MHT CET 2022 PCM Aug 10 Shift 1 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

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

General Instructions

(i) This **PCM** paper is from **MHT CET 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 particle performing U.C.M. of radius $\frac{\pi}{2}$ m makes $_x$ revolutions in time t. Its tangential velocity is

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

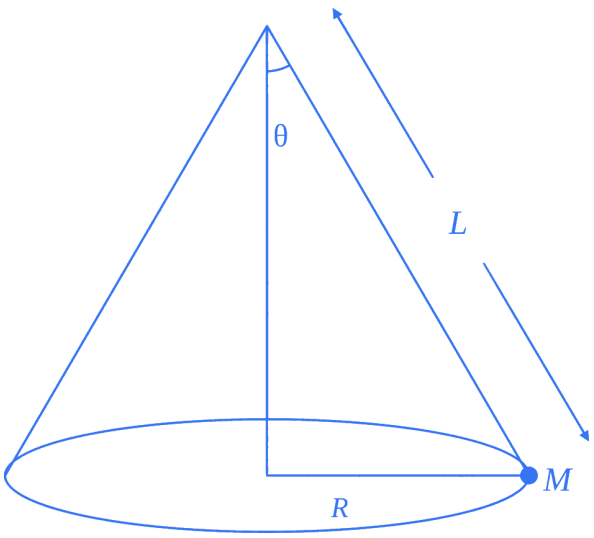
(C) $\frac{\pi^2 x^2}{t}$ (D) $\frac{2\pi x}{t}$

2. A spring has length l and force constant K. If is cut into two springs of length l_1 and l_2 such that, $l_1 = nl_2 (n$ is integer). The force constant of the spring of length l_2 is

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

(C) $\frac{K}{(n+1)}$ (D) $K(1+n)$

3. A string of L is fixed at one end and carries a mass M at the other end. The string makes $\frac{2}{\pi}$ revolutions per second around the vertical axis through the fixed end as shown in the figure, then the tension in the string is



(A) $2ML$ (B) ML

(C) $16ML$ (D) $4ML$

4. When a long spring of 4 cm is stretched by 1 cm, the potential energy stored in the spring is U. If it is stretched by 4 cm, the potential energy stored in it is

(A) $4U$ (B) $16U$

(C) $9U$ (D) $25U$

5. A uniform rod of mass M and length L is suspended from the rigid support. A small bullet of mass m hits the rod with velocity v and gets embedded into the rod. The angular velocity of the system just after impact is

(A) $\frac{3MV}{(M+m)L}$ (B) $\frac{3MV}{(M+3m)L}$

(C) $\frac{3mV}{(M+3m)L}$ (D) $\frac{3mV}{(M+m)L}$

6. A thin metal rod of mass M and length L is into four equal parts by cutting it perpendicular to the length. If moment of inertia of the rod about an axis passing through its centre and perpendicular to its axis it I, then moment of inertia of each part about the similar axis is

(A) $\frac{I}{64}$ (B) $\frac{I}{8}$

(C) $\frac{I}{16}$ (D) $\frac{I}{32}$

7. Consider earth to be a sphere of radius R_e rotating about its own axis with angular speed ω. If g_{E} and g_{P} are the accelerations due to gravity at the equator and the poles respectively, then $(g_{\mathrm{P}} - g_{\mathrm{E}})$ is given by $\left[\cos(0^\circ) = \sin\left(\frac{\pi}{2}\right) = 1,\ \sin(0^\circ) = \cos\left(\frac{\pi}{2}\right) = 0\right]$

(A) $\frac{R_{\mathrm{E}}}{\omega^2}$ (B) $R_{\mathrm{E}}\omega^2$

(C) $R_{\mathrm{E}}\omega$ (D) $R_{\mathrm{E}}^2\omega^2$

8. A body is projected vertically, upwards from earth's surface with velocity $2V_e$ where V_e is the escape velocity from earth's surface. The velocity when body escapes the gravitational pull is

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

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

9. A spherical solid ball of volume V is made up of material of density ρ. It is falling through a liquid of density $\sigma(\sigma < \rho)$. Assume that the liquid applies a viscous force on the ball that is proportional to square of the terminal speed $v_{\mathrm{T}}, F = -Kv_{\mathrm{T}}^2, \forall(K > 0)$, then the terminal speed of the ball is (g = acceleration due to gravity)

(A) $\left[\frac{Vg\rho}{K}\right]^{\frac{1}{2}}$ (B) $\left[\frac{Vg(\rho-\sigma)}{K}\right]^{\frac{1}{2}}$

(C) $\frac{Vg(\rho-\sigma)}{K}$ (D) $\frac{Vg\rho}{K}$

10. A square wire frame of each side L is dipped in soap solution. On taking out, a membrane is formed. If the surface tension of solution is T, the force acting on the frame will be

(A) $8TL$ (B) $10TL$

(C) $2TL$ (D) $54TL$

11. Water rises up to a height h in a capillary tube immersed vertically in water. When this whole arrangement is taken to a depth d in a mine, the water level rises up to a height h'. If R is the radius of the earth, then the ratio $\frac{h}{h'}$ is

(A) $1+\frac{d}{R}$ (B) $1-\frac{d}{R}$

(C) $\frac{R+d}{R-d}$ (D) $\frac{R-d}{R+d}$

12. Two metal slabs of same cross-sectional area have thicknesses d_1 and d_2, and thermal conductivities K_1 and K_2 respectively, are connected in series. The free ends of the two slabs are kept at temperatures T_1 and $T_2(T_1>T_2)$. The temperature T of their common junction is

(A) $\frac{K_1T_1d_2+K_2T_2d_1}{K_1d_2+K_2d_1}$ (B) $\frac{K_1T_1+K_2T_2}{K_1+K_2}$

(C) $\frac{K_1T_1+K_2T_2}{T_1+T_2}$ (D) $\frac{K_1T_1d_1+K_2T_2d_2}{K_1d_2+K_2d_1}$

13. About black body radiation, which one of the following is the WRONG statement?

(A) All wavelengths are emitted by a black body

(B) For longer wavelengths, intensity is less.

(C) For shorter wavelengths, intensity is more.

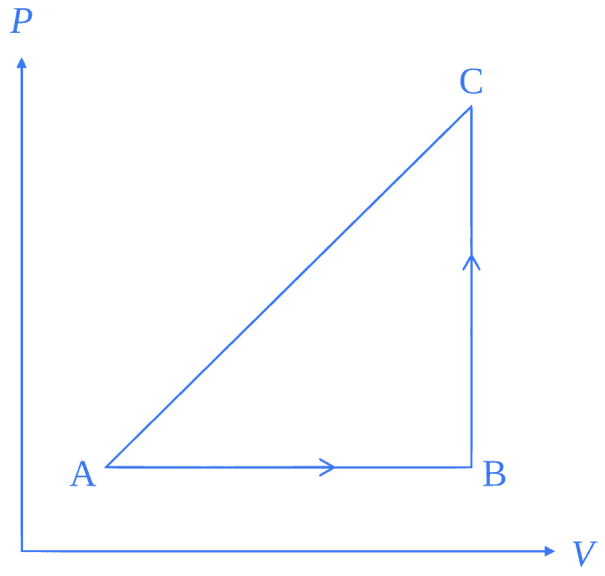
(D) For all wavelengths, intensity is the same.

14. For monoatomic gas work done at constant pressure is W.For the same rise in temperature of the gas, the heat supplied at constant volume is

(A) $\frac{W}{2}$ (B) $2W$

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

15. The $p-V$ diagram of a system undergoing thermodynamic changes is as shown in the figure. The work done by the system in going from $A\to B\to C$ is 30 J. If 68 J of heat is given to the system, then the change in the internal energy of the system between A and C is



(A) 34 J (B) 98 J

(C) -38 J (D) 38 J

16. At constant temperature, the pressure of gas is decreased by 20%. The percentage change in volume

(A) increase by 29% (B) decreases by 25%

(C) increases by 25% (D) decreases by 20%

17. The translational kinetic energy of the molecules of a gas at absolute temperature T can be doubled by

(A) decreasing T to $\frac{T}{2}$ (B) increasing T to $4T$

(C) increasing T to $\sqrt{2}T$ (D) increasing T to $2T$

18. A simple harmonic motion is represented by $\alpha\frac{d^2x}{dt^2}+\beta x=0$. Its period is

(A) $\frac{2\pi\beta}{\alpha}$ (B) $2\pi\sqrt{\frac{\alpha}{\beta}}$

(C) $2\pi\sqrt{\frac{\beta}{\alpha}}$ (D) $\frac{2\pi\alpha}{\beta}$

19. The fundamental frequency of a wire stretched by 2kgwt is 100 Hz. The weight required to produce its octave is

(A) 12kgwt (B) 8 kgwt

(C) 4 kgwt (D) 16kgwt

20. The equation of stationary wave on a string clamped at both ends and vibrating in third harmonic is $Y = 0.5\sin(0.314x)\cos(600\pi t)$ where x and y are in cm, t in second. The length of the vibrating string is

(A) 20 cm (B) 10 cm

(C) 40 cm (D) 30 cm

21. A cylindrical tube open at both ends has fundamental frequency f in air. When the tube is dipped vertically in water so that one-third part of the tube is in water, the fundamental frequency of air column becomes (neglect end correction)

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

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

22. A string of mass M is under a tension T. The length of the string is L. A transverse wave starts at one end of the string., the time required for the disturbance to reach the other end is

(A) $\sqrt{\frac{LM}{T}}$ (B) $\sqrt{LMT}$

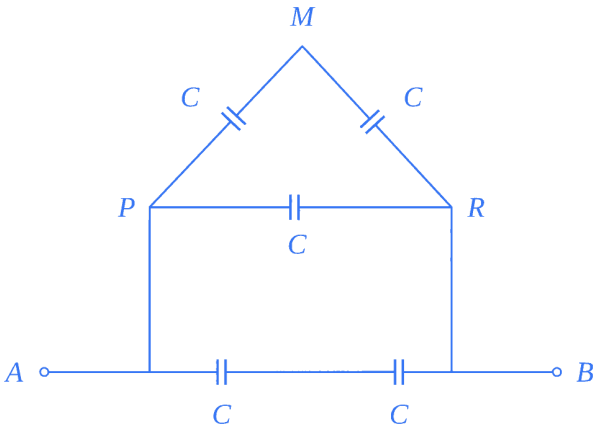
(C) $\sqrt{\frac{T}{LM}}$ (D) $\sqrt{\frac{LT}{M}}$

23. Two-point charges $+Q$ and $+q$ repel each other with a force of 100 N. Keeping the distance between them unchanged, if Q is increased by 10% and q is decreased by q the force of repulsion between them will.

(A) decrease by 10 N (B) decrease by 1 N

(C) increase by 10 N (D) remain same

24. The equivalent capacitance between points A and B as shown in figure is



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

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

25. The dielectric slab is introduced between the plates of a parallel plate charged capacitor. Which one of the following quantities will not change?

(A) The charge on the capacitor. (B) The potential difference between the plates.

(C) The energy stored in the capacitor. (D) The electric field between the plates of a capacitor.

26. The earth is assumed to be charged conducting sphere having volume V and surface area A. The capacitance of the earth in free space is

(A) $\frac{2\pi\epsilon_0 V}{A}$ (B) $\frac{12\pi\epsilon_0 V}{A}$

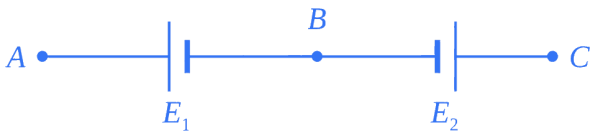
(C) $\frac{8\pi\epsilon_0 V}{A}$ (D) $\frac{4\pi\epsilon_0 V}{A}$

27. Two known resistances are connected in two gaps of a meter bridge. The null point is obtained at 20 cm from zero end. A resistance of 15Ω is connected in series with the smaller of the two. The null point shifts to 40 cm. The smaller resistances is

(A) 9Ω (B) 7Ω

(C) 3Ω (D) 5Ω

28. A potentiometer is used to measure the potential difference between A and B, the null point is obtained at 0.9 m. Now potential difference between A and C is measured, the null point is obtained at 0.3 m. The ratio $\frac{E_2}{E_1}$ is $(E_1 > E_2)$



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

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

29. Electrical conductivity of insulators is

(A) extremely small. (B) exactly zero.

(C) sometimes small and sometimes large. (D) extremely large.

30. If the distance between two current carrying parallel wire is made $\left(\frac{1}{3}\right)^{rd}$ then the magnitude of the force between them (the same current is passing through both wires)

(A) is tripled. (B) becomes 6 times.

(C) becomes q times. (D) remains same.

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31. A charge moves in a circular path perpendicular to a magnetic field. The time period of the revolution is independent of

(A) strength of charge.
(B) magnetic field.
(C) mass of the charge.
(D) velocity of the charge.

32. An electron accelerated through potential difference V passes through a uniform transverse magnetic field and experiences a force F. If the accelerating potential is increased to 2 V, the electron in the same magnetic field will experience a force

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

33. A toroid is a long coil of wire (N turns) wound over a circular core. The coefficient of self-induction of the toroid is [The magnetic field in it is uniform and $R >> r$, where r = radius of wire, R = radius of coil] (μ_0 = permeability of free space)

(A) $\frac{\mu_0 N^2 R^2}{2r}$
(B) $\frac{\mu_0 N r}{2R}$
(C) $\frac{\mu_0 N^2 r^2}{R}$
(D) $\frac{\mu_0 N^2 r^2}{2R}$

34. When a capacitor is connected in series LR circuit, the alternating current flowing in the circuit.

(A) remains constant.
(B) increases.
(C) becomes zero.
(D) decreases.

35. The primary and secondary voltage of an ideal step-down transformer is 200 V and 25 V respectively. The secondary is connected to a device, which draws a current of 2 A. The current in the primary is

(A) 25 mA
(B) 42 mA
(C) 160 mA
(D) 250 mA

36. An alternating e.m.f. is given as $e = e_0 \sin \omega t$. In what time, the e.m.f. will have half its maximum value if e starts from zero? (T = time period, $\sin 30^\circ = \cos 60^\circ = 0.5$)

(A) $\frac{T}{12}$
(B) $\frac{T}{8}$
(C) $\frac{T}{16}$
(D) $\frac{T}{4}$

37. Same current is flowing in two alternating circuits. The first circuit contains only inductor and the other contains only a capacitor. If the frequency of the alternating e.m.f. is increased, the values of current will

(A) decrease in first circuit and increase in the other.
(B) increase in first circuit and decrease in the other.
(C) increase in both circuits.
(D) decrease in both circuits.

38. The coil of inductance 0.25mH has a reactance of 330Ω, when connected to an a.c. source. The frequency of a.c. source is (Take $\pi = \frac{22}{7}$)

(A) 210kHz
(B) 105kHz
(C) 420kHz
(D) 330kHz

39. Which one of the following statements is not the property of light?

(A) Light involves transportation of energy.
(B) Light can travel through vacuum.
(C) Light requires material medium.
(D) Light has finite speed.

40. For a light ray to undergo total internal reflection, light must travel from (i = angle of incidence,i_C = critical angle)

(A) rarer to denser medium and $i < i_c$
(B) denser to rarer medium and $i < i_c$
(C) denser to rarer medium and $i > i_c$
(D) rarer to denser medium and $i > i_c$

41. A monochromatic ray of light travels through glass slab and water column. The number of waves in glass slab of thickness 4 cm is same as in water column of height 5 cm. If refractive index of glass is $\frac{5}{3}$ then refractive index of water is

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

42. Rays from a point source of light situated at height h below the liquid surface having refractive index μ, forms a circular patch of light of radius r on the surface. The area of the patch is

(A) $\frac{\pi}{h(\mu^2-1)}$
(B) $\frac{\pi h}{(\mu^2-1)}$
(C) $\frac{\pi h^2}{(\mu^2-1)}$
(D) $\frac{\pi h^2}{\sqrt{(\mu^2-1)}}$

43. In a biprism experiment, the distance between the two sources is doubled and the distance between the slit and the eyepiece is also doubled. Then the width of the fringe is

(A) halved. (B) unchanged.

(C) reduced to $\left(\frac{1}{3}\right)^{rd}$ (D) doubled.

44. Threshold frequency for a metal is 15×10^{14} Hz. The light of wavelength 6000Å falls on the metal surface. Then photoelectrons [velocity of light in air, $c = 3 \times 10^8$ m/s]

(A) come out with zero velocity. (B) come out with velocity 3×10^6 m/sa

(C) will not be emitted (D) are emitted with velocity c

45. The kinetic energy of an electron is tripled, then the de-Broglie wavelength associated with it, will change by a factor

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

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

46. The maximum velocity of the photoelectron emitted by the metal surface is v, charge and mass of the photoelectron are denoted by e and m respectively. The stopping potential in volt is

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

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

47. Ratio of centripetal acceleration for an electron revolving in 3^{rd} orbit and 5^{th} Bohr orbit of hydrogen atom is

(A) $\frac{125}{81}$ (B) $\frac{625}{81}$

(C) $\frac{625}{27}$ (D) $\frac{25}{9}$

48. An electron moving around the nucleus with an angular momentum L has a magnetic moment (e = charge on electron, m = mass of electron)

(A) $\frac{2e}{m}L$ (B) $\frac{e}{m}L$

(C) $\frac{e}{2m}L$ (D) $\frac{e}{2\pi m}L$

49. The output characteristics of a transistor in common emitter (CE) mode is the graph obtained by plotting

(A) I_C against V_{BE} at constant I_B (B) I_C against I_B at constant V_{BE}

(C) I_C against V_{CE} at constant I_B (D) I_C against I_B at constant V_{CE}

50. The truth-table for the two-input Ex-OR gate is (A, B are the inputs, Y is the 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	0
0	1	1
1	0	1
1	1	0

(A) P (B) Q

(C) R (D) S

51. Find the quantity of dihydrogen required to prepare 2 L ammonia gas from 1 L dinitrogen.

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

(C) 2 L (D) 3 L

52. What is the quantity of dehydrated water when 34.2 g cane sugar is treated with conc. H_2SO_4 under normal conditions of temperature and pressure?

(A) 11.0 g (B) 19.8 g

(C) 39.6 g (D) 34.2 g

53. Calculate the radius of first orbit of Be^{3+}.

(A) 13.23pm (B) 52.9pm

(C) 17.63pm (D) 26.45pm

54. Identify the correct decreasing order of atomic radii from following.

(A) Ce > Tm > Pm > Yb

(B) Ce > Pm > Tm > Yb

(C) Pm > Yb > Ce > Tm

(D) Pm > Tm > Ce > Yb

55. Identify amphoteric oxide from following.

(A) MgO (B) BeO

(C) BaO (D) Li_2O

56. Which of the following molecules has intramolecular hydrogen bonding?

(A) Ammonia (B) Hydrogen fluoride

(C) Water (D) Ethylene glycol

57. Which among the following molecules is NOT linear in shape?

(A) HBr (B) H_2 S

(C) $BeBr_2$ (D) CO_2

58. What is the bond length between carbon and bromine in $CH_3 - Br$ molecule?

(A) 193 pm (B) 214 pm

(C) 139pm (D) 178 pm

59. What is the bond order of O_2 molecule?

(A) 1 (B) 1.5

(C) 2 (D) 3

60. Identify false statement among the following.

(A) Work is a state function. (B) Work appears at the boundary of the system.

(C) Temperature is a state function. (D) Pressure and volume are state functions.

61. An ideal gas is compressed from $10dm^3$ to $1dm^3$ at a constant pressure 2 bar. Calculate the work done by gas during compression.

(A) 1.0 kJ (B) 1.5 kJ

(C) 1.8 kJ (D) 2.0 kJ

62. The bond enthalpies of $C - C$, $C = C$, $H - H$ and $C - H$ bonds are $360, 600, 400$ and 410 kJ mol^{-1} respectively. What is the heat of hydrogenation of ethylene?

(A) -450 kJ mol^{-1} (B) -260 kJ mol^{-1}

(C) -180 kJ mol^{-1} (D) -400 kJ mol^{-1}

63. According to Bronsted - Lowry theory the acids in the following are $ClO_4^- + HCO_3^- \rightarrow HClO_4 + CO_3^{2-}$

(A) HCO_3^- and $HClO_4$ (B) ClO_4^- and CO_3^{2-}

(C) $HClO_4$ and CO_3^{-2} (D) ClO_4^- and HCO_3^-

64. What is the pH of solution containing H^+ion concentration 2.5×10^{-3} $moldm^{-3}$? (Given $\log 2.5 = 0.3979$)

(A) 2.6 (B) 3.6

(C) 3.9 (D) 5.2

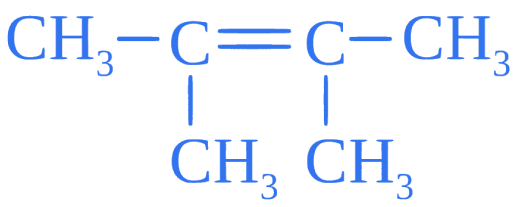
65. Identify the correct statement from following.

(A) Oxidation number of oxygen is -2 in all of its compounds. (B) Hydrogen has same electronegativity as halogens.

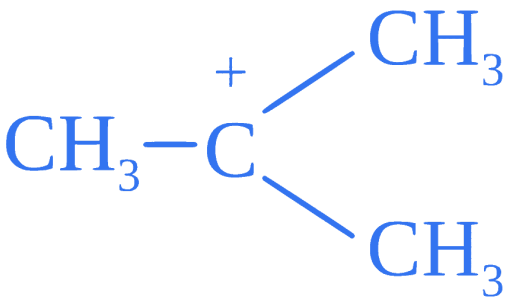
(C) Hydrogen exhibits oxidation number -1 and +1 . (D) Hydrogen has same ionisation enthalpy as alkali metals.

66. Hyperconjugation is not observed in

(A) $CH_3 - CH = CH_2$



(B)



(C)

(D) $CH_2 = CH_2$

67. When two-COOH groups are attached to adjacent carbon atoms of benzene then the name of compound is

(A) Benzoic acid (B) Salicylic acid

(C) Phthalic acid (D) O-Toluic acid

68. Which among the following statements is NOT true about aliphatic compounds?

(A) These are easily attacked by oxidizing agent.

(B) These burn with sooty flame.

(C) Saturated aliphatic compounds undergo substitution reactions.

(D) Unsaturated aliphatic compounds undergo addition reactions easily.

69. What is the product formed when benzene diazonium chloride reacts with ethanol?

(A) Phenol (B) Ethyl benzene

(C) Benzyl alcohol (D) Benzene

70. What is the void volume in the crystal lattice formed by bcc unit cell?

(A) 32% (B) 30%

(C) 47.64% (D) 26%

71. Calculate the volume of unit cell having four particles in it with density $19.0\ g\ cm^{-3}$ [molar mass of element $= 190\ g\ mol^{-1}$]

(A) $3.32 \times 10^{-23}\ cm^3$ (B) $5.0 \times 10^{-23}\ cm^3$

(C) $6.64 \times 10^{-23}\ cm^3$ (D) $2.4 \times 10^{-23}\ cm^3$

72. Calculate the molar mass of metal with density $1 gcm^{-3}$ forming bcc structure with edge length 420pm.

(A) $32.2\ g\ mol^{-1}$ (B) $22.3\ g\ mol^{-1}$

(C) $25.5\ g\ mol^{-1}$ (D) $43.3\ g\ mol^{-1}$

73. A centimolar solution of weak acid is 1.3% dissociated at 298 K. What is its dissociation constant?

(A) 1.3×10^{-6} (B) 1.5×10^{-6}

(C) 1.9×10^{-6} (D) 1.7×10^{-6}

74. Find the amount of solute in solution obtained by dissolving it in $2.5 dm^3$ water that generates osmotic pressure 0.245 atm. at 300 K ? (Molar mass of solute $= 58\ g\ mol^{-1} R = 0.0821 dm^3\ atm\ K^{-1}\ mol^{-1}$)

(A) 1.75 gram (B) 1.0 gram

(C) 0.72 gram (D) 1.44 gram

75. Calculate the cryoscopic constant when 0.8 gram nonvolatile solute with molar mass $64\ g\ mol^{-1}$ dissolved in 43 gram solvent lowers the freezing point by 0.34 K.

(A) $2.5\ K\ kg\ mol^{-1}$ (B) $2.0\ K\ kg\ mol^{-1}$

(C) $0.85\ K\ kg\ mol^{-1}$ (D) $1.17\ K\ kg\ mol^{-1}$

76. Calculate the molar conductivity of $CH_2ClCOOH$ at zero concentration if molar conductivities of HCl, KCl and $CH_2ClCOOK$ at zero concentration are $4.2, 1.4$ and $1.1 \Omega^{-1}\ cm^2\ mol^{-1}$ respectively.

(A) $3.9 \Omega^{-1}\ cm^2\ mol^{-1}$ (B) $4.5 \Omega^{-1}\ cm^2\ mol^{-1}$

(C) $6.6 \Omega^{-1}\ cm^2\ mol^{-1}$ (D) $1.7 \Omega^{-1}\ cm^2\ mol^{-1}$

77. How many Faraday of electricity is required to produce 5 g of magnesium from magnesium chloride? (Molar mass Mg $= 24\ g\ mol^{-1}$)

(A) 2.451 F (B) 0.417 F

(C) 6.0 F (D) 9.634 F

78. What is value of rate constant of a first order reaction if slope of graph between $\log_{10}\frac{[A]_0}{[A]_t}$ (y axis) and time (x axis) is 1×10^{-3} ?

(A) 4.34×10^{-3} (B) 6.93×10^{-3}

(C) 2.303×10^{-3} (D) 5.12×10^{-3}

79.

$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$, $\frac{d[NO_2]}{dt} = 0.052$ $moldm^{-3}\ s^{-1}$

. Calculate $-\frac{d[O_2]}{dt}$

(A) 0.026 $moldm^{-3}\ s^{-1}$ (B) 0.052 $moldm^{-3}\ s^{-1}$

(C) 0.078 $moldm^{-3}\ s^{-1}$ (D) 0.114 $moldm^{-3}\ s^{-1}$

80. Rate of a chemical reaction can be expressed in terms of

(A) rate of consumption of reactant only. (B) rate of consumption of reactant and formation of product.

(C) rate of formation of products only. (D) rate of consumption of catalyst.

81. What type of solution is sea water?

(A) liquid in solid (B) solid in solid

(C) solid in liquid (D) liquid in liquid

82. Identify correct statement for "oil in water" type of emulsion.

(A) Basic metal sulfates are used as emulsifiers. (B) Oil is dispersion medium.

(C) Water is dispersed phase. (D) No effect on conducting power when small amount of an electrolyte is added.

83. Identify the product obtained when excess chlorine reacts with ammonia.

(A) Nitrogen dioxide and hydrochloric acid (B) Ammonium chloride and dinitrogen

(C) Dinitrogen and hydrochloric acid (D) Nitrogen trichloride and hydrochloric acid

84. Which from following is a good reducing agent?

(A) Sn (B) Au

(C) Li (D) Cu

85. What is the number of unpaired electrons present in Sc^{3+} and Zn^{2+} ions respectively?

(A) 1,0 (B) 3,1

(C) 2,2 (D) 0,0

86. Which following pair of structure and magnetic properties is correct for tetracyanonickalate (II) ion?

(A) Square planar, paramagnetic (B) Tetrahedral, diamagnetic

(C) Square planar, diamagnetic (D) Tetrahedral, paramagnetic

87. What is the oxidation state of cobalt in a complex $[Co(NH_3)_6]^{3+}$?

(A) +4 (B) +3

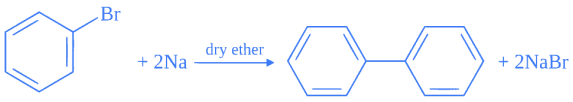
(C) +2 (D) +6

88. Which among the following is NOT an example of Wurtz reaction?

(A) $2C_2H_5Br + 2Na \xrightarrow{\text{dry ether}} C_4H_{10} + 2NaBr$

(B) $CH_3Br + C_2H_5Br \xrightarrow[\text{dry ether}]{Na} C_2H_6 + C_3H_8 + C_4H_{10}$

(C) $2CH_3Br + 2Na \xrightarrow{\text{dry ether}} C_2H_6 + 2NaBr$

(D) 

89. Identify Swartz reaction from the following.

(A) $R - Cl + AgF \xrightarrow{\Delta} R - F + AgCl$

(B) $R - OH + HX \xrightarrow[\text{condition}]{\text{suitable}} R - X + H_2O$

(C) $R - OH + PCl_5 \rightarrow R - Cl + HCl + POCl_3$

(D) $R - Cl + NaI \xrightarrow{\text{acetone}} R - I + NaCl$

90. What is the temperature at which the ethers can be prepared from alcohols by the action of concentrated H_2SO_4 ?

(A) 413 K (B) 213 K

(C) 113 K (D) 443 K

91. When aldehyde is treated with excess of monohydric alcohol, forms.

(A) Hemiacetal (B) Oxime

(C) Imine (D) Acetal

92. Which among the following is not a property of alcohols?

(A) These are non-polar molecules.
(B) Methanol is toxic liquid.
(C) The boiling points of alcohols increases with increase in their molecular mass.
(D) Dihydric alcohols contain two $-OH$ groups in their structures.

93. Identify compound A in the following reaction.

$$R - Mg - X + A \xrightarrow{\text{dry ether}} R - COOMgX$$
$$\xrightarrow[\text{dil HCl}]{\text{HOH}} R - COOH + Mg(X)OH$$

(A) $K_2Cr_2O_7$
(B) NaOH
(C) CO_2 (Solid)
(D) NH_3

94. Which among the following reactions represents Carbylamines reaction?

(A) $R - NH_2 + CHCl_3 + 3KOH \xrightarrow[\text{alc}]{\Delta} R - NC + 3KCl + 3H_2O$

(B) $R - NH_2 + NHO_2 \xrightarrow{\text{(i) } NaNO_2 + HCl} R - OH + N_2 \uparrow + HCl$

(C) $R - NH_2 + CH_3COCl \xrightarrow{\text{pyridine}} R - NH - COCH_3 + CHl$

(D) $R - NH_2 + R - X \rightarrow R_4N^+\overline{X} + 2HX$

95. Identify the reagent used for conversion of aniline to phenol from following.

(A) $NaNO_2/HCl/$
(B) $LiAlH_4$
(C) $\frac{H_2}{Ni}$
(D) Co-naphthenate

96. Identify the sugar molecule involved in polynucleotide formation.

(A) Tetrose
(B) Triose
(C) Hexose
(D) Pentose

97. Identify the nitrogen base of nucleic acid from following having double ring structure.

(A) Thymine
(B) Uracil
(C) Cytosine
(D) Guanine

98. Identify the use of HDPE.

(A) To prepare drinking straw
(B) Manufacturing the disposable cups and plates
(C) Manufacturing the bottles to store shampoo
(D) To obtain bags used for shopping

99. Which among the following polymers is heat resistant and used to obtain oil seals?

(A) Polyacrylonitrile
(B) Polycarbonate
(C) Teflon
(D) Polyacrylamide

100. Which of the following statements is NOT true about Buna-S?

(A) It is a copolymer.
(B) It is an elastomer.
(C) Mechanical strength of Buna-S is less than natural rubber.
(D) It is a vulcanized rubber.

101. Let $A = \{x \in R/x$ is not a positive integer$\}$. Let a function f be defined as $f : A \to R$ so that $f(x) = \frac{2x}{x-1}$, then f is

(A) Not injective.
(B) surjective but not injective.
(C) neither injective nor surjective.
(D) injective but not surjective.

102. Let $f : R \to R$ be a differentiable function with $f(0) = 1$ and satisfying the equation $f(x + y) = f(x) \cdot f'(y) + f'(x) \cdot f(y), \forall x, y \in R$, then the value of $\log(f(4))$ is

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

103. $\frac{\sin^2(-160^\circ)}{\sin^2 70^\circ} + \frac{\sin(180^\circ - \theta)}{\sin\theta} =$

(A) $\sec^2(20^\circ)$
(B) $\cot^2(20^\circ)$
(C) $\tan^2(20^\circ)$
(D) $\text{cosec}^2(20^\circ)$

104. In a triangle ABC, with usual notations, if $b = \sqrt{3}, c = 1, \angle A = 30^\circ$, then angle B is

(A) 60°
(B) 90°
(C) 30°
(D) 120°

105. If $\left(\frac{1-i}{1+i}\right)^{100} = a + ib$, where, $ab \in R$ and $i = \sqrt{-1}$, then (a, b) is equal to

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

106. Number of ways, in which 6 men and 5 women can sit at a round table, if no two women sit together, are

(A) $5! \times 4!$
(B) $6! \times 5!$
(C) 30
(D) $7! \times 5!$

107. Let a, b, c and be non-zero real numbers, if the point of intersection of the lines $4ax + 2ay + c = 0$ and $5bx + 2by + d = 0$ lies in the 4^{th} quadrant and is equidistant from the two axes, then

(A) $3bc + 2ad = 0$
(B) $2bc - 3ad = 0$
(C) $2bc + 3ad = 0$
(D) $2ad - 3bc = 0$

108. The combined equation of the lines whose inclinations are $\frac{\pi}{6}$ and $\frac{5\pi}{6}$, and passing through the origin, is

(A) $y^2 - \sqrt{3}x^2 = 0$
(B) $3x^2 - y^2 = 0$
(C) $x^2 - 3y^2 = 0$
(D) $\sqrt{3}y^2 - x^2 = 0$

109. The equation of a circle, which passes through the centre of the circle $x^2 + y^2 + 8x + 10y - 7 = 0$ and is concentric with the circle. $2x^2 + 2y^2 - 8x - 12y - 9 = 0$, is

(A) $x^2 + y^2 - 4x + 6y - 87 = 0$
(B) $x^2 + y^2 + 4x + 6y - 87 = 0$
(C) $x^2 + y^2 + 4x + 6y + 87 = 0$
(D) $x^2 + y^2 - 4x - 6y - 87 = 0$

110. $\lim_{x\to 2}\left(\frac{5x-8}{8-3x}\right)^{\frac{3}{2x-4}} =$

(A) $e^{5/2}$
(B) $e^{3/2}$
(C) e^2
(D) e^6

111. The negation of statement ' I study or I fail' is

(A) I study and I fail.
(B) I do not study and I fail.
(C) I study and I do not fail.
(D) I do not study and I do not fail.

112. Which of the following is correct statement? (a) $S_1 : (p \wedge q) \equiv \sim (p \to \sim q)$. (b) $S_2 : (p \wedge q) \wedge (\sim pv \sim q)$ is tautology. (c) $S_3 : [p \wedge (p \to \sim q)] \to q)$ is contradiction. (d) $S_4 : p \to (q \to p)$ is contingency.

(A) Statement S_3 is correct,
(B) Statement S_1 is correct,
(C) Statement S_1 and S_2 are correct,
(D) Statement S_4 is correct,

113. p and q are two logical statements. If $r : p \to (\sim p \vee q)$ has truth value false, then truth values of p and q are respectively

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

114. The value of $\tan\left[2\tan^{-1}\left(\frac{1}{5}\right) - \frac{\pi}{4}\right]$ is

(A) $\frac{7}{17}$
(B) $-\frac{7}{17}$
(C) $-\frac{17}{7}$
(D) $\frac{17}{7}$

115. If $\cos^{-1} x - \cos^{-1} \frac{y}{2} = \alpha$, where $-1 \le x \le 1, -2 \le y \le 2, x \le \frac{y}{2}$, then for all $x, y 4x^2 - 4xy\cos a + y^2$ is equal to

(A) $2\sin^2 a$ (B) $4\sin^2 a$

(C) $4\cos^2 a + 2x^2y^2$ (D) $4\sin^2 a - 2x^2y^2$

116. The principal value of $\cot^{-1}\left(\frac{-1}{\sqrt{3}}\right)$ is

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

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

117. If matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}$ and $A^{-1} = \alpha I + \beta A$ where I is a unit matrix of order 2 and α, β are constants, then the value of $\alpha + \beta + \alpha\beta$ is

(A) 11 (B) -7

(C) 7 (D) -11

118. If $|A| = -3$ and $A^{-1} = \begin{bmatrix} 1 & 0 & 0 \\ -1 & \frac{1}{3} & 0 \\ 3 & \frac{2}{3} & -1 \end{bmatrix}$, then $(\text{adj}A)$ is

(A) $\begin{bmatrix} -3 & 0 & 0 \\ 3 & -1 & 0 \\ -9 & -2 & 3 \end{bmatrix}$ (B) $\begin{bmatrix} -\frac{1}{3} & 0 & 0 \\ \frac{1}{3} & -\frac{1}{9} & 0 \\ 1 & -\frac{2}{9} & \frac{1}{3} \end{bmatrix}$

(C) $\begin{bmatrix} 3 & 0 & 0 \\ -3 & 1 & 0 \\ 9 & 2 & -3 \end{bmatrix}$ (D) $\begin{bmatrix} \frac{1}{3} & 0 & 0 \\ -\frac{1}{3} & \frac{1}{9} & 0 \\ -1 & \frac{2}{9} & -\frac{1}{3} \end{bmatrix}$

119. The function $(f)(x) = [x]^2 - [x^2]$ (where, $[x]$ is the greatest integer less than or equal to x), is discontinuous at

(A) all integers. (B) all integers except 0 .

(C) all integers except 0 and 1 . (D) all integers except 1 .

120. If $\log(x+y) = \log(xy) + a$, where a is constant, then $\frac{dy}{dx}$ at $x = 2$ and $y = 4$ is

(A) -4 (B) -8

(C) 4 (D) 8

121. If $f(x) = b \cdot e^{ax} + a \cdot e^{bx}$, then $f''(0) =$

(A) $(a+b)$ (B) $ab(a+b)^2$

(C) $2ab(a+b)$ (D) $ab(a+b)$

122. The domain of the derivative of the functions $f(x)\begin{cases} \tan^{-1} x, & \text{if } |x| \le 1 \\ \frac{1}{2}(|x|-1), & \text{if } |x| > 1 \end{cases}$ is given by

(A) $R - \{1\}$ (B) $R - \{0\}$

(C) $R - \{-1, 1\}$ (D) $R - \{-1\}$

123. Let $f(x) = 15 - |x - 10|; x \in R$. Then, the set of all values of x, at which the function $g(x) = f(f(x))$ is not differentiable, is

(A) $\{10\}$ (B) $\{10, 15\}$

(C) $\{5, 10, 15, 20\}$ (D) $\{5, 10, 15\}$

124. A spherical iron ball 10 cm in radius is coated with a layer of ice of uniform thickness that melts at a rate of $50\ \text{cm}^3/\text{min}$. When the thickness of ice is 5 cm, then the rate at which the thickness of ice decreases, is

(A) $\frac{1}{36\pi}\text{cm}/\text{min}$ (B) $\frac{5}{6\pi}\text{cm}/\text{min}$

(C) $\frac{1}{54\pi}\text{cm}/\text{min}$ (D) $\frac{1}{18\pi}\text{cm}/\text{min}$

125. The sides of an equilateral triangle are increasing at the rate of $2\ \text{cm}/\text{sec}$. The rate at which the area increases, when side is 10 cm, is

(A) $\frac{\sqrt{3}}{10}\ \text{cm}^2/\text{sec}$ (B) $\frac{10}{\sqrt{3}}\ \text{cm}^2/\text{sec}$

(C) $\sqrt{3}\ \text{cm}^2/\text{sec}$ (D) $10\sqrt{3}\ \text{cm}^2/\text{sec}$

126. The set of all points, for which $f(x) = x^2 \cdot e^{-x}$ strictly increases, is

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

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

127. The integral $\int \frac{\sin^2 x \cos^2 x}{(\sin^5 x + \cos^3 x \sin^2 x + \sin^3 x \cos^2 x + \cos^5 x)^2} dx$ is equal to (Where C is a constant of integration).

(A) $\frac{1}{1+\cot^3 x} + C$ (B) $\frac{-1}{1+\cot^3 x} + C$

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

128. $\int \frac{4x^2 \cot^{-1}(x^3)}{1+x^6}\, dx =$ (where C is a constant of integration.)

(A) $\frac{-2}{3}\left(\cot^{-1} X^3\right) + C$ (B) $\frac{-2}{3}\left(\cot^{-1} X^3\right)^2 + C$

(C) $\frac{2}{3}\left(\cot^{-1} x^3\right) + C$ (D) $\frac{2}{3}\left(\cot^{-1} x^3\right)^2 + C$

129. $\int \frac{\sin 2x}{4\sin^2 x+9\cos^2 x}\,dx =$ (Where C is a constant of integration).

(A) $-\log\left(4\sin^2 x+9\cos^2 x\right)+C$

(B) $\frac{1}{5}\log\left(4\sin^2 x+9\cos^2 x\right)+C$

(C) $-\frac{1}{5}\log\left(4\sin^2 x+9\cos^2 x\right)+C$

(D) $\log\left(4\sin^2 x+9\cos^2 x\right)+C$

130. $\int_{-3}^{0} x\sqrt{x+4}dx =$

(A) $\frac{-94}{15}$ (B) $\frac{94}{15}$

(C) $\frac{-34}{15}$ (D) $\frac{64}{15}$

131. The value of $\int_{-\pi}^{\pi} \frac{\cos^2 x}{1+\alpha^x}\,dx, \alpha > 0$ is

(A) 2π (B) π

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

132. $\int_0^1 \frac{1}{\sqrt{3+2x-x^2}}dx =$

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

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

133. The area bounded by the curve $y^2 = 2x+1$ and the line $x-y=1$ is

(A) $\frac{2}{3}$ sq. units (B) $\frac{4}{3}$ sq. units

(C) $\frac{8}{3}$ sq. units (D) $\frac{16}{3}$ sq. units

134. The differential equation of family of lines, having x-intercept as a and y-intercept as b, is

(A) $\frac{d^2y}{dx^2}=0$ (B) $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}-\frac{\mathrm{d}y}{\mathrm{d}x}+y=0$

(C) $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}+\frac{\mathrm{d}y}{\mathrm{d}x}=y$ (D) $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}+\frac{\mathrm{d}y}{\mathrm{d}x}=0$

135. An ice ball melts at the rate which is proportional to the amount of ice at that instant. Half the quantity of ice melts in 20 minutes. x_0 is the initial quantity of ice. If after 40 minutes the amount of ice left is kx_0x, then k is

(A) $\frac{1}{8}$ (B) $\frac{1}{2}$

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

136. The order and degree of a differential equation obtained by eliminating arbitrary constant C from the family of curves $y^2 = 2C(x+\sqrt{C})$ are respectively

(A) 1,3 (B) 1,4

(C) 1,1 (D) 1,2

137. If $\vec{a},\vec{b},\vec{c}$ are unit vectors such that $\vec{a}+\vec{b}+\vec{c}=\vec{0}$, then the value of $\vec{a}\cdot\vec{b}+\vec{b}\cdot\vec{c}+\vec{c}\cdot\vec{a}$ is

(A) 0 (B) $\frac{-1}{2}$

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

138. $|\vec{a}|=\sqrt{3}, |\vec{b}|=5, \vec{b}\cdot\vec{c}=10$ and angle between $\vec{b}$ and $\vec{c}$ is $\left(\frac{\pi}{3}\right)$. If $\vec{a}$ is perpendicular to $\vec{b}\times\vec{c}$, then value of $|\vec{a}\times(\vec{b}\times\vec{c})|$ is

(A) 15 (B) $10\sqrt{3}$

(C) 30 (D) 10

139. Let O be the origin and let PQR be an arbitrary triangle. The point S

$OP\cdot OQ + OR\cdot OS = OR\cdot OP + OQ\cdot OS$
$= OQOQ\cdot OR + OP\cdot OS$

that

$OP\cdot OQ + OR\cdot OS = OR\cdot OP + OQ\cdot OS = OQ$
$\cdot OR + OP\cdot OS$

, then the triangle PQR has S as its

(A) Incentre. (B) Centroid.

(C) Orthocentre. (D) Circumcentre.

140. If the area of the parallelogram with $\vec{a}$ and $\vec{b}$ as two adjacent sides is 15 sq. units, then the area of the parallelogram having $3\vec{a}+\vec{b}$ and $\vec{a}+3\vec{b}$ as two adjacent sides, in square units, is

(A) 135 (B) 90

(C) 150 (D) 120

141. The length of the perpendicular from the point $(0,2,3)$ on the line $\frac{x+3}{5}=\frac{y-1}{2}=\frac{z+4}{3}$

(A) $\sqrt{15}$ units (B) $\sqrt{21}$ units

(C) $\sqrt{33}$ units (D) $\sqrt{11}$ units

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

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

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

143. The Cartesian equation of the line which passes through the points $(3,1,2)$ and $(-1,2,1)$ is

(A) $\frac{x-3}{-4}=\frac{y-1}{1}=\frac{z-2}{1}$ (B) $\frac{x-3}{-4}=\frac{y-1}{1}=\frac{z-2}{-1}$

(C) $\frac{x-3}{-4}=\frac{y-1}{-1}=\frac{z-2}{-1}$ (D) $\frac{x-3}{-4}=\frac{y-1}{-1}=\frac{z-2}{1}$

144. The magnitude of the projection of the vector $2\hat{i}+\hat{j}+\hat{k}$, on the vector perpendicular to the plane containing the vectors $\hat{i}+\hat{j}+\hat{k}$ and $\hat{i}+2\hat{j}+3\hat{k}$, is

(A) $\frac{5}{\sqrt{6}}$ units (B) $\frac{1}{\sqrt{6}}$ units

(C) $\sqrt{6}$ units (D) $\frac{2}{\sqrt{6}}$ units

145. If the foot of the perpendicular drawn from the origin to a plane is $M(-1,-2,2)$, then the vector equation of the plane is

(A) $\overline{r}\cdot(-\hat{i}-2\hat{j}+2\hat{k})=9$

(B) $\bar{r}\cdot(\hat{i}+2\hat{j}+2\hat{k})=9$

(C) $\bar{r}\cdot(-\hat{i}-2\hat{j}-2\hat{k})=9$

(D) $\bar{r}\cdot(\hat{i}+2\hat{j}-2\hat{k})=9$

146. For the inequalities $x+y\leq 3, 2x+5y\geq 10, x\geq 0, y\geq 0$, which of the following points lies in the feasible region?

(A) $(2,2)$ (B) $(4,2)$

(C) $(1,2)$ (D) $(2,1)$

147. One coin is thrown 100 times, then the probability of getting head in odd number is

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

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

148. If p.m.f. of a r.v.X is $P(X=x)=\frac{1}{10}$, for $x=1,2,3,\ldots\ldots,10=0$, otherwise, then $\text{Var}(x)$ is equal to

(A) $\frac{11}{2}$ (B) $\frac{33}{4}$

(C) $\frac{121}{4}$ (D) $\frac{77}{2}$

149. For given data $N=60, \sum X^2=18000$ and $\sum X=960$, then variance of data is

(A) 54 (B) 34

(C) 22 (D) 44

150. One ticket is selected at random from 50 tickets numbered $\{00,01,02,\ldots..,49\}$. Then the probability that the sum of the igits on the selected ticket is 8 , given that the product of these digits is zero, is

(A) $\frac{1}{50}$ (B) $\frac{1}{14}$

(C) $\frac{14}{50}$ (D) $\frac{1}{10}$

- End of Question Paper -