MHT CET 2024 PCM May 16 Shift 2 Question Paper

Conducted by the State Common Entrance Test Cell, Maharashtra

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

General Instructions

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

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

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

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

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

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

1. A circular coil of resistance ' R ', area ' A ', number of turns ' N ' is rotated about its vertical diameter with angular speed ' ω ' in a uniform magnetic field of magnitude ' B '. The average power dissipated in a complete cycle is

(A) $\frac{N^2 A^2 B^2 \omega^2}{2R}$ (B) $\frac{BNA\omega}{R}$

(C) $\frac{BNA\omega}{2R}$ (D) $\frac{N^2 A^2 B^2 \omega^2}{R}$

2. The linear speed of a particle at the equator of the earth due to its spin motion is ' V '. The linear speed of the particle at latitude 30° is

$$\begin{bmatrix} \sin 30^\circ = \cos 60^\circ = 1/2 \\ \cos 30^\circ = \sin 60^\circ = \sqrt{3}/2 \end{bmatrix}$$

(A) $\frac{V}{\sqrt{2}}$ (B) $\frac{V}{2}$

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

3. Three point masses, each of mass ' m ' are placed at the corners of an equilateral triangle of side ' L '. The moment of inertia of the system about an axis passing through one of the vertices and parallel to the side joining other two vertices will be

(A) $\frac{3\,mL^2}{4}$ (B) $\frac{mL^2}{4}$

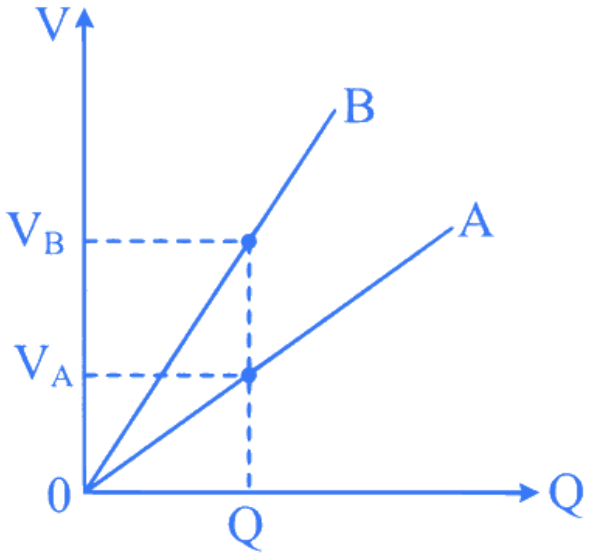
(C) $\frac{3\,mL^2}{2}$ (D) $\frac{mL^2}{2}$

4. In the second orbit of hydrogen atom, the energy of an electron is ' E '. In the third orbit of helium atom, the energy of the electron will be (atomic number of helium = 2)

(A) $\frac{4E}{9}$ (B) $\frac{4E}{3}$

(C) $\frac{16E}{9}$ (D) $\frac{16E}{3}$

5. The graph shows the variation of voltage ' V ' across the plates of two capacitors A and B versus increase in charge ' Q ' stored in them. Then



(A) capacitance A has high capacity.

(B) capacitance B has high capacity.

(C) both have same capacity.

(D) capacity of $A = 2$ times capacity of B.

6. The bob of a pendulum of length ' l ' is pulled aside from its equilibrium position through an angle ' θ ' and then released. The bob will then pass through its equilibrium position with speed ' v ', where ' v ' equal to (g = acceleration due to gravity)

(A) $\sqrt{2gl(1-\cos\theta)}$ (B) $\sqrt{2\,gl(1+\sin\theta)}$

(C) $\sqrt{2gl(1-\sin\theta)}$ (D) $\sqrt{2\,gl(1+\cos\theta)}$

7. On the surface of the liquid in equilibrium, molecules of the liquid possess

(A) maximum potential energy.

(B) minimum potential energy.

(C) maximum kinetic energy.

(D) minimum kinetic energy.

8. An optician makes spectacles having a combination of a convex lens of focal length 40 cm in contact with a concave lens of focal length 25 cm . The power of this combination of lenses in dioptre is

(A) -6.67 (B) -1.5

(C) $+6.67$ (D) $+1.5$

9. A ray of light travelling through a rarer medium is incident at very small angle ' i ' on a glass slab and after refraction its velocity is reduced by 25%. The angle of deviation is

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

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

10. Kinetic energy of a proton is equal to energy E of a photon. Let ' λ_1 ' be the de-Broglie wavelength of proton and ' λ_2 ' be the wavelength of photon. If $\left(\frac{\lambda_1}{\lambda_2}\right) \propto E^n$ then the value of ' n ' is

(A) 1 (B) 2

(C) 5 (D) 0.5

11. An inductance of 2 mH , a condenser of 20μ F and a resistance of 50Ω are connected in series to an a.c. source. The reactance of inductor and condenser are same. The reactance of either of them will be

(A) 100Ω (B) 50Ω

(C) 40Ω (D) 10Ω

12. Two sound waves having frequencies 250 Hz and 256 Hz superimpose to produce beat wave. The resultant beat wave has intensity maximum at t = 0. After how much time an intensity will be minimum produced at the same point?

(A) $\frac{1}{6}$ s (B) $\frac{1}{24}$ s

(C) $\frac{1}{18}$ s (D) $\frac{1}{12}$ s

13. A body travelling with uniform acceleration crosses two points A and B with velocities 20 m/s and 30 m/s respectively. The speed of the body at mid point of A and B is (nearly)

(A) 25 m/s (B) 25.5 m/s

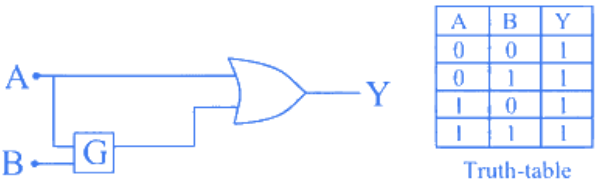
(C) 24 m/s (D) $10\sqrt{6}$ m/s

14. During an experiment, an ideal gas is found to obey an additional law VP^2 = constant. The gas is initially at temperature ' T ' and volume ' V '. What will be the temperature of the gas when it expands to a volume 2 V ?

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

(C) $\sqrt{2}$ T (D) $\sqrt{3}$ T

15. To get the truth table shown from the following logic circuit, the logic gate G should be



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

Truth-table

(A) AND (B) OR

(C) NAND (D) NOR

16. In an LCR circuit, if ' V ' is the effective value of the applied voltage, V_R is the voltage across ' R ', ' V_L ' and ' V_C ' is the effective voltage across ' L ' and ' C ' respectively then

(A) $V = V_R + V_L + V_C$

(B) $V^2 = V_R^2 + V_L^2 + V_C^2$

(C) $V^2 = V_R^2 + (V_L - V_c)^2$

(D) $V^2 = V_L^2 + (V_R - V_C)^2$

17. Two objects of masses ' m_1 ' and ' m_2 ' are moving in the circles of radii ' r_1 ' and ' r_2 ' respectively. Their respective angular speeds ' ω_1 ' and ' ω_2 ' are such that they both complete one revolution in the same time ' t '. The ratio of linear speed of ' m_2 ' to that of ' m_1 ' is

(A) $\omega_1 : \omega_2$ (B) $T_2 : T_1$

(C) $m_1 : m_2$ (D) $r_2 : r_1$

18. A hollow cylinder has charge ' q ' C within it. If ' ϕ ' is the electric flux associated with the curved surface B, the flux linked with the plane surface A will be :



(A) $\frac{1}{2}(\frac{q}{\epsilon_0} - \varrho)$ (B) $\frac{q}{2\epsilon_0}$

(C) $\frac{\varrho}{3}$ (D) $\frac{q}{\epsilon_0} - \varrho$

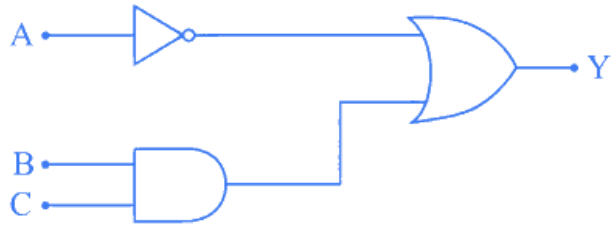
19. A water drop is divided into 8 equal droplets. The pressure difference between the inner and outer side of the big drop will be

(A) same as the smaller droplet.
(B) half of that for smaller droplet
(C) $(\frac{1}{4})^{\text{th}}$ of that for smaller droplet.
(D) twice that for smaller droplet

20. An arc of a circle of radius ' R ' subtends an angle $\frac{\pi}{2}$ at the centre. It carries a current I. The magnetic field at the centre will be (μ_0 = permeability of free space)

(A) $\frac{\mu_0 I}{2R}$
(B) $\frac{\mu_0 I}{8R}$
(C) $\frac{\mu_0 I}{4R}$
(D) $\frac{2\mu_0 I}{5R}$

21. The Boolean expression for the given combination of logic gates is



(A) $Y = (\bar{A} \cdot B) + C$
(B) $Y = (\bar{A} + B) \cdot C$
(C) $Y = \bar{A} + (B \cdot C)$
(D) $Y = \bar{A} \cdot (B + C)$

22. A body performing uniform circular motion of radius ' R ' has frequency ' n '. Its centripetal acceleration per unit radius is proportional to $(n)^x$. The value of x is

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

23. A solenoid having 400 turns per metre has a core of a material with relative permeability 400. When a current of 0.5 A is passed through it, the magnetization of the core material in Am^{-1} is nearly

(A) 6×10^5
(B) 6×10^4
(C) 8×10^5
(D) 8×10^4

24. Three identical metal balls each of radius ' r ' are placed such that an equilateral triangle is formed when centres of three ball are joined. The centre of mass of the system is located at

(A) centre of one of the balls.
(B) point of intersection of medians.
(C) line joining centres of any two balls.
(D) on the circumference of any one of the balls.

25. Two identical galvanometers are converted into an ammeter and into milliammeter. For the same current, the value of shunt of the ammeter as compared to that of milliammeter is

(A) less
(B) equal
(C) more
(D) zero

26. A boy weighs 72 N on the surface of earth. The gravitational force on a body due to earth at a height equal to half the radius of earth will be

(A) 32 N
(B) 48 N
(C) 96 N
(D) 162 N

27. In a single slit diffraction experiment, for a wavelength of light ' λ ', half-angular width of the principle maxima is ' θ '. Also for wavelength of light pλ, the half angular width of the principle maxima is $q\theta$. The ratio of the halfangular widths of the first secondary maxima in the first case to second case will be

(A) p : 1
(B) q : 1
(C) p : q
(D) q : p

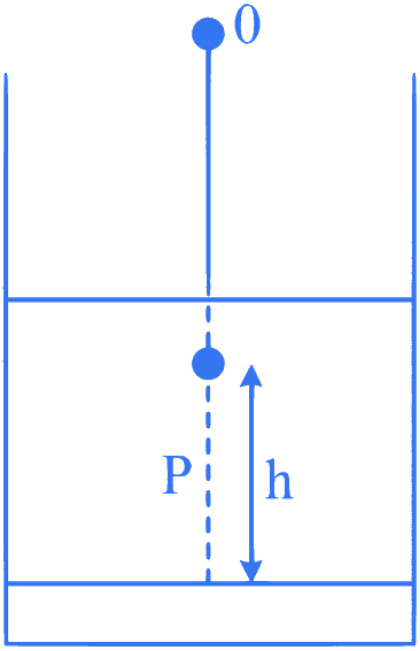
28. The first operation involved in a Carnot cycle is

(A) isothermal expansion.
(B) adiabatic expansion.
(C) isothermal compression.
(D) adiabatic compression.

29. Temperature remaining constant, the pressure of gas is decreased by 20%. The percentage change in volume

(A) increases by 29%
(B) decreases by 20%
(C) increases by 25%
(D) decreases by 25%

30. A plane mirror is placed at the bottom of a tank containing a liquid of refractive index ' μ ', ' p ' is a small object at a height ' h ' above the mirror. An observer ' O ' vertically above ' p ' outside the liquid sees ' p ' and the image in a mirror. The apparent distance between these two will be



(A) 2μ h
(B) $\frac{2h}{\mu}$
(C) $\frac{2\,\mathrm{h}}{(\mu-1)}$
(D) $h(1+\frac{1}{\mu})$

31. A light bulb connected in series with a capacitor and an a.c. source is glowing with a certain brightness. On reducing the capacity of capacitance and frequency of source, the brightness of the lamp (respectively)

(A) is reduced, is increased
(B) is reduced, is reduced
(C) is increased, is reduced
(D) is increased, is increased

32. A pipe 60 cm long and open at both the ends produces harmonics. Which harmonic mode of pipe resonates a 2.2 KHz source? (Speed of sound in air $= 330$ m/s)(Neglect end correction)

(A) First
(B) Eighth
(C) Third
(D) Second

33. A point source of light is used in a photoelectric effect. If the source is removed farther from the emitting metal, then the stopping potential will

(A) increase.
(B) decrease.
(C) remain constant.
(D) either increase or decrease.

34. The kinetic energy of a particle, executing simple harmonic motion is 16 J when it is in mean position. If amplitude of motion is 25 cm and the mass of the particle is 5.12 kg , the period of oscillation is

(A) $\frac{\pi}{5}$ s
(B) 2π s
(C) 20π s
(D) 5π s

35. At certain temperature, rod A and rod B of different materials have lengths $\mathrm{L_A}$ and L_B respectively. Their co-efficients of linear expansion are α_A and α_B respectively. It is observed that the difference between their lengths remain constant at all temperatures. The ratio L_A/L_B is given by

(A) $\frac{\alpha_A}{\alpha_B}$
(B) $\frac{\alpha_B}{\alpha_A}$
(C) $\frac{\alpha_A+\alpha_B}{\alpha_A}$
(D) $\frac{\alpha_A+\alpha_B}{\alpha_B}$

36. A liquid drop having surface energy ' E ' is spread into 512 droplets of same size. The final surface energy of the droplets is

(A) 2 E
(B) 4 E
(C) 8 E
(D) 12 E

37. Two radioactive substances A and B have decay constants ' 5λ ' and ' λ ' respectively. At $\mathrm{t} = 0$, they have the same number of nuclei. The ratio of number of nuclei of A to those of B will be $\left(\frac{1}{\mathrm{e}}\right)^2$ after a time interval

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

38. A monoatomic ideal gas is heated at constant pressure. The percentage of total heat used in changing the internal energy is

(A) 30%
(B) 40%
(C) 50%
(D) 60%

39. A source and listener are both moving towards each other with speed $\frac{V}{10}$. (where V is speed of sound) If the frequency of sound note emitted by the source is ' n ', then the frequency heard by the listener would be nearly

(A) 1.1 n (B) 1.22 n
(C) n (D) 1.27 n

40. The ratio of the specific heats $\frac{C_p}{C_v} = \gamma$, in terms of degrees of freedom (n) is

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

41. In a double slit experiment, the distance between slits is increased 10 times, whereas their distance from screen is halved, the fringe width

(A) remain the same. (B) becomes $\frac{1}{10}$ times.
(C) becomes $\frac{1}{20}$ times. (D) becomes $\frac{1}{90}$ times.

42. If a transformer of an audio amplifier has output impedance 8000Ω and the speaker has input impedance 8Ω, the primary and secondary turns of this transformer connected between the output of amplifier and to loudspeaker should have the ratio

(A) 1000 : 1 (B) 100 : 1
(C) 1 : 32 (D) 32 : 1

43. A particle performs linear S.H.M. At a particular instant, velocity of the particle is ' u ' and acceleration is ' α ' while at another instant, velocity is ' v ' and acceleration is ' β ' $(0 < \alpha < \beta)$. The distance between the two positions is

(A) $\frac{u^2-v^2}{\alpha+\beta}$ (B) $\frac{u^2+v^2}{\alpha+\beta}$
(C) $\frac{u^2-v^2}{\alpha-\beta}$ (D) $\frac{u^2+v^2}{\alpha-\beta}$

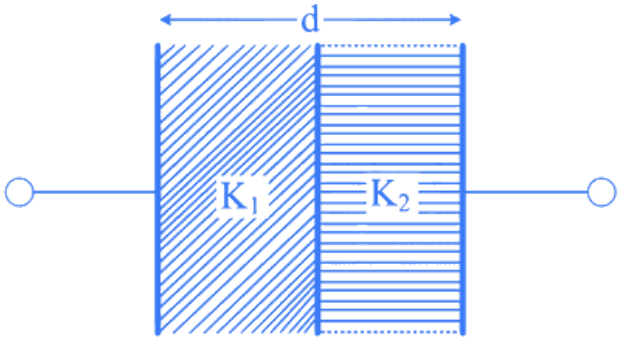
44. Two uniform strings A and B made of steel are made to vibrate under the same tension. If first overtone of A is equal to the second overtone of B and if the radius of A is twice that of B, the ratio of the length of string B to that of A is

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

45. ' n ' small drops of same size are charged to ' V ' volt each. If they coalesce to form a single large drop, then its potential will be

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

46. Air capacitor has capacitance ' C_1 '. The space between two plates of capacitor is filled with two dielectrics as shown in figure. The new capacitance of the capacitor is ' C_2 '. The ratio $\frac{C_1}{C_2}$ is ($d =$ distance between two plates of capacitor, K_1 and K_2 are dielectric constants of two dielectrics respectively)



(A) $K_1 + K_2$ (B) $\frac{K_1+K_2}{K_1-K_2}$
(C) $\frac{2K_1K_2}{K_1+K_2}$ (D) $\frac{K_1+K_2}{2K_1K_2}$

47. A coil is wound on a core of rectangular crosssection. If all the linear dimensions of the core are increased by a factor 2 and number of turns per unit length of coil remains same, the self inductance increases by a factor of (Assume, permeability is same)

(A) 16 (B) 8
(C) 4 (D) 2

48. When a small amount of impurity atoms are added to semiconductor, then generally its resistivity

(A) may increase or decrease depending upon the percentage of doping. (B) increases.
(C) decreases. (D) does not change.

49. A current 'I' flows in anticlockwise direction in a circular arc of a wire having $\left(\frac{3}{4}\right)^{\text{th}}$ of circumference of a circle of radius R. The magnetic field ' B ' at the centre of circle is ($\mu_0 =$ permeability of free space)

(A) $\frac{\mu_0 I}{3R}$ in upward direction (B) $\frac{\mu_0 I}{2R}$ in downward direction
(C) $\frac{3\mu_0 I}{8R}$ in downward direction (D) $\frac{3\mu_0 I}{8R}$ in upward direction

50. When a resistance of 200Ω is connected in series with a galvanometer of resistance ' G ', its range is ' V '. To triple its range, a resistance of 2000Ω is connected in series. The value of ' G ' is

(A) 200Ω (B) 400Ω

(C) 600Ω (D) 700Ω

51. What is the number of moles of donor atoms present in one mole oxalate ion?

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

52. Which from following substances acts as a base when reacted with water?

(A) CH_3COOH (B) $H_2C_2O_4$
(C) HCl (D) NH_3

53. Which from following polymers is classified as fibres?

(A) Polyesters (B) Vulcanized rubber
(C) Polythene (D) Polyvinyls

54. What type of solution is the iodine in air?

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

55. Identify ' Y ' in the following reaction.

$$CH_3Br \xrightarrow{KcN} X \xrightarrow{Na_2/C_2H_5OH} Y$$

(A) $CH_3 - CH_2 - NH_2$ (B) $CH_3 - O - Na$
(C) $CH_3 - O - C_2H_5$ (D) CH_3CN

56. What is de Broglie's wavelength for a particle having mass 6.64×10^{-27} kg moving with velocity of $3 \times 10^3\ ms^{-1}$? $\left[h = 6.63 \times 10^{-34} Js\right]$

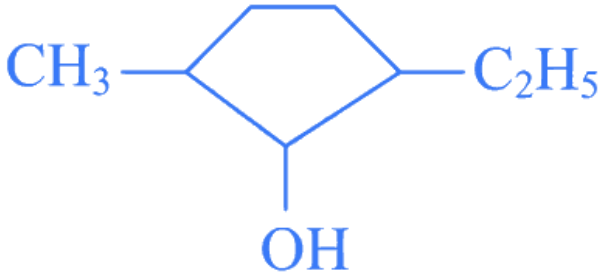
(A) 0.111 nm (B) 0.0333 nm
(C) 1.22 nm (D) 2.42 nm

57. Identify the product formed in the following reaction.

$$C_6H_5 - CH_2 - CH_3 \xrightarrow[(ii)\ H_3O^+]{(i)\ alk.KMnO_4} \text{product}$$

(A) $C_6H_5 - CH_2COOH$
(B) $C_6H_5 - CH_2 - CH_2 - CH_2 - COOH$
(C) $C_6H_5 - OH$
(D) $C_6H_5 - COOH$

58. What is the IUPAC name of the following compound?



(A) 2-Ethyl-3-methylcyclopentanol
(B) 2-Ethyl-5-methylcyclopentanol
(C) 2-Methyl-3-ethylcyclopentanol
(D) 1-Methyl-3-ethylcyclopentan-2-ol

59. Calculate the pH of 0.02 M monobasic acid having 2% dissociation.

(A) 3.4 (B) 4.5
(C) 5.1 (D) 5.8

60. Which of the following molecule can form hydrogen bonding with itself?

(A) NH_3 (B) C_2H_6
(C) H_2S (D) $CH_3 - O - CH_3$

61. Calculate the cell constant of conductivity cell containing 0.1 M KCl solution having resistance 60Ω and conductivity $0.014\Omega^{-1}\,cm^{-1}$ at $25^\circ C$.

(A) $0.42\ cm^{-1}$ (B) $0.84\ cm^{-1}$
(C) $0.60\ cm^{-1}$ (D) $1.04\ cm^{-1}$

62. Calculate standard internal energy change for $OF_{2(g)} + H_2O_{(g)} \longrightarrow 2HF_{(g)} + O_{2(g)}$ at 300 K, if $\Delta_f H^\circ$ of $OF_{2(g)}, H_2O_{(g)}$ and $HF_{(g)}$ are 20, -250 and $-270\ kJ\ mol^{-1}$ respectively. $\left[R = 8.314\ J\ K^{-1}\ mol^{-1}\right]$

(A) -307.50 kJ (B) -342.48 kJ
(C) -412.00 kJ (D) -214.48 kJ

63. Which of the following compounds is obtained by using Finkelstein reaction?

(A) Alkyl fluorides (B) Alkyl chlorides
(C) Alkyl bromides (D) Alkyl iodides

64. In a first order reaction 60% of the reactant converts into product in 45 minute. Calculate rate constant of the reaction.

(A) 0.0102 minute $^{-1}$ (B) 0.0204 minute^{-1}

(C) 0.0306 minute $^{-1}$ (D) 0.0408 minute $^{-1}$

65. Identify a compound having properties of tear gas.

(A) $SOCl_2$

(B) $COCl_2$

(C) $Cl(CH_2)_2\ S(CH_2)_2Cl$

(D) CCl_3NO_2

66. Which of the following series of emission spectral lines for hydrogen observed in visible region?

(A) Paschen (B) Lyman

(C) Pfund (D) Balmer

67. What is the number of faraday required to produce 0.18 g aluminium at cathode during electrolysis of molten $AlCl_3$? (Molar mass of $Al = 27\ g\ mol^{-1}$)

(A) 0.02 F (B) 0.03 F

(C) 0.25 F (D) 0.30 F

68. Which pair of metal ions from following have same number of unpaired electrons?

(A) Co^{2+} and Mn^{3+} (B) Mn^{2+} and Zn^{2+}

(C) Fe^{3+} and Mn^{2+} (D) Sc^{3+} and Co^{2+}

69. Which from following compounds contains oxygen as a heteroatom?

(A) Furan (B) Pyridine

(C) Thiophene (D) Piperidine

70. What type of glycosidic linkages are developed when excess glucose is to be stored for future use in animals?

(A) $\beta-1,4$ and $\alpha-1,4$ (B) $\alpha-1,6$ and $\beta-1,4$

(C) $\beta-1,6$ and $\beta-1,4$ (D) $\alpha-1,4$ and $\alpha-1,6$

71. Calculate the relative lowering of vapour pressure if vapour pressure of pure solvent and vapour pressure of solution at 25°C are 32 and 30 mm Hg respectively.

(A) 0.0721 (B) 0.0552

(C) 0.0625 (D) 0.9375

72. Which from following ligands is neutral?

(A) Ammine (B) Chloro

(C) Sulphato (D) Nitrito

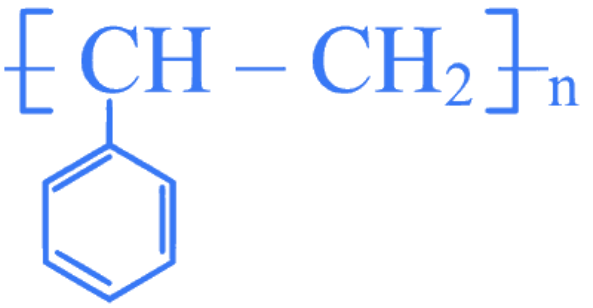
73. Identify chiral molecule from following:

(A) 2-Bromopropane (B) 2-Bromo-2-methylbutane

(C) 2-Bromo-3-methylbutane (D) 3-Bromopentane

74. Which from following polymers is a urea-formaldehyde resin?

(A) 

(B) 

(C) 

(D) 

75. Which reagent is used in the conversion of phenol to picric acid?

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

(C) Sulphuric acid (conc.) (D) Nitric acid (conc.) + Sulphuric acid (conc.)

76. Identify the reactivity order for halogens towards alkanes.

(A) $I_2 > Br_2 > Cl_2 > F_2$

(B) $Br_2 > Cl_2 > F_2 > I_2$

(C) $F_2 > Cl_2 > Br_2 > I_2$

(D) $Cl_2 > F_2 > Br_2 > I_2$

77. What is the total number of tetrahedral voids in 0.6 mole of compound that forms hcp structure?

(A) 3.6132×10^{23} (B) 7.2264×10^{23}

(C) 4.8396×10^{23} (D) 5.0331×10^{23}

78. Identify name of reaction when aldehyde or ketone react with $Zn - Hg/$ conc. HCl to give alkane.

(A) Stephen reduction (B) Clemmensen reduction

(C) Wolf Kishner reduction (D) Rosenmund reduction

79. What products are obtained when beryllium oxide is treated separately with aq. HCl and aq. NaOH solutions respectively?

(A) $BeCl_2$ and $Be(OH)_2$ (B) $BeCl_2$ and Na_2BeO_4

(C) $Be(OH)_2$ and $BeCl_2$ (D) $BeCl_2$ and Na_2BeO_2

80. Calculate internal energy change of a system if work done by the system is 8 J and heat supplied to it is 40 J .

(A) -48 J (B) -40 J

(C) 32 J (D) 24 J

81. Identify basic oxide from following.

(A) SO_3 (B) NO

(C) Al_2O_3 (D) CaO

82. Calculate the solubility product of sparingly soluble salt BA at 27°C if its solubility is 1.8×10^{-5} moldm^{-3} at same temperature.

(A) 3.24×10^{-10} (B) 2.44×10^{-10}

(C) 1.64×10^{-10} (D) 4.00×10^{-10}

83. Which of the following conversions is Hofmann Elimination reaction?

(A) $RCONH_2 \xrightarrow{Br_2, KOH_{(aq)}} R - NH_2$

(B) $R - NH_2 \xrightarrow[\text{excess}]{R-X} R_4NX$

(C) $R_4NX \xrightarrow[\Delta]{\text{moist } Ag_2O}$ Alkene $+ R_3N$

(D) $RCN \xrightarrow{Na/C_2H_5OH} RCH_2NH_2$

84. For the reaction,
$CH_3Br_{(aq)} + OH^-_{(aq)} \longrightarrow CH_3OH_{(aq)} + Br^-_{(aq)}$
rate of consumption of $OH^-_{(aq)}$ is xmoldm^{-3} s^{-1}
What is the rate of formation of $Br^-_{(9q)}$?

(A) 0.5x mol dm^{-3} s^{-1} (B) x mol dm^{-3} s^{-1}

(C) $2x$ mol dm^{-3} s^{-1} (D) $\frac{3}{2}x$ mol dm^{-3} s^{-1}

85. Identify the product X in the following reaction.
Ethanoyl chloride $\xrightarrow{H_2O}$ X

(A) Ethanol (B) Ethanoic acid

(C) Ethanal (D) Ethylethanoate

86. Which of the following is allylic alcohol?

(A) But-1-en-1-ol (B) But-3-en-1-ol

(C) But-2-en-1-ol (D) Butane-1,3-diol

87. Identify positively charged sol from the following.

(A) Haemoglobin (B) Gum

(C) Gelatin (D) Cadmium sulfide

88. Calculate the number of unit cells in 0.4 g metal if the product of density and volume of unit cell is 1.2×10^{-22} g.

(A) 1.1×10^{21} (B) 2.2×10^{21}

(C) 3.3×10^{21} (D) 4.4×10^{21}

89. What is the major product obtained when tert-butyl bromide is heated with silver fluoride?

(A) 1-Fluoro-2-methylpropane (B) 2-Fluoro-2-methylpropane

(C) 1-Flurobutane (D) 2-Flurobutane

90. Which from following equations represents a correct relationship between standard cell potential and equilibrium constant for cell reaction?

(A) $E^\circ_{cell} = -\frac{2.303RT}{nF}$ (B) $E^\circ_{cell} = \frac{0.0592}{nF}\log_{10}K$

(C) $E^\circ_{cell} = \frac{0.0592}{n}\log_{10}K$ (D) $E^\circ_{cell} = \frac{0.0592}{n}\ln K$

91. What is the total number of particles present in base centred unit cell?

(A) 1 (B) 2

(C) 4 (D) 6

92. Which of the following equation relates temperature of a reaction with ΔH° and ΔS° at equilibrium?

(A) $\Delta H^\circ = \frac{T}{\Delta S^\circ}$ (B) $\Delta H^\circ = \frac{\Delta S^\circ}{T}$

(C) $\Delta H^\circ = T\Delta S^\circ$ (D) $\Delta H^\circ = \frac{1}{T\Delta S^\circ}$

93. Calculate the molality of solution if its depression in freezing point is 0.18 K . $\left[K_f = 1.6 \text{ K kg mol}^{-1}\right]$

(A) 0.195 m (B) 0.174 m

(C) 0.156 m (D) 0.113 m

94. For the reaction,

$H_{2(g)} + Br_{2(8)} \longrightarrow 2HBr_{(g)}, r = k\left[H_2\right]\left[Br_2\right]^{\frac{1}{2}}$

What is the molecularity and order of reaction respectively?

(A) Monomolecular and $\frac{1}{2}$ (B) Monomolecular and 1

(C) Monomolecular and $\frac{3}{2}$ (D) Bimolecular and $\frac{3}{2}$

95. Identify an actinoid element from following.

(A) No (B) Mo

(C) Co (D) Ce

96. What is the oxidation number of Mn in MnO_4^-?

(A) -5 (B) 5

(C) 6 (D) 7

97. What is the number of electrons present in antibonding orbitals of N_2 molecule according to molecular orbital theory?

(A) 14 (B) 10

(C) 04 (D) 06

98. Which from following is a largest size nanomaterial?

(A) Water (molecular level) (B) Glucose (molecular level)

(C) Virus (D) Bacteria

99. Which from following nitrogen bases of nucleic acids is derived from purine?

(A) Cytosine (B) Guanine

(C) Uracil (D) Thymine

100. Calculate mass in kg of 2.5 mole ammonia.

(A) 5.10×10^{-2} kg (B) 4.25×10^{-2} kg

(C) 1.72×10^{-2} kg (D) 3.44×10^{-2} kg

101. If $g(x) = [f(2f(x) + 2)]^2$ and $f(0) = -1, f'(0) = 1$ then $g'(0)$ is

(A) -4 (B) 4

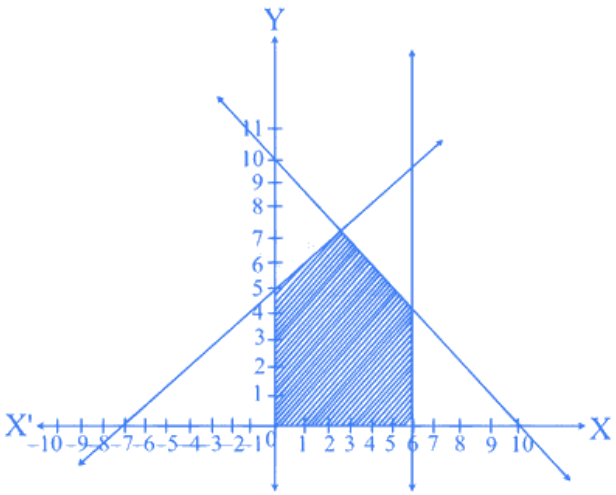
(C) -3 (D) 3

102. If $\tan^{-1}\left(\frac{1}{4}\right) + \tan^{-1}\left(\frac{2}{9}\right) = \frac{1}{2}\cos^{-1} x$, then x is

(A) $\frac{1}{5}$ (B) $\frac{2}{5}$

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

103. The shaded area in the given figure is a solution set for some system of inequalities. The maximum value of the function $z = 4x + 3y$ subject to linear constraints given by the system is



(A) 38 (B) 36

(C) 33 (D) 34

104. If $z_1 = 5 - 2i$ and $z_2 = 3 + i$, where $i = \sqrt{-1}$, then $\arg\left(\frac{z_1+z_2}{z_1-z_2}\right)$ is

(A) $\tan^{-1}(\frac{22}{19})$ (B) $\tan^{-1}(\frac{22}{13})$

(C) $\tan^{-1}(\frac{21}{19})$ (D) $\tan^{-1}(\frac{19}{22})$

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

(A) $(\frac{48}{19}, \frac{23}{19}, \frac{-13}{19})$ (B) $(\frac{-48}{19}, \frac{23}{19}, \frac{-13}{19})$

(C) $(\frac{-48}{19}, \frac{-23}{19}, \frac{-13}{19})$ (D) $(\frac{48}{19}, \frac{-23}{19}, \frac{-13}{19})$

106. The slope of tangent at (x, y) to a curve passing through $\left(1, \frac{\pi}{4}\right)$ is $\frac{y}{x} - \cos^2\frac{y}{x}$, then the equation of curve is

(A) $y = \tan^{-1}(\log(\frac{e}{x}))$

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

(C) $y = x(\tan^{-1}(\log\frac{e}{x}))$

(D) $y = \frac{1}{x}(\tan^{-1}(\log\frac{e}{x}))$

107. If $\cos^{-1}\left(\frac{12}{13}\right) + \sin^{-1}\left(\frac{3}{5}\right) = \sin^{-1} P$, then the value of P is

(A) $\frac{63}{65}$ (B) $\frac{56}{65}$

(C) $\frac{48}{65}$ (D) $\frac{36}{65}$

108. The rate of change of the volume of a sphere with respect to its surface area, when its radius is 2 cm , is _____ cm^3/cm^2.

(A) 0.1 (B) 0.5

(C) 1 (D) 2

109. In a triangle ABC, $l(AB) = \sqrt{23}$ units, $l(BC) = 3$ units, $l(CA) = 4$ units, then $\frac{\cot A + \cot C}{\cot B}$ is

(A) 1 (B) 2

(C) 4 (D) 8

110. Truth values of p $\rightarrow$ r is F and p $\leftrightarrow$ q is F . Then the truth values of $(\sim p \vee q) \rightarrow (p \vee \sim q)$ and $(p \wedge \sim q) \rightarrow (\sim p \wedge q)$ are respectively

(A) T, F (B) F, T

(C) T, T (D) F, F

111. Water is being poured at the rate of 36 m^3/min into a cylindrical vessel, whose circular base is of radius 3 meters. Then the water level in the cylinder is rising at the rate of

(A) 4π m/min (B) $\frac{4}{\pi}$ m/min

(C) $\frac{1}{4\pi}$ m/min (D) $\frac{\pi}{4}$ m/min

112. A line having direction ratios $1, -4, 2$ intersects the lines $\frac{x-7}{3} = \frac{y-1}{-1} = \frac{z+2}{1}$ and $\frac{x}{2} = \frac{y-7}{3} = \frac{z}{1}$ at the points A and B resp., then co-ordinates of points A and B are

(A) A$(-8, 6, -7)$ B$(-6, -2, -3)$ (B) A$(8, 6, 7)$ B$(6, 2, 3)$

(C) A$(8, 6, 7)$ B$(6, -2, -3)$ (D) A$(7, 6, 8)$ B$(-3, -2, 6)$

113. $\int \frac{x^2-4}{x^4+9x^2+16}dx = \tan^{-1}(f(x)) + c$ (where c is a constant of integration), then value of $f(2)$ is

(A) 1 (B) 2

(C) 3 (D) 4

114. If $\overline{a} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\overline{b} = 2\hat{i} + 3\hat{j} - \hat{k}$ are two vectors, then the angle between the vectors $3\overline{a} + 5\overline{b}$ and $5\overline{a} + 3\overline{b}$ is

(A) $\cos^{-1}(\frac{10}{19})$ (B) $\cos^{-1}(\frac{11}{19})$

(C) $\cos^{-1}(\frac{13}{19})$ (D) $\cos^{-1}(\frac{14}{19})$

115. Let $A = \begin{bmatrix} 1 & 2 \\ -1 & 4 \end{bmatrix}$ and $A^{-1} = \alpha I + \beta A, \alpha, \beta \in \mathbb{R}$, I is the identity matrix of order 2 , then $4(\alpha - \beta)$ is

(A) $\frac{8}{3}$ (B) 4

(C) 2 (D) 5

116.

$$\lim_{y \to 0} \frac{\sqrt{1+\sqrt{1+y^4}} - \sqrt{2}}{y^4} =$$

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

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

117. If $\overline{a}$ is perpendicular to $\overline{b}$ and $\overline{c}, |\overline{a}| = 2$, $|\overline{b}| = 3, |\overline{c}| = 4$ and the angle between $\overline{b}$ and $\overline{c}$ is $\frac{\pi}{3}$, then $\left[\begin{array}{ccc} \overline{a} & \overline{b} & \overline{c} \end{array}\right] =$

(A) $4\sqrt{3}$ (B) $6\sqrt{3}$

(C) $24\sqrt{3}$ (D) $12\sqrt{3}$

118. The mean and variance of seven observations are 8 and 16 respectively. If five of the observations are $2, 4, 10, 12, 14$, then the product of remaining two observations is

(A) 45 (B) 44

(C) 48 (D) 40

119. If $y = \tan^{-1}\left(\frac{2+3x}{3-2x}\right) + \tan^{-1}\left(\frac{4x}{1+5x^2}\right)$, then $\frac{dy}{dx} =$

(A) $\frac{1}{1+25x^2}$ (B) $\frac{5}{1+25x^2}$

(C) $\frac{1}{1+5x^2}$ (D) $\frac{5}{1+5x^2}$

120. If $f(x) = \frac{a\sin x + b\cos x}{c\sin x + d\cos x}$ is decreasing for all x then

(A) $ad - bc > 0$ (B) $ad - bc < 0$

(C) $ab - cd > 0$ (D) $ab - cd < 0$

121. If a discrete random variable X is defined as follows

$$P[X = x] = \begin{cases} \frac{k(x+1)}{5^x}, & \text{if } x = 0, 1, 2 \ldots\ldots \\ 0, & \text{otherwise} \end{cases}$$

then k =

(A) $\frac{19}{25}$ (B) $\frac{18}{25}$

(C) $\frac{16}{25}$ (D) $\frac{7}{25}$

122. If $\overline{a} = 2\hat{i} - \hat{j} + \hat{k}, \overline{b} = \hat{i} + \hat{j} - 2\hat{k}$ and $\overline{c} = 4\hat{i} - 2\hat{j} + \hat{k}$, then the unit vector in the direction of $3\overline{a} + \overline{b} - 2\overline{c}$ is

(A) $\frac{1}{\sqrt{6}}(-\hat{i} + 2\hat{j} - \hat{k})$ (B) $\frac{1}{\sqrt{6}}(\hat{i} + 2\hat{j} + \hat{k})$

(C) $\frac{1}{\sqrt{6}}(2\hat{i} - \hat{j} - \hat{k})$ (D) $\frac{1}{\sqrt{6}}(-\hat{i} - 2\hat{j} + \hat{k})$

123. Numbers are selected at random, one at a time from two digit numbers $10, 11, 12 \ldots, 99$ with replacement. An event E occurs if and only if the product of the two digits of a selected number is 18 . If four numbers are selected, then probability that the event E occurs at least 3 times is

(A) $\frac{87}{90^4}$ (B) $\frac{348}{90^4}$

(C) $87(\frac{4}{90})^4$ (D) $(\frac{4}{10})^4$

124. The function $y(x)$ represented by $x = \sin t$, $y = ae^{t\sqrt{2}} + be^{t\sqrt{2}}, t \in \left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$ satisfies the equation $\left(1 - x^2\right) y'' - xy' = ky$, then the value of k is k is

(A) 1 (B) 2

(C) -1 (D) 0

125. The value of $\cos 20^\circ + 2\sin^2 55^\circ - \sqrt{2}\sin 65^\circ$ is

(A) 0 (B) 1

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

126. If $[x]$ denotes the greatest integer function, then

$$\int_0^5 x^2[x]dx =$$

(A) $\frac{244}{3}$ (B) $\frac{316}{3}$

(C) $\frac{200}{3}$ (D) $\frac{400}{3}$

127. If the function f defined on $\left(\frac{\pi}{6}, \frac{\pi}{3}\right)$ by

$$f(x) = \begin{cases} \frac{\sqrt{2}\cos x - 1}{\cot x - 1}, & x \neq \frac{\pi}{4} \\ k \quad , & x = \frac{\pi}{4} \end{cases}$$

is continuous, then k is equal to

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

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

128.

$$\int \cos^{\frac{-3}{7}} x \cdot \sin^{\frac{-11}{7}} x dx =$$

(A) $\frac{-4}{7}\tan^{\frac{-4}{7}} x + c$, where c is a constant of integration.

(B) $\frac{4}{7}\tan^{\frac{4}{7}} x + c$, where c is a constant of integration.

(C) $\frac{-7}{4}\tan^{\frac{-4}{7}} x + c$, where c is a constant of integration.

(D) $\frac{7}{4}\tan^{\frac{4}{7}} x + c$, where c is a constant of integration.

129. If $\bar{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\bar{b} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$, $\bar{c} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$ and

$$\left[3\bar{a} + \bar{b} \quad 3\bar{b} + \bar{c} \quad 3\bar{c} + \bar{a}\right] = \lambda \begin{vmatrix} a\cdot\hat{i} & a\cdot\hat{j} & a\cdot\hat{k} \\ b\cdot\hat{i} & b\cdot\hat{j} & b\cdot\hat{k} \\ c\cdot\hat{i} & c\cdot\hat{j} & c\cdot\hat{k} \end{vmatrix},$$

then the value of λ is

(A) 27 (B) 28

(C) 4 (D) 3

130. The domain of the function $f(x) = \frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$ is

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

(C) $[2, 3]$ (D) $(2, 3]$

131. If $\bar{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\bar{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\bar{c} = 3\hat{i} + \hat{j}$ are the vectors such that $\bar{a} + \lambda\bar{b}$ is perpendicular to $\bar{c}$, then value of λ is

(A) 6 (B) -6

(C) 8 (D) -8

132. The area (in sq. units) bounded between the parabolas $x^2 = \frac{y}{4}$ and $x^2 = 9y$ and the line $y = 2$ is

(A) $20\sqrt{2}$ (B) $\frac{10\sqrt{2}}{3}$

(C) $\frac{20\sqrt{2}}{3}$ (D) $10\sqrt{2}$

133. A plane makes positive intercepts of unit length on each of X and Y axis. If it passes through the point $(-1, 1, 2)$ and makes angle θ with the X -axis, then θ is

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

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

134. The rate of growth of bacteria in a culture is proportional to the number of bacteria present and the bacteria count is 1000 at t = 0. The number of bacteria is increased by 20% in 2 hours. If the population of bacteria is 2000 after $\frac{k}{\log\left(\frac{6}{5}\right)}$ hours, then $\left(\frac{k}{\log 2}\right)^2$ is

(A) 16 (B) 8

(C) 2 (D) 4

135. One end of the diameter of the circle $x^2 + y^2 - 6x - 5y - 1 = 0$ is $(-1, 3)$, then the equation of the tangent at the other end of the diameter is

(A) $8x + y - 58 = 0$ (B) $8x - 2y - 52 = 0$

(C) $8x - y - 54 = 0$ (D) $8x + 2y - 60 = 0$

136. If $\tan^{-1}\left(\frac{x+1}{x-1}\right) + \tan^{-1}\left(\frac{x-1}{x}\right) = \tan^{-1}(-7)$, then x is equal to

(A) -1 (B) 1

(C) 2 (D) 4

137. The equation of the normal to the curve $y = x\log x$ parallel to $2x - 2y + 3 = 0$ is

(A) $x + y = 3e^{-2}$ (B) $x - y = 3e^{-2}$

(C) $x - y = 3e^{2}$ (D) $x + y = 3e^{2}$

138.

$$\int \frac{e^{\tan^{-1}x}}{1+x^2}\left[\left(\sec^{-1}\sqrt{1+x^2}\right)^2 + \cos^{-1}\left(\frac{1-x^2}{1+x^2}\right)\right] dx,$$

where $x > 0$ is

(A) $(\tan^{-1}x)e^{\tan^{-1}x} + c$, where c is a constant of integration.

(B) $(\tan^{-1}x)^2 e^{\tan^{-1}x} + c$, where c is a constant of integration.

(C) $2(\tan^{-1}x)e^{\tan^{-1}x} + c$, where c is a constant of integration.

(D) $2(\tan^{-1}x)^2 e^{\tan^{-1}x} + c$, where c is a constant of integration.

139. The equation of plane through the point $(2,-1,-3)$ and parallel to lines $\frac{x-1}{3}=\frac{y+2}{2}=\frac{z}{-4}$ and $\frac{x}{2}=\frac{y-1}{-3}=\frac{z-2}{2}$ is

(A) $8x+14y+13z-37=0$

(B) $8x-14y-13z-34=0$

(C) $8x-14y-13z+37=0$

(D) $8x+14y+13z+37=0$

140. The co-ordinates of the foot of perpendicular, drawn from the point $(-2,3)$ on the line $3x-y-1=0$ are

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

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

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

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

(C) $\frac{\pi}{12}$ (D) $\frac{7\pi}{12}$

142. The general solution of the differential equation $\frac{dy}{dx}=y\tan x-y^2\sec x$ is

(A) $\tan x=(c+\sec x)y$, where c is constant of integration.

(B) $\sec y=(c+\tan y)x$, where c is constant of integration.

(C) $\sec x=(c+\tan x)y$, where c is constant of integration.

(D) $\cos y=(c+\tan y)$, where c is constant of integration.

143. If $\overline{a},\overline{b},\overline{c}$ are three vectors such that $\overline{a}\neq\overline{0}$ and $\overline{a}\times\overline{b}=2\overline{a}\times\overline{c}, |\overline{a}|=|\overline{c}|=1, |\overline{b}|=4$ and $|\overline{b}\times\overline{c}|=\sqrt{15}$. If $\overline{b}-2\overline{c}=\lambda\overline{a}$, then λ is

(A) 1 (B) -4

(C) 3 (D) -2

144. Two friends A and B apply for a job in the same company. The probabilities of A getting selected is $\frac{2}{5}$ and that of B is $\frac{4}{7}$. Then the probability, that one of them is selected, is

(A) $\frac{8}{35}$ (B) $\frac{18}{35}$

(C) $\frac{26}{35}$ (D) $\frac{34}{35}$

145. If P_1 and P_2 are perpendicular distances (in units) from point $(2,-1)$ to the pair of lines $2x^2-5xy+2y^2=0$, then the value of P_1P_2 is

(A) 2 (B) 5

(C) 10 (D) 4

146.

$$\int\frac{x^3-7x+6}{x^2+3x}\,dx=$$

(A) $\frac{x^2}{2}+3x-\log x+c$, where c is a constant of integration.

(B) $\frac{x^2}{2}+3x+2\log x+c$, where c is a constant of integration.

(C) $\frac{x^2}{2}-3x+2\log x+c$, where c is a constant of integration.

(D) $\frac{x^2}{2}-3x-\log x+c$, where c is a constant of integration.

147. The cumulative distribution function of a discrete random variable X is given by

$X=x$	-1	0	1	2
$F(X=x)$	0.3	0.7	0.8	1

Then $E(X^2)=$

(A) 0.2 (B) 1.2

(C) 0.8 (D) 2.5

148. A five digit number divisible by 3 is to be formed using the digits $0,1,2,3,4,5$ without repetition, then the total number of ways this can be done is

(A) 216 (B) 240

(C) 96 (D) 120

149. The statement $\sim(p\leftrightarrow\sim q)$ is

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

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

150. If $x=-1$ and $x=2$ are extreme points of $f(x)=\alpha\log|x|+\beta x^2+x$, then

(A) $\alpha=-6,\beta=\frac{1}{2}$ (B) $\alpha=-6,\beta=-\frac{1}{2}$

(C) $\alpha=2,\beta=-\frac{1}{2}$ (D) $\alpha=2,\beta=\frac{1}{2}$

- End of Question Paper -