20 students in a test is

Marks :	**2**	**3**	**5**	**7**
Frequency :	$(x+1)^2$	$2x-5$	x^2-3x	x

then the mean of the marks is

(A) 3.0 (B) 2.5

(C) 2.8 (D) 3.2

150. One hundred identical coins, each with probability p , of showing up heads are tossed once. If $0 < p < 1$ and the probability of heads showing on 50 coins is equal to that of heads showing on 51 coins, then the value of p is

(A) $\frac{1}{2}$ (B) $\frac{49}{101}$

(C) $\frac{50}{101}$ (D) $\frac{51}{101}$

- End of Question Paper -