MHT CET 2022 PCM Aug 5 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 2022**, conducted by the **State Common Entrance Test Cell, Maharashtra**.

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

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

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

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

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

1. A projectile thrown from the ground has initial speed ' u ' and its direction makes an angle ' q ' with the horizontal. If at maximum height from ground, the speed of projectile is half its initial speed of projection, then the maximum height reached by the projectile is

[g = acceleration due to gravity, $\sin 30^\circ = \cos 60^\circ = 0.5$, $\cos 30^\circ = \sin 60^\circ = \sqrt{3}/2$]

(A) $\frac{2u^2}{g}$ (B) $\frac{3u^2}{8g}$

(C) $\frac{u^2}{g}$ (D) $\frac{u^4}{2g}$

2. A particle is performing a uniform circular motion along a circular of radius ' R '. In half the period of revolution, its displacement and distance covered are respectively

(A) $2R, \pi R$ (B) $R, \pi R$

(C) $2R, 2\pi R$ (D) $\sqrt{2R}, 2\pi R$

3. A gardener pushes a lawn roller through a distance 20 m. If he applies a force of 30 kg − wt in a direction inclined at 60° to the ground, the work done by the gardener in pushing the roller is

$\left[g = 9.8\ m/s^2,\ \sin 30^\circ = \cos 60^\circ = \frac{1}{2},\ \cos 30^\circ = \sin 60^\circ = \frac{\sqrt{3}}{2}\right]$

(A) 3640 J (B) 2460 J

(C) 3940 J (D) 2940 J

4. A disc has mass ' m ' and radius ' R '. How much tangential force should be applied to the rim of the disc so as to rotate with angular velocity ' ω ' in time t?

(A) $\frac{mR\omega}{2t}$ (B) $mR\omega t$

(C) $\frac{mR\omega}{4t}$ (D) $\frac{mR\omega}{t}$

5. A body is rotating about its own axis. Its rotational kinetic energy is ' x ' and its angular momentum is ' y '. Hence its moment of inertia about the axis is

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

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

6. The difference in the acceleration due to gravity at the pole and equator is (g = acceleration due to gravity, R = radius of earth, θ = latitude, ω = angular velocity, $\cos 0^\circ = 1$, $\cos 90^\circ = 0$)

(A) $R\omega^2 \cos^2\theta$ (B) $R\omega^2$

(C) $\frac{R\omega^2}{g^2}$ (D) $\omega \cos^2\theta$

7. The acceleration due to gravity on moon is $\frac{1^{th}}{6}$ times the acceleration due to gravity on earth. If the ratio of the density of earth ' e_e ' to the density of moon ' e_m ' is $\frac{5}{3}$ then the radius of moon ' R_m ' in terms of the radius of earth ' R_e ' is

(A) $\left(\frac{3}{18}\right) R_e$ (B) $\left(\frac{1}{2\sqrt{3}}\right) R_e$

(C) $\left(\frac{5}{18}\right) R_e$ (D) $\left(\frac{7}{6}\right) R_e$

8. If a capillary tube of radius 1 mm is immersed in water, the mass of water rising in the capillary tube is m. If the radius of the capillary tube is doubled, then the mass of water that rises in the same capillary tube will be

(A) 3 m (B) m/2

(C) m (D) 2 m

9. The surface tension of a soap solution is ' T '. Work done in blowing a soap bubble of diameter 2 d is

(A) $8\pi d^2 T$ (B) $2\pi d^2 T$

(C) $4\pi d^2 T$ (D) $6\pi d^2 T$

10. A liquid drop of density ' Q ' is floating half immersed in a liquid of density ' d '. Diameter of the liquid drop is (Q > d, g = acceleration due to gravity, T = surface tension)

(A) $\left[\frac{3T}{g(2Q-d)}\right]^{\frac{1}{2}}$ (B) $\left[\frac{6T}{g(Q-d)}\right]^{\frac{1}{2}}$

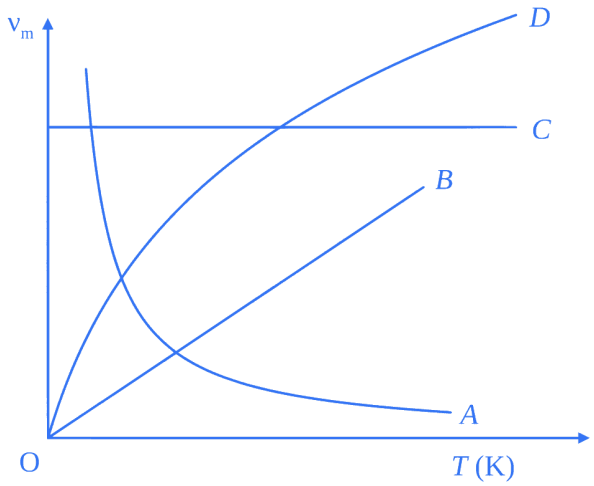
(C) $\left[\frac{12\ T}{g(2Q-d)}\right]^{\frac{1}{2}}$ (D) $\left[\frac{9T}{g(Q-d)}\right]^{\frac{1}{2}}$

11. A clock with iron pendulum keeps correct time at 15°C. If the room temperature is 20°C, the error in second per day will be nearly (coefficient of linear expansion of iron is $\alpha = 1.2 \times 10^{-5}/^\circ C$)

(A) 3.1 s (B) 1.3 s

(C) 6.2 s (D) 2.6 s

12. For a perfectly black body, the graph is plotted between the frequency of radiation with maximum intensity (v_m) and the absolute temperature ' T '. Out of the following which is the correct graph?



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

13. ' V ' cc volume of a gas having $Y = \frac{5}{2}$ is suddenly compressed to $\left(\frac{V}{4}\right)$ c.c. The initial pressure of the gas is P. The final pressure of the gas will be

(A) $\frac{P}{32}$ (B) 16P
(C) $\frac{P}{16}$ (D) 32P

14. In a thermodynamic system, ' W ' represents the work done by the system and ' ΔU ' is the increase in internal energy. Which of the following statements is TRUE?

(A) In an adiabatic process, $\Delta U = -W$ (B) In an isothermal process, $\Delta U = W$
(C) In an adiabatic process, $\Delta U = W$ (D) In an isothermal process, $\Delta U = -nW$

15. Two gases A and B are at absolute temperatures 360 K and 420 K respectively. The ratio of average kinetic energy of the molecules of gas B to that of gas A is

(A) 6 : 7 (B) $\sqrt{7} : \sqrt{6}$
(C) 7 : 6 (D) 49 : 36

16. If the absolute temperature of a gas is increased 5 times, the r.m.s. velocity of the gas molecules will be

(A) 5 times (B) 10 times
(C) 25 times (D) $\sqrt{5}$ times

17. A particle starts oscillating simple harmonically from its equilibrium position with time period ' T '. At time $t = \frac{T}{12}$, the ratio of its kinetic energy to potential energy is $\left[\sin\frac{\pi}{3}\cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}, \sin\frac{\pi}{6} = \cos\frac{\pi}{3} = \frac{1}{2}\right]$

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

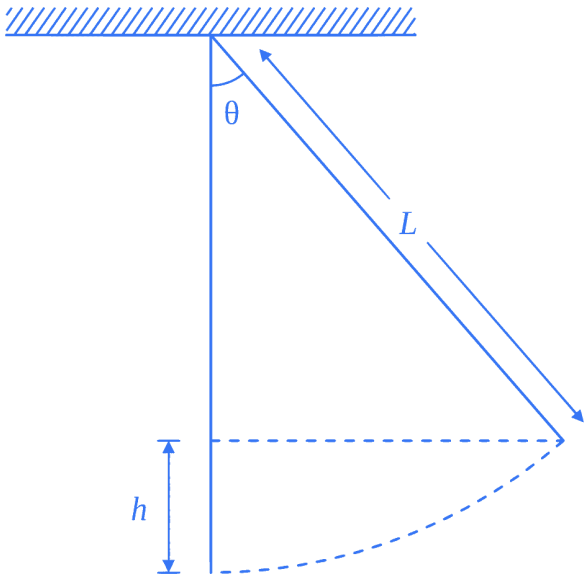
18. A particle move in S.H.M. such that its acceleration is $a = -px$, where ' x ' is the displacement of particle from equilibrium position and ' p ' is a constant. The period of oscillation is

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

19. The ratio of frequencies of two oscillating pendulums are 3 : 2. Their lengths are in the ratio

(A) $\sqrt{2} : \sqrt{3}$ (B) 9 : 4
(C) $\sqrt{3} : \sqrt{2}$ (D) 4 : 9

20. A simple pendulum with bob of mas ' m ' and conducting wire of length ' L ' swings under gravity through an angle ' θ '. The component of earth's magnetic field in the direction perpendicular to swing is ' B '. Maximum e.m.f. induced across the pendulum is (g = acceleration due to gravity)



(A) $BL\sin\left(\frac{\theta}{2}\right)(gL)$ (B) $2BL\sin\left(\frac{\theta}{2}\right)(gL)^2$
(C) $2BL\sin\left(\frac{\theta}{2}\right)(gL)^{3/2}$ (D) $2BL\sin\left(\frac{\theta}{2}\right)(gL)^{1/2}$

21. When tension ' T ' is applied to a sonometer wire of length ' l ' it vibrates with the fundamental frequency ' n '. Keeping the setup same, when the tension is increased by 8 N, the fundamental frequency becomes three times the earlier. The initial tension applied to the wire was

(A) 2 N (B) 0.5 N

(C) 1 N (D) 2.5 N

22. The displacement of a wave travelling in the x direction is $y = 10^{-4}\sin[600t - 2x + \pi/3]$m, where x is in metre and t in second. The speed of the wave is

(A) 200 m/s (B) 300 m/s

(C) 600 m/s (D) 150 m/s

23. A pipe P_C closed at one end and pipe P_O open at both ends are vibrating in second overtone. They are in resonance with a given tuning fork. The ratio of the length of pipe P_C vs P_O is (Neglect end correction)

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

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

24. The pitch of the whistle of an engine appears to drop by 20% of original value when it passes a stationary observer. If speed of sound in air 350 m/s, then speed of engine in m/s is

(A) 1050 (B) 175

(C) 520.5 (D) 87.5

25. An electron of mass ' m_e ' and a proton of mass ' m_p ' are kept in a uniform electric field. The ratio of the acceleration of electron (a_e) to the acceleration of proton (a_p) is

(A) $\frac{m_e}{m_p}$ (B) $\frac{m_p}{m_e}$

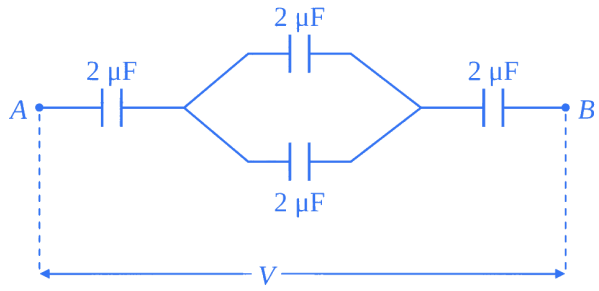
(C) one (D) infinity

26. Consider the following statement about electric field intensity and electric potential. A. The electric field intensity due to a charged spherical shell is inversely proportional to square of its radius. B. The electric potential due to a point charge is inversely proportional to the distance between charge and the point.

(A) Both A and B are incorrect (B) Only B is correct

(C) Only A is correct (D) Both A and B are correct

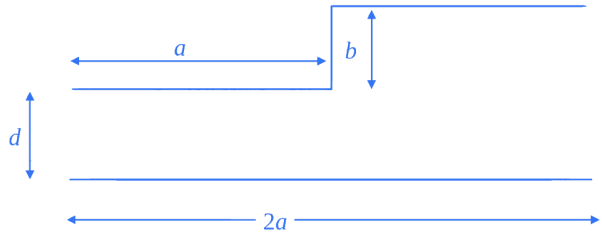
27. Four capacitors each of capacity 2μF are connected as shown in the figure $V_A - V_B = 10$ V. The energy stored in the system is



(A) 40×10^{-8} J (B) 625×10^{-6} J

(C) 6250×10^{-7} J (D) 400×10^{-7} J

28. A capacitor is made of a flat plate of area ' A ' and the second plate has staircase like structure. Width of each stair is ' a ' and its height is ' b '. The capacity of the capacitor is



(A) $\frac{\epsilon_0 A}{4d}\left[\frac{b+2d}{b}\right]$ (B) $\frac{\epsilon_0^A}{4d}\left[\frac{b+2d}{d+b}\right]$

(C) $\epsilon_0 A\left[\frac{2d+b}{d-b}\right]$ (D) $\frac{\epsilon_0^A}{2d}\left[\frac{2d+b}{d+b}\right]$

29. A resistance of 20Ω is connected in the left gap of a metre bridge and an unknown resistance greater than 20Ω is connected in the right gap. When these resistances are interchanged, the balance point shift by 20 cm. The unknown resistance is

(A) 25Ω (B) 40Ω

(C) 35Ω (D) 30Ω

30. An ammeter of resistance ' R ' gives a full scale deflection when a current of 2 A passes through it. If it is to be converted into an ammeter to measure maximum current of 10 A, the required shunt is

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

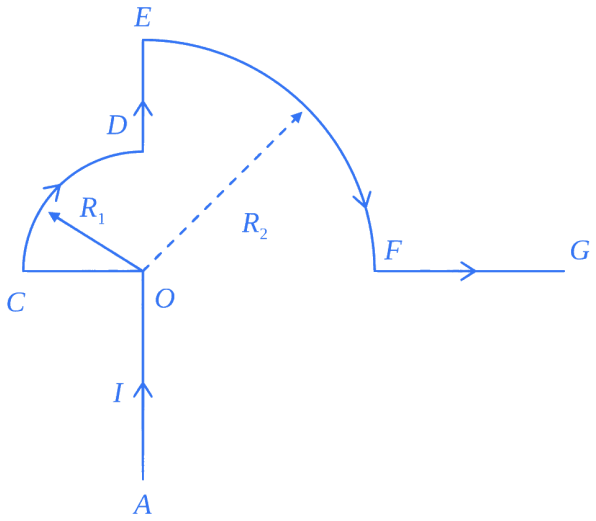
(C) 2R (D) R

31. The magnetic field at the centre of a current carrying circular coil of an area ' A ' is ' B '. The magnetic moment of the coils is [$\mu 0 =$ permeability of free space.]

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

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

32. In the current carrying conductor (AOCDEFG) as shown, the magnetic induction at the point O is (R_1 and R_2 are radii of are CD \& EF respectively, I = current in the loop, μ_0 = permeability of free space)



(A) $\frac{\mu_0 I}{8}\left(\frac{R_1+R_2}{R_1-R_2}\right)$ (B) $\frac{\mu_0 I}{8}\left(\frac{R_1+R_2}{R_1R_2}\right)$

(C) $\frac{\mu_0 I}{8}\left(\frac{R_1R_2}{R_1-R_2}\right)$ (D) $\frac{\mu_0 I}{8}\left(\frac{R_1R_2}{R_1+R_2}\right)$

33. Inductance of solenoid ' L ' having diameter ' d '. Let n be the number of turns per unit length. The inductance per length near the middle of a solenoid is (Asume that current passes through the turns, μ_0 = Permeability of vacuum)

(A) $\frac{\mu_0\pi nd^2}{4}$ (B) $\frac{\mu_0\pi n^2 d}{2}$

(C) $\frac{\mu_0\pi n^2 d^2}{2}$ (D) $\frac{\mu_0\pi n^2 d^2}{4}$

34. The charge which will flow through a galvanometer of resistance 200Ω connected to a 400Ω circular coil of 1000 turns wound on a wooden stick 20 mm in diameter, if a magnetic field B = 0.012 T parallel to the axis of the stick decreased suddenly to zero is nearly

(A) 63μC (B) 630μC

(C) 6.3μC (D) 0.63μC

35. In LC parallel resonance circuit, choose the wrong statement

(A) Resonance occurs when inductive and capacitive reactance is same.

(B) At resonance, current is minimum.

(C) At resonance, impedance is maximum.

(D) At resonance, resonant frequency $= \sqrt{LC}$

36. In an LCR series circuit, if the angular frequency is gradually in creased then match the following columns

	Column-I		**Column-II**
(A)	Capacitive reactance	(i)	Will continuously increase
(B)	Inductive reactance	(ii)	Will remain constant
(C)	Resistance	(iii)	Will first decrease and then increase
(D)	Total impedance	(iv)	Will continuously decrease

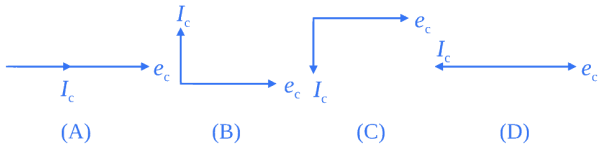
(A) (A) – (iv), (B) – (i), (C) – (ii), (D) – (iii)

(B) (A) - (i), (B) - (iii), (C) - (iv), (D) - (ii)

(C) (A) – (ii), (B) – (iii), (C) – (i), (D) – (iv)

(D) $(A)-(i),(B)-(iv),(C)-(ii),(D)-(iii)$

37. When a.c. source is connected across a pure capacitor, the correct phase relation between current (i_c) and voltage (e_c) is shown in figure



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

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

38. The refractive index of material of glass is $\sqrt{3}$. If the angle of minimum deviation is equal to the angle of prism, the angle of prism is $\left(\cos 30^\circ = \frac{\sqrt{3}}{2} = \sin 60^\circ, \sin 30^\circ = \frac{1}{2} = \cos 60^\circ\right)$

(A) 45° (B) 60°

(C) 30° (D) 50°

39. In a compound microscope, let ' u_0 ' and ' v_0 ' be the object distance and image distance respectively. The objective of focal length ' f_0 ' magnifies a tiny object into a real, inverted image. The linear magnification of the objective is

(A) $\frac{f_0+u_0}{u_0 f_0}$ (B) $\frac{f_0}{f_0+u_0}$

(C) $\frac{u_0}{u_0 f_0+1}$ (D) $\frac{u_0 f_0}{f_0+u_0}$

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

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

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

41. Young's double slit experiment, the intensity at a point where the path difference is $\frac{'}{4}$ ' is ' I '. If the maximum intensity is I_0 then the ration $\frac{I_0}{I}$ is $\left(\cos 45^\circ = \frac{1}{\sqrt{2}} = \sin 45^\circ\right)$

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

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

42. The path difference between two interfering light waves meeting at point on the screen is $\left(\frac{87}{2}\right)\lambda$. The band obtained at that point is

(A) 87th bright band (B) 44th dark band

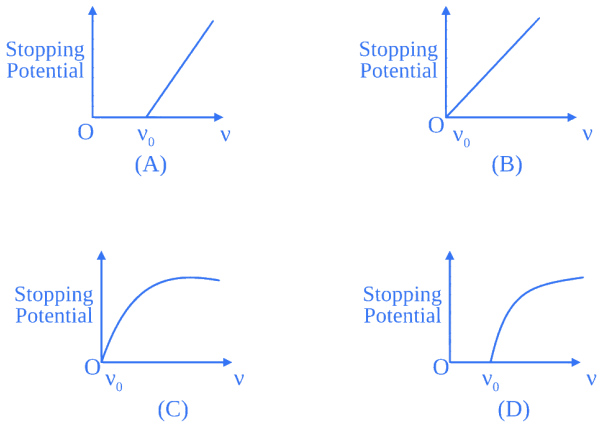
(C) 87th dark band (D) 44 th bright band

43. Light of two different frequencies whose photons have energies 1.3eV and 2.8eV respectively, successfully illuminate a metallic surface whose work function is 0.8eV. The ratio of maximum speeds of emitted electrons will be

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

(C) 1 : 3 (D) 1:5

44. Following graph shown the variation of stopping potential corresponding to the frequency of incident radiation (v) for a given metal. The correct variation is shown in graph [v_0 = threshold frequency]



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

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

45. In hydrogen atoms, transition from the state $n = 6$ to $n = 1$ result in ultraviolet radiation. Infrared radiation will be obtained in the transition

(A) $n = 6$ to $n = 2$ (B) $n = 5$ to $n = 3$

(C) $n = 3$ to $n = 5$ (D) $n = 4$ to $n = 2$

46. The magnetic moment (m_{orb}) of a revolving electron around the nucleus varies with the principal quantum number (n) as

(A) $m_{orb} \propto n^2$ (B) $m_{orb} \propto \frac{1}{n^2}$

(C) $m_{orb} \propto \frac{1}{n}$ (D) $m_{orb} \propto n$

47. For a substance, fraction of its initial quantify (N_0) which will disintegrate in its average life time is about $(e = 2.71)$

(A) $\left(\frac{1}{3}\right) N_0$ (B) $\left(\frac{1}{2}\right) N_0$

(C) $\left(\frac{2}{3}\right) N_0$ (D) $(0.9)N_0$

48. The output of a 'NAND' gate is shown in the truth-table (A and B are inputs, Y is output)

(P)

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

(Q)

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

(R)

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

(S)

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

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

49. In a forward bias arrangement of a p-n junction diode, the

(A) p-region is connected to the positive terminal of battery.
(B) n-region is connected to the positive terminal of battery.
(C) p-region is connected to negative terminal of battery.
(D) p-region is connected to negative terminal of the battery.

50. In the logic circuit diagram, A, B and C are the inputs, Y is the output. The output Y is ' HIGH '



(A) when A = 1, B = 0, C = 1
(B) for all the input ' HIGH '
(C) for all the inputs 'LOW'
(D) when $A = 1, B = 0, C = 0$

51. What is the amount of water formed by combustion of 1.6 g methane?

(A) 6.2 g (B) 3.2 g
(C) 3.6 g (D) 16 g

52. What is the energy associated with first orbit of Li^{2+} $\left(R_H = 2.18 \times 10^{-18}\ J\right)$?

(A) -8.72×10^{-18} J (B) -34.88×10^{-18} J
(C) -2.18×10^{-18} J (D) -19.62×10^{-18} J

53. Identify the correct decreasing order of atomic size from following.

(A) Gd > Er > Pr > Yb
(B) Pr > Gd > Er > Yb
(C) Yb > Er > Gd > Pr
(D) Pr > Yb > Er > Gd

54. What is the bond order of O_2 molecule?

(A) 1 (B) 1.5
(C) 2.0 (D) 3.5

55. Identify the molecular geometry of XeF_4 is

(A) Square planar (B) Octahedral
(C) Tetrahedral (D) Trigonal planar

56. Which of the following molecules has maximum value of dipole moment?

(A) $CH_3 - Cl$ (B) $CH_3 - O - CH_3$
(C) $CH_3 - CH_2 - CH_3$ (D) $CH_3 - CN$

57. Calculate ΔU if 2 kJ heat is released and 10 kJ of work is done on the system.

(A) 20 kJ (B) 12 kJ
(C) 8 kJ (D) 5 kJ

58. An ideal gas is compressed from a volume of 1 m^3 to 0.5 m^3 at a pressure of 0.2 bar. what is the value of work done by the gas during compression?

(A) 10 kJ (B) 201.0 kJ
(C) 497 kJ (D) 190 kJ

59. Which among the following pair is of extensive and intensive properties respectively?

(A) Volume and number of moles (B) Volume and pressure
(C) Surface tension and heat capacity (D) Internal energy and temperature

60. What is the pH of a 2.6×10^{-8}MH$^+$ion solution? $(\log 2.6 = 0.4150)$

(A) 7.6 (B) 6.9
(C) 10.6 (D) 8.4

61. A weak monobasic acid is 20% dissociated in it's 0.01M solution. What is the dissociation constant of weak acid?

(A) 2.5×10^{-6} (B) 3×10^{-6}
(C) 2×10^{-6} (D) 4×10^{-6}

62. Identify the conjugate acid - base pair in the following reaction. $H_2O + HCl \rightarrow H_3O^+ + Cl^-$

(A) $Cl^-$and H_2O (B) $H_3O^+$and Cl^-
(C) H_2O and HCl (D) $H_3O^+$and H_2O

63. What is oxidation number of oxygen in OF_2 ?

(A) +2 (B) −2
(C) −1 (D) +1

64. What is the IUPAC name of $(CH_3)_2 - N - CH_3$?

(A) 2, 2-Dimethylmethanamine
(B) N - Methyldimethanamine
(C) N, N-Dimethylmethanamine
(D) Trimethylamine

65. Identify the group that exerts electron withdrawing resonance effect.

(A) −COOH (B) −OH
(C) −OR (D) -NHR

66. Which from following pairs of compound is an example of position isomerism?

(A) 2 methylprop-1-ene and But-1-ene (B) But-2-ene and Cis-But-2-ene
(C) But-2-ene and 2-methylprop-1-ene (D) But-1-ene and But-2-ene

67. Which among the following carboxylic acids is strongest acid?

(A) $F - CH_2 - COOH$ (B) $Br - CH_2 - COOH$

(C) $Cl_3 - C - COOH$ (D) $Cl - CH_2 - COOH$

68. Identify unit cell from following having four particles in it.

(A) Simple cubic (B) Face centred cubic

(C) Body centred cubic (D) Base centred cubic

69. Calculate the density of metal with molar mass $56\ g\ mol^{-1}$ that crystallises to force bcc structure with edge length 288pm.

(A) $9.8\ g\ cm^{-3}$ (B) $5.8\ g\ cm^{-3}$

(C) $8.7\ g\ cm^{-3}$ (D) $7.8\ g\ cm^{-3}$

70. Find the molar mass of an element that crystallizes forming unit cell structure having edge length 4×10^{-8} cm and containing 4 particles. ($Q = 19.7\ g\ cm^{-3}$)

(A) $140.2\ g\ mol^{-1}$ (B) $189.8\ g\ mol^{-1}$

(C) $160.5\ g\ mol^{-1}$ (D) $220.0\ g\ mol^{-1}$

71. Calculate the solubility of gas in water at 1.2 atm and 25°C if Henry's law constant is $0.45\ moldm^{-3}\ atm^{-1}$ at 25°C.

(A) $0.45\ moldm^{-3}$ (B) $0.54\ moldm^{-3}$

(C) $0.25\ moldm^{-3}$ (D) $0.31\ moldm^{-3}$

72. What is the unit of cryoscopic constant?

(A) $Kkgmol^{-1}$ (B) K_{kgd^3}

(C) Kkgmol (D) $kKgdm^{-3}$

73. What is te mass of solute having molar mass $60\ g\ mol^{-1}$ when dissolved in 98 gram solvent decreases its freezing point by 0.2 K ? (The numerical value of cryoscopic constant of solvent is 1.71)

(A) 0.5 gram (B) 1.5 gram

(C) 0.687 gram (D) 2.0 gram

74. Which element from following has highest negative standard reduction potential?

(A) K (B) Li

(C) Na (D) Rb

75. Calculate the quantity of electricity required to produced 0.42 g Ag at cathode during electrolysis of $AgNO_3$ solution. (molar mass Ag $= 108\ g\ mol^{-1}$)

(A) 965.0C (B) 470.0C

(C) 257.1C (D) 375.3 C

76. Calculate standard cell potential for a cell having following reaction, $2Al_{(s)} + 3Ni^{2+} \rightarrow 2Al^{3+} + 3Ni(s)$

$(E^{\circ}_{Ni} = -0.25\ V, E^{\circ}_{A1} = -1.66\ V)$

(A) 0.50 V (B) 1.41 V

(C) −0.50 V (D) 0.41 V

77. Which of the following cannot be considered as application of electrochemical series?

(A) Spontaneity of redox reaction (B) Relative strength of reducing agent

(C) Relative strength of oxidizing agent (D) Use of SHE in automobile battery

78. Which of the following unit is used to express rate of a reaction?

(A) $mol^{-1}dm^3t^{-1}$ (B) $moldm^3t$

(C) $mol\ dm^{-3}t^{-1}$ (D) $mol^{-1}dm^3t$

79. For the reaction,

$2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$ If $\frac{d[NO_2]}{dt} = 0.052\ moldm^{-3}\ s^{-1}$

Calculate rate of consumption of $NO_{(g)}$.

(A) $0.114\ moldm^{-3}\ s^{-1}$ (B) $0.078\ moldm^{-3}\ s^{-1}$

(C) $0.026\ mol^{-3}\ s^{-1}$ (D) $0.052\ moldm^{-3}\ s^{-1}$

80. Calculate half-life of a first order reaction in minute if the rate constant is $1 \times 10^{-3}\ sec^{-1}$.

(A) 6.93 (B) 15

(C) 9.3 (D) 11.55

81. Identify the colloidal molecule containing hydrophilic head and hydrophobic

(A) Detergent (B) Cellulose

(C) Starch (D) Gold sol

82. What is action of chlorine on excess ammonia?

(A) Formation of nitrogen trichloride
(B) Formation of nitric oxide and hydrochloric acid
(C) Formation of ammonium chloride and dinitrogen
(D) Formation of dinitrogen and hydrochloric acid

83. What is the number of unpaired electrons present in f-orbital at +3 oxidation state of $Lu(Z = 71)$?

(A) 0
(B) 4
(C) 2
(D) 7

84. What is the number of unpaired electrons of nickel observed in $[Ni(CN)_4]^{-2}$

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

85. Which among the following cations forms a least stable complex if the ligand is same?

(A) Cd^{2+}
(B) Co^{2+}
(C) Ni^{2+}
(D) Fe^{2+}

86. Which among the following statements is NOT correct about SN^2 reaction mechanism?

(A) Nucleophile attacks the atom from the side opposite to halogen.
(B) Rate of reaction is dependent on the concentration of nucleophile.
(C) Bond formation and bond breaking occurs simultaneously.
(D) SN^2 mechanism is observed in tertiary alkyl halides.

87. Which of the following reaction is used to prepare toluene from bromobenzene?

(A) Wurtz-Fittig reaction
(B) Swartz reaction
(C) Wurtz reaction
(D) Fittig reaction

88. What is the product formed when aniline is treated with $NaNO_2 + HCl$ previous to hydrolysis?

(A) Benzene diazonium chloride
(B) Benzene
(C) Phenol $+N_2 \uparrow$
(D) Phenol

89. What is the number of different products formed when mixture of ethanal and propanal reacts with aq. NaOH after warming?

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

90. What is the product obtained in Reimer - Tiemann reaction?

(A) Salicylaldehyde
(B) Salicylic acid
(C) 2, 4, 6-trinitrophenol
(D) Aniline

91. Choose the false statement from following.

(A) Good yield of alkyl halide may be obtained by heating alcohols with NaI in $95\% H_3PO_4$.
(B) Constant boiling $HBr(48\%)$ is used for the preparation of alkyl bromides from alcohols.
(C) Tertiary alcohol readily react with conc. HCl in absence of zinc chloride.
(D) The order of reactivity of alcohols with a given halo acid $1^\circ > 2^\circ > 3$.

92. Which among the following is not the method of preparation of phenol?

(A) Aniline $\xrightarrow[\text{(ii) } H_2O,\ \Delta]{\text{(i) } NaNO_2+HCl,\ 273\ K}$ Phenol

(B) Cumene $\xrightarrow[\text{(ii) dil. HCl, } \Delta]{\text{(i) } O_2/\text{Co-naphthenate, } 423\ K}$ Phenol

(C) Chlorobenzene $\xrightarrow[\text{(ii) } H_3O^+]{\text{(i) NaOH, } 623\ K,\ 150\ atm}$ Phenol

(D) Benzene + conc. $H_2SO_4 \xrightarrow{\Delta}$ Phenol

93. What is the number of -COOH groups present in phthalic acid?

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

94. Identify the x in the reaction.

$$R - NH_2 + NHO_2 \xrightarrow[273-278\ K]{NaNO_2 + HCl} X \xrightarrow{H_2O} R - OH + N_2 + HCl$$

(A) $R - NH - NO_2$
(B) $R - N_2^{\oplus}C^{\ominus}1$
(C) $R - NH - N = O$
(D) $R - NO_2$

95. What is the number of moles of water removed from one mole of cane sugar when charred completely using conc. H_2SO_4 ?

(A) 1
(B) 11
(C) 4
(D) 2

96. Which among the following enzymes hydrolyzes starch?

(A) Amylase (B) Proteases

(C) Glucose isomerase (D) Insulin

97. Which carbon atoms of fructose are bonded together through oxygen forming fructofuranose?

(A) 2 and 5 (B) 1 and 6

(C) 1 and 5 (D) 2 and 6

98. Identify the monomer used to prepared neoprene.



(A)

(B) $H_2C = CH - CH = CH_2$



(C)

(D) $H_2C = CH - CN$

99. Identify the use of polyethylene terephthalate.

(A) To obtain bags for bread and shopping

(B) To manufacture soft drink bottles

(C) To prepare bottles to store shampoo

(D) To obtain disposable cups and plates

100. Which among the following polymers has high tensile strength and is used to obtain tyre cords?

(A) Nylon 6 (B) PHBV

(C) Teflon (D) Dacron

101. If R denotes the set of all real numbers then the function f : R $\to$ R defined by $f(x) = |x|$ is

(A) injective and surjective.
(B) neither injective nor surjective.
(C) injective.
(D) surjective.

102. The value of $\cos^2 10^\circ - \cos 10^\circ \cdot \cos 50^\circ + \cos^2 50^\circ$

(A) $\frac{3}{2} + \cos 20^\circ$
(B) $\frac{3}{4}(1 + \cos 20^\circ)$
(C) $\frac{3}{2}$
(D) $\frac{3}{4}$

103. With usual notations, In $\triangle ABC, \angle C = 90^\circ$, then the value of $\sin(A - B)$ is

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

104. The value of $\frac{i^{592}+i^{590}+i^{588}+i^{586}+i^{584}}{i^{582}+i^{580}+i^{578}+i^{576}+i^{574}} - 1 =$

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

105. If $(x - iy)(3 + 5i)$ is the conjugate of $-6 - 24i$ (where $x, y \in R$ and $i = \sqrt{-1}$), then the value of x and y are respectively

(A) 5,3
(B) $5, -3$
(C) $-3, 3$
(D) $3, -3$

106. The number of ways in which the letters of the word MACHINE can be arranged such that the vowels may occupy only odd positions, is

(A) 288
(B) 625
(C) 576
(D) 1152

107. If the line through the points $(-2, 6)$ and $(4, 8)$ is perpendicular to the line passing through the points $(8, 12)$ and $(x, 24)$, then the value of x is

(A) 4
(B) $\frac{1}{3}$
(C) 12
(D) -2

108. The joint equation of pair of lines which bisects the angle between the lines $x^2 + 3xy + 2y^2 = 0$ is

(A) $3x^2 - r4egh2xy - 3y^2 = 0$
(B) $3x^2 + 2xy - 3y^2 = 0$
(C) $2x^2 - 3xy - 2y^2 = 0$
(D) $2x^2 + 3xy - 2y^2 = 0$

109. If the slopes of the lines $Kx^2 - 4xy + 5y^2 = 0$ differ by 2 , then K =

(A) $\frac{-21}{5}$
(B) $\frac{21}{5}$
(C) $\frac{5}{21}$
(D) $\frac{4}{5}$

110. The equation of tangents to the circle $x^2 + y^2 = 4$ which are parallel to $x + 2y + 3 = 0$ are

(A) $x + 2y = \pm 2\sqrt{5}$
(B) $x + 2y = \pm 2\sqrt{3}$
(C) $x - 2y = \pm 2$
(D) $x - 2y = \pm 2\sqrt{5}$

111. $\lim_{x \to 0} \frac{27^x - 9^x - 3^x + 1}{\sqrt{5} - \sqrt{4 + \cos x}} =$

(A) $8\sqrt{5}\log 3$
(B) $16\sqrt{5}\log 3$
(C) $8\sqrt{5}(\log 3)^2$
(D) $\sqrt{5}(\log 3)^2$

112. Negation of a statement 'If $\forall x, x$ is a complex number then $x^2 < 0$ ' is

(A) $\exists x, x$ is not a complex number and $x^2 \geq 0$
(B) $\exists x, x$ is not a complex number and $x^2 < 0$
(C) $\forall x, x$ is not a complex number and $x^2 \geq 0$
(D) $\forall$x, x is not a complex number and $x^2 < 0$

113. If $p \to (p \wedge \sim q)$ is false, then the truth values of p and q are respectively

(A) F, F
(B) T, F
(C) F, T
(D) T, T

114. The means of 5 observations is 4.4 and variance is 8.24 . If three of the five observations are 1,2 and 6 , then the values of other two observations are

(A) 5,7
(B) 4,9
(C) 3,9
(D) 4,8

115. In a pizza hut, the following distribution is found for the daily demand of pizzas.

No. of Pizzas	5	6	7	8	9	10
Probability	0.07	0.2	0.3	0.3	0.07	0.06

Then expected daily demand and variance are respectively

(A) 7.28 and 1.52
(B) 1.52 and 7.28
(C) 7.28 and 54.52
(D) 7.28 and 53

116. If $A = 2\tan^{-1}\left(\frac{1+x}{1-x}\right)$ and $B = \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)$, where $x \in (0,1)$, then $A - B =$

(A) $\frac{\pi}{4}$ (B) $4\tan^{-1}x$

(C) $\tan^{-1}x$ (D) $\frac{\pi}{2}$

117. The value of $2\sin^{-1}\left(\frac{1}{2}\right) + \cot^{-1}\left(\frac{1}{\sqrt{3}}\right)$ is

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

(C) $\frac{\pi}{6}$ (D) $\frac{2\pi}{3}$

118. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 1 & 3 & 4 \\ 3 & 4 & 3 \end{bmatrix}$, then $A^{-1} =$

(A) $-\frac{1}{4}\begin{bmatrix} -7 & -6 & -1 \\ 9 & 6 & -1 \\ -5 & -2 & 1 \end{bmatrix}$

(B) $\frac{1}{4}\begin{bmatrix} -7 & 6 & -1 \\ 9 & -6 & -1 \\ -5 & 2 & 1 \end{bmatrix}$

(C) $-\frac{1}{4}\begin{bmatrix} -7 & 6 & 1 \\ 9 & -1 & 1 \\ -5 & 2 & 1 \end{bmatrix}$

(D) $-\frac{1}{4}\begin{bmatrix} -7 & 6 & -1 \\ 9 & -6 & -1 \\ -5 & 2 & 1 \end{bmatrix}$

119. If $A = \begin{bmatrix} 1 & 3 & -2 \\ -3 & 0 & -5 \\ 2 & 5 & 0 \end{bmatrix}$ and $A(\text{adj}A) = KI$, then the value of K is (where I is unit matrix of order 3)

(A) -25 (B) 25

(C) 85 (D) -85

120. If $A = \begin{bmatrix} 0 & 1+2i & i-2 \\ -1-2i & 0 & K \\ 2-1 & 7 & 0 \end{bmatrix}$ and A^{-1} does not exists, then $K =$ (where i $= \sqrt{-1}$)

(A) $1+2i$ (B) -7

(C) 7 (D) $1-2i$

121. If $f(x) = K+1$, for $x = 0$ is continuous at $x = 0$, then value of K is

(A) 1 (B) e^{-1}

(C) 0 (D) e

122. $\frac{d}{dx}\left(\sqrt{\frac{1-\tan x}{1+\tan x}}\right) =$

(A) $\frac{\sec^2 x}{(1+\tan x)^{3/2}(1-\tan x)^{1/2}}$ (B) $\frac{-\sec^2 x}{(1-\tan^2 x)^{1/2}}$

(C) $\frac{\sec^2 x}{(1-\tan^2 x)^{1/2}}$ (D) $\frac{-\sec^2 x}{(1+\tan x)^{3/2}(1-\tan x)^{1/2}}$

123. If $y = \tan^{-1}\sqrt{\frac{1+\cos x}{1-\cos x}}$, then $\frac{dy}{dx}$ is

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

(C) -1 (D) 1

124. If $x = e^{\left(\frac{x}{y}\right)}$, then $\frac{dy}{dx} =$

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

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

125. The function f(x) is defined by $f(x) = (x+2)e^{-x}$ is

(A) monotonically decreasing in $(-1,\infty)$ and monotonically increasing in $(-\infty,-1)$

(B) decreasing for all x

(C) increasing for all x

(D) decreasing in $(-\infty,-1)$ and increasing in $(-1,\infty)$

126. The rate at which the population of a city increases varies as the population present. Within the period of 30 years, the population grew from 20 lakhs to 40 lakhs. Then, the population after a further period of 15 years will be (Take $\sqrt{2} = 1.41$)

(A) 56 lakhs (B) 60 lakhs

(C) 57.4 lakhs (D) 56.4 lakhs

127. A circular sector of perimeter 60 meter with maximum area is to be constructed. The radius of the circular are in meter must be

(A) 5 m (B) 15 m

(C) 10 m (D) 20 m

128. The side of a square sheet of metal is increasing at the rate of 3 cm/ min. At what rate is the area increasing when the length of the side is 6 cm long?

(A) 36 cm^2/min (B) 12 cm^2/min

(C) 18 cm^2/min (D) 9 cm^2/min

129. $\int \sqrt{\frac{1+x}{1-x}}dx =$ (where C is a constant of integration.)

(A) $\sin^{-1}x - \sqrt{1-x^2} + C$

(B) $\sqrt{1-x^2} - \sqrt{x} + C$

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

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

130. If $f(x) = \int \frac{x^2+\sin^2 x}{1+x^2}, \sec^2 x dx$ and $f(0) = 0$, then $f(1) =$

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

(C) $1 - \frac{\pi}{4}$ (D) $\tan 1 - \frac{\pi}{4}$

131. $\int \frac{x^{2x}}{(1+2x)}dx =$ (where C is a constant of integration.)

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

(C) $\frac{4e^{2x}}{1+2x} + C$ (D) $\frac{e^{2x}}{2(1+2x)} + C$

132. $\int_0^1 x(1-x)^n dx =$

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

(C) $\frac{2n+3}{(n+1)(n+2)}$ (D) $\frac{4}{(n+1)(n+2)}$

133. $\int_0^{2\pi}(\sin x + |\sin x|)dx =$

(A) 0 (B) 8

(C) 4 (D) 1

134. The area of the region bounded by the line $2y + x = 8, x-$ axis and the lines $x = 2$ and $x = 4$ is

(A) 6 sq. units (B) 5 sq. units

(C) 4 sq. units (D) 10 sq. units

135. The general solution of differential equation $\frac{dy}{dx} = e^{x+y} + x^2 e^{x^3+y}$ is (where C is a constant of integration.)

(A) $e^x + e^{-y} + \frac{1}{3}e^{x^3} = C$

(B) $e^x - e^{-y} - \frac{1}{3}e^{x^3} = C$

(C) $e^x - e^{-y} + \frac{1}{3}e^{x^3} = C$

(D) $e^x - e^{-y} + \frac{1}{3}e^{x^3} = C$

136. The particular solution of the differential equation $\frac{dy}{dx} = e^{2y}\cos x$, when $y\left(\frac{\pi}{6}\right) = 0$ is

(A) $\sin x - \frac{e^{2y}}{2} = 0$

(B) $4\sin x - e^{-2y} - 1 = 0$

(C) $\sin x + e^{-2y} - 2 = 0$

(D) $2\sin x + e^{-2y} - 2 = 0$

137. General solution of the differential equation $\left(y^3 + y\right)\left(x^2 + 1\right)dy = \left(xy^4 + 2y^2x\right)dx$ is (where C is a constant of integration.)

(A) $y^2\left(y^2+1\right) = C\left(x^2+1\right)^2$

(B) $y^2\left(y^2+2\right) = C\left(x^2+1\right)$

(C) $y^2\left(y^2+2\right) = C\left(x^2+1\right)^2$

(D) $y^2\left(y^2+1\right) = C\left(x^2+2\right)^2$

138. If $\bar{a}$ and $\bar{b}$ are vectors such that $|\bar{a}| = 3, |\bar{b}| = 2$ and $\bar{a}\cdot\bar{b} = 5$, then $= |\bar{a} - \bar{b}| =$

(A) $\sqrt{23}$ (B) $\sqrt{3}$

(C) 5 (D) 3

139. If $|\bar{a}| = 5, |\bar{b}| = 3, |\bar{c}| = 4$ and $\bar{a}$ is perpendicular to $\bar{b}$ and $\bar{c}$ such that angle between $\bar{b}$ and $\bar{c}$ is $\frac{5\pi}{6}$, then $[\bar{a}\bar{b}\bar{c}] =$

(A) 25 (B) 10

(C) 30 (D) 20

140. If angle between the vectors $\bar{a} = 2\lambda 2\hat{i} + 4\lambda\hat{j} + \hat{k}$ and $\bar{b} = 7\hat{i} - 2\hat{j} + \lambda\hat{k}i$ obtuse, then the values of λ lie in

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

(C) $\left(0, \frac{1}{2}\right)$ (D) $(-\infty, 0)$

141. The sum of the lengths of projections of $p\hat{i} + q\hat{j} + rk$ on the co-ordinate axes, where $p = 4, q = -5, r = 7$ is

(A) 6 units (B) 16 units

(C) 20 units (D) 28 units

142. The position vector of a point that divides the line segment joining $P \equiv (1, 2, -1)$ and $Q \equiv (-1, 1, 1)$ externally in the ratio $1:2$, is

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

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

143. The acute angle between the lines $x = -y, z = 0$ and $x = 0, z = 0$ is

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

(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{18}$

144. The vector equation of the line passing through the point having position vector $2\hat{i}+\hat{j}-3\hat{k}$ and perpendicular to vectors $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}-\hat{k}$ is

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

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

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

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

145. The equation of the plane through the intersection of the planes $x+y+z=1$ and $2x+3y-x+4=0$ and parallel to X-axis is

(A) $y+3z+6=0$ (B) $3y-z+6=0$

(C) $y-3z+6=0$ (D) $3y-2z+6=0$

146. The co-ordinates of the foot of the perpendicular drawn from the origin to the plane $2x+6y-3z=63$ are

(A) $(4,2,-4)$ (B) $\left(\frac{18}{7},\frac{54}{7},\frac{-27}{7}\right)$

(C) $\left(\frac{2}{7},\frac{6}{7},\frac{-3}{7}\right)$ (D) $\left(\frac{9}{7},\frac{6}{7},\frac{-3}{7}\right)$

147. The maximum value of the objective function $z=4x+5y$ subject to constraints $2x+3y\leq 12, 2x+y\leq 8$ and $x\geq 0, y\geq 0$ is

(A) 24 (B) 23

(C) 22 (D) 21

148. A bag contains 5 red balls and 3 green balls. A ball is selected at random and not replaced. A second ball is then selected. The probability of selecting one red ball and one green ball is

(A) $\frac{15}{28}$ (B) $\frac{15}{64}$

(C) $\frac{15}{56}$ (D) $\frac{15}{112}$

149. A die is thrown five times. If getting an odd number is a success, then the probability of getting at least 4 successes is

(A) $\frac{13}{16}$ (B) $\frac{5}{32}$

(C) $\frac{1}{32}$ (D) $\frac{3}{16}$

150. The random variable X has the following probability distribution

X	8	12	16	20	24
$P(X)$	K	$\frac{1}{6}$	$\frac{3}{8}$	$2K$	$\frac{1}{12}$

then the value of K is

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

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

- End of Question Paper -