MHT CET 2023 PCM May 12 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 2023**, 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 glass prism deviates the red and violet rays through 9° and 11° respectively. A second prism of equal angle deviates them through 11° and 13° respectively. The ratio of dispersive power of second prism to first prism is

(A) 5 : 6 (B) 6 : 5

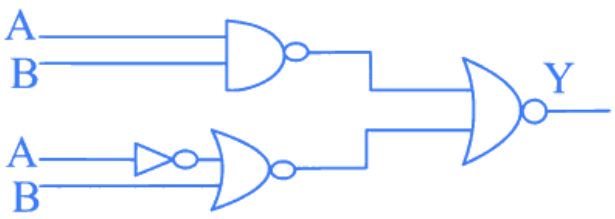
(C) 9 : 13 (D) 13 : 9

2. Eight small drops of mercury each of radius 'r', coalesce to form a large single drop. The ratio of total surface energy before and after the change is

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

(C) 1 : 4 (D) 1 : 8

3. In the following digital logic circuit, the output Y will be '1' for inputs



(A) A = 0, B = 0 (B) A = 0, B = 1

(C) A = 1, B = 0 (D) A = 1, B = 1

4. Two different radioactive elements with half lives 'T_1' and 'T_2' have undecayed atoms 'N_1' and 'N_2' respectively present at a given instant. The ratio of their activities at that instant is

(A) $\frac{N_1 T_1}{N_2 T_2}$ (B) $\frac{N_2 T_2}{N_1 T_1}$

(C) $\frac{N_1 T_2}{N_2 T_1}$ (D) $\frac{N_1 N_2}{T_1 T_2}$

5. The equation of wave motion is

$$Y = 5\sin(10\pi t - 0.02\pi x + \pi/3)$$

where x is in metre and t in second. The velocity of the wave is

(A) 300 m/s (B) 400 m/s

(C) 500 m/s (D) 600 m/s

6. A potentiometer wire of length 4 m and resistance 5 Ω is connected in series with a resistance of 992 Ω and a cell of e.m.f. 4 V with internal resistance 3 Ω. The length of 0.75 m on potentiometer wire balances the e.m.f. of

(A) 4.00 mV (B) 3.75 mV

(C) 3.00 mV (D) 2.50 mV

7. Select the correct statement from the following.

(A) Gravitational force is stronger than electrostatic force

(B) Gravitational as well as electrostatic force always attractive.

(C) Gravitational as well as electrostatic force always act along the line joining the two objects.

(D) Inverse square law ($F \propto \frac{1}{r^2}$) is not obeyed by electrostatic force.

8. End correction at open end for air column in a pipe of length 'l' is 'e'. For its second overtone of an open pipe, the wavelength of the wave is

(A) $\frac{2(l+e)}{3}$ (B) $\frac{2(l+2e)}{3}$

(C) $\frac{4(l+e)}{5}$ (D) $\frac{4(l+2e)}{5}$

9. In a stationary lift, time period of a simple pendulum is 'T'. The lift starts accelerating downwards with acceleration

$$\left(\frac{g}{4}\right)$$

, then the time period of the pendulum will be

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

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

10. A body is projected vertically upwards from earth's surface of radius 'R' with velocity equal to

$$\frac{1^{rd}}{3}$$

of escape velocity. The maximum height reached by the body is

(A) $\frac{R}{8}$ (B) $\frac{R}{6}$

(C) $\frac{R}{4}$ (D) $\frac{R}{9}$

11. Which one of the following statements is WRONG regarding LED?

(A) LEDs are energy efficient

(B) LEDs have long time if properly manufactured.

(C) Brightness of light emitted by LED cannot be controlled.

(D) Colours produced by LED do not fade out.

12. A thin wire of length 'L' and uniform linear mass density 'm' is bent into a circular coil. The moment of inertia of this coil about tangential axis and in plane of the coil is

(A) $\frac{3\,mL^2}{5\pi^2}$ (B) $\frac{3\,mL^3}{8\pi^2}$

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

13. A black body radiates maximum energy at wavelength 'λ' and its emissive power is 'E'. Now due to a change in temperature of that body, it radiates maximum energy at wavelength

$$\frac{\lambda}{3}$$

. At that temperature emissive power is

(A) 16 : 1 (B) 256 : 1

(C) 81 : 1 (D) 128 : 1

14. If the charge on the capacitor is increased by 3 coulombs, the energy stored in it increases by 44%. The original charge on the capacitor is

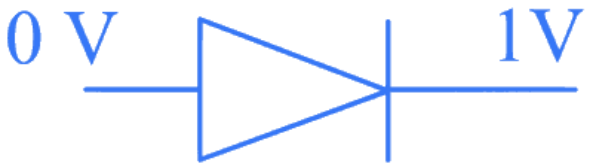
(A) 10 C (B) 15 C

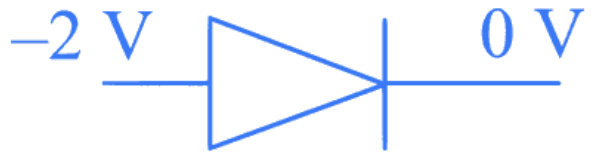
(C) 20 C (D) 25 C

15. In which figure, the junction diode is forward biased?

(A) 

(B) 

(C) 

(D) 

16. A particle starts from mean position and performs S.H.M. with period 4 second. At what time its kinetic energy is 50% of total energy?

$$\left(\cos 45^\circ = \frac{1}{\sqrt{2}}\right)$$

(A) 0.1 s (B) 0.2 s

(C) 0.4 s (D) 0.5 s

17. For polyatomic gases, the ratio of molar specific heat at constant pressure to constant volume is (f = degrees of freedom)

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

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

18. A particle is moving in a circle with uniform speed 'v'. In moving from a point to another diametrically opposite point

(A) the momentum changes by mv (B) the momentum changes by 2 mv

(C) the kinetic energy changes by $\frac{1}{2}mv^2$ (D) the kinetic energy changes by mv^2

19. Select the WRONG statement from the following. For an isothermal process

(A) Energy exchanged is used to do work (B) Perfect thermal equilibrium with environment

(C) Equation of state PV is not constant. (D) No change internal energy.

20. Two concentric circular coils of 10 turns each are situated in the same plane. Their radii are 20 cm and 40 cm and they carry respectively 0.2 A and 0.3 A current in opposite direction. The magnetic field at the centre is ($\mu_0 = 4\pi \times 10^{-7}$ SI units)

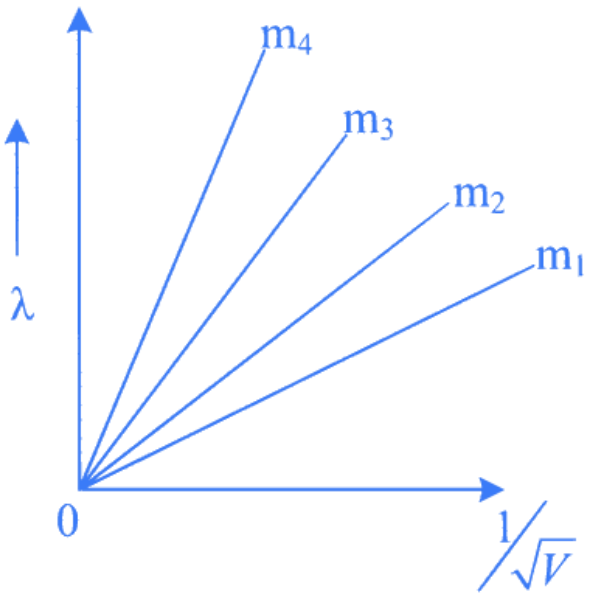
(A) $4\pi \times 10^{-7}$ T (B) $5\pi \times 10^{-7}$ T

(C) $2\pi \times 10^{-5}$ T (D) $7\pi \times 10^{-6}$ T

21. Graph shows the variation of de-Broglie wavelength (λ) versus

$$\frac{1}{\sqrt{V}}$$

where 'V' is the accelerating potential for four particles A, B, C, D carrying same charge but of masses m_1, m_2, m_3, m_4. Which on represents a particle of largest mass?



(A) m_1 (B) m_2

(C) m_3 (D) m_4

22. SI units of self inductance is

(A) $\frac{V-A}{S}$ (B) $\frac{V}{A-S}$

(C) $\frac{V-S}{A}$ (D) $\frac{A}{V-S}$

23. When an inductor 'L' and a resistor 'R' in series are connected across a 15 V, 50 Hz a.c. supply, a current of 0.3 A flows in the circuit. The current differs in phase from applied voltage by

$$\left(\frac{\pi}{3}\right)^c$$

. The value of 'R' is

$$\left(\sin\frac{\pi}{6}=\cos\frac{\pi}{3}=\frac{1}{2}, \sin\frac{\pi}{3}=\cos\frac{\pi}{6}=\frac{\sqrt{3}}{2}\right)$$

(A) 10Ω (B) 15Ω

(C) 20Ω (D) 25Ω

24. When an electron is accelerated through a potential 'V', the de-Broglie wavelength associated with it is '4λ'. When the accelerating potential is increased to 4 V, its wavelength will be

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

(C) λ (D) 2λ

25. Compare the rate of loss of heat from a metal sphere at 627°C with the rate of loss of heat from the same sphere at 327°C, if the temperature of the surrounding is 27°C. (nearly)

(A) 6.2 (B) 5.3

(C) 4.8 (D) 7.4

26. In Balmer series, wavelength of the 2nd line is 'λ_1' and for Paschen series, wavelength of the 1st line is 'λ_2', then the ratio 'λ_1' to 'λ_2' is

(A) 5 : 128 (B) 5 : 81

(C) 7 : 27 (D) 9 : 132

27. A coil of 'n' turns and radius 'R' carries a current 'I'. It is unwound and rewound again to make another coil of radius

$$\left(\frac{R}{3}\right)$$

, current remaining the same. The ratio of magnetic moment of the new coil to that of original coil is

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

(C) 9 : 1 (D) 1 : 9

28. An ink mark is made on a piece of paper on which a glass slab of thickness 't' is placed. The ink mark appears to be raised up through a distance 'x' when viewed at nearly normal incidence. If the refractive index of the material of glass slab is 'μ' then the thickness of glass slab is given by

(A) $\frac{\mu x}{\mu-1}$ (B) $\frac{(\mu-1)}{\mu}$

(C) $\frac{\mu-1}{\mu x}$ (D) $\frac{\mu}{(\mu-1)x}$

29. A spherical metal ball of radius 'r' falls through viscous liquid with velocity 'V'. Another metal ball of same material but of radius

$$\left(\frac{r}{3}\right)$$

falls through same liquid, then its terminal velocity will be

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

(C) $\frac{V}{6}$ (D) $\frac{V}{9}$

30. A body of mass 'm' attached at the end of a string is just completing the loop in a vertical circle. The apparent weight of the body at the lowest point in its path is (g = gravitational acceleration)

(A) zero (B) mg

(C) 3 mg (D) 6 mg

31. Select the WRONG statement from the following. In a streamline flow

(A) velocity of a fluid at a given point is never constant.
(B) velocity is smaller than critical velocity.
(C) layers are always parallel.
(D) the particles do not move in random direction.

32. Two point charges '$q1$' and '$q2$' are separated by a distance 'd'. What is the increase in potential energy of the system when '$q2$' is moved towards '$q1$' by a distance 'x' ?

$$(x < d)(\frac{1}{4\pi\varepsilon_0} = K$$

, constant)

(A) $-\frac{Kq_1q_2x}{d(d-x)}$
(B) $-\frac{Kq_1q_2}{d(d-x)}$
(C) $\frac{Kq_1q_2x}{(d^2-x^2)}$
(D) $\frac{Kq_1q_2x}{(d^2-x^2)}$

33. The ratio of intensities of two points on a screen in Young's double slit experiment when waves from the two slits have a path difference of

$$\frac{\lambda}{4}$$

and

$$\frac{\lambda}{6}$$

is

$$(\cos 90^\circ = 0, \cos 60^\circ = 0.5)$$

(A) 2 : 1
(B) 2 : 3
(C) 3 : 4
(D) 3 : 5

34. A simple pendulum is oscillating with frequency 'F' on the surface of the earth. It is taken to a depth

$$\frac{R}{3}$$

below the surface of earth. (

$$R =$$

radius of earth). The frequency of oscillation at depth R/3 is

(A) $\frac{2F}{3}$
(B) $\frac{F}{\sqrt{1.5}}$
(C) F
(D) $\frac{F}{3}$

35. An a.c. source of 15 V, 50 Hz is connected across an inductor (L) and resistance (R) in series R.M.S. current of 0.5 A flows in the circuit. The phase difference between applied voltage and current is

$$\left(\frac{\pi}{3}\right)$$

radian. The value of resistance (R) is

$$\left(\tan 60^\circ = \sqrt{3}\right)$$

(A) 10Ω
(B) 12Ω
(C) 15Ω
(D) 20Ω

36. A ball is projected vertically upwards from ground. It reaches a height 'h' in time t_1, continues its motion and then takes a time t_2 to reach ground. The height h in terms of g, t_1 and t_2 is

(g =

acceleration due to gravity)

(A) $\frac{1}{2}\frac{gt_1}{t_2}$
(B) $\frac{1}{2}gt_1t_2$
(C) gt_1t_2
(D) $2\ gt_1t_2$

37. The volume of a metal block increases by 0.225% when its temperature is increased by 30°C . Hence coefficient of linear expansion of the material of metal block is

(A) $7.5 \times 10^{-5}/^\circ$C.
(B) $6.75 \times 10^{-5}/^\circ$C.
(C) $2.5 \times 10^{-5}/^\circ$C.
(D) $1.5 \times 10^{-5}/^\circ$C.

38. A tuning fork gives 3 beats with 50 cm length of sonometer wire. If the length of the wire is shortened by 1 cm, the number of beats is still the same. The frequency of the fork is

(A) 256 Hz
(B) 288 Hz
(C) 297 Hz
(D) 320 Hz

39. The depth at which acceleration due to gravity becomes

$$\frac{g}{2n}$$

is

(R =

radius of earth,

g =

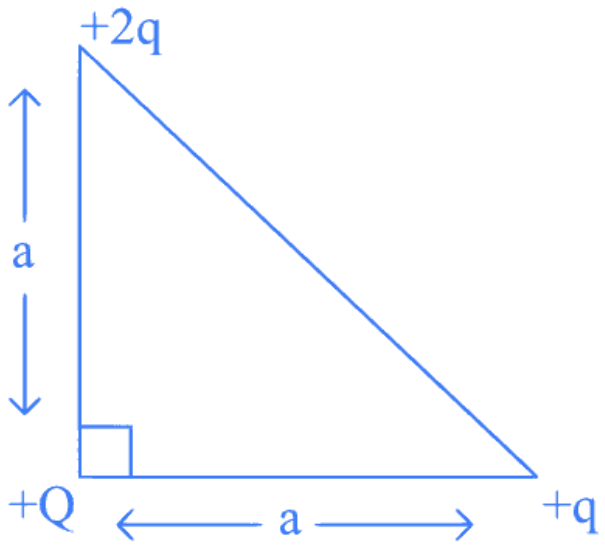
acceleration due to gravity on earth's surface, n is integer)

(A) $\frac{R(1-2n)}{n}$
(B) $\frac{R(1-n)}{2n}$
(C) $\frac{R(n-1)}{n}$
(D) $\frac{R(2n-1)}{2n}$

40. Two resistance X and Y are connected in the two gaps of a meterbridge and the null points is obtained at 20 cm from zero end. When the resistance of 20Ω is connected in series with the smaller of the two resistance X and Y, the null point shifts to 40 cm from left end. The value of smaller resistance in ohm is

(A) 6 (B) 9
(C) 12 (D) 15

41. Three point charges $+Q, +2q$ and $+q$ are placed at the vertices of a right angled isosceles triangle. The net electrostatic potential energy of the configuration is zero, if Q is equal to



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

42. Resistor of 2Ω, inductor of 100μH and capacitor of 400pF are connected in series across a source of

$$e_{rms} = 0.1$$

Volt. At resonance, voltage drop across inductor is

(A) 25 V (B) 2.5 V
(C) 250 V (D) 20 V

43. An electron makes a full rotation in a circle of radius 0.8 m in one second. The magnetic field at the centre of the circle is

$$\left(\mu_0 = 4\pi \times 10^{-7}\right.$$

SI units)

(A) $4\pi \times 10^{-26}$ T (B) $2\pi \times 10^{-26}$ T
(C) $4\pi \times 10^{-19}$ T (D) $2\pi \times 10^{-19}$ T

44. In Young's double slit experiment when a glass plate of refractive index 1.44 is introduced in the path of one of the interfering beams, the fringes are displaced by a distance 'y'. If this plate is replaced by another plate of same thickness but of refractive index 1.66, the fringes will be displaced by a distance

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

45. A monoatomic ideal gas initially at temperature 'T_1' is enclosed in a cylinder fitted with massless, frictionless piston. By releasing the piston suddenly the gas is allowed to expand to adiabatically to a temperature 'T_2'. If 'L_1' and 'L_2' are the lengths of the gas columns before and after expansion respectively, then

$$\frac{T_2}{T_1}$$

is

(A) $\frac{L_1}{L_2}$ (B) $\frac{L_2}{L_1}$
(C) $(\frac{L_1}{L_2})^{2/3}$ (D) $(\frac{L_2}{L_1})^{2/3}$

46. A tuning fork of frequency 220 Hz produces sound waves of wavelength 1.5 m in air at N.T.P. The increase in wavelength when the temperature of air is 27°C is nearly

$$\left(\sqrt{\frac{300}{273}} = 1.05\right)$$

(A) 0.06 m (B) 0.10 m
(C) 0.09 m (D) 0.07 m

47. An air craft of wing span 40 m files horizontally in earth's magnetic field 5×10^{-5} T at a speed of 500 m/s. The e.m.f. generated between the tips of the wings of the air craft is

(A) 0.5 V (B) 1 V
(C) 1.2 V (D) 1.5 V

48. In P^{th} second, a particle describes angular displacement of 'β' rad. If it starts from rest, the angular acceleration is

(A) $\frac{\beta}{P}$ (B) $\frac{\beta}{(P-1)}$
(C) $\frac{2\beta}{(2P-1)}$ (D) $\frac{(2\beta+1)}{(2P-1)}$

49. Inductance per unit length near the middle of a long solenoid is (μ_0 = permeability of free space, n = number of turns per unit length, d = the diameter of the solenoid)

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

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

50. One of the slits in Young's double slit experiment is covered with a transparent sheet of thickness 2.9×10^{-3} cm. The central fringe shifts to a position originally occupied by the 25^{th} bright fringe. If $\lambda = 5800 \overset{o}{A}$, the refractive index of the sheet is

(A) 1.65 (B) 1.60

(C) 1.55 (D) 1.50

51. Which of the following expressions represents molar conductivity of AB_3 type electrolyte?

(A) $3\lambda^{\circ}_{A^{\cdots}} + \lambda^{\circ}_{B^-}$ (B) $\lambda^{\circ}_{A^{\cdots}} + \lambda^{\circ}_{B^-}$

(C) $\lambda^{\circ}_{A^{\cdots}} + 3\lambda^{\circ}_{B^-}$ (D) $2\lambda^{\circ}_{A^{\cdots}} + \lambda^{\circ}_{B^-}$

52. What is the mass of $KClO_{3(s)}$ required to liberate 22. 4 dm^3 oxygen at STP during thermal decomposition?
(Molar Mass of $KClO_{3(s)} = 122.5$ g/mol)

(A) 122.5 g (B) 81.67 g

(C) 10.25 g (D) 8.16 g

53. Identify product B in the following reaction.

$$\text{Aniline} \xrightarrow[273\ K]{NaNO_2 + HCl} A \xrightarrow[\Delta]{H_2O} B + N_2\uparrow$$

(A) Chlorobenzene (B) Benzyl alcohol

(C) Benzenediazonium chloride (D) Phenol

54. If 0.15 m aqueous solution of KCI freezes at $-0.511^{\circ}C$, calculate van't Hoff factor of KCI (cryoscopic constant of water is 1.86 K kg mol^{-1})

(A) 1.45 (B) 1.26

(C) 1.82 (D) 3.00

55. Which among the following is NOT the feature of reversible process?

(A) The driving and opposing forces differ by large amount. (B) The process can be reversed by infinitesimal change in pressure.

(C) A reversible process proceeds very slowly. (D) The system attains mechanical equilibrium at the end of every step.

56. Which from following functional groups is at the lowest order to decide principal functional group in polyfunctional compound?

(A) $-COOR$ (B) $-COCl$

(C) $> C = O$ (D) $-CONH_2$

57. Calculate the E_{cell} for
$Zn_{(s)}|Zn^{++}_{(0.1M)}||Cr^{+++}_{(0.1M)}|Cr_{(s)}$
at 25°C if E°_{cell} is 0.02 V

(A) -0.05 V (B) 0.03 V

(C) -0.06 V (D) 0.07 V

58. Which from following formulae is of galena?

(A) $CaSO_4 \cdot 2H_2O$ (B) PbS

(C) ZnS (D) $BaSO_4$

59. What is the solubility of $AgCl_{(s)}$ if its solubility product is 1.6×10^{-10} ?

(A) 1.26×10^{-5}M (B) 1.00×10^{-9}M

(C) 2.6×10^{-5}M (D) 1.56×10^{-9}M

60. Which from following nanoparticle catalysts is used in photocatalysis?

(A) TiO_2 (B) Pd

(C) Pt (D) Au

61. A gas absorbs 150 J heat and expands by 300 cm^3 against a constant external pressure 2×10^5 N m^{-2}, What is ΔU of the system?

(A) 210 J (B) 90 J

(C) 450 J (D) -300 J

62. A first order reaction takes 23.03 minutes 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) 9.69×10^{-3} $minute^{-1}$

63. Which among the following is dicarboxylic acid?

(A) Valeric acid (B) Caproic acid

(C) Glutaric acid (D) Butyric acid

64. Which from following elements belongs to group 17 of periodic table?

(A) At (B) Zn

(C) As (D) Te

65. What is the number of moles of donor atoms in n mole of NO_2^- ?

(A) 3n (B) 0

(C) 2n (D) n

66. Calculate the density of an element having molar mass 27 g mol^{-1} that forms fcc unit cell.

$$\left[a^3 \cdot N_A = 38.5\ cm^3\ mol^{-1}\right]$$

(A) 2.8 g cm^{-3} (B) 3.5 g cm^{-3}

(C) 2.1 g cm^{-3} (D) 4.1 g cm^{-3}

67. Which of the following is not a globular protein?

(A) Myosin (B) Insulin

(C) Legumelin (D) Serum albumin

68. Crotonyl alcohol is an example of

(A) Allylic alcohol (B) Benzylic alcohol

(C) Vinylic alcohol (D) Polyhydric alcohol

69. What type of following solids the ice is

(A) ionic solid (B) covalent network solid

(C) molecular solid (D) metallic solid

70. A buffer solution is prepared by mixing 0.01 M weak acid and 0.05 M solution of a salt of weak acid and strong base. What is the pH of buffer solution?

(pKa = 4.74)

(A) 3.34 (B) 4.80

(C) 5.44 (D) 6.93

71. Which of the following gases is formed during oxidation of trichloromethane?

(A) $CO_{(g)}$ (B) $CO_{2(g)}$

(C) $COCl_{2(g)}$ (D) $H_{2(g)}$

72. What type of ligand the EDTA is?

(A) Monodentate (B) Bidentate

(C) Tetradentate (D) Hexadentate

73. Which of the following compounds has difficulty in breaking of C – X bond during nucleophilic substitution reaction?

(A) o-Nitrochlorobenzene

(B) p-Nitrochlorobenzene

(C) m-Nitrochlorobenzene

(D) 2,4,6-Trinitrochlorobenzene

74. What is the change in oxidation number of Cr in the following redox reaction?

$$3H_2O_{2(aq)} + Cr_2O_{7(aq)}^{2-} + 8H_{(aq)}^{+} \longrightarrow 3O_{2(g)} + 2Cr^3 + 7H_2O$$

(A) +2 to +3 (B) −2 to +3

(C) +7 to +3 (D) +6 to +3

75. Equal masses of $H_{2(g)}$ and $He_{(g)}$ are enclosed in a container at constant temperature. The ratio of partial pressure of H_2 to He is

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

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

76. Identify the reaction intermediate of following reaction.

i. $2SO_{2(g)} + 2NO_{2(g)} \rightarrow 2SO_{3(g)} + 2NO$

ii. $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$

(A) $NO_{2(g)}$ (B) $NO_{(g)}$

(C) $SO_{2(g)}$ (D) $O_{2(g)}$

77. What is the number of −OH groups present in one molecule of ribose?

(A) 2 (B) 3

(C) 4 (D) 5

78. What is the position of copper in long form of periodic table?

(A) Group -12, period-3 (B) Group-11, period-4

(C) Group-8, period-4 (D) Group-11, period-5

79. What is bond order of F_2 molecule?

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

(C) 2 (D) 3

80. Which of the following compounds does NOT develop intermolecular hydrogen bonding?

(A) Cyclohexylamine (B) Allylamine

(C) Trimethylamine (D) Diphenylamine

81. Which of the following is CORRECT IUPAC name of catechol?

(A) Benzene-1,2-diol (B) Benzene-1,3-diol

(C) Benzene-1,4-diol (D) Benzene-1,3,5 triol

82. What is the solubility of gas in water at 25°C if partial pressure is 0.346 bar [Henry's law constant is $[0.159 \text{ mol dm}^{-3} \text{ bar}^{-1}]$?

(A) $0.055 \text{ mol dm}^{-3}$ (B) $0.028 \text{ mol dm}^{-3}$

(C) $0.083 \text{ mol dm}^{-3}$ (D) 0.11 mol dm^{-3}

83. Which from following coloured light has the highest energy?

(A) Red (B) Blue

(C) Yellow (D) Violet

84. Which among the following is haloalkyne?

(A) $CH_3 - CH_2 - CH = CH - X$

(B) $CH_3 - C = C - CH_2 - X$

(C) $CH \equiv C - CH_2 - CH_2 - X$

(D) $CH_3 - CH_2 - C \equiv C - X$

85. Which element from the following possesses half-filled d-orbitals either in expected or in observed electronic configuration?

(A) Fe (B) Mn

(C) Ni (D) Co

86. What is the radius of the fourth orbit of hydrogen atom?

(A) 846.4 pm (B) 211.6 pm

(C) 476.1 pm (D) 1322.5 pm

87. A conductivity cell containing 5×10^{-4} M NaCl solution develops resistance 14000 ohms at 25°C. Calculate the conductivity of solution if the cell constant is 0.84 cm^{-1}

(A) $6.0 \times 10^{-5} \Omega^{-1} \text{ cm}^{-1}$

(B) $3.0 \times 10^{-5} \Omega^{-1} \text{ cm}^{-1}$

(C) $9.0 \times 10^{-5} \Omega^{-1} \text{ cm}^{-1}$

(D) $12.0 \times 10^{-5} \Omega^{-1} \text{ cm}^{-1}$

88. Which among the following statements is NOT true for LDP?

(A) It needs O_2 or peroxide as initiator synthesis process.

(B) It is a branched chain polymer.

(C) It needs low pressure about 6-7 atm in synthesis process.

(D) It has low melting point than HDP.

89. Equal masses in grams of H_2, N_2, Cl_2, and O_2 , are enclosed in cylinders separately. If these gases expand isothermally and reversibly by 10 dm^3 at 300 K, the work done by gas is maximum for

(A) H_2 (B) N_2

(C) Cl_2 (D) O_2

90. Which of the following compounds is obtained by Rosenmund reduction of benzoyl chloride?

(A) Benzene (B) Benzyl alcohol

(C) Benzaldehyde (D) Chlorobenzene

91. The partial vapour pressure of any volatile component of a solution is equal to the vapour pressure of the pure component multiplied by its mole fraction in the solution is called

(A) Dalton's law (B) Avogadro's law

(C) Raoult's law (D) Henry's law

92. Which from following polymers is grouped in the category of elastomers?

(A) Neoprene (B) Terylene

(C) Polystyrene (D) Bakelite

93. Which among the following is NOT an example of salt of strong acid and weak base?

(A) NH_4Cl (B) NH_4NO_3

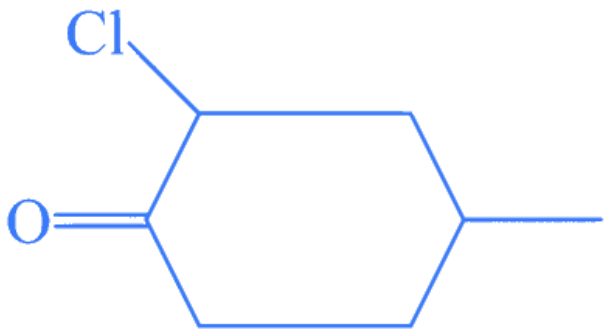
(C) $CuSO_4$ (D) Na_2SO_4

94. Calculate the edge length of simple cubic unit cell if radius of an atom is 167.3 pm.

(A) 473.2 pm (B) 334.6 pm

(C) 386.3 pm (D) 836.5 pm

95. What is IUPAC name of following compound?



(A) 1-Chloro-4-methylcyclohexan-2-one

(B) 2-Chloro-3-methylcyclohexanone

(C) 2-Chloro-4-methylcyclohexanone

(D) 4-Methyl-2-chlorocyclohexanone

96. Which element from following is used for cancer treatment?

(A) Ba (B) Sr

(C) Ra (D) Ru

97. The rate law for the reaction $A + B \rightarrow C$ at 25°C is given by rate

$$= k[A][B]^2$$

. Calculate the rate of reaction if rate constant at same temperature is

$6.25\ mol^{-2}\ dm^6\ s^{-1}[[\ A] = 1M, [B] = 0.2M]$

(A) $0.25\ mol\ dm^{-3}\ s^{-1}$ (B) $0.5\ mol\ dm^{-3}\ s^{-1}$

(C) $0.75\ mol\ dm^{-3}\ s^{-1}$ (D) $1.25\ mol\ dm^{-3}\ s^{-1}$

98. Select the CORRECT increasing order of boiling points of alcohols, amines and carboxylic acids of comparable molar mass from the following.

(A) Alcohols < Amines < Carboxylic acids (B) Amines < Carboxylic acids < Alcohols

(C) Amines < Alcohols < Carboxylic acids (D) Carboxylic acids < Alcohols < Amines

99. What is the number of moles of 'C' atoms present in n mole molecule of alkane if it exhibits three structural isomers?

(A) 3n (B) 4n

(C) 5n (D) 6n

100. Which of the following reactions is used for the conversion of alkyl chloride to alkyl iodide?

(A) Fitting reaction (B) Friedel Crafts reaction

(C) Finkelstein reaction (D) Swartz reaction

101. The equation of the line, passing through $(1, 2, 3)$ and parallel to planes
$$x - y + 2z = 5$$
and
$$3x + y + z = 6$$
, is

(A) $\frac{x-1}{-3} = \frac{y-2}{5} = \frac{z-3}{4}$ (B) $\frac{x-1}{-3} = \frac{y-2}{-5} = \frac{z-3}{4}$

(C) $\frac{x-1}{4} = \frac{y-2}{5} = \frac{z-3}{3}$ (D) $\frac{x-1}{5} = \frac{y-2}{7} = \frac{z-3}{1}$

102.
$$\lim_{x \to 0} \frac{x \cot 4x}{\sin^2 x \cdot \cot^2(2x)} \text{ is equal to}$$

(A) 0 (B) 1

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

103.
$$\int \frac{1}{\cos^3 x \sqrt{\sin 2x}} dx =$$

(A) $\sqrt{2}\ (\sqrt{\tan x}\ + \frac{1}{5}(\tan x)^{\frac{5}{2}}) + c$, where c is a constant of integration.

(B) $(\sqrt{\tan x} + \frac{2}{5}(\tan x)^{\frac{5}{2}}) + c$, where c is a constant of integration.

(C) $\frac{1}{\sqrt{2}}(\sqrt{\tan x} + \frac{2}{5}(\tan x)^{\frac{5}{2}}) + c$, where c is a constant of integration.

(D) $2(\sqrt{\tan x} + \frac{1}{5}(\tan x)^{\frac{5}{2}}) + c$, where c is a constant of integration.

104. The shortest distance (in units) between the lines
$$\frac{x+1}{3} = \frac{y+2}{1} = \frac{z+1}{2}$$
and
$$\bar{r} = (2\hat{i} - 2\hat{j} + 3\hat{k}) + \lambda(\hat{i} + 2\hat{j})$$
is

(A) $\frac{8}{3\sqrt{5}}$ (B) $\frac{1}{3\sqrt{5}}$

(C) $\frac{7}{3\sqrt{5}}$ (D) $\frac{2}{3\sqrt{5}}$

105. The maximum value of
$$z = 7x + 8y$$
subject to the constraints $x + y \leq 20, y \geq 5, x \leq 10, x \geq 0, y \geq 0$ is

(A) 150 (B) 160

(C) 110 (D) 180

106. The value of
$$\int_0^{\pi} \left| \sin x - \frac{2x}{\pi} \right| dx$$
is

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

(C) π (D) 2π

107. If
$$f(x) = \sin^{-1}\left(\frac{2 \log x}{1 + (\log x)^2}\right)$$
, then $f'(e)$ is

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

(C) e (D) $\frac{1}{e}$

108. If the pair of lines given by
$$(x \cos \alpha + y \sin \alpha)^2 = (x^2 + y^2) \sin^2 \alpha$$
are perpendicular to each other, then α is

(A) 0 (B) $\frac{\pi}{2}$

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

109. The solution of
$$e^{y-x} \frac{dy}{dx} = \frac{y(\sin x + \cos x)}{(1 + y \log y)}$$
is

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

(B) $e^y \log y = e^x \cos x + c$, where c is a constant of integration.

(C) $e^y \log y = e^x \sin x + c$, where c is a constant of integration.

(D) $e^y y = e^x \sin x + c$, where c is a constant of integration.

110. For
$$x > 1$$
, if
$$(2x)^{2y} = 4e^{2x-2y}$$
, then
$$\left(1 + \log_e 2x\right)^2 \frac{dy}{dx}$$
is equal to

(A) $\frac{x \log_e 2x + \log_e 2}{x}$ (B) $\frac{x \log_e 2x - \log_e 2}{x}$

(C) $x \log_e 2x + \frac{\log_e 2}{x}$ (D) $x \log_e 2x - \frac{\log_e 2}{2}$

111. A poster is to be printed on a rectangular sheet of paper of area $18\ m^2$. The margins at the top and bottom of $75\ cm$ each and at the sides $50\ cm$ each are to be left. Then the dimensions i.e. height and breadth of the sheet, so that the space available for printing is maximum, are _____ respectively.

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

(C) $3\ m, 6\ m$ (D) $6\ m, 3\ m$

112. The equation of the normal to the curve

$$3x^2 - y^2 = 8$$

, which is parallel to the line

$$x + 3y = 10$$

, is

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

(C) $x + 3y + 8 = 0$ (D) $x + 3y - 4 = 0$

113. An irregular six faced die is thrown and the probability that, in 5 throws it will give 3 even numbers is twice the probability that it will give 2 even numbers. The number of times, in 6804 sets of 5 throws, you expect to give no even number is

(A) 18 (B) 28

(C) 27 (D) 19

114. If the curves

$$y^2 = 6x$$

and

$$9x^2 + by^2 = 16$$

intersect each other at right angle, then value of 'b' is

(A) $\frac{9}{2}$ (B) 6

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

115. The circles

$$x^2 + y^2 + 2ax + c = 0$$

and

$$x^2 + y^2 + 2by + c = 0$$

touch each other externally, if

(A) $\frac{1}{a^2} - \frac{1}{b^2} = \frac{1}{c}$ (B) $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{c}$

(C) $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{c^2}$ (D) $\frac{1}{a^2} - \frac{1}{b^2} = \frac{1}{c^2}$

116. Given

$$f(x) = \begin{cases} \frac{1-\cos 4x}{x^2} & , \text{ if } x < 0 \\ a & , \text{ if } x = 0 \\ \frac{\sqrt{x}}{\sqrt{16-\sqrt{x}}-4}, & \text{if } x > 0 \end{cases}$$

If $f(x)$ is continuous at

$$x = 0$$

, then value of a is

(A) -8 (B) 2

(C) -2 (D) 8

117. A, B, C, D are four points in a plane with position vectors $\bar{a}, \bar{b}, \bar{c}, \bar{d}$ respectively such that

$$(\bar{a} - \bar{d}) \cdot (\bar{b} - \bar{c}) = (\bar{b} - \bar{d}) \cdot (\bar{c} - \bar{a}) = 0$$

. The point D, then is the _____ of $\triangle ABC$

(A) centroid (B) circumcentre

(C) incentre (D) orthocentre

118. Two adjacent of sides parallelogram ABCD are given by

$$AB = 2\hat{i} + 10\hat{j} + 11\hat{k}$$

and

$$AD = -\hat{i} + 2\hat{j} + 2\hat{k}$$

. The side AD is rotated by angle α in plane of parallelogram so that AD becomes AD$'$. If AD$'$ makes a right angle with the side AB, then the cosine of the angle α is given by

(A) $\frac{8}{9}$ (B) $\frac{1}{9}$

(C) $\frac{\sqrt{17}}{9}$ (D) $\frac{4\sqrt{5}}{9}$

119. The value of x, for which

$$\sin\left(\cot^{-1}(x)\right) = \cos\left(\tan^{-1}(1+x)\right)$$

, is

(A) 0 (B) 1

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

120. The unit vector which is orthogonal to the vector $3\hat{i} + 2\hat{j} + 6\hat{k}$ and coplanar with the vectors $2\hat{i} + \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$ is

(A) $\frac{8\hat{i}-3\hat{j}+3\hat{k}}{\sqrt{82}}$ (B) $\frac{-8\hat{i}-3\hat{j}+3\hat{k}}{\sqrt{82}}$

(C) $\frac{-8\hat{i}+3\hat{j}+3\hat{k}}{\sqrt{82}}$ (D) $-\frac{8\hat{i}+3\hat{j}+3\hat{k}}{\sqrt{82}}$

121. A ladder, 5 meters long, rests against a vertical wall. If its top slides downwards at the rate of $10\ cm/s$, then the angle between the ladder and the floor is decreasing at the rate of _____ radians/second when it's lower end is $4\ m$ away from the wall.

(A) -0.1 (B) -0.025

(C) 0.1 (D) 0.025

122. If $\vec{a}, \vec{b}, \vec{c}$ are three non-zero vectors, no two of them are collinear, $\vec{a}+2\vec{b}$ is collinear with $\vec{c}, \vec{b}+3\vec{c}$ is collinear with $\vec{a}$, then $\vec{a}+2\vec{b}$ is

(A) $6\bar{c}$ (B) $-6\bar{c}$

(C) $\bar{c}$ (D) $2\bar{c}$

123. If $|z-2+i| \leq 2$, then the difference between the greatest and least value of $|z|$ is _____,

$$(\mathrm{i}=\sqrt{-1}\ )$$

(A) $2\sqrt{5}+4$ (B) $2\sqrt{5}$

(C) 4 (D) 8

124. A box contains 100 tickets numbered 1 to 100 . A ticket is drawn at random from the box. Then the probability, that number on the ticket is a perfect square, is

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

(C) $\frac{7}{100}$ (D) $\frac{9}{100}$

125. If

$$\int \frac{\sqrt{1-x^2}}{x^4}\,\mathrm{d}x = \mathrm{A}(x)\left(\sqrt{1-x^2}\ \right)^{\mathrm{m}} + \mathrm{c}$$

for a suitable chosen integer m and a function $\mathrm{A}(x)$, where c is a constant of integration, then $(\mathrm{A}(x))^{\mathrm{m}}$ equals

(A) $\frac{1}{9x^4}$ (B) $\frac{-1}{3x^3}$

(C) $\frac{-1}{27x^9}$ (D) $\frac{1}{27x^6}$

126. If $\mathrm{k_i}$ are possible values of k for which lines

$$\mathrm{k}x+2y+2=0, 2x+\mathrm{k}y+3=0$$

and

$$3x+3y+\mathrm{k}=0$$

are concurrent, then

$$\sum \mathrm{k_i}$$

has the value

(A) 0 (B) -2

(C) 2 (D) 5

127. A tank with a rectangular base and rectangular sides, open at the top is to be constructed so that its depth is 4 meter and volume is 36 cubic meters. If building of the tank costs ₹ 100 per square meter for the base and ₹ 50 per square meter for the sides, then the cost of least expensive tank is

(A) ₹ 3000 (B) ₹ 3300

(C) ₹ 2400 (D) ₹ 3500

128. The length (in units) of the projection of the line segment, joining the points $(5,-1,4)$ and $(4,-1,3)$, on the plane

$$x+y+z=7$$

is

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

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

129. If the volume of tetrahedron, whose vertices are $\mathrm{A}(1,2,3), \mathrm{B}(-3,-1,1), \mathrm{C}(2,1,3)$ and $D(-1,2,x)$ is

$$\frac{11}{6}$$

cubic units, then the value of x is

(A) 3 (B) -2

(C) 4 (D) -1

130. Let

Statement 1 : If a quadrilateral is a square, then all of its sides are equal.

Statement 2: All the sides of a quadrilateral are equal, then it is a square.

(A) Statement 2 is contrapositive of statement 1.

(B) Statement 2 is negation of statement 1.

(C) Statement 2 is inverse of statement 1.

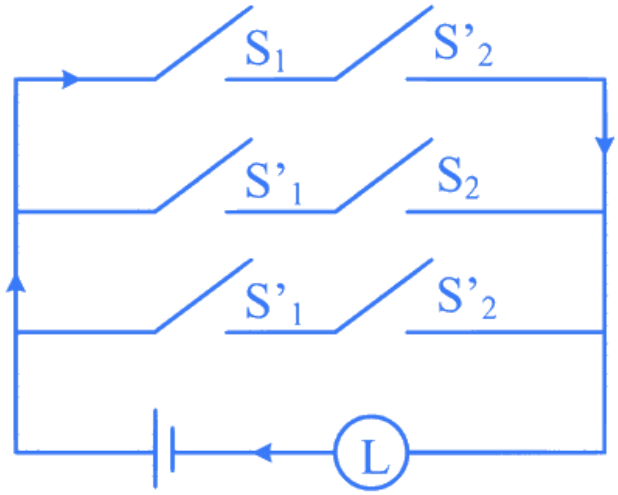
(D) Statement 2 is the converse of statement 1.

131. The number of words that can be formed by using the letters of the word CALCULATE such that each word starts and ends with a consonant, are

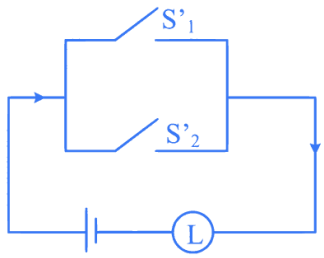
(A) $5 \times 7!$ (B) $\frac{9!}{8}$

(C) $\frac{5 \times 7!}{2}$ (D) $20 \times 7!$

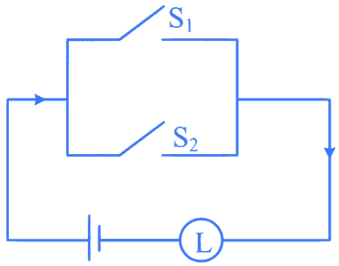
132. The given following circuit is equivalent to



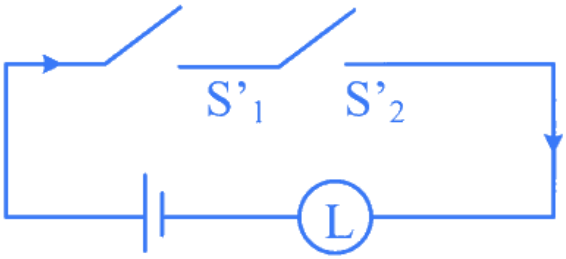
(A)



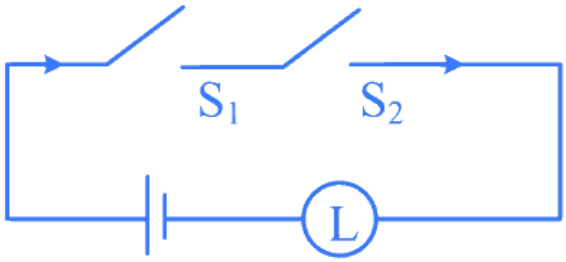
(B)



(C)



(D)



133. Water flows from the base of rectangular tank, of depth 16 meters. The rate of flow of the water is proportional to the square root of depth at any time t. If depth is 4 m when $t = 2$ hours, then after 3.5 hours the depth (in meters) is

(A) 0 (B) 0.25

(C) 0.5 (D) 3

134. The area (in sq. units) of the smaller part of the circle

$$x^2 + y^2 = a^2$$

cut off by the line

$$x = \frac{a}{\sqrt{2}}$$

is

(A) $\frac{a^2}{4}|\frac{\pi}{2} - 1|$ (B) $a^2|\frac{\pi}{4} - 1|$

(C) $\frac{a^2}{2}|\frac{\pi}{2} - 1|$ (D) $\frac{a^2}{4}|\frac{\pi}{4} - 1|$

135. $\cos^2 48^\circ - \sin^2 12^\circ =$ _____, if

$$\sin 18^\circ = \frac{\sqrt{5} - 1}{4}$$

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

(C) $\frac{\sqrt{5}+1}{8}$ (D) $\frac{-\sqrt{5}-1}{8}$

136. The discrete random variable X can take all possible integer values from 1 to k, each with a probability

$$\frac{1}{k}$$

, then its variance is

(A) $\frac{k^2-1}{12}$ (B) $\frac{k^2-1}{6}$

(C) $\frac{k^2+1}{12}$ (D) $\frac{k^2+1}{6}$

137. If

$$\tan y = \frac{x \sin \alpha}{1 - x \cos \alpha}$$

and

$$\frac{dy}{dx} = \frac{m}{x^2 + 2nx + 1}$$

, then $m^2 + n^2$ is

(A) 2 (B) 3

(C) 1 (D) 4

138. The lengths of sides of a triangle are three consecutive natural numbers and its largest angle is twice the smallest one. Then the length of the sides of the triangle (in units) are

(A) 3, 4, 5 (B) 4, 5, 6

(C) 5, 6, 7 (D) 2, 3, 4

139. For 20 observations of variable x, if

$$\sum (x_i - 2) = 20$$

and

$$\sum (x_i - 2)^2 = 100$$

, then the standard deviation of variable x is

(A) 2 (B) 3

(C) 4 (D) 9

---

140. Equation of plane containing the line

$$\frac{x}{2} = \frac{y}{3} = \frac{z}{4}$$

and perpendicular to the plane containing the lines

$$\frac{x}{3} = \frac{y}{4} = \frac{z}{2}$$

and

$$\frac{x}{4} = \frac{y}{2} = \frac{z}{3}$$

is

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

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

---

141. If

$$(2 + \sin x)\frac{dy}{dx} + (y + 1)\cos x = 0$$

and

$$y(0) = 1$$

, then

$$y\left(\frac{\pi}{2}\right)$$

is

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

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

---

142. If

$$A = \begin{bmatrix} 2a & -3b \\ 3 & 2 \end{bmatrix}$$

and

$$A \cdot \text{adj}\, A = AA^T$$

, then $2a + 3b$ is

(A) -1 (B) 1

(C) 5 (D) -5

143.

$$\int \left(\frac{\tan\left(\frac{1}{x}\right)}{x} \right)^2 dx =$$

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

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

144.

$$\int \frac{1}{(x+2)(1+x)^2} dx$$

has the value

(A) $2\log(\frac{x+2}{x^2+1}) + 4\tan^{-1}x + c$, where c is a constant of integration.

(B) $\log\frac{x+2}{x^2+1} - 4\tan^{-1}x + c$, where c is a constant of integration.

(C) $\log\frac{(x+2)^2}{(x^2+1)} + 4\tan^{-1}x + c$, where c is a constant of integration.

(D) None

---

145. If two angles of $\triangle$ABC are

$$\frac{\pi}{4}$$

and

$$\frac{\pi}{3}$$

, then the ratio of the smallest and greatest sides are

(A) $(\sqrt{3} - 1) : 1$ (B) $\sqrt{3} : \sqrt{5}$

(C) $\sqrt{2} : \sqrt{3}$ (D) $(\sqrt{3} - 1) : 4$

---

146. In

$$\triangle \text{ABC}, \text{m}\angle\text{B} = \frac{\pi}{3}$$

and

$$\text{m}\angle\text{C} = \frac{\pi}{4}$$

. Let point D divide BC internally in the ratio 1 : 3 , then

$$\frac{\sin(\angle BAD)}{\sin(\angle CAD)}$$

has the value

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

(C) $\frac{1}{\sqrt{6}}$ (D) $\sqrt{\frac{2}{3}}$

147. If

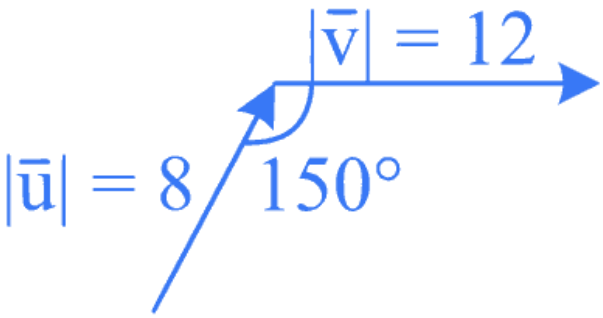
$$\tan^{-1}\left(\frac{1-x}{1+x}\right) = \frac{1}{2}\tan^{-1} x$$

, then x is

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

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

148. If



then $|\vec{u} \times \vec{v}|$ is

(A) 96 (B) 80

(C) 42 (D) 48

149. Three fair coins with faces numbered 1 and 0 are tossed simultaneously. Then variance (X) of the probability distribution of random variable X, where X is the sum of numbers on the upper most faces, is

(A) 0.7 (B) 0.75

(C) 0.65 (D) 0.6

150. If

$$f(x) = x^2 + 1$$

and

$$g(x) = \frac{1}{x}$$

, then the value of $f(g(g(f(x))))$ at $x = 1$ is

(A) 4 (B) 1

(C) 5 (D) 3

- End of Question Paper -