MHT CET 2024 PCM May 2 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. In semiconductors at room temperature,

(A) the valence band is completely filled.
(B) the conduction band is completely empty.
(C) the conduction band is partially filled and the valence band is partially empty.
(D) the valence band is completely filled and conduction band is partially empty.

2. A particle at rest starts moving with a constant angular acceleration of 4 rad/s^2 in a circular path. The time at which magnitudes of its centripetal acceleration and tangential acceleration will be equal, is (in second)

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

3. The logic circuit in figure is equivalent to



(A) OR gate
(B) AND gate
(C) NOR gate
(D) NAND gate

4. The intensity of light coming from one of the slits in Young's double slit experiment is double the intensity from the other slit. The ratio of the maximum intensity to the minimum intensity in the interference fringe pattern observed is

(A) 9 : 1
(B) 34 : 1
(C) 4 : 1
(D) 16 : 1

5. A sample of oxygen gas and a sample of hydrogen gas both have the same mass, same volume and the same pressure. The ratio of their absolute temperature is (Molecular wt. of O_2&H_2 is 32 and 2 respectively)

(A) 1 : 4
(B) 1 : 8
(C) 16 : 1
(D) 12 : 1

6. The height above the earth's surface at which the acceleration due to gravity becomes $\left(\frac{1}{n}\right)$ times the value at the surface is (R = radius of earth)

(A) $\frac{\mathrm{R}}{\sqrt{\mathrm{n}}}$
(B) $\mathrm{R}\cdot\sqrt{\mathrm{n}}$
(C) $(\sqrt{n}+1)R$
(D) $(\sqrt{\mathrm{n}}-1)\mathrm{R}$

7. A streamline flow of a liquid of density ' ρ ' is passing through a horizontal pipe of crosssectional area A_1 and A_2 at two ends. If the pressure of liquid is ' P ' at a point where flow speed is ' v ', then pressure at another point where the flow of speed becomes 3 v is

(A) $\mathrm{P}-\frac{3}{4}\rho v^2$
(B) $\mathrm{P}-2\rho\mathrm{v}^2$
(C) $\mathrm{P}-3\rho\mathrm{v}^2$
(D) $\mathrm{P}-4\rho\mathrm{v}^2$

8. In an a.c. circuit $\mathrm{I}=100\sin 200\pi\mathrm{t}$. The time required for the current to achieve its peak value will be

(A) $\frac{1}{100}$ s
(B) $\frac{1}{200}$ s
(C) $\frac{1}{300}$ s
(D) $\frac{1}{400}$ s

9. 90 J of work is done to move an electric charge of magnitude 3 C from a place A , where potential is -10 V to another place B , where potential is ' V_1 ' volt. The value of V_1 is

(A) 10 V
(B) 20 V
(C) 30 V
(D) -40 V

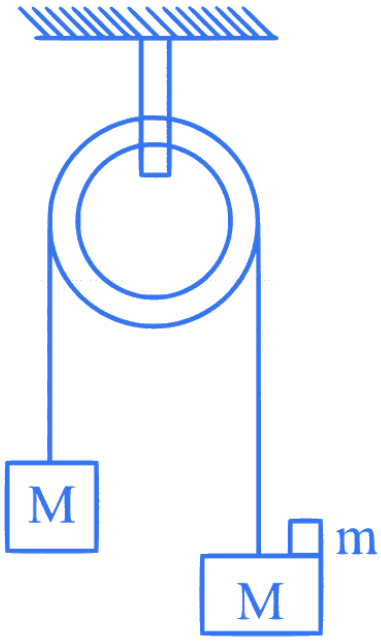
10. A particle is performing simple harmonic motion and if the oscillations are Camped oscillations then the angular frequency is given by

(A) $\sqrt{\frac{k}{m}+(\frac{b}{2m})^2}$
(B) $\frac{\mathrm{k}}{\mathrm{m}}+(\frac{\mathrm{b}}{2\,\mathrm{m}})^2$
(C) $\sqrt{\frac{k}{m}-(\frac{b}{2m})^2}$
(D) $\frac{\mathrm{k}}{\mathrm{m}}-(\frac{\mathrm{b}}{2\,\mathrm{m}})^2$

11. The magnetic energy stored in an inductor of inductance 5μH carrying a current of 2 A is

(A) 10 mJ
(B) 5 mJ
(C) 10μ J
(D) 5μ J

12. Two identical blocks each of mass ' M ' attached to the ends of a massless inextensible string which passes over a pulley with a fixed axis as shown below. A small mass ' m ' is now placed on the block B. The acceleration with which the two blocks move together is [g = gravitational acceleration]



(A) $\frac{mg}{2M+m}$ (B) $\frac{Mg}{M+2m}$
(C) $\frac{\mathrm{Mg}}{\mathrm{2M+m}}$ (D) $\frac{mg}{M+2m}$

13. The radius of innermost orbit of hydrogen atom is 5.3×10^{-11} m. The radius of fourth allowed orbit of hydrogen atom is

(A) 8.48 $\overset{o}{A}$ (B) 2.12 $\overset{o}{A}$
(C) 4.77 $\overset{o}{A}$ (D) 0.53 $\overset{o}{A}$

14. Two thin lenses have a combined power of +9D. When they are separated by a distance of 20 cm , their equivalent power becomes $+\frac{27}{5}$D. The power of both the lenses in dioptre are respectively

(A) $4, 5$ (B) $3, 6$
(C) $2, 7$ (D) $1, 8$

15. Two simple harmonic progressive waves have displacements $\rightarrow \mathrm{y_1} = \mathrm{a_1} \sin\left(\frac{2\pi \mathrm{x}}{\lambda} - \omega \mathrm{t}\right)$ and $\mathrm{y_2} = \mathrm{a_2} \cos\left(\frac{2\pi \mathrm{x}}{\lambda} - \omega \mathrm{t} + \phi\right)$ What is the phase difference between two waves?

(A) $(\varrho + \frac{\pi}{2})$ (B) ϱ
(C) $(\varrho - \frac{\pi}{2})$ (D) $(\varrho + \pi)$

16. The pressure inside a soap bubble A is 1.01 atmosphere and that in a soap bubble B is 1.02 atmosphere. The ratio of volume of A to that of B is

(A) 2 : 1 (B) 8 : 1
(C) 101 : 102 (D) 102 : 101

17. A bicycle wheel of radius ' R ' has ' n ' spokes. It is rotating at the rate of ' F ' r.p.m. perpendicular to the horizontal component of earth's magnetic field $\vec{B}$. The e.m.f. induced between the rim and the centre of the wheel is

(A) $\frac{1}{2}\ \mathrm{B}\pi\mathrm{FR}^2$ (B) $\mathrm{B}\pi\mathrm{FR}^2$
(C) $\frac{1}{\mathrm{n}}\mathrm{B}\pi\mathrm{FR}$ (D) $B\pi\mathrm{FR}^2 n$

18. Choose the correct answer. When a point of suspension of pendulum is moved vertically upward with acceleration ' a ', its period of oscillation

(A) decreases (B) increases
(C) remains same (D) some times increases and some times decreases

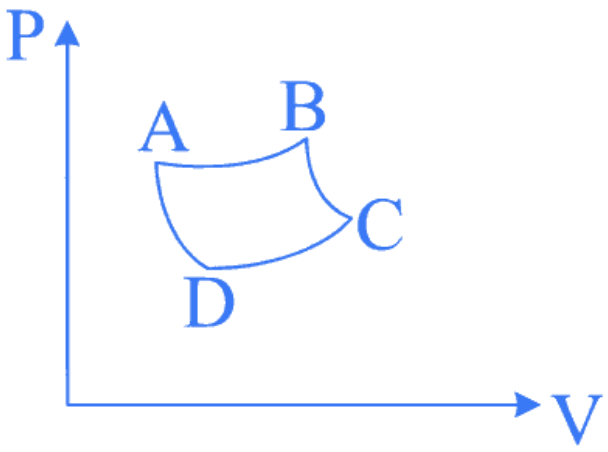
19. When a metallic surface is illuminated with a radiation of wavelength ' λ ', the stopping potential is ' V '. If the same surface is illuminated with radiation of wavelength ' 3λ ', the stopping potential is ' $\left(\frac{\mathrm{V}}{6}\right)$ '. The threshold wavelength for the surface is

(A) 3λ (B) 4λ
(C) 5λ (D) 6λ

20. The magnetic field at the centre of a current carrying circular coil of area ' A ' is ' B '. The magnetic moment of the coil is (μ_0 = permeability of free space)

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

21. The P-V graph of an ideal gas, cycle is shown. The adiabatic process is described by the region



(A) AB and BC
(B) AB and CD
(C) AD and BC
(D) BC and CD

22. A galvanometer of resistance ' G ' is shunted by resistance of 'S' ohm. To keep the main current in the circuit unchanged the resistance to be put in series with Galvanometer is

(A) $\frac{G^2}{S+G}$
(B) $\frac{G}{S+G}$
(C) $\frac{S^2}{G+S}$
(D) $\frac{GS}{S+G}$

23. In an A.C. circuit, the potential difference ' V ' and current 'I' are given respectively by $V = 100\sin(100t)V, I = 100\sin\left(100t + \frac{\pi}{3}\right)mA$ The power dissipated in the circuit will be [Given $\rightarrow \cos\frac{\pi}{3} = \frac{1}{2}$]

(A) 10^4 W
(B) 10 W
(C) 2.5 W
(D) 5 W

24. An annular ring has mass 10 kg and inner and outer radii are 10 m and 5 m respectively. Its moment of inertia about an axis passing through its centre and perpendicular to its plane is

(A) 525 kgm^2
(B) 625 kgm^2
(C) 525 gcm^2
(D) 625 gcm^2

25. Railway track is made of steel segments separated by small gaps to allow for linear expansion. The segment of track is 10 m long when laid at temperature 17°C. The maximum temperature that can be reached is 45°C. Increase in length of the segment of railway track is ' x ' $\times 10^{-5}$ m. The value of ' x ' is $(\alpha_{steel} = 1.2 \times 10^{-5}/°C)$

(A) 168
(B) 204
(C) 336
(D) 530

26. A wire under tension 225 N produces 6 beats per second when it is tuned with a fork. When the tension changes to 256 N , it is again tuned with the same tuning fork, the number of beats remain unchanged. The frequency of tuning fork will be

(A) 256 Hz
(B) 186 Hz
(C) 225 Hz
(D) 280 Hz

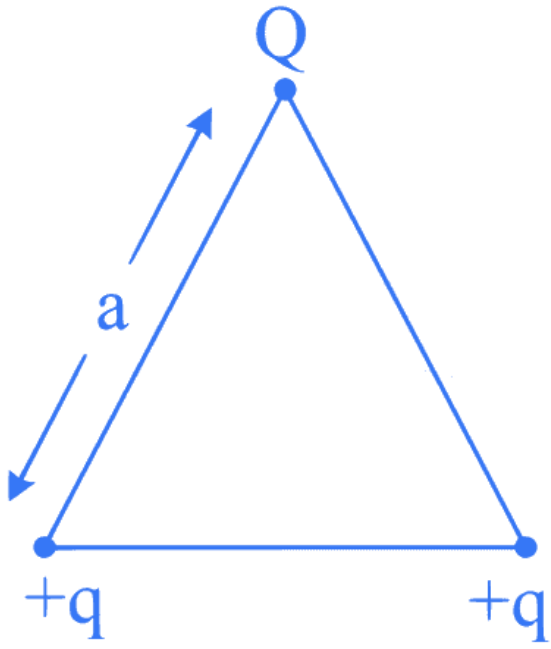
27. In the third orbit of hydrogen atom the energy of an electron ' E '. In the fifth orbit of helium $(Z = 2)$ the energy of an electron will be

(A) $\frac{25E}{36}$
(B) $\frac{36E}{25}$
(C) $\frac{3E}{5}$
(D) $\frac{5E}{3}$

28. At S.T.P, the mean free path of gas molecule is 1500 d , where ' d ' is diameter of molecule. What will be the mean free path at 373 K at constant volume?

(A) 1500 d
(B) $\frac{373}{273} \times 1500$ d
(C) $\frac{273}{373} \times 1500$ d
(D) $\sqrt{\frac{373}{273}} \times 1500$ d

29. Three charges are placed at the vertices of an equilateral triangle as shown in the figure. For what value of charge ' Q ', the electrostatic potential energy of the system is zero?



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

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30. One mole of an ideal gas at an initial temperature of ' T ' K does ' $6R$ ' of work adiabatically. If the ratio of specific heats of this gas at constant pressure and at constant volume is $5/3$, the final temperature of gas will be $\left(\mathrm{R} = 8.31 \text{ J mole}^{-1} \text{ K}^{-1}\right)$

(A) $(\mathrm{T} + 4 \cdot 2)\mathrm{K}$ (B) $(\mathrm{T} - 4 \cdot 2)\mathrm{K}$

(C) $(\mathrm{T} + 4)\mathrm{K}$ (D) $(\mathrm{T} - 4)\mathrm{K}$

31. In a Young's double slit experiment, the source is white light. One of the holes is covered by a red filter and another by a blue filter. In this case

(A) there shall be alternative interference fringes of red and blue.

(B) there shall be interference fringes for red distinct from that for blue.

(C) there shall be no interference fringes.

(D) there shall be interference fringes for red mixing with one for blue.

32. Glycerine of density $1.25 \times 10^3 \text{ kg/m}^3$ is flowing in conical shaped horizontal pipe. Crosssectional area of the pipe at its both ends is 10 cm^2 and 5 cm^2 respectively. Pressure difference at both the ends is 3 N/m^2. Rate of flow of liquid in the pipe is

(A) $4 \times 10^{-5} \text{ m}^3/\text{s}$ (B) $2 \times 10^{-5} \text{ m}^3/\text{s}$

(C) $5 \times 10^{-5} \text{ m}^3/\text{s}$ (D) $6 \times 10^{-5} \text{ m}^3/\text{s}$

33. In an NPN transistor 10^{10} electrons enter the emitter in 10^{-6} s and 2% electrons recombine with holes in base. The current ratios ' α ' and ' β ' of a transistor are respectively (nearly)

(A) $0.98, 49$ (B) $49, 0.98$

(C) $0.49, 98$ (D) $98, 0.49$

34. Velocity of sound waves in air is 330 m/s. For a particular sound wave in air, path difference of 40 cm is equivalent to phase difference of 1.6π. The frequency of this wave is

(A) 165 Hz (B) 150 Hz

(C) 660 Hz (D) 330 Hz

35. A particle is performing uniform circular motion along the circumference of the circle of diameter 1 m with frequency 4 Hz . The acceleration of the particle in m/s^2 is

(A) $8\pi^2$ (B) $16\pi^2$

(C) $24\pi^2$ (D) $32\pi^2$

36. A uniformly charged conducting sphere of diameter 14 cm has surface charge density of $40\mu\text{Cm}^{-2}$. The total electric flux leaving the surface of the sphere is nearly (Permittivity of free space $= 8.85 \times 10^{-12}$ SI unit)

(A) 40 kWb (B) 140 kWb

(C) 240 kWb (D) 280 kWb

37. The acceleration of a moving body can be found from

(A) area under velocity - time graph.

(B) area under distance - time graph.

(C) slope of the velocity - time graph.

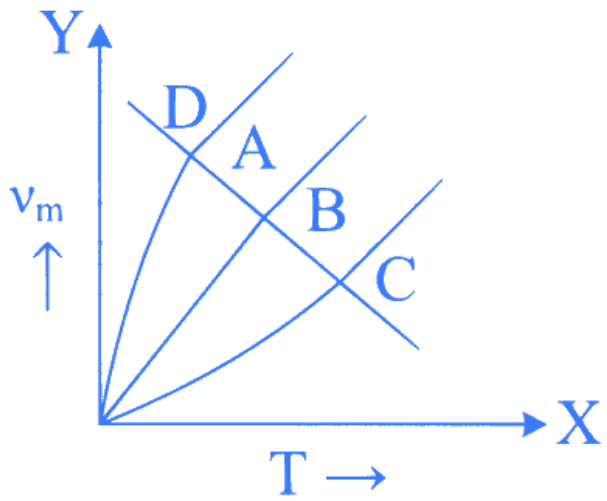
(D) slope of the distance - time graph.

38. Two identical current carrying coils with same centre are placed with their planes perpendicular to each other. If current $\mathrm{I} = \sqrt{2}$ A and radius of the coil is $R = 1$ m, then magnetic field at centre is equal to ($\mu_0 =$ permeability of free space)

(A) μ_0 (B) $\frac{\mu_0}{2}$

(C) $2\mu_0$ (D) $\sqrt{2}\mu_0$

39. The frequency ' v_m ' corresponding to which the energy emitted by a black body is maximum may vary with the temperature ' T ' of the body as shown by the curves ' A ', ' B ', ' C ' and ' D ' in the figure. Which one of these represents the correct variation?



(A) straight line D (B) curve C

(C) straight line B (D) curve A

40. The resistances in the left and right gap of a metre bridge are 40Ω and 60Ω respectively. When the bridge is balanced, the distance of the null point from the centre of the wire towards left is

(A) 5 cm (B) 10 cm

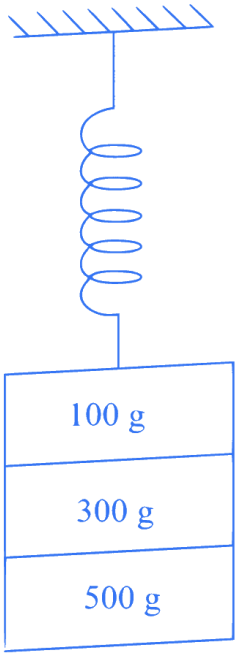
(C) 15 cm (D) 20 cm

41. The magnitude of gravitational field at distance ' r_1 ' and ' r_2 ' from the centre of a uniform sphere of radius ' R ' and mass ' M ' are ' F_1 ' and ' F_2 ' respectively. The ratio ' (F_1/F_2) ' will be (if $r_1 > R$ and $r_2 < R$)

(A) $\frac{R^2}{r_1 r_2}$ (B) $\frac{R^3}{r_1 r_2^2}$

(C) $\frac{R^3}{r_1^2 r_2}$ (D) $\frac{R^4}{r_1^2 r_2^2}$

42. Three masses 500 g, 300 g and 100 g are suspended at the end of spring as shown in figure and are in equilibrium. When the 500 g mass is removed, the system oscillates with a period of 3 second. When the 300 g mass is also removed it will oscillate with a period of



(A) 1 s (B) 1.5 s

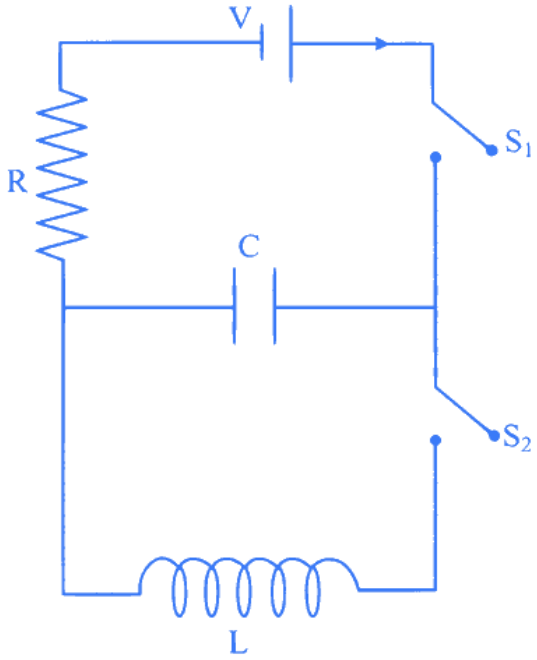
(C) 2 s (D) 2.5 s

43. The electrostatic potential inside a charged spherical ball is given by $V = ar^2 + b$ where ' r ' is the distance from its centre and ' a ' and ' b ' are constants. The volume charge density of the ball is [ε_0 = permittivity of free space]

(A) $-24\pi a\epsilon_0 r$ (B) $-6a\epsilon_0 r$

(C) $-24\pi a\epsilon_0$ (D) $-6a\epsilon_0$

44. In the given circuit, when S_1 is closed, the capacitor gets fully charged. Now S_1 is open and S_2 is closed. Then



(A) there is no exchange of energy between L and C .

(B) the current in the circuit is in the same direction.

(C) the instantaneous current in the circuit may be $V(\sqrt{\frac{C}{L}})$.

(D) the energy stored in the circuit is purely in the form of magnetic energy.

45. A plane mirror produces a magnification of

(A) -1 (B) zero

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

46. The work function of metal ' A ' and ' B ' are in the ratio 1 : 2. If light of frequency ' f ' and ' $2f$ ' is incident on surface ' A ' and ' B ' respectively, then the ratio of kinetic energies of emitted photo electrons is

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

(C) 1 : 3 (D) 1 : 4

47. The telescopes, for a given wavelength, the objectives with large aperture are used for

(A) greater magnification.

(B) greater resolution.

(C) reducing lens aberration.

(D) ease of manufacture.

48. A circuit having a self inductance of 1 henry carries a current of 1 A . To prevent the sparking when the circuit is broken, a capacitor which can withstand 500 V is connected across the switch. What is the minimum value of the capacitance of the capacitor?

(A) 2μ F
(B) 4μ F
(C) 6μ F
(D) 8μ F

49. An air column in a closed organ pipe vibrating in unison with a fork, produces second overtone. The vibrating air column has

(A) three nodes and two antinodes.
(B) three nodes and three antinodes.
(C) four nodes and three antinodes.
(D) three nodes and four antinodes.

50. At certain place a magnet makes 30 oscillations per minute. At another place if the magnetic induction is increased by two times the magnetic induction at first place, then the time period of same magnet will be

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

51. Which element from following is used in photoelectric cells?

(A) Li (B) Be
(C) Cs (D) Mg

52. What is the total number of particles present in bcc unit cell?

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

53. Which among the following polymers is obtained by ring opening polymerization process?

(A) Polyacrylonitrile (B) Nylon 6,6
(C) Nylon 6 (D) Terylene

54. Identify an example of solution that consists of solid as solute and liquid as solvent.

(A) Sea water (B) Bronze
(C) Carbonated water (D) Chloroform in nitrogen

55. Which of the following compounds is obtained when cyclohexene is oxidized using $KMnO_4$ in dilute H_2SO_4 ?

(A) Cyclohexanol (B) Cyclohexanone
(C) Benzoic acid (D) Adipic acid

56. Which from following expressions is used to calculate E_{cell} for the following cell at 25°C ?

$$Pb_{(s)}\left|Pb^{++}_{(1M)}\right\|Ag^{+}_{(10M)}\left|Ag_{(s)}\right.$$

(A) $E_{cell} = (E^{\circ}_{cell} + 0.0592)V$
(B) $E_{cell} = (E^{\circ}_{cell} - 0.0592)V$
(C) $E_{cell} = (E^{\circ}_{cell} - 0.0296)V$
(D) $E_{cell} = (E^{\circ}_{cell} + 0.0296)V$

57. Which of the following compounds is obtained by using Swartz reaction?

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

58. What is the bond order in CO molecule?

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

59. Which of the following is an example of heterogenous catalysis?

(A) Oxidation of $SO_{2(g)}$ in presence of $NO_{(g)}$.
(B) Decomposition of aqueous H_2O_2 in presence of $I^{-}_{(aq)}$.
(C) Hydrolysis of sugar in presence of aq. H_2SO_4.
(D) Hydrogenation of vegetable oil in presence of $Ni_{(s)}$.

60. Identify the monomers used for preparation of Buna-S.

(A) Phenol and formaldehyde (B) 1,3-butadiene and styrene
(C) Ethylene glycol and styrene (D) β-hydroxy butyric acid and phenol

61. Which among the following is NOT an intensive property?

(A) Internal energy (B) Viscosity
(C) Surface tension (D) Specific heat

62. How many moles of iodomethane are consumed in the following conversion?

$$CH_3NH_2 \xrightarrow[\Delta]{CH_3I} (CH_3)_4N^{+}I^{-}$$

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

63. Calculate the time required for reactant to decrease the concentration from 100% to 20%, if rate constant of first order reaction is 0.02303 hours $^{-1}$.

(A) 28 hour (B) 42 hour
(C) 56 hour (D) 70 hour

64. Identify the number of donor atoms in EDTA molecule that form coordinate bond with central metal atom or ion in a complex.

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

65. Which from following gases of same mass exerts highest pressure at constant temperature?

(A) H_2 (B) N_2
(C) O_2 (D) Cl_2

66. Calculate the volume of unit cell of an element having molar mass 27 g mol^{-1} that forms fcc unit cell. $\left[\rho.N_A = 16.0 \times 10^{23}\ g\ cm^{-3}\ mol^{-1}\right]$

(A) $7.50 \times 10^{-23}\ cm^3$ (B) $6.75 \times 10^{-23}\ cm^3$

(C) $5.75 \times 10^{-23}\ cm^3$ (D) $8.25 \times 10^{-23}\ cm^3$

67. What is the ratio of concentration of salt to concentration of weak acid in buffer solution to maintain its pH value 7.2 ($pK_a = 6.2$).

(A) 1.5 (B) 10.0

(C) 5.0 (D) 8.5

68. Which of the following isomers has highest boiling point?

(A) tert-Butylamine (B) Ethyldimethylamine

(C) Diethylamine (D) n-Butylamine

69. Identify the product obtained when methyl bromide reacts with sodium tert-butoxide.

(A) Isobutylene and methanol (B) 1-Methoxybutane

(C) 2-Methoxybutane (D) 2-Methoxy-2-methylpropane

70. Which from following is NOT true about electrolysis of molten NaCl ?

(A) Cl_2 gas is liberated at anode. (B) Na is deposited at cathode.

(C) The decomposition of NaCl into $Na_{(s)}$ and $Cl_{2(g)}$ is spontaneous. (D) Electrical energy is used to carry out the reaction.

71. Which element from following exhibits lowest number of different oxidation states?

(A) Sc (B) Cu

(C) Ti (D) Zn

72. Which functional group from following is considered as principal functional group if polyfunctional compound is to be named by IUPAC system?

(A) $-CHO$ (B) $-OH$

(C) $-NH_2$ (D) $-C \equiv C-$

73. Calculate the edge length of fcc unit cell if radius of metal atom is 139 pm .

(A) 2.78×10^{-8} cm (B) 3.21×10^{-8} cm

(C) 3.93×10^{-8} cm (D) 6.95×10^{-8} cm

74. Which from following techniques is used for preliminary confirmation of nanoparticles?

(A) UV-visible spectroscopy (B) X ray diffraction

(C) Scanning electron microscopy (D) Transmission electron microscopy

75. What is the value of pOH if a buffer solution is prepared by mixing equal volumes of 0.4 M NH_4OH and 0.5 M NH_4Cl solutions. ($pK_b = 4.730$)

(A) 6.0 (B) 4.83

(C) 10.42 (D) 7.81

76. In a process 605 J heat is absorbed by the system and 380 J work is done by the system on surrounding. What is the value of ΔU?

(A) $-225J$ (B) $-985J$

(C) $+225$ J (D) $+985$ J

77. Identify false statement from following.

(A) Cellulose is constituent of cell wall in animal cells. (B) Starch is common constituent of food grains.

(C) Lactose is constituent of milk. (D) Animals store polysaccharides in their body in the form of glycogen.

78. The resistance of decimolar solution of NaCl is 30 ohms. Calculate the conductivity of solution if the cell constant is 0.33 cm^{-1}.

(A) $0.025\Omega^{-1}\ cm^{-1}$ (B) $0.035\Omega^{-1}\ cm^{-1}$

(C) $0.011\Omega^{-1}\ cm^{-1}$ (D) $0.029\Omega^{-1}\ cm^{-1}$

79. What is the total number of unpaired electrons in an element placed at period-4 and group-12 either in excited or at ground state?

(A) Zero (B) One

(C) Two (D) Three

80. Which of the following is NOT obtained when a mixture of bromoethane and 1-bromopropane is treated with sodium metal in dry ether?

(A) Propane (B) Butane

(C) Pentane (D) Hexane

81. What is the oxidation number of underlined species in PF_6^- and $V_2O_7^{-4}$ ions respectively?

(A) $+5$ and -5 (B) $+5$ and $+5$

(C) -5 and $+5$ (D) 3 and $+3$

82. Calculate the molality of solution of non volatile solute having depression in freezing point 0.93 K and cryoscopic constant of solvent 1.86 K kg mol^{-1}.

(A) 0.3 mol kg^{-1} (B) 0.5 mol kg^{-1}

(C) 0.4 mol kg^{-1} (D) 0.6 mol kg^{-1}

83. Which of the following salt solutions turns red litmus blue?

(A) NH_4CN (B) NH_4Cl

(C) NH_4NO_3 (D) $NaNO_3$

84. Which from following compounds is obtained when acyl chloride is hydrolysed with water?

(A) Alcohols (B) Carboxylic acids

(C) Aldehydes (D) Esters

85. What is the rate of formation of O_2 for the reaction stated below?

$$2\,N_2O_{5(8)} \longrightarrow 4NO_{2(g)} + O_{2(g)}$$

$$\left[\frac{d[N_2O_5]}{dt} = 0.02\ \text{moldm}^{-3}\ s^{-1}\right]$$

(A) 0.01 mol dm^{-3} s^{-1} (B) 0.02 mol dm^{-3} s^{-1}

(C) 0.03 mol dm^{-3} s^{-1} (D) 0.04 mol dm^{-3} s^{-1}

86. Which from following complexes contains only neutral ligands in it?

(A) Pentaammineaquacobalt(III) chloride

(B) Triamminetrithiocyanatorhodium(III)

(C) Bis(ethylenediamine) dithiocyanatoplatinum(IV)

(D) Triamminetrinitrocobalt(III)

87. What is the number of moles of carbon atoms present in n mole molecules of an alkane if it exhibits five structural isomers?

(A) 4n (B) 3n

(C) 5n (D) 6n

88. Identify the product ' B ' in the following sequence of reactions.

$$CH_3MgBr \xrightarrow{CdCl_2} A \xrightarrow{CH_3COCl_1} B$$

(A) Dimethyl cadmium (B) Propanone

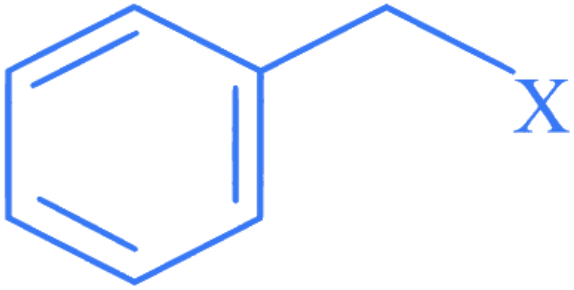
(C) Butanone (D) Propanal

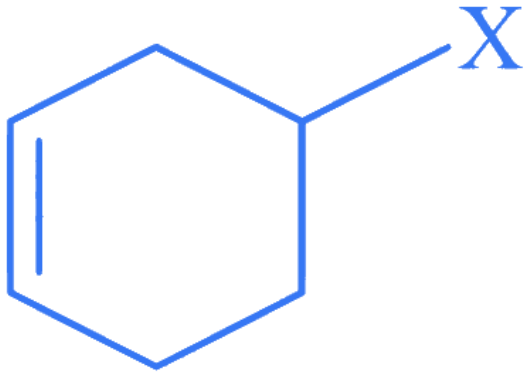
89. Rate law for the reaction $2NO + Cl_2 \rightarrow 2NOCl$ is rate $= k[NO]^2\,[Cl_2]$. When will the value of k increase?

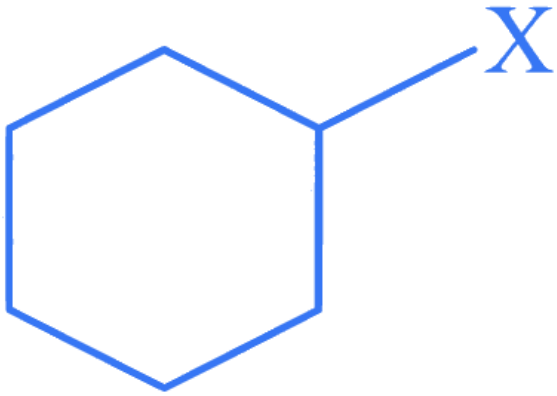
(A) by increasing temperature (B) by increasing [NO]

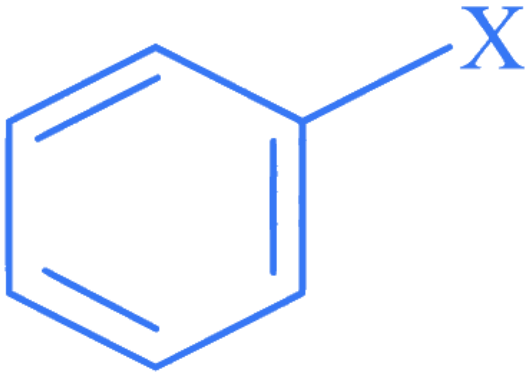
(C) by increasing $[Cl_2]$ (D) by increasing both [NO] and $[Cl_2]$

90. Which among the following is haloarene?

(A) 

(B) 

(C) 

(D) 

91. What is energy associated with fourth orbit of hydrogen atom?

$\left(R_H = 2.18 \times 10^{-18}\ J\right)$

(A) -0.436×10^{-18} J (B) -0.545×10^{-18} J

(C) -0.242×10^{-18} J (D) -0.136×10^{-18} J

92. Identify glycosidic linkages for formation of chain and branches respectively in amylopectin.

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

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

93. Which from following species does not have number of electrons similar to other three species?

(A) Ne (B) O^{--}

(C) Na (D) Na^{+}

94. What is the name of tert-butyl alcohol according to carbinol system?

(A) Methyl carbinol (B) Ethyl carbinol

(C) Propyl carbinol (D) Trimethyl carbinol

95. Identify the element having outer electronic configuration ns^2np^5.

(A) I (B) Te

(C) Ar (D) Ne

96. What is the mass in kg of 5 mole of acetic acid $\left(\text{mol. mass} = 60\ \text{g mol}^{-1}\right)$?

(A) 0.3 kg (B) 3.0 kg

(C) 30 kg (D) 300 kg

97. A solution of non volatile solute is obtained by dissolving 2 g in 50 g benzene. Calculate the vapour pressure of solution if vapour pressure of pure benzene is 640 mmHg at 25°C. [mol. mass of benzene $= 78\ \text{g mol}^{-1}$, mol. mass of solute $= 64\ \text{g mol}^{-1}$]

(A) 600.21 mm Hg (B) 604.52 mm Hg

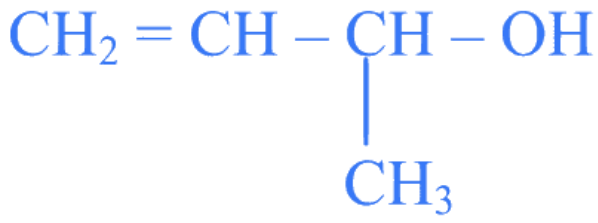
(C) 608.64 mm Hg (D) 612.83 mm Hg

98. A gas absorbs certain amount of heat and expands by 200 cm^3 against a constant external pressure of $2 \times 10^5 Nm^{-2}$. What is work done by system?

(A) -400.3 J (B) -40.53 J

(C) -3.947 J (D) -253.1 J

99. Which of the following is primary allylic alcohol?



(A)

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

(C) $CH_2 = CH - C(CH_3)_2 - OH$

(D) $CH_3 - CH = CH - CH_2 - CH_2 - OH$

100. Identify elements present in copper pyrites.

(A) Cu, K, S

(B) Mg, Cu, P

(C) Ca, S, O

(D) Fe, Cu, S

101. The vector equation of a line whose Cartesian equations are $y = 2, 4x - 3z + 5 = 0$ is

(A) $\bar{r} = (3\hat{i} + 4k) + \lambda(2\hat{j} + \frac{5}{3}\hat{k})$

(B) $\bar{r} = (3\hat{i} + 4k) + \lambda(2\hat{j} - \frac{5}{3}\hat{k})$

(C) $\bar{r} = (2\hat{j} + \frac{5}{3}\hat{k}) + \lambda(3\hat{i} + 4k)$

(D) $\bar{r} = (2\hat{j} - \frac{5}{3}\hat{k}) + \lambda(3\hat{i} + 4k)$

102. If 3 books on Physics, 2 books on Chemistry and 4 books on Mathematics are to be arranged on a shelf so that all the Physics books are together and all the Mathematics books are together, then the number of such arrangements is

(A) 576 (B) 288

(C) 3456 (D) 1152

103. The value of $\lim_{x\to 0} \frac{x}{|x|+x^2}$ is

(A) 1 (B) -1

(C) 0 (D) does not exist

104. Let $\bar{a} = 2\hat{i} + \hat{j} - 2\hat{k}$ and $\bar{b} = \hat{i} + \hat{j}$. Let $\bar{c}$ be a vector such that $|\bar{c} - \bar{a}| = 3$ and $|(\bar{a} \times \bar{b}) \times \bar{c}| = 3$ and the angle between $\bar{c}$ and $\bar{a} \times \bar{b}$ is $30°$, then $\bar{a} \cdot \bar{c}$ is equal to

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

(C) $\frac{25}{8}$ (D) 5

105. The value of $\cos\left(2\cos^{-1}x + \sin^{-1}x\right)$ at $x = \frac{1}{5}$ where $0 \le \cos^{-1}x \le \pi$ and $-\frac{\pi}{2} \le \sin^{-1}x \le \frac{\pi}{2}$, is

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

(C) $\frac{2\sqrt{6}}{5}$ (D) $-\frac{2\sqrt{6}}{5}$

106. Considering only the principal values of inverse function, the set

$$A = \left\{x \ge 0 / \tan^{-1}(2x) + \tan^{-1}(3x) = \frac{\pi}{4}\right\}$$

(A) is an empty set. (B) is a singleton set.

(C) contains more than two elements. (D) contains two elements.

107. The slopes of the lines given by $x^2 + 2hxy + 2y^2 = 0$ are in the ratio $1 : 2$, then h is

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

(C) 3 (D) 1

108. If $y = \left[e^{4x}\left(\frac{x-4}{x+3}\right)^{\frac{3}{4}}\right]$ then $\frac{dy}{dx} =$

(A) $\frac{dy}{dx} = y[4 + \frac{21}{4(x-4)(x+3)}]$

(B) $\frac{dy}{dx} = [4 + \frac{21}{4(x-4)(x+3)}]$

(C) $\frac{dy}{dx} = \frac{1}{y}[4 + \frac{21}{4(x-4)(x+3)}]$

(D) $\frac{dy}{dx} = y[4 + \frac{21}{4(x+4)(x+3)}]$

109.

$$\int 3^{3^x} \cdot 3^x dx =$$

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

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

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

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

110. If $f(x) = \frac{1+\cos \pi x}{\pi(1-x)^2}$, for $x \neq 1$ is continuous at $x = 1$, then $f(1)$ is equal to

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

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

111. The length of the longest interval, in which the function $3\sin x - 4\sin^3 x$ is increasing, is

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

(C) $\frac{3\pi}{2}$ (D) π

112. The scalar $\bar{a} \cdot [(\bar{b} + \bar{c}) \times (\bar{a} + \bar{b} + \bar{c})]$ equals

(A) 0 (B) $[\bar{a}\bar{b}\bar{c}] + [\bar{b}\bar{c}\bar{a}]$

(C) $[\bar{a}\bar{b}\bar{c}]$ (D) 1

113. The volume of parallelopiped formed by vectors $\hat{i} + m\hat{j} + \hat{k}, \hat{j} + m\hat{k}$ and $m\hat{i} + \hat{k}$ becomes minimum when m is

(A) 2 (B) 3

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

114. If the vectors $\bar{a} = \hat{i} - \hat{j} + 2\hat{k}, \bar{b} = 2\hat{i} + 4\hat{j} + \hat{k}$ and $\bar{c} = mi + j + nk$ are mutually perpendicular, then (m, n) is

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

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

115.

$$\int \log(1+x)^{1+x}\,dx =$$

(A) $(1+x)^2\log(1+x) - \frac{1}{2} + c$, where c is a constant of integration.

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

(C) $\frac{(1+x)^2}{2}[\log(1+x) - \frac{1}{2}] + c$, where c is a constant of integration.

(D) $\frac{1+x}{2}\log(1+x) + c$, where c is a constant of integration.

116.

$$\int \left(\frac{x+2}{x+4}\right)^2 \cdot e^x\,dx =$$

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

(B) $e^x(\frac{x+2}{x+4}) + c$, where c is a constant of integration.

(C) $e^x(\frac{x-2}{x+4}) + c$, where c is a constant of integration.

(D) $e^x(\frac{2x}{x+4}) + c$, where c is a constant of integration.

117. In $\triangle ABC$, with usual notations, if $\frac{1}{b+c} + \frac{1}{c+a} = \frac{3}{a+b+c}$, then $m\angle C$ is equal to

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

(C) $\frac{\pi}{4}$ (D) $\frac{\pi}{6}$

118. If $a > 0$ and $z = \frac{(1+i)^2}{a-i}, i = \sqrt{-1}$, has magnitude $\sqrt{\frac{2}{5}}$ then $\bar{z}$ is equal to

(A) $\frac{1}{5} - \frac{3}{5}i$ (B) $-\frac{1}{5} - \frac{3}{5}i$

(C) $-\frac{1}{5} + \frac{3}{5}i$ (D) $-\frac{3}{5} - \frac{1}{5}i$

119. A bag contains 4 Red and 6 Black balls. A ball is drawn at random from the bag, its colour is observed and this ball along with 3 additional balls of the same colour are returned to the bag. If now a ball is drawn at random from the bag, then the probability that this drawn ball is red is

(A) $\frac{41}{65}$ (B) $\frac{24}{65}$

(C) $\frac{26}{65}$ (D) $\frac{28}{65}$

120. Let K be the set of all real values of x, where the function $f(x) = \sin|x| - |x| + 2(x-\pi)\cos|x|$ is not differentiable. Then the set K is

(A) $\{0\}$ (B) an empty set

(C) $\{\pi\}$ (D) $\{0, \pi\}$

121. Let f and g be continuous functions on $[0, a]$ such that $f(x) = f(a-x)$ and $g(x) + g(a-x) = 4$, then $\int_0^a f(x)g(x)dx$ is equal to

(A) $4\int_0^a f(x)dx$ (B) $\int_0^a f(x)dx$

(C) $2\int_0^a f(x)dx$ (D) $-3\int_0^a f(x)dx$

122. The principal solutions, of the equation $\sqrt{3}\sec x + 2 = 0$, are

(A) $\frac{2\pi}{3}, \frac{4\pi}{3}$ (B) $\frac{4\pi}{3}, \frac{5\pi}{3}$

(C) $\frac{5\pi}{6}, \frac{7\pi}{6}$ (D) $\frac{7\pi}{6}, \frac{11\pi}{6}$

123. The number of real solutions of $\tan^{-1}\sqrt{x(x+1)} + \sin^{-1}\sqrt{x^2+x+1} = \frac{\pi}{2}$ is

(A) zero. (B) one.

(C) two. (D) infinite.

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

(A) -8 (B) 8

(C) 10 (D) $\frac{8}{3}$

125. The solution of the differential equation $\frac{dy}{dx} = (x-y)^2$ when $y(1) = 1$ is

(A) $\log|\frac{2-y}{2-x}| = 2(y-1)$

(B) $-\log|\frac{1+x-y}{1-x+y}| = x + y - 2$

(C) $\log|\frac{2-x}{2-y}| = x - y$

(D) $-\log|\frac{1-x+y}{1+x-y}| = 2(x-1)$

126. If x_0 is the point of local minima of $f(x) = \bar{a}\cdot(\bar{b}\times\bar{c})$ where $\bar{a} = x\hat{i} - 2\hat{j} + 3\hat{k}$, $\bar{b} = -2\hat{i} + x\hat{j} - \hat{k}, \bar{c} = 7\hat{i} - 2\hat{j} + x\hat{k}$, then value of $\bar{a}\cdot\bar{b}$ at $x = x_0$ is

(A) -3 (B) -15

(C) -12 (D) -9

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

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

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

128. For a suitable chosen real constant a, let a function $f : \mathbb{R} - \{-a\} \to \mathbb{R}$ be defined by $f(x) = \frac{a-x}{a+x}$. Further suppose that for any real number $x \neq -a$ and $f(x) \neq -a$, $(fof)(x) = x$. Then $f\left(-\frac{1}{5}\right)$ is equal to

(A) 1.5 (B) 2.0

(C) 1.0 (D) 3.0

129. If the statement $p \vee \sim (q \wedge r)$ is false, then the truth values of p, q and r are respectively

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

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

130. If $\left(m_i, \frac{1}{m_i}\right), m_i > 0, i = 1, 2, 3, 4$ are four distinct points on a circle, then the product $m_1\ m_2\ m_3\ m_4$ is equal to

(A) -1 (B) 1

(C) 0 (D) 2

131. If two lines $x + (a-1)y = 1$ and $2x + a^2y = 1 (a \in R - \{0, 1\})$ are perpendicular, then the distance of their point of intersection from the origin is

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

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

132. If $x\frac{dy}{dx} = y(\log y - \log x + 1)$, then general solution of this equation is

(A) $\log(\frac{x}{y}) = cy$, where c is a constant of integration.

(B) $\log(\frac{x}{y}) = cx$, where c is a constant of integration.

(C) $\log(\frac{y}{x}) = cy$, where c is a constant of integration.

(D) $\log(\frac{y}{x}) = cx$, where c is a constant of integration.

133. A spherical metal ball at 80°C cools in 5 minutes to 60°C, in surrounding temperature of 20°C, then the temperature of the ball after 20 minutes is approximately

(A) (8.15)°C (B) (11.85)°C

(C) (28.15)°C (D) (31.85)°C

134. If a discrete random variable X takes values $0, 1, 2, 3, \ldots\ldots$ with probability $P(X = x) = k(x+1)5^{-x}$, where k is a constant, then $P(X = 0)$ is

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

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

135. The Cartesian equation of the plane, passing through the points $(3, 1, 1), (1, 2, 3)$ and $(-1, 4, 2)$, is

(A) $5x + 6y - 2z - 23 = 0$

(B) $-5x + 6y + 2z + 23 = 0$

(C) $5x + 6y + 2z - 23 = 0$

(D) $5x - 6y + 2z - 23 = 0$

136. The equation of the line passing through the point $(-1, 3, -2)$ and perpendicular to each of the lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and $\frac{x+2}{-3} = \frac{y-1}{2} = \frac{z+1}{5}$, is

(A) $\frac{x+1}{2} = \frac{y-3}{7} = \frac{z+2}{4}$ (B) $\frac{x+1}{-2} = \frac{y-3}{-7} = \frac{z+2}{4}$

(C) $\frac{x+1}{2} = \frac{y-3}{7} = \frac{z+2}{-4}$ (D) $\frac{x+1}{2} = \frac{y-3}{-7} = \frac{z+2}{4}$

137. If $y = a\sin x + b\cos x$ (where a and b are constants), then $y^2 + \left(\frac{dy}{dx}\right)^2$ is

(A) a function of x. (B) a function of x and y.

(C) a function of y. (D) a constant.

138. If Rolle's theorem holds for the function $f(x) = x^3 + bx^2 + ax + 5$ on $[1, 3]$ with $c = 2 + \frac{1}{\sqrt{3}}$, then the values of a and b respectively are

(A) $-11, 6$ (B) $-11, -6$

(C) $11, 6$ (D) $11, -6$

139. Ten bulbs are drawn successively, with replacement, from a lot containing 10% defective bulbs, then the probability that there is at least one defective bulb, is

(A) $1 - (\frac{1}{10})^{10}$ (B) $1 - (\frac{3}{10})^{10}$

(C) $1 - (\frac{9}{10})^{10}$ (D) $1 - (\frac{7}{10})^{10}$

140. If statement I : If the work is not finished on time, the contractor is in trouble. statement II : Either the work is finished on time or the contractor is in trouble. then

(A) statement II is negation of statement I.

(B) statement II is converse of statement I.

(C) statement II and statement I are equivalent.

(D) statement II is an inverse of statement I.

141. The value of $\sin\left(2\cos^{-1}\left(-\frac{3}{5}\right)\right)$ is

(A) $\frac{24}{25}$ (B) $-\frac{24}{25}$

(C) $\frac{8}{25}$ (D) $-\frac{8}{25}$

142. If $y = \sqrt{\frac{1-\sin^{-1}x}{1+\sin^{-1}x}}$, then $\left(\frac{dy}{dx}\right)$ at $x = 0$ is

(A) 1 (B) 2

(C) -2 (D) -1

143. The point, at which the maximum value of $10x + 6y$ subject to the constraints $x + y \leq 12$, $2x + y \leq 20, x \geq 0, y \geq 0$ occurs, is

(A) $(10, 0)$ (B) $(8, 4)$

(C) $(0, 12)$ (D) $(12, 0)$

144. If the line $\frac{x-3}{2} = \frac{y+2}{-1} = \frac{z+4}{3}$ lies in the plane $\ell x + my - z = 9$, then $\ell^2 + m^2$ is

(A) 1 (B) 4

(C) 2 (D) 5

145. The mean of 100 observations is 50 and their standard deviation is 5 , then the sum of all squares of all the observations is

(A) 252500 (B) 250500

(C) 250000 (D) 255000

146. The area of the region bounded by hyperbola $x^2 - y^2 = 9$ and its latus rectum is

(A) $9[\sqrt{2} - \log(\sqrt{2} + 1)]$ sq. units

(B) $4[\sqrt{2} - \log(\sqrt{2} + 1)]$ sq. units

(C) $3[\sqrt{2} - \log(\sqrt{2} + 1)]$ sq. units

(D) $18[\sqrt{2} - \log(\sqrt{2} + 1)]$ sq. units

147. $\int \frac{dx}{3-2\cos 2x} = \frac{\tan^{-1}(f(x))}{\sqrt{5}} + c$, (where c is a constant of integration), then $f(\pi/4)$ has the value

(A) $-\sqrt{5}$ (B) $\sqrt{5}$

(C) $\frac{2}{\sqrt{5}}$ (D) $\frac{1}{\sqrt{5}}$

148. The normal to the curve, $y(x-2)(x-3) = x + 6$ at the point, where the curve intersects the Y-axis, passes through the point

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

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

149. For all real x, the vectors $Cx\hat{i} - 6\hat{j} - 3\hat{k}$ and $x\hat{i} + 2\hat{j} + 2Cx\hat{k}$ make an obtuse angle with each other, then the value of C can be in

(A) $(0, 1)$ (B) $(-2, \frac{-4}{3})$

(C) $(\frac{-4}{3}, 0)$ (D) $(0, \frac{4}{3})$

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

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

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

- End of Question Paper -