MHT CET 2024 PCM May 15 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 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.

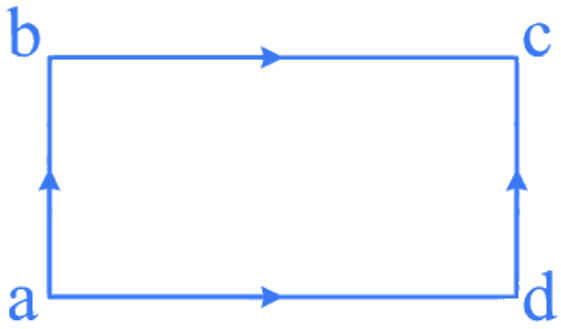
1. A thin uniform metal rod of mass ' M ' and length ' L ' is swinging about a horizontal axis passing through its end. Its maximum angular velocity is ' ω '. Its centre of mass rises to a maximum height of (g = Acceleration due to gravity)

(A) $\frac{L^2\omega^2}{3g}$ (B) $\frac{L^2\omega^2}{2g}$
(C) $\frac{L^2\omega^2}{6g}$ (D) $\frac{L^2\omega^2}{4g}$

2. When the number of turns in a coil are made 3 times without any change in the length of the coil, its self inductance becomes

(A) (9) times (B) two times
(C) three times (D) four times

3. When a system is taken from state ' a ' to state ' c ' along a path abc, it is found that Q = 80cal and W = 35cal. Along path adc Q = 65cal the work done W along path adc is



(A) 20 cal. (B) 35 cal.
(C) 45 cal. (D) 65 cal.

4. The driver of a car travelling with a speed ' V_1 ' m/s towards a wall sounds a siren of frequency ' n ' Hz. If the velocity of sound in air is Vm/s, then the frequency of sound reflected from the wall and as heard by the driver, in Hz , is

(A) $(\frac{V+V_1}{V-V_1})n$ (B) $(\frac{V-V_1}{V+V_1})n$
(C) $(\frac{V_1-V}{V_1+V})n$ (D) $(\frac{V_1}{V_1-V})n$

5. When a mercury drop of radius ' R ' splits up into 1000 droplets of radius ' r ', the change in surface energy is (T = surface tension of mercury)

(A) $8\pi R^2T$ (B) $16\pi R^2T$
(C) $34\pi R^2$ T (D) $36\pi R^2T$

6. Two different logic gates giving output ' 1 ' for the inputs $(1,0)$ and then for $(0,1)$ are

(A) 'AND', 'OR' (B) 'OR', 'NOR'
(C) 'NAND', 'NOR' (D) 'NAND', 'OR'

7. An open organ pipe of length ' l ' is sounded together with another open organ pipe of length $(l+l_1)$ in their fundamental modes. Speed of sound in air is ' V '. The beat frequency heard will be ($l_1 << l$)

(A) $\frac{Vl_1^2}{2l}$ (B) $\frac{Vl_1}{2l^2}$
(C) $\frac{Vl_1}{4l^2}$ (D) $\frac{vl^2}{2l_1}$

8. When a coil is connected to a d.c. source of e.m.f. 12 volt; then the current of 4 A flows in it . If the same coil is connected to a 12 volt, 50 Hz a.c. source, then the current flowing in it is 2.4 A . Then self-inductance of the coil will be

(A) 48 H (B) 12 H
(C) $\frac{4}{\pi} \times 10^{-2}$H (D) $\frac{8}{\pi} \times 10^{-2}$H

9. The ratio of work done by an ideal rigid diatomic gas to the heat supplied by the gas in an isobaric process is

(A) $\frac{3}{7}$ (B) $\frac{2}{7}$
(C) $\frac{4}{7}$ (D) $\frac{5}{7}$

10. A galvanometer has resistance 80Ω and it is shunted with resistance 20Ω. If 20% of the main current flows through galvanometer, then what is the value of main current?

(A) 0.2 A (B) 0.8 A
(C) 1 A (D) 1.2 A

11. The weights of an object are measured in a coal mine of depth ' h_1 ', then at sea level of height ' h_2 ' and lastly at the top of a mountain of height ' h_3 ' as W_1, W_2 and W_3 respectively. Which one of the following relation is correct? [h $h_1 \ll R, h_3 \gg h_2 = R, R$ = radius of the earth]

(A) $W_1 = W_2 = W_3$ (B) $W_1 < W_2 < W_3$
(C) $W_1 > W_2 < W_3$ (D) $W_1 < W_2 > W_3$

12. The angle of contact between glass and water is 0° and water rises in a glass capillary upto 6 cm (Surface tension of water is T). Another liquid of surface tension ' 2 T$'$ ', angle of contact 60° and relative density 2 will rise in the same capillary up to $(\cos 0^\circ = 1, \cos 60^\circ = 0.5)$

(A) 1.5 cm
(B) 2 cm
(C) 3 cm
(D) 4.0 cm

13. In double slit experiment, instead of taking slits of equal widths, one slit is made twice as wide as the other. Then in interference pattern

(A) the intensity of the maxima decreases and the minima has zero intensity.
(B) the intensity of maxima decreases and that of the minima increases.
(C) the intensity of the maxima increases and the minima has zero intensity.
(D) the intensities of both the maxima and the minima increase.

14. Two parallel wires separated by distance 'b' are carrying equal current ' I ' in the same direction. The force per unit length of the wire is

(A) $\frac{\mu_0}{4\pi}(\frac{I}{b^2})$
(B) $\frac{\mu_0}{4\pi}(\frac{I^2}{b^2})$
(C) $\frac{\mu_0}{4\pi}(\frac{I^2}{b})$
(D) $\frac{\mu_0}{4\pi}(\frac{2I^2}{b})$

15. In an a.c. circuit, the reactance of a coil is $\sqrt{3}$ times its resistance. The phase difference between the voltage across the coil to the current through the coil will be

(A) $\tan^{-1}(0)$
(B) $\tan^{-1}\frac{1}{\sqrt{3}}$
(C) $\tan^{-1}(1)$
(D) $\tan^{-1}(\sqrt{3})$

16. Three thin rods, each of mass ' M ' and length ' L ' are placed along X, Y and Z axes which are mutually perpendicular. One end of each rod is at origin. M. I. of the system about Z axis is

(A) $\frac{3ML^2}{4}$
(B) $\frac{2M^2}{5}$
(C) $\frac{2ML^2}{3}$
(D) $\frac{3ML^2}{5}$

17. For a symmetric (equilateral) prism, the prism formula can be written as

(A) $2\sin(30 + \frac{\delta m}{2})$
(B) $\frac{2}{\sqrt{3}}\sin(30 + \frac{\delta m}{2})$
(C) $2\sin(60 + \frac{\delta m}{2})$
(D) $\frac{2}{\sqrt{3}}\sin(60 + \frac{\delta m}{2})$

18. The internal energy of an ideal diatomic gas corresponding to volume ' V ' and pressure ' P ' is 2.5 PV. The gas expands from 1 litre to 2 litre at a constant pressure of 10^5 N/m^2. The heat supplied to a gas is

(A) 350 J
(B) 300 J
(C) 250 J
(D) 200 J

19. Two photons having energies twice and thrice the work function of metal are incident one after another on the metal surface. Then the ratio of maximum velocities of the photoelectrons emitted in the two cases is respectively

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

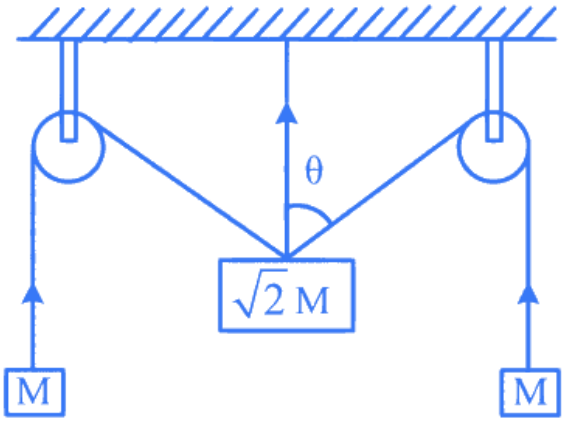
20. If a unit positive charge is shifted from a region of low potential to a region of high potential, then the electric potential energy of the system

(A) increases.
(B) decreases.
(C) does not change.
(D) is zero.

21. Magnetic induction produced at the centre of a circular loop of radius ' R ' carrying a current is ' B '. The magnetic moment of the loop is (μ_0 = permeability of free space)

(A) $\frac{BR^3}{2\pi\mu_0}$
(B) $\frac{2\pi BR^3}{\mu_0}$
(C) $\frac{BR^2}{2\pi\mu_0}$
(D) $\frac{2\pi BR^2}{\mu_0}$

22. The pulleys and strings shown in figure are smooth and of negligible mass. For the system to remain in equilibrium, angle θ should be



(A) $\cos^{-1}(1)$
(B) $\cos^{-1}(\frac{\sqrt{3}}{2})$
(C) $\cos^{-1}(\frac{1}{2})$
(D) $\cos^{-1}(\frac{1}{\sqrt{2}})$

23. In biprism experiment, the fringe width is 0.6 mm . The distance between 6^{th} dark fringe and 8^{th} bright fringe on the same side of central bright fringe is

(A) 6 mm (B) 4 mm
(C) 1.5 mm (D) 0.9 mm

24. A radioactive substance has half-life of 60 minute. During 3 hour, the amount of substance decayed would be

(A) 8.5% (B) 25%
(C) 12.5% (D) 87.5%

25. A horizontal platform with a small object placed on it executes a linear S.H.M. in the vertical direction. The amplitude of oscillation is 40 cm . What should be the least period of these oscillations, so that the object is not detached from the platform? [Take $g = 10\ m/s^2$]

(A) 0.2π s (B) 0.3π s
(C) 0.4π s (D) 0.5π s

26. In Young's double slit experiment, 'I' is the minimum intensity and ' I_1 ' is the intensity at a point where the path difference is $\frac{\lambda}{4}$ where ' λ ' is the wavelength of light used. The ratio $I_1 I_1$ is (Intensities of the two interfering waves are same) $(\cos 0^\circ = 1, \cos 90^\circ = 0)$

(A) 0 (B) 4
(C) 3 (D) 2

27. For a ray of light, the critical angle is minimum, when it travels from

(A) glass to air (B) air to glass
(C) glass to water (D) water to glass

28. Four moles of hydrogen, two moles of helium and one mole of water vapour form an ideal gas mixture. [C_v for hydrogen $= \frac{5}{2}R, C_v$ for helium $= \frac{3}{2}R$, C_v for water vapour $= 3R$] What is the molar specific heat at constant pressure of the mixture?

(A) $\frac{11}{3}R$ (B) $\frac{23}{7}R$
(C) $\frac{16}{7}R$ (D) $\frac{23}{3}R$

29. Electrons are accelerated through a potential difference of 16 kV . If the potential difference is increased to 64 kV , then de-Broglie wavelength associated with electron will

(A) remain same. (B) becomes half.
(C) becomes four time. (D) becomes quarter.

30. Starting from mean position, a body oscillates simple harmonically with a period ' T '. After what time will its kinetic energy be 75% of the total energy? $(\sin 30^\circ = 0.5)$

(A) $\frac{T}{8}$ (B) $\frac{T}{12}$
(C) $\frac{T}{16}$ (D) $\frac{T}{24}$

31. Two solenoids of equal number of turns have their lengths as well as radii in the same ratio 1 : 3. The ratio of their self inductance will be

(A) 1 : 3 (B) 1 : 9
(C) 9 : 1 (D) 3 : 2

32. In an extrinsic n-type semiconductor, the free electrons donated by the impurity atoms occupy energy levels in

(A) the conduction band. (B) the valance band.
(C) the band gap and are close to conduction band. (D) the band gap and are close to valance band.

33. If the angular velocity of a body rotating about the given axis increases by 20%, then its kinetic energy of rotation will increase by

(A) 20% (B) 30%
(C) 44% (D) 66%

34. Two progressive waves $Y_1 = \sin 2\pi\left(\frac{t}{0{\cdot}4} - \frac{x}{4}\right)$ and $Y_2 = \sin 2\pi\left(\frac{t}{0{\cdot}4} + \frac{x}{4}\right)$ superpose to form a standing wave. ' x ' and ' y ' are in SI system. Amplitude of the particle at $x = 0.5$ m is $\left[\sin 45^\circ = \cos 45^\circ = \frac{1}{\sqrt{2}}\right]$

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

35. The strength of magnetic field at a perpendicular distance ' x ' near a long straight conductor carrying current ' I ' is ' B '. The magnetic field at a distance $\frac{x}{3}$ from straight conductor will be

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

36. The ratio of the areas of the electron orbits for the second excited state to the first excited state for the hydrogen atom is

(A) 3 : 2 (B) 9 : 4
(C) 16 : 81 (D) 81 : 16

37. Two point charges $+8q$ and $-2q$ are located at X = 0 (origin) and X = L respectively. The net electric field due to these two charges is zero at point P on X-axis. The location of point P from the origin is

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

(C) 4L (D) 8L

38. A series L − C − R circuit containing a resistance ' R ' has angular frequency ' ω '. At resonance the voltage across resistance and inductor are ' V_R ' and ' V_L ' respectively, then value of capacitance will be

(A) $\frac{V_R}{V_L \omega R}$ (B) $\frac{V_L}{V_R R \omega^2}$

(C) $\frac{V_R}{V_L R \omega^2}$ (D) $\frac{V_L R}{V_R \omega}$

39. Consider a long uniformly charged cylinder having constant volume charge density ' λ ' and radius ' R '. A Gaussian surface is in the form of a cylinder of radius ' r ' such that vertical axis of both the cylinders coincide. For a point inside the cylinder $(r < R)$, electric field is directly proportional to

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

(C) r^2 (D) r^{-2}

40. Two capillary tubes A and B of the same internal diameter are kept vertically in two different liquids whose densities are in the ratio 4 : 3. If the surface tensions of these two liquids are in the ratio 6 : 5, then the ratio of rise of liquid in capillary A to that in B is (assume their angles of contact are nearly equal)

(A) 10 : 9 (B) 9 : 10

(C) 7 : 10 (D) 10 : 7

41. For a transistor, current gain $(\beta) = 50$. To change the collector current by 350μ A, the base current should be changed by

(A) $(\frac{50}{350})\mu A$ (B) $(350 - 50)\mu A$

(C) $(350 + 50)\mu A$ (D) $(\frac{350}{50})\mu A$

42. A sheet of steel is 40 cm long and 5 cm broad at 0°C. The surface area of the sheet increases by 1.4 cm^2 at 100°C. Coefficient of linear expansion of steel is

(A) $1.9 \times 10^{-5}/°C$ (B) $2.4 \times 10^{-5}/°C$

(C) $3.5 \times 10^{-5}/°C$ (D) $7 \times 10^{-5}/C$

43. When a sonometer wire vibrates in third overtone there are

(A) 4 nodes and 3 antinodes. (B) 6 nodes and 5 antinodes.

(C) 5 nodes and 4 antinodes. (D) 4 nodes and 5 antinodes.

44. Alternating current of peak value $(\frac{2}{\pi})$ A flows through the primary coil of a transformer. The coefficient of mutual inductance between primary and secondary coils is 1 H . The peak e.m.f. induced in secondary coil (Frequency of a.c. = 50 Hz)

(A) 50 V (B) 100 V

(C) 150 V (D) 200 V

45. Three condensers of capacities ' C_1 ', ' C_2 ', ' C_3 ' are connected in series with a source of e.m.f. ' V '. The potentials across the three condensers are in the ratio

(A) 1 : 1 : 1 (B) $C_1 : C_2 : C_3$

(C) $C_1^2 : C_2^2 : C_3^2$ (D) $\frac{1}{C_1} : \frac{1}{C_2} : \frac{1}{C_3}$

46. The maximum velocity of a particle, executing S.H.M. with an amplitude 7 mm is 4.4 ms^{-1} The period of oscillation is $[\pi = \frac{22}{7}]$

(A) 100 s (B) 10 s

(C) 0.1 s (D) 0.01 s

47. A satellite of mass ' m ' is revolving around the earth of mass ' M ' in an orbit of radius ' r ' with constant angular velocity ' ω '. The angular momentum of satellite is (G = Universal constant of gravitation)

(A) $m(GMr)^{3/2}$ (B) $m(GMr)$

(C) $m(GMr)^{1/2}$ (D) $m(GMr)^{-1/2}$

48. A cell balances against a length of 150 cm on a potentiometer wire when it is shunted by a resistance of 5Ω. But when it is shunted by a resistance of 10Ω, then balancing length increases by 25 cm . The balancing length when the cell is in an open circuit is

(A) 200 cm (B) 210 cm

(C) 225 cm (D) 250 cm

49. A quantity of heat ' Q ' is supplied to monoatomic ideal gas which expands at constant pressure. The fraction of heat converted into work is $\left[\gamma=\frac{C_p}{C_v}=\frac{5}{3}\right]$

(A) 3 : 5 (B) 5 : 3

(C) 2 : 5 (D) 3 : 2

50. A body of mass 1 kg starts from rest and moves with uniform acceleration. In 2 seconds, its velocity is 10 m/s. The power exerted on the body in one second is

(A) 20 W (B) 25 W

(C) 50 W (D) 100 W

51. How many amino acids are linked together by $(n-1)$ amide bonds?

(A) $n-1$ (B) n

(C) $n+1$ (D) $2n$

52. What is the percentage by mass of oxygen in NaOH ? (Atomic mass of $Na = 23u, O = 16u, H = 1u$)

(A) 16 (B) 20

(C) 40 (D) 60

53. For the reaction

$$2NO_{(s)} + 2H_{2(g)} \longrightarrow N_{2(g)} + 2H_2O_{(s)}$$

$$\text{rate} = k[NO]^2[H_2].$$

What is the order of reaction with respect to H_2 and overall order of reaction respectively?

(A) $0, 2$ (B) $1, 3$

(C) $2, 1$ (D) $3, 1$

54. Identify the alloy used for construction of gas turbine engines.

(A) Nichrome (B) Bronze

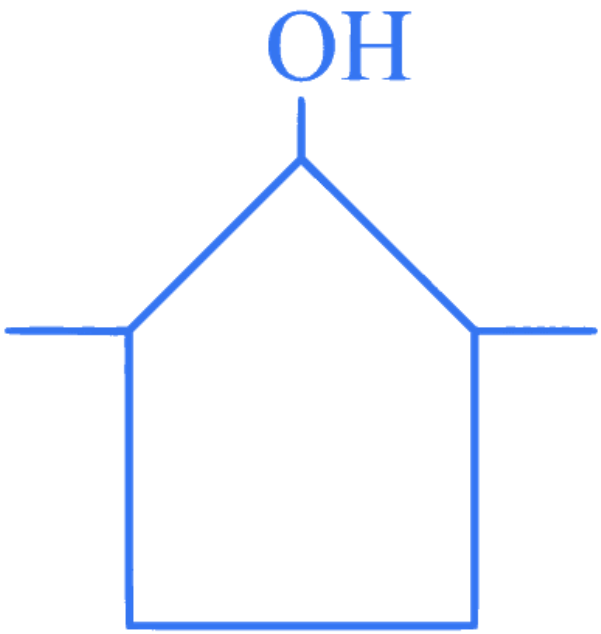
(C) Stainless steel (D) Cupra-nickel

55. Calculate the partial pressure exerted by dioxygen from a mixture of $32\ gO_2, 80\ gAr$ (mol.-mass 40) and 4 g dihydrogen ($P_{total} = 10bar$).

(A) 1 bar (B) 2 bar

(C) 4 bar (D) 5 bar

56. What is IUPAC name of following compound?



(A) 2,5-Dimethylpentan-1-ol

(B) 1,3-Dimethylpentan-2-ol

(C) 2,5-Dimethylcyclopentanol

(D) 1,3-Dimethylcyclopentan-2-ol

57. Which among the following is ferromagnetic substance?

(A) NaCl (B) H_2O

(C) O_2 (D) CrO_2

58. What is $O-O$ bond length in ozone molecule?

(A) 128 pm (B) 117 pm

(C) 107 pm (D) 134 pm

59. Find the number of electrons that generate 1 coulomb charge?

(A) 6.24×10^{18} (B) 1.25×10^{18}

(C) 6.22×10^{23} (D) 3.12×10^{18}

60. Which among the following statements is NOT true about rate constant?

(A) It is independent of concentration.
(B) It varies with temperature.
(C) For unit concentration it is equal to rate of reaction.
(D) It is directly proportional to the product of concentrations of reacting species.

61. Calculate the oxidation number of Cr in CrO_4^{2-} ion and $K_2Cr_2O_7$ respectively.

(A) +4 and +6
(B) +3 and +2
(C) +6 and +6
(D) +8 and +2

62. Identify the monomer used to obtain a polymer that resembles the wool.

(A) $CH_2 = CHCN$

(B) $F_2C = CF_2$

(C) $H_2C = CHCl$

(D) 

63. Which from following is a correct stability order of complex formed by metal ions if the ligand remains same?

(A) $Fe^{2+} > Mn^{2+} > Co^{2+}$

(B) $Co^{2+} > Fe^{2+} > Mn^{2+}$

(C) $Co^{2+} > Mn^{2+} > Fe^{2+}$

(D) $Fe^{2+} > Co^{2+} > Mn^{2+}$

64. Aldol condensation reaction is

(A) Electrophilic substitution
(B) Nucleophilic substitution
(C) Electrophilic addition-elimination reaction
(D) Nucleophilic addition-elimination reaction

65. What is the numerical difference in molar masses of second and third member of a homologous series?

(A) 14
(B) 12
(C) 10
(D) 2

66. What is the number of chiral carbon atoms present in 2-chloro-3,4-dimethylhexane?

(A) One
(B) Two
(C) Three
(D) Four

67. Which of the following is a primary amine?

(A) N-methyl methanamine
(B) Phenyl methanamine
(C) N-phenyl benzenamine
(D) N-methyl benzenamine

68. The E^{+}_{cell} of $Cu_{(s)}\left|Cu^{++}_{(1M)}\right\|Ag^{+}_{(1M)}\left|Ag_{(s)}\right.$ is 0.647 volt. Calculate the E°_{Ag} if E°_{Cu} is 0.153 V .

(A) 0.8 V
(B) 0.5 V
(C) -0.8 V
(D) -0.5 V

69. Conjugate acid of NH_2^- and NH_3 are respectively

(A) NH_4OH and NH_2OH
(B) NH_3 and NH_2^-
(C) NH_3 and NH_4^+
(D) NH_4^+ and NH_3

70. Calculate the value of ΔG for the following reaction. $N_2O_{4(g)} \longrightarrow 2NO_{2(g)}$ if $\Delta H = 57.44$ kJ and $\Delta S = 176$ J K^{-1} mol^{-1}.

(A) 120.20 kJ
(B) -110.24 kJ
(C) -46.4 kJ
(D) 4.64 kJ

71. Calculate the radius of first orbit of Li^{++}.

(A) 70.53 pm
(B) 158.7 pm
(C) 17.63 pm
(D) 282.13 pm

72. Which from following polymers (trade name) is used to obtain paints?

(A) Glyptal
(B) Polycarbonate
(C) Perspexe
(D) PVC

73. What is the number of electrons lost by Cr in a complex $[Cr(CO)_6]$?

(A) 0
(B) 4
(C) 6
(D) 2

74. Identify the reagent ' R ' used in the following reaction.

Ketone $\xrightarrow{R}$ Semicarbazone

(A) NH_2OH

(B) $NH_2 - NH - CONH_2$

(C) $NH_2 - NH - C_6H_5$

(D) $NH_2 - NH_2$

75. Identify alkadiene molecule from following.

(A) Isoprene (B) β-Phellandrene

(C) But-2-ene (D) Pent-1-ene

76. Identify the product obtained in the following reaction.

$$CH_3CH_2Br + CH_3COOAg \xrightarrow{\Delta} x + AgBr$$

(A) $CH_3CH_2COOCH_3$

(B) $CH_3COOCH_2CH_3$

(C) CH_3COOCH_3

(D) $CH_3CH_2COOCH_2CH_3$

77. Identify the reagent R used in following conversion?

tert-butyl bromide $\xrightarrow{R}$ Isobutylene

(A) Sn/HCl (B) $Na - Hg/H_2O$

(C) NH_3 (alc) (D) $LiAlH_4$

78. Calculate the mass of ' Ca ' deposited at cathode by passing 0.8 ampere current through molten $CaCl_2$ in 60 minutes. [Molar mass of Ca $= 40$ g mol^{-1}]

(A) 0.4 g (B) 0.5 g

(C) 0.6 g (D) 0.7 g

79. What is the expected value of ΔT_f for 1.25 m$CaCl_2$ solution if 1.25 m sucrose solution has ΔT_f value x K ?

(A) xK (B) $\frac{x}{2}$K

(C) $2x$ K (D) $3x$ K

80. Calculate Henry's law constant if solubility of gas in water at 25°C is 5.14×10^{-4} moldm^{-3} and partial pressure of the gas is 0.75 bar above solution.

(A) 6.85×10^{-4} moldm^{-3}bar^{-1}

(B) 5.14×10^{-4}moldm^{-3}bar^{-1}

(C) 1.028×10^{-4} moldm^{-3}bar^{-1}

(D) 1.371×10^{-4} moldm^{-3}bar^{-1}

81. What is the total number of orbitals present in N shell?

(A) 1 (B) 4

(C) 9 (D) 16

82. What is value of percent atom economy when reactants having sum of formula weight 78 u results in the formation of a product with formula weight 65 u ?

(A) 70% (B) 83%

(C) 78% (D) 65%

83. Identify the product formed in the following reaction.

CH_3CH_2MgBr $\xrightarrow[\text{ii) dil. HCl}]{\text{i) dry ice/dry ether}}$ product

(A) Ethanoic acid (B) Propanoic acid

(C) 2-Methylpropanoic acid (D) Butanoic acid

84. Which from following is a mineral of copper?

(A) Chalcopyrite (B) Zincite

(C) Limonite (D) Siderite

85. Identify dispersed phase and dispersion medium in fog respectively.

(A) liquid and gas. (B) gas and liquid.

(C) solid and gas. (D) gas and solid.

86. Ethers when dissolved in cold concentrated sulfuric acid forms,

(A) Alkanols (B) Alkanoic acids

(C) Alkyl hydrogen sulphate (D) Oxonium salts

87. Calculate the total volume occupied by all atoms in simple cubic unit cell if radius of atom is 3×10^{-8} cm.

(A) 1.13×10^{-22} cm^3 (B) 2.25×10^{-22} cm^3

(C) 3.15×10^{-22} cm^3 (D) 4.37×10^{-22} cm^3

88. Under similar conditions enthalpy of freezing is exactly opposite to

(A) enthalpy of fusion (B) enthalpy of vaporization

(C) enthalpy of solution (D) enthalpy of atomization

89. A buffer solution is prepared by mixing 0.2 M NHO_4OH and 1 M NH_4Cl. What is the pH value of buffer solution? (Give $pK_b = 7.744$)

(A) 5.56 (B) 6.99

(C) 8.44 (D) 9.56

90. A solution of nonvolatile solute is obtained by dissolving 0.8 g in 0.3dm^3 water has osmotic pressure 0.2 atm at 300 K . Calculate the molar mass of solute.

$$\left[R = 0.082\ atmdm^3\ K^{-1}\ mol^{-1}\right]$$

(A) 300 g mol^{-1} (B) 340 g mol^{-1}

(C) 328 g mol^{-1} (D) 352 g mol^{-1}

91. Which of the following molecules is an example of sp hybridization?

(A) Methane (B) Acetylene

(C) Ethylene (D) Ammonia

92. A first order reaction takes 40 minute for 20% decomposition. Calculate its rate constant.

(A) 5.6×10^{-3} minute^{-1} (B) 4.5×10^{-3} minute^{-1}

(C) 6.5×10^{-3} minute^{-1} (D) 7.2×10^{-3} minute^{-1}

93. What is the number of moles of water molecules present in a mole of carnallite?

(A) 6 (B) 4

(C) 5 (D) 1

94. What is the number of amino acids present in single turn of α-helix of protein?

(A) 1.3 (B) 3.1

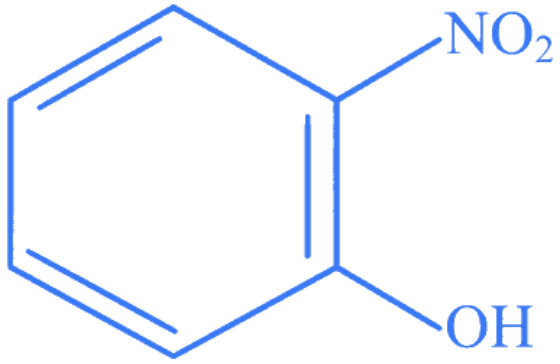
(C) 3.6 (D) 6.3

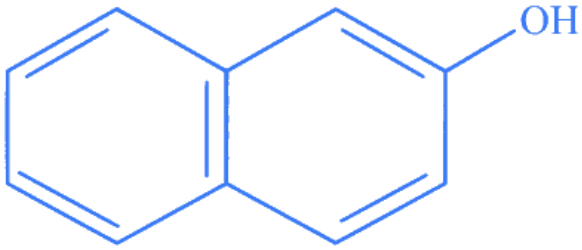
95. Which from following compounds is obtained as by product in synthesis of sodium carbonate by Solvay process?

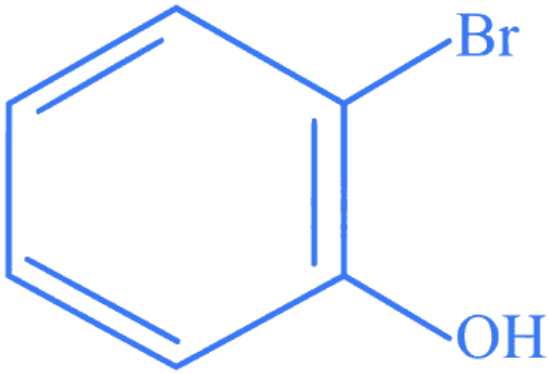
(A) Ammonium carbonate (B) Sodium bicarbonate

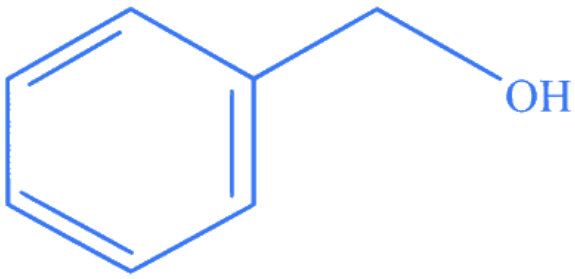
(C) Calcium Chloride (D) Ammonium Chloride

96. Which of the following compounds is NOT a phenol?

(A) 

(B) 

(C) 

(D) 

97. A compound is formed by two elements A and B. The atoms of element B form ccp structure. The atoms of A occupy $\frac{1}{3}$ of tetrahedral voids. What is the formula of the compound?

(A) A_2B_3 (B) AB

(C) AB_2 (D) AB_3

98. Which of the following isomers of C_4H_9Br is a chiral molecule?

(A) n-Butyl bromide (B) sec- Butyl bromide

(C) Isobutyl bromide (D) tert-Butyl bromide

99. The dissociation constant of a weak monobasic acid is 3.2×10^{-4}. Calculate the degree of dissociation in its 0.04 M solution.

(A) 0.0128 (B) 0.0151

(C) 0.078 (D) 0.089

100. 100 ml of $H_{2(g)}$ and 100 ml of $Cl_{2(g)}$ were allowed to react at 1 bar pressure as

$$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$$

What will be the PV type of work done during reaction?

(A) Zero J (B) +10 J

(C) −10 J (D) −100 J

101. If
$y = [(x+1)(2x+1)(3x+1) \ldots \ldots \ldots (nx+1)]^2$
then $\frac{dy}{dx}$ at $x = 0$ is

(A) $2n(n+1)$ (B) $n(n+1)$
(C) $\frac{n(n+1)}{2}$ (D) $(\frac{n(n+1)}{2})^2$

102. For the probability distribution

x :	0	1	2	3	4	5
$p(x)$:	k	0.3	0.15	0.15	0.1	2k

The expected value of X is

(A) 1.45 (B) 2.45
(C) 1.55 (D) 2.55

103. The value of $\int \frac{dx}{7+6x-x^2}$ is equal to

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

104. The value of

$\cos(18^\circ - A)\cos(18^\circ + A) - \cos(72^\circ - A)$
$\cos(72^\circ + A)$ is equal to

(A) $\cos54^\circ$ (B) $\cos36^\circ$
(C) $\sin54^\circ$ (D) $\sin36^\circ$

105. If $\int \frac{dx}{1+3\sin^2 x} = \frac{1}{2}\tan^{-1}(f(x)) + c$, where c is a constant of integration, then $f(x)$ is equal to

(A) $2\tan x$ (B) $\tan x$
(C) $2\sin x$ (D) $\sin x$

106. A random variable X has the following probability distribution

X	1	2	3	4	5
$p(x)$	k^2	2k	k	2k	$5k^2$

Then $p(x \geq 2)$ is equal to

(A) $\frac{35}{36}$ (B) $\frac{34}{36}$
(C) $\frac{33}{36}$ (D) $\frac{31}{36}$

107. Let $f : [-1, 3] \to \mathbb{R}$ be defined as

$$\begin{cases} |x| + [x], & -1 \leqslant x < 1 \\ x + |x|, & 1 \leqslant x < 2 \\ x + [x], & 2 \leqslant x \leqslant 3 \end{cases}$$

where $[t]$ denotes the greatest integer function. Then f is discontinuous at

(A) only two points (B) only three points
(C) four or more points (D) only one point

108. Let $\overline{a} = \hat{i} + \hat{j} + \hat{k}, \overline{b} = \hat{i} - \hat{j} + \hat{k}$ and $\overline{c} = \hat{i} - \hat{j} - \hat{k}$ be three vectors. A vector $\bar{v}$ in the plane of $\overline{a}$ and $\overline{b}$, whose projection on $\overline{c}$ is $\frac{1}{\sqrt{3}}$, is given by

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

109. The differential equation, having general solution as $Ax^2 + By^2 = 1$, where A and B are arbitrary constants, is

(A) $xy\frac{d^2y}{dx^2} - x(\frac{dy}{dx})^2 - y\frac{dy}{dx} = 0$
(B) $xy\frac{d^2y}{dx^2} - x(\frac{dy}{dx})^2 + y\frac{dy}{dx} = 0$
(C) $xy\frac{d^2y}{dx^2} + x(\frac{dy}{dx})^2 + y\frac{dy}{dx} = 0$
(D) $xy\frac{d^2y}{dx^2} + x(\frac{dy}{dx})^2 - y\frac{dy}{dx} = 0$

110. Let z be a complex number such that $|z| + z = 2 + i$, where $i = \sqrt{-1}$, then $|z|$ is equal to

(A) $\frac{4}{5}$ (B) $\frac{5}{4}$
(C) $\frac{5}{3}$ (D) $\frac{\sqrt{41}}{4}$

111. If $\overline{a}$ and $\overline{b}$ are two unit vectors such that $5\overline{a} + 4\overline{b}$ and $\overline{a} - 2\overline{b}$ are perpendicular to each other, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{\pi}{3}$ (B) $\cos^{-1}(\frac{2}{3})$
(C) $\frac{2\pi}{3}$ (D) $\cos^{-1}(\frac{1}{3})$

112. The value of $\int \frac{\sec x \cdot \tan x}{9 - 16\tan^2 x} dx$ is equal to

(A) $\frac{1}{24}\log(\frac{5+4\sec x}{5-4\sec x}) + c$, (where c is a constant of integration)
(B) $\frac{1}{40}\log(\frac{5+4\sec x}{5-4\sec x}) + c$, (where c is a constant of integration)
(C) $\frac{1}{24}\log(\frac{5-4\sec x}{5+4\sec x}) + c$, (where c is a constant of integration)
(D) $\frac{1}{40}\log(\frac{5-4\sec x}{5+4\sec x}) + c$, (where c is a constant of integration)

113. If $n(A) = 4, n(B) = 2$. Then the number of subsets of the set A $\times$ B each having at least 3 elements are

(A) 275 (B) 510
(C) 219 (D) 256

114. A radio active substance has half-life of h days, then its initial decay rate is given by Note that at $t = 0, M = m_o$

(A) $\frac{m_o}{h}(\log 2)$ (B) $(m_o h)(\log 2)$
(C) $-\frac{m_o}{h}(\log 2)$ (D) $(-m_o h)(\log 2)$

115. If $(a + \sqrt{2}b\cos x)(a - \sqrt{2}b\cos y) = a^2 - b^2$, where $a > b > 0$, then $\frac{dx}{dy}$ at $\left(\frac{\pi}{4}, \frac{\pi}{4}\right)$ is

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

116. Contrapositive of the statement. 'If two numbers are equal, then their squares are equal' is

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

117. Let A and B be 3×3 real matrices such that A is symmetric matrix and B is skew-symmetric matrix. Then the system of linear equations $\left(A^2B^2 - B^2A^2\right)X = O$. where X is 3×1 column matrix of unknown variables and O is a 3×1 null matrix, has

(A) a unique solution
(B) exactly two solutions
(C) no solution
(D) infinitely many solutions

118. If $f(x) = x^3 - 10x^2 + 200x - 10$, then

(A) $f(x)$ is decreasing in $(-\infty, 10]$ and increasing in $[10, \infty)$
(B) $f(x)$ is increasing in $(-\infty, 10]$ and decreasing in $[10, \infty)$
(C) $f(x)$ is increasing throughout real line
(D) $f(x)$ is decreasing throughout real line

119. The number of common tangents to the circles $x^2 + y^2 - x = 0$ and $x^2 + y^2 + x = 0$ is /are

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

120. Let $\bar{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\bar{b} = \hat{i} + \hat{j}$. If $\bar{c}$ is a vector such that $\bar{a} \cdot \bar{c} = |\bar{c}|, |\bar{c} - \bar{a}| = 2\sqrt{2}$ and the angle between $(\bar{a} \times \bar{b})$ and $\bar{c}$ is 30°, then $|(\bar{a} \times \bar{b}) \times \bar{c}|$ is equal to

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

121. The equation $e^{\sin x} - e^{-\sin x} = 4$ has _____ solutions.

(A) 2 (B) 4
(C) 3 (D) no

122. The value of $\int \frac{dx}{5+4\sin x}$ is equal to

(A) $\frac{2}{5}\tan^{-1}\left(\frac{5\tan\frac{x}{2}+4}{3}\right) + c$, (where c is a constant of integration)
(B) $\frac{2}{3}\tan^{-1}\left(\frac{5\tan\frac{x}{2}+4}{3}\right) + c$, (where c is a constant of integration)
(C) $\frac{2}{5}\log\left(\frac{5\tan\frac{x}{2}+7}{5\tan\frac{x}{2}+1}\right) + c$, (where c is a constant of integration)
(D) $\frac{2}{3}\log\left(\frac{5\tan\frac{x}{2}+7}{5\tan\frac{x}{2}+1}\right) + c$, (where c is a constant of integration)

123. If $p \to (q \vee r)$ is false, then the truth values of p, q, r are respectively

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

124. The area of the region bounded by curves $y = 3x + 1, y = 4x + 1$ and $x = 2$ is

(A) 1 sq. units (B) 2 sq. units
(C) 3 sq. units (D) 4 sq. units

125. The region represented by the inequations $2x + 3y \leqslant 18, x + y \geqslant 10, x \geqslant 0, y \geqslant 0$ is

(A) unbounded
(B) bounded region, but not a singleton set
(C) singleton set
(D) null set

126. Let $f(x) = (x+1)^2 - 1, x \geqslant -1$, then the set $\{x/f(x) = f^{-1}(x)\}$ is

(A) $\{0, 1, -1\}$
(B) $\{0, -1\}$
(C) $\{0, -1, \frac{-3+i\sqrt{3}}{2}, \frac{-3-i\sqrt{3}}{2}$, where $i = \sqrt{-1}\}$
(D) ϱ

127. The probability, that a year selected at random will have 53 Mondays, is

(A) $\frac{1}{4}$ (B) $\frac{3}{28}$

(C) $\frac{5}{28}$ (D) $\frac{3}{4}$

128. Let $L_1 : \frac{x+2}{5} = \frac{y-3}{2} = \frac{z-6}{1}$ and $L_2 : \frac{x-3}{4} = \frac{y+2}{3} = \frac{z-3}{5}$ be the given lines. Then the unit vector perpendicular to both L_1 and L_2 is

(A) $\frac{-\hat{i}-3\hat{j}+\hat{k}}{\sqrt{11}}$ (B) $\frac{\hat{i}-3\hat{j}+\hat{k}}{\sqrt{11}}$

(C) $\frac{\hat{i}+3\hat{j}-\hat{k}}{\sqrt{11}}$ (D) $\frac{\hat{i}+3\hat{j}+\hat{k}}{\sqrt{11}}$

129. A multiple choice examination has 5 questions. Each question has three alternative answers of which exactly one is correct. The probability that a student will get 4 or more correct answers just by guessing is

(A) $\frac{17}{243}$ (B) $\frac{13}{243}$

(C) $\frac{11}{243}$ (D) $\frac{10}{243}$

130. The perpendicular distance from the origin to the plane containing the two lines $\frac{x+2}{3} = \frac{y-2}{5} = \frac{z+5}{7}$ and $\frac{x-1}{1} = \frac{y-4}{4} = \frac{z+4}{7}$, is

(A) $\frac{11}{\sqrt{6}}$ units (B) $11\sqrt{6}$ units

(C) 11 units (D) $6\sqrt{11}$ units

131. The number of integral values of k for which the equation $7\cos x + 5\sin x = 2k+1$ has a solution, is

(A) 4 (B) 8

(C) 10 (D) 12

132. The value of integral $\int_{-2}^{0} \left(x^3+3x^2+3x+5+(x+1)\cos(x+1)\right) dx$ is equal to

(A) 0 (B) 6

(C) 4 (D) 1

133. If $x = 2\cos\theta - \cos 2\theta$ and $y = 2\sin\theta - \sin 2\theta$, then $\frac{d^2y}{dx^2}$ is equal to

(A) $\frac{3}{2}\tan\frac{3\theta}{2}$ (B) $\frac{3}{2}\sec\frac{3\theta}{2}\tan\frac{3\theta}{2}$

(C) $\frac{3}{2}\sec^2\frac{3\theta}{2}$ (D) $\sec^2\frac{3\theta}{2}$

134. $2\pi - \left(\sin^{-1}\frac{4}{5} + \sin^{-1}\frac{5}{13} + \sin^{-1}\frac{16}{65}\right)$ is equal to

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

(C) $\frac{7\pi}{4}$ (D) $\frac{3\pi}{2}$

135. If two sides of a square are $4x+3y-20=0$ and $4x+3y+15=0$, then the area of the square is

(A) 36 sq. units (B) 16 sq. units

(C) 4 sq. units (D) 49 sq. units

136. Twenty meters of wire is available for fencing off a flower-bed in the form of a circular sector. Then the maximum area (in sq.m) of the flowerbed is

(A) 30 (B) 12.5

(C) 25 (D) 10

137. Let a, b, c be three non-zero real numbers such that the equation $\sqrt{3}a\cos x + 2b\sin x = c$, $x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ has two distinct real roots α and β with $\alpha+\beta = \frac{\pi}{3}$. Then the value of $\frac{b}{a}$ is

(A) 0.1 (B) 0.5

(C) -0.5 (D) 1

138. Let $P(2,1,5)$ 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 $3x-y+4z=1$ is

(A) $\frac{-16}{13}$ (B) $\frac{16}{13}$

(C) $-\frac{13}{16}$ (D) $\frac{13}{10}$

139.

$$\lim_{x\to\frac{\pi}{2}} \frac{\left(1-\tan\left(\frac{x}{2}\right)\right)(1-\sin x)}{\left(1+\tan\left(\frac{x}{2}\right)\right)(\pi-2x)^3}$$

is

(A) 0 (B) $\frac{1}{32}$

(C) $\frac{1}{8}$ (D) $\frac{1}{16}$

140. A ladder 5 m in length is leaning against a wall. The bottom of the ladder is pulled along the ground away from the wall, at the rate of 2 m/sec . How fast is the height on the wall decreasing when the foot of the ladder is 4 m away from the wall?

(A) $\frac{4}{3}$ m/sec (B) $\frac{2}{3}$ m/sec

(C) $\frac{5}{3}$ m/sec (D) $\frac{8}{3}$ m/sec

141. If the equation $\cos^4\theta + \sin^4\theta + \lambda = 0$ has real solutions for θ, then λ lies in the interval

(A) $(-\frac{5}{4}, -1)$ (B) $[-\frac{3}{2}, -\frac{5}{4}]$

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

142. The equation of the tangent to the parabola $y^2 = 8x$, which is parallel to the line $4x - y + 3 = 0$ is

(A) $2x - 8y + 1 = 0$ (B) $8x - 2y + 1 = 0$

(C) $8x + 2y + 1 = 0$ (D) $2x - 8y - 1 = 0$

143. The centroid of tetrahedron with vertices $P(5, -7, 0), Q(a, 5, 3), R(4, -6, b)$ and $S(6, c, 2)$ is $(4, -3, 2)$, then the value of $2a + 3b + c$ is equal to

(A) 15 (B) -7

(C) 7 (D) -5

144. The approximate value of $3^{2.001}$, if $\log 3 = 1.0986$ is

(A) 9.00898 (B) 9.0989

(C) 9.0898 (D) 9.00989

145. If the vectors $\overline{a} = \hat{i} - \hat{j} + 2\hat{k}, \overline{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\overline{c} = pi + \hat{j} + q\hat{k}$ are mutually orthogonal, then (p, q) is equal to

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

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

146. If $\bar{u}, \bar{v}$ and $\bar{w}$ are three non-coplanar vectors, then $(\bar{u} + \bar{v} - \bar{w}) \cdot [(\bar{u} - \bar{v}) \times (\bar{v} - \bar{w})]$ is equal to

(A) $\bar{u} \cdot (\bar{v} \times \bar{w})$ (B) $\bar{u} \cdot (\bar{w} \times \bar{v})$

(C) $3\overline{u} \cdot (\overline{v} \times \overline{w})$ (D) 0

147. The value of k, if the slope of one of the lines given by $4x^2 + kxy + y^2 = 0$ is four times that of the other, is given by

(A) 4 (B) 2.5

(C) 5 (D) 1

148. The differential equation of $y = e^x (a + bx + x^2)$ is

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

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

(C) $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} - 2e^x + y = 0$

(D) $\frac{d^2y}{dx} + 2\frac{dy}{dx} - e^x + 2y = 0$

149. The mean of the numbers $a, b, 8, 5, 10$ is 6 and the variance is 6.8 . Then which of the following gives possible values of a and b ?

(A) $a = 3,\ b = 4$ (B) $a = 0,\ b = 7$

(C) $a = 5, b = 2$ (D) $a = 1,\ b = 6$

150. Let $\overline{u} = \hat{i} + \hat{j}, \overline{v} = \hat{i} - \hat{j}$ and $\overline{w} = \hat{i} + 2\hat{j} + 3\hat{k}$. If $\hat{n}$ is a unit vector such that $\overline{u} \cdot \hat{n} = 0$ and $\overline{v} \cdot \hat{n} = 0$, then $|\overline{w} \cdot \hat{n}|$ is equal to

(A) 0 (B) 1

(C) 2 (D) 3

- End of Question Paper -