MHT CET 2023 PCM May 11 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 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 coil of radius 'r' is placed on another coil (whose radius is R and current flowing through it is changing) so that their centres coincide ($R \gg r$). If both the coils are coplanar then the mutual inductance between them is ($\mu_0 =$ permeability of free space)

(A) $\frac{\mu_0 \pi R^2}{2r}$ (B) $\frac{\mu_0 \pi r^2}{2R}$

(C) $\frac{\mu_0 \pi r^2}{R}$ (D) $\mu_0 \pi R^2$

2. Two capillary tubes of the same diameter are kept vertically in two different liquids whose densities are in the ratio $4:3$. The rise of liquid in two capillaries is 'h_1' and 'h_2' respectively. If the surface tensions of liquids are in the ratio $6:5$, the ratio of heights

$$\left(\frac{h_1}{h_2}\right)$$

is

(Assume that their angles of contact are same)

(A) 0.4 (B) 0.5

(C) 0.8 (D) 0.9

3. Two spherical black bodies of radii 'r_1' and 'r_2' at temperature 'T_1' and 'T_2' respectively radiate power in the ratio $1:2$ Then $r_1 : r_2$ is

(A) $\frac{1}{2}(\frac{T_2}{T_1})^4$ (B) $\frac{1}{\sqrt{2}}(\frac{T_2}{T_1})^2$

(C) $2(\frac{T_1}{T_2})^4$ (D) $2(\frac{T_1}{T_2})^2$

4. For a particle executing S.H.M., its potential energy is 8 times its kinetic energy at certain displacement 'x' from the mean position. If 'A' is the amplitude of S.H.M the value of 'x' is

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

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

5. The maximum kinetic energies of photoelectrons emitted are K_1 and K_2 when lights of wavelengths λ_1 and λ_2 are incident on a metallic surface. If

$$\lambda_1 = 3\lambda_2$$

then

(A) $K_1 = \frac{K_2}{3}$ (B) $K_1 < \frac{K_2}{3}$

(C) $K_1 = 3K_2$ (D) $3K_1 = 2K_2$

6. A particle moves along a circular path with decreasing speed. Hence

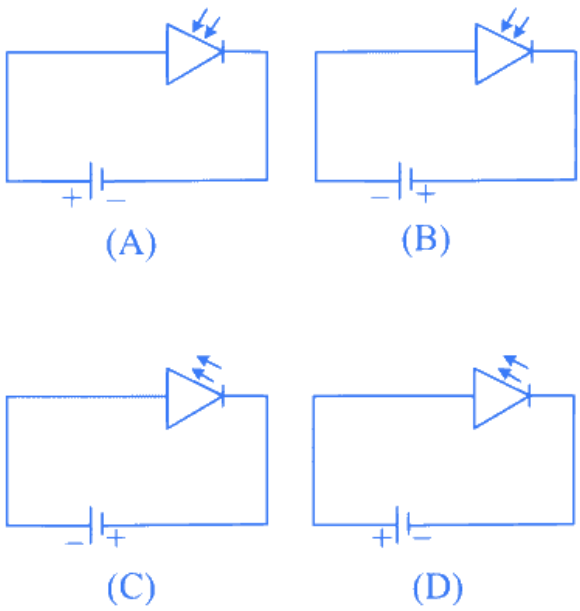
(A) its resultant acceleration is towards the centre.

(B) it moves in a spiral path with decreasing radius.

(C) the direction of angular momentum remains constant.

(D) its angular momentum remains constant

7. Identify the correct circuit diagrams for the normal operation from the following.



(A) (A), (B) (B) (B), (C)

(C) (A), (C) (D) (B), (D)

8. With the gradual increase in frequency of an a. c. source, the impedance of an LCR series circuit

(A) first decreases, becomes minimum and then increases.

(B) increases.

(C) decreases.

(D) remains constant.

9. In energy band diagram of insulators, a band gap and the conduction band is respectively

(A) very low and partially filled.

(B) very high and completely filled.

(C) very high and empty.

(D) very low and empty.

10. Two positively charged identical spheres separated by a distance 'd' exert some force (F) on each other when they are kept in air. If both the spheres are immersed in a liquid of dielectric constant 5 , the force experienced by each is (All other parameters are unchanged.)

(A) 5 F (B) $\frac{F}{3}$

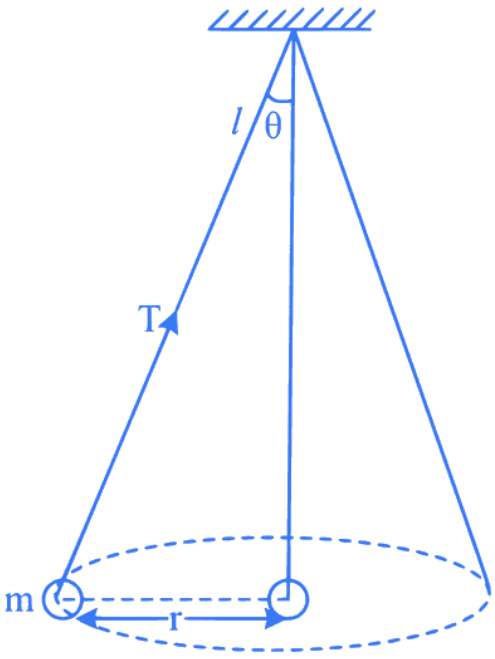
(C) $\frac{F}{4}$ (D) $\frac{F}{5}$

11. A string fixed at both the ends forms standing wave with node separation of 5 cm. If the velocity of the wave on the string is 2 m/s, then the frequency of vibration of the string is

(A) 0.2 Hz (B) 10 Hz

(C) 20 Hz (D) 40 Hz

12. A ball of mass 'm' is attached to the free end of a string of length 'l'. The ball is moving in horizontal circular path about the vertical axis as shown in the diagram.
The angular velocity 'ω' of the ball will be [T = Tension in the string.]



(A) $\sqrt{\frac{Tl}{m}}$ (B) $\sqrt{\frac{Tm}{l}}$

(C) $\sqrt{\frac{ml}{T}}$ (D) $\sqrt{\frac{T}{ml}}$

13. Radius of gyration of a thin uniform circular disc about the axis passing through its centre and perpendicular to its plane is K_c. Radius of gyration of the same disc about a diameter of the disc is K_d. The ratio $K_c : K_d$ is

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

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

14. When a current of 1 A is passed through a coil of 100 turns, the flux associated with it is 2.5×10^{-5} Wb/ turn. The self inductance of the coil in millihenry is

(A) 40 (B) 25

(C) 4 (D) 2.5

15. A spherical liquid drop of radius R is divided into 8 equal droplets. If surface tension is S, then the work done in this process will be

(A) $2\pi R^2 S$ (B) $3\pi R^2$ S

(C) $4\pi R^2 S$ (D) $2\pi RS^2$

16. The rate of flow of heat through a metal rod with temperature difference 40°C is 1600 cal/s. The thermal resistance of metal rod in °Cs/cal is

(A) 0.025 (B) 0.25

(C) 2.5 (D) 40

17. Two charges of equal magnitude 'q' are placed in air at a distance '$2r$' apart and third charge '$-2q$' is placed at mid point. The potential energy of the system is (ε_0 = permittivity of free space)

(A) $-\frac{q^2}{8\pi\epsilon_0 r}$ (B) $-\frac{3q^2}{8\pi\epsilon_0 r}$

(C) $-\frac{5q^2}{8\pi\epsilon_0 r}$ (D) $-\frac{7q^2}{8\pi\epsilon_0 r}$

18. The size of the real image produced by a convex lens of focal length F is 'm' times the size of the object. The image distance from the lens is

(A) $\frac{F}{(m-1)}$ (B) $\frac{(m-1)}{F}$

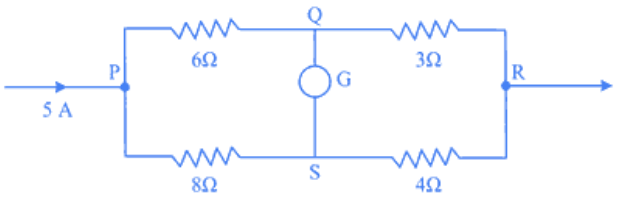
(C) $F(m+1)$ (D) $F(m-1)$

19. A double slit experiment is immersed in water of refractive index 1.33. The slit separation is 1 mm, distance between slit and screen is 1.33 m The slits are illuminated by a light of wavelength 6300 Å. The fringe width is

(A) 4.9×10^{-4} m (B) 5.8×10^{-4} m

(C) 6.3×10^{-4} m (D) 8.6×10^{-4} m

20. Potential difference between the points P and Q is nearly



(A) 6 V (B) 8 V
(C) 17 V (D) 21 V

21. An electron in the hydrogen atom jumps from the first excited state to the ground state. What will be the percentage change in the speed of electron?

(A) 25% (B) 50%
(C) 75% (D) 100%

22. In series LCR circuit, the voltage across the inductance and the capacitance are not

(A) out of phase with the voltage across the resistance by 90°. (B) equal in magnitude at resonance.
(C) out of phase with each other by 180°. (D) in phase with the source voltage.

23. If the temperature of a hot body is increased by 50%, then the increase in the quantity of emitted heat radiation will be approximately

(A) 125% (B) 200%
(C) 300% (D) 400%

24. The second overtone of an open pipe has the same frequency as the first overtone of a closed pipe of length 'L'. The length of the open pipe will be

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

25. The radius of earth is 6400 km and acceleration due to gravity

$$g = 10\ ms^{-2}$$

. For the weight of body of mass 5 kg to be zero on equator, rotational velocity of the earth must be (in rad/s)

(A) $\frac{1}{80}$ (B) $\frac{1}{400}$
(C) $\frac{1}{800}$ (D) $\frac{1}{1600}$

26. A car sounding a horn of frequency 1000 Hz passes a stationary observer. The ratio of frequencies of the horn noted by the observer before and after passing the car is 11 : 9. If the speed of sound is 'v', the speed of the car is

(A) V (B) $\frac{v}{2}$
(C) $\frac{v}{5}$ (D) $\frac{v}{10}$

27. The time period of a simple pendulum inside a stationary lift is 'T'. When the lift starts accelerating upwards with an acceleration

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

, the time period of the pendulum will be

(A) $\frac{\sqrt{5}}{2}$ T (B) $\frac{\sqrt{3}}{2}$ T
(C) $\frac{2T}{\sqrt{3}}$ (D) $\frac{2T}{\sqrt{5}}$

28. The mutual inductance of a pair of coils, each of 'N' turns, is 'M' henry. If a current of 'I' ampere in one of the coils is brought to zero in 't' second, the e. m. f. induced per turn in the other coil in volt is

(A) $\frac{MI}{t}$ (B) $\frac{NMI}{t}$
(C) $\frac{NM}{It}$ (D) $\frac{MI}{Nt}$

29. To manufacture a solenoid of length 1 m and inductance 1 mH, the length of thin wire required is
(cross - sectional diameter of a solenoid is considerably less than the length)

(A) 0.10 m (B) 0.10 km
(C) 1 km (D) 10 km

30. In a radioactive disintegration, the ratio of initial number of atoms to the number of atoms present at time

$$t = \frac{1}{2\lambda}$$

is [

$$\lambda =$$

decay constant]

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

31. A bullet is fired on a target with velocity 'V'. Its velocity decreases from 'V' to 'V/2' when it penetrates 30 cm in a target. Through what thickness it will penetrate further in the target before coming to rest?

(A) 5 cm (B) 8 cm
(C) 10 cm (D) 20 cm

32. In the experiment of diffraction due to a single slit, if the slit width is decreased, the width of the central maximum

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

33. A cylindrical magnetic rod has length 5 cm and diameter 1 cm. It has uniform magnetization 5.3×10^3 A/m^3. Its net magnetic dipole moment is nearly

(A) 1×10^{-2} J/T (B) 0.5×10^{-2} J/T
(C) 2.5×10^{-2} J/T (D) 2×10^{-2} J/T

34. In biprism experiment, if 5^{th} bright band with wavelength λ_1' coincides with 6^{th} dark band with wavelength λ_2' then the ratio

$$\left(\frac{\lambda_2}{\lambda_1}\right)$$

is

(A) $\frac{9}{7}$ (B) $\frac{7}{9}$
(C) $\frac{10}{11}$ (D) $\frac{11}{10}$

35. A body of mass 'm' kg starts falling from a distance 3R above earth's surface. When it reaches a distance 'R' above the surface of the earth of radius 'R' and Mass 'M', then its kinetic energy is

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

36. In the case of NAND gate, if A and B are the inputs and Y is the output then

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

37. A monoatomic gas at pressure 'P', having volume 'V' expands isothermally to a volume '2 V' and then adiabatically to a volume '16 V'. The final pressure of the gas is (Take

$$\gamma = 5/3$$

)

(A) P/64 (B) P/32
(C) 16P (D) 32P

38. In potentiometer experiments, two cells of e. m. f. 'E_1' and 'E_2' are connected in series

$$\left(E_1 > E_2\right)$$

, the balancing length is 64 cm of the wire. If the polarity of E_2 is reversed, the balancing length becomes 32 cm. The ratio E_1/E_2 is

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

39. A diatomic gas

$$\left(\gamma = \frac{7}{5}\right)$$

is compressed adiabatically to volume

$$\frac{V_i}{32}$$

where V_i is its initial volume. The initial temperature of the gas is T_i in Kelvin and the final temperature is 'xT_i'. The value of 'x' is

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

40. A disc has mass M and radius R. How much tangential force should be applied to the rim of the disc, so as to rotate with angular velocity 'ω' in time t ?

(A) $\frac{MR\omega}{4t}$ (B) $\frac{MR\omega}{2t}$
(C) $\frac{MR\omega}{t}$ (D) MRωt

41. An electron moving with velocity 1.6×10^7 m/s has wavelength of

$$0.4\,\mathring{A}$$

. The required accelerating voltage for the electron motion is [charge on electron

$$= 1.6 \times 10^{-19} C$$

, mass of electron

$$= 9 \times 10^{-31} \text{ kg}$$

]

(A) 7.2×10^3 V (B) 7.2×10^2 V
(C) 7.2 V (D) 7.2×10^{-2} V

42. The prism has refracting angle 'A'. The second refracting surface of the prism is silvered. Light ray falling on first refracting surface with angle of incidence '2 A', reaches the second surface and returns back through the same path due to reflection at the silvered surface. The refractive index of the material of the prism is

(A) $\frac{1}{2}$sinA (B) $\frac{1}{2}$cosA
(C) 2sinA (D) 2cos$A$

43. Two parallel wires of equal lengths are separated by a distance of 3 m from each other. The currents flowing through 1^{st} and 2^{nd} wire is 3 A and 4.5 A respectively in opposite directions. The resultant magnetic field at mid point between the wires

$$(\mu_0 =$$

permeability of free space)

(A) $\frac{\mu_0}{2\pi}$ (B) $\frac{3\mu_0}{2\pi}$

(C) $\frac{7\mu_0}{2\pi}$ (D) $\frac{5\mu_0}{2\pi}$

44. Three point charges $+q, +2q$ and $+Q$ are placed at the three vertices of an equilateral triangle. If the potential energy of the system of three charges is zero, the value of Q in terms of q is

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

(C) $Q = \frac{3q}{2}$ (D) $Q = \frac{q}{2}$

45. If a gas is compressed isothermally then the r.m.s. velocity of the molecules

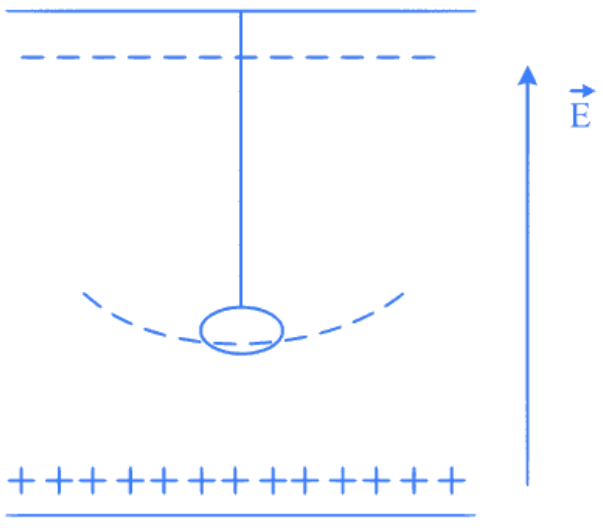
(A) decreases. (B) increases.

(C) remains the same. (D) first decreases and then increases.

46. The bob of a simple pendulum of length 'L' has a mass 'm' and charge 'q'. The pendulum is suspended between the plates of a charged parallel plate capacitor. The direction of electric field is shown in figure. The period of oscillations of the simple pendulum is (acceleration due to gravity

$$g > qE/m$$

)



(A) $2\pi\sqrt{\frac{L}{g}}$ (B) $2\pi[\frac{L}{\frac{qE}{m}-g}]^{\frac{1}{2}}$

(C) $2\pi[\frac{L}{g-\frac{qE}{m}}]^{\frac{1}{2}}$ (D) $2\pi[\frac{L}{g+\frac{qE}{m}}]^{\frac{1}{2}}$

47. An electron is projected along the axis of circular conductor carrying current I. Electron will experience

(A) no force. (B) a force along the axis.

(C) a force at angle 30° with the axis. (D) a force perpendicular to axis.

48. Two identical capacitors have the same capacitance 'C'. One of them is charged to a potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is

(A) $\frac{1}{4}C(V_1^2 - V_2^2)$ (B) $\frac{1}{4}C(V_1^2 + V_2^2)$

(C) $\frac{1}{4}C(V_1 - V_2)^2$ (D) $\frac{1}{4}C(V_1 + V_2)^2$

49. A transverse wave

$$Y = 2\sin(0.01x + 30t)$$

moves on a stretched string from one end to another end in 0.5 second. If x and y are in cm and t in second, then the length of the string is

(A) 5 m (B) 10 m

(C) 15 m (D) 20 m

50. A body of density 'ρ' is dropped from rest at a height 'h' into a lake of density '

$$\sigma'(\sigma > \rho)$$

. The maximum depth to which the body sinks before returning to float on the surface is (neglect air dissipative forces)

(A) $\frac{h\rho}{(\sigma-\rho)}$ (B) $\frac{h\rho}{(\sigma+\rho)}$

(C) $\frac{h\rho}{(\rho-\sigma)}$ (D) $\frac{2h\rho}{(\sigma-\rho)}$

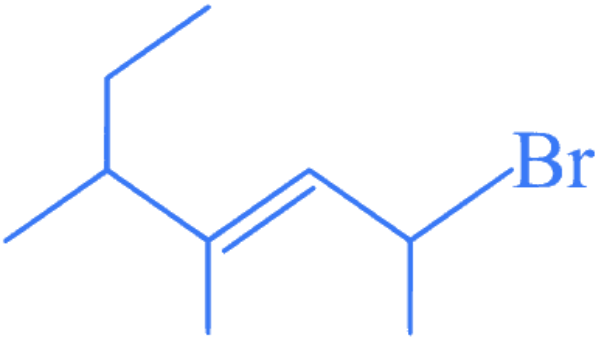
51. Name the accelerator used to introduce network of crosslink in elastomer.

(A) Zinc butyl xanthate
(B) Zinc ethyl xanthate
(C) Zinc butyl stearate
(D) Zinc propyl xanthate

52. Which of the following is a property of alkali metals?

(A) High density
(B) Compounds are paramagnetic
(C) Form dipositive ions only
(D) Most electropositive elements

53. The IUPAC name of following compound is:



(A) 1-Bromo-1,3,4-trimethylhex-2-ene
(B) 2-Bromo-4,5-dimethylhept-3-ene
(C) 2-Bromo-5-ethyl-4-methylhex-3-ene
(D) 1-Bromo-4-ethyl-1,3-dimethylpent-2-ene

54. If K_b denote molal elevation constant of water, then boiling point of an aqueous solution containing 36 g glucose (molar mass $= 180$) per dm^3 is:

(A) $(100 + K_b)^\circ C$
(B) $(100 + 2\,K_b)^\circ C$
(C) $(100 + \frac{K_b}{10})^\circ C$
(D) $(100 + \frac{2\,K_b}{10})^\circ C$

55. Which metal halide from following has lowest ionic character (M = metal atom)?

(A) MF
(B) MCl
(C) MBr
(D) MI

56. Which among the following reagents is called as Hinsberg's reagent?

(A) Benzenesulphonyl chloride
(B) Sodium nitroprusside
(C) Chromyl chloride
(D) Hydrazine

57. Which among the following amines has highest value of pK_b ?

(A) $(CH_3)_2NH$
(B) $(CH_3)_3N$
(C) CH_3NH_2
(D) $C_6H_5NH_2$

58. What is vapour pressure of a solution containing 1 mol of a nonvolatile solute in 36 g of water $\left(P_1^0 = 32 \text{ mm Hg}\right)$?

(A) 8.14 mm Hg
(B) 12.31 mm Hg
(C) 16.08 mm Hg
(D) 21.44 mm Hg

59. Identify the product obtained when phenol is reacted with dilute nitric acid at low temperature.

(A) ortho-Nitrophenol
(B) para-Nitrophenol
(C) Mixture of ortho and para-nitrophenols
(D) 2,4,6-Trinitrophenol

60. For an elementary reaction $2\,A + B \longrightarrow 3C$ rate of appearance of C is 1.3×10^{-4} mol L^{-1} s^{-1}, the rate of disappearance of A is:

(A) 1.3×10^{-4} mol L^{-1} s^{-1}
(B) 2.6×10^{-4} mol L^{-1} s^{-1}
(C) 5.2×10^{-4} mol L^{-1} s^{-1}
(D) 8.66×10^{-5} mol L^{-1} s^{-1}

61. Which among the following alkenes is most stable?

(A) $R_2C = CH_2$
(B) $H_2C = CH_2$
(C) $RCH = CHR$
(D) $R_2C = CR_2$

62. Identify a CORRECT formula for spin only magnetic moment.

(A) $\mu = (n^2 + 2)BM$
(B) $\mu = \sqrt{n^2 + 2}$BM
(C) $\mu = \sqrt{n(n+2)}$ BM
(D) $\mu = (n+2)^2$BM

63. Which of the following salts turns red litmus blue in its aqueous solution?

(A) NH_4NO_3 (B) NH_4Cl

(C) NH_4CN (D) NH_4F

64. What is the value of increase in internal energy when system does 8 J of work on surrounding by supplying 40 J of heat to it?

(A) 23 J (B) 32 J

(C) 40 J (D) 48 J

65. Benzonitrile on reduction with stannous chloride in presence of hydrochloric acid followed by acid hydrolysis forms:

(A) Benzal chloride (B) Benzoyl chloride

(C) Benzophenone (D) Benzaldehyde

66. Which among the following is TRUE for isobaric process?

(A) $\Delta U = 0$

(B) $-\Delta U = -W$

(C) $\Delta U = Q$

(D) $Q_P = \Delta U + P_{ext}\Delta V$

67. Which among the following statements is TRUE about gammexane?

(A) It is an isomer of BHC.

(B) It is one of the herbicides.

(C) It is obtained from benzene by bromination.

(D) It is monochloro derivative of benzene.

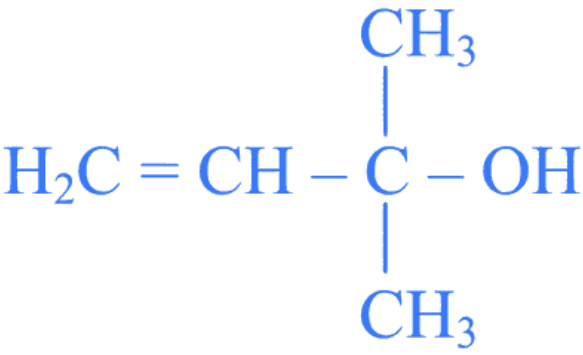
68. Which of the following is primary allylic alcohol?

(A)

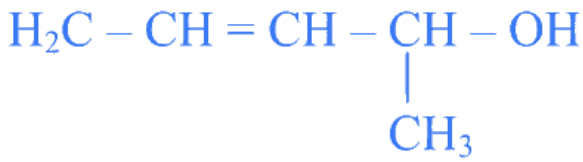


(B) $H_2C = CH - CH_2OH$

(C)



(D)



69. Which of following is NOT correct about fructose?

(A) It is ketohexose.

(B) It is reducing sugar.

(C) It is laevorotatory.

(D) Its ring structure is hemiacetal.

70. Which among following salts shows decrease in solubility with increase in temperature?

(A) Na_2SO_4 (B) KNO_3

(C) $NaNO_3$ (D) KBr

71. Find the number of faradays of electricity required to produce 45 g of Al from molten Al_2O_3. (At. mass of Al = 27)

(A) 1 F (B) 3 F

(C) 5 F (D) 7 F

72. Identify the reagent that confirms the presence of five $-OH$ groups in glucose.

(A) NH_2OH (B) HCN

(C) dil. HNO_3 (D) Acetic anhydride

73. What is the concentration of OH^- ion in a solution containing 0.05 M H^+ ions?

(A) 2.5×10^{-13}M (B) 5.0×10^{-2}M

(C) 2.0×10^{-13}M (D) 4.2×10^{-12}M

74. Which formula is used to calculate edge length in bcc structure?

(A) $a = \frac{\sqrt{3}r}{4}$ (B) $a = \frac{4}{\sqrt{3}r}$

(C) $a = \frac{\sqrt{3}}{4r}$ (D) $a = \frac{4r}{\sqrt{3}}$

75. Identify the products of following reaction:

$$\text{Methanal + Benzene carbaldehyde} \xrightarrow[\text{ii. } H_3O^+]{\text{i. conc. NaOH}}$$

(A) Methanoic acid and phenyl methanol (B) Methanol and benzoic acid

(C) Methanol and phenol (D) Methanoic acid and phenol

76. What is the volume in dm^3 occupied by 3 mol of ammonia gas at STP?

(A) 2.24 (B) 22.4

(C) 56.0 (D) 67.2

77. Slope of the graph between

$$\log \frac{[A]_0}{[A]_t}$$

(y axis) and time (x axis) for first order reaction is equal to:

(A) $+\frac{k}{2.303}$ (B) k

(C) $-k$ (D) $-\frac{2.303}{k}$

78. What is total number of donor atoms in

$$\left[Co(H_2O)(NH_3)_5\right]I_3$$

?

(A) 5 (B) 9

(C) 6 (D) 3

79. Which from following equations is used to express the angular momentum of an electron in a stationary state?

(A) $mvr = \frac{nh}{2\pi}$ (B) $mvr = \frac{2\pi}{nh}$

(C) $r = \frac{mvh}{n2\pi}$ (D) $mv = \frac{2\pi r}{nh}$

80. Which emission transition series is obtained when electron jumps from

$$n_2 = \infty$$

to

$$n_1 = 1$$

?

(A) Balmer (B) Lyman

(C) Paschen (D) Bracket

81. What is half life time of a first order reaction if initial conc. of reactant is 0.01 mol L^{-1} and rate of reaction is 0.00352 mol L^{-1} minute $^{-1}$?

(A) 1.969 minute (B) 7.75 minute

(C) 16.69 minute (D) 19.69 minute

82. Which among the following pairs of polymers contains both members as copolymers?

(A) Neoprene and Isoprene (B) Orlon and Teflon

(C) Bakelite and Orlon (D) SBR and PHBV

83. What is atomic mass of an element with BCC structure and density 10 g cm^{-3} having edge length 300 pm ?

(A) 51.0 g mol^{-1} (B) 60.0 g mol^{-1}

(C) 81.3 g mol^{-1} (D) 96.8 g mol^{-1}

84. Oxidation state of manganese in potassium permanganate is:

(A) +3 (B) +7

(C) +5 (D) +1

85. Which among following complexes is a neutral complex?

(A) $[Co(H_2O)(NH_3)_5]I_3$

(B) $[Co(NO_2)_3(NH_3)_3]$

(C) $Na[Co(NO_2)_6]$

(D) $[Fe(H_2O)_3(NCS)]Cl_2$

86. Which among the following halogens combines readily with metals to form metal halides with highest ionic character?

(A) Chlorine (B) Bromine

(C) Iodine (D) Fluorine

87. Which of the following compounds has highest boiling point?

(A) Chloromethane (B) Fluoromethane

(C) Iodomethane (D) Bromomethane

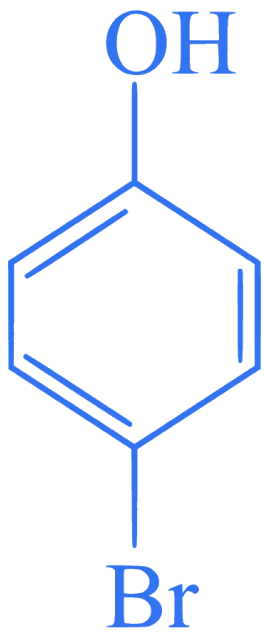
88. Identify physisorption from following.

(A) O_2 gas deposited on tungsten
(B) H_2 gas deposited on nickel
(C) N_2 gas deposited on iron
(D) All gases deposited on charcoal

89. Identify the product of following reaction.
Benzoyl chloride $\xrightarrow{H_2O}$ product

(A) Benzyl alcohol
(B) Benzaldehyde
(C) Benzoic acid
(D) Benzophenone

90. What is IUPAC name of the compound?



(A) 1-Bromo-4-hydroxybenzene
(B) 1-Hydroxy-4-bromobenzene
(C) 4-Hydroxybromobenzene
(D) 4-Bromophenol

91. Calculate the pH of 1.36×10^{-2}M solution of perchloric acid.

(A) 1.43
(B) 1.86
(C) 2.43
(D) 2.86

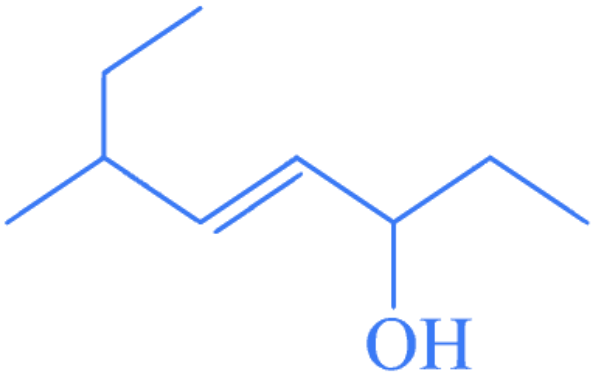
92. Which of the following formulae is used to determine compressibility factor for measurement of deviation from ideal behaviour?

(A) $Z = \frac{nRT}{PV}$
(B) $Z = \frac{PV}{nRT}$
(C) $Z = \frac{nRT}{V}$
(D) $Z = \frac{nRT}{P}$

93. The molar conductivity of 0.02 M AgI at 298 K is $142.3\Omega^{-1}\,cm^2\,mol^{-1}$. What is its conductivity?

(A) $1.42 \times 10^{-3}\Omega^{-1}\,cm^{-1}$
(B) $2.41 \times 10^{-3}\Omega^{-1}\,cm^{-1}$
(C) $2.85 \times 10^{-3}\Omega^{-1}\,cm^{-1}$
(D) $7.11 \times 10^{-3}\Omega^{-1}\,cm^{-1}$

94. What is IUPAC name of following compound?



(A) 2-Ethylhept-3-en-5-ol
(B) 3-Methyloct-4-en-6-ol
(C) 6-Methyloct-4-en-3-ol
(D) 6-Ethylhept-4-en-3-ol

95. Identify a molecule with incomplete octet from following.

(A) SF_6
(B) PCl_5
(C) LiCl
(D) H_2SO_4

96. What is the number of unit cells present in a cubic pack crystal lattice having 4 atoms per unit cell and weighing 0.60 g (molar mass 60 g mol^{-1}) ?

(A) 1×10^{21}
(B) 1.5×10^{21}
(C) 3.0×10^{21}
(D) 6.0×10^{21}

97. Identify 'A' in the following reaction.

$$\text{A + Chloromethane} \xrightarrow[AlCl_3]{\text{Anhydrous}} \text{2-Chlorotouene + 4-Chlorotoluene}$$

(A) Benzene
(B) Chlorobenzene
(C) Toluene
(D) Phenol

98. Which among the following is CORRECT formula for determination of cell constant?

(A) $\frac{l}{a} = \frac{k}{R}$
(B) $\frac{l}{a} = k \cdot R$
(C) $\frac{l}{a} = \frac{R}{k}$
(D) $\frac{l}{a} = \frac{1}{R}$

99. Identify the catalyst (A) used in following reaction.

$$CO + H_2O \overset{A}{\rightleftharpoons} CO_2 + H_2$$

(A) Platinised asbestos (B) MnO_2

(C) Co-Th alloy (D) $Fe - Cr$

100. What is value of PV type of work for following reaction at 1 bar?

$$\underset{(200\ mL)}{C_2H_{4(g)}} + \underset{(150\ mL)}{HCl_{(g)}} \longrightarrow C_2H_5Cl_{(g)}$$

(A) 3.5 J (B) 4.5 J

(C) 9.0 J (D) 15 J

101.

$$\int_0^{\pi} \frac{dx}{4+3\cos x} =$$

(A) $\frac{2\pi}{7}$ (B) $\frac{\pi}{\sqrt{7}}$

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

102. If

$$y = \log_{\sin x} \tan x$$

, then

$$\left(\frac{dy}{dx}\right)_{x=\frac{\pi}{4}}$$

has the value

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

(C) $\frac{-4}{\log 2}$ (D) $3\log 2$

103.

$$\lim_{x \to 2}\left[\frac{1}{x-2} - \frac{2}{x^3-3x^2+2x}\right]$$

is equal to

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

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

104. From a lot of 20 baskets, which includes 6 defective baskets, a sample of 2 baskets is drawn at random one by one without replacement. The expected value of number of defective basket is

(A) 0.6 (B) 0.06

(C) 0.006 (D) 1.07

105. If the angle between the lines represented by the equation

$$x^2 + \lambda xy - y^2\tan^2\theta = 0$$

is 2θ, then the value of λ is

(A) 0 (B) 1

(C) $\tan\theta$ (D) 2

106. Number of common tangents to the circles

$$x^2 + y^2 - 6x - 14y + 48 = 0$$

and

$$x^2 + y^2 - 6x = 0$$

are

(A) 0 (B) 1

(C) 4 (D) 2

107. The left-hand derivative of

$$f(x) = [x]\sin(\pi x)$$

, at

$$x = k, k$$

is an integer and [.] is the greatest integer function, is

(A) $(-1)^k(k-1)\pi$ (B) $(-1)^{k-1}(k-1)\pi$

(C) $(-1)^k k\pi$ (D) $(-1)^{k-1}k\pi$

108. Let

$$f(x) = \int \frac{\sqrt{x}}{(1+x)^2}\,dx, x \geq 0$$

, then $f(3) - f(1)$ is equal to

(A) $-\frac{\pi}{6} + \frac{1}{2} + \frac{\sqrt{3}}{4}$ (B) $-\frac{\pi}{12} + \frac{1}{2} + \frac{\sqrt{3}}{4}$

(C) $\frac{\pi}{6} + \frac{1}{2} - \frac{\sqrt{3}}{4}$ (D) $\frac{\pi}{12} + \frac{1}{2} - \frac{\sqrt{3}}{4}$

109. Value of c satisfying the conditions and conclusions of Rolle's theorem for the function

$$f(x) = x\sqrt{x+6}\ , x \in [-6,0]$$

is

(A) -4 (B) 4

(C) 3 (D) -3

110. Three of six vertices of a regular hexagon are chosen at random. The probability that the triangle with these three vertices is equilateral, equals _____.

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

(C) $\frac{1}{10}$ (D) $\frac{1}{20}$

111. If the direction cosines l, m, n of two lines are connected by relations

$$l - 5m + 3n = 0$$

and

$$7l^2 + 5m^2 - 3n^2 = 0$$

, then value of $l + m + n$ is

(A) $\frac{2}{\sqrt{6}}$ or $\frac{6}{\sqrt{14}}$ (B) $\frac{1}{\sqrt{6}}$ or $\frac{5}{\sqrt{14}}$

(C) $\frac{2}{\sqrt{6}}$ or $\frac{5}{\sqrt{14}}$ (D) $\frac{1}{\sqrt{6}}$ or $\frac{6}{\sqrt{14}}$

112. Let

$$f(x) = \log(\sin x), 0 < x < \pi$$

and

$$g(x) = \sin^{-1}(e^{-x}), x \geq 0$$

. If α is a positive real number such that

$$a = (fog)'(\alpha)$$

and

$$b = (fog)(\alpha)$$

, then

(A) $a\alpha^2 - b\alpha - a = 0$

(B) $a\alpha^2 - b\alpha - a = 1$

(C) $a\alpha^2 + b\alpha - a = -2\alpha^2$

(D) $a\alpha^2 + b\alpha + a = 0$

113. Five students are to be arranged on a platform such that the boy B_1 occupies the second position and such that the girl G_1 is always adjacent to the girl G_2. Then, the number of such possible arrangements is

(A) 4 (B) 7

(C) 8 (D) 6

114. If the volume of the parallelopiped is 158 cu . units whose coterminus edges are given by the vectors

$$\bar{a} = (\hat{i} + \hat{j} + n\hat{k}), \bar{b} = 2\hat{i} + 4\hat{j} - n\hat{k}$$

and

$$\bar{c} = \hat{i} + n\hat{j} + 3\hat{k}$$

, where $n \geq 0$, then the value of n is

(A) 8 (B) $\frac{19}{3}$

(C) 7 (D) 19

115. Let $f(x)$ be positive for all real x. If

$$I_1 = \int_{1-h}^{h} xf(x(1-x))dx$$

and

$$I_2 = \int_{1-h}^{h} f(x(1-x))dx$$

, where

$$(2h-1) > 0$$

, then

$$\frac{I_1}{I_2}$$

is

(A) 2 (B) h

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

116. The mirror image of the point $(1, 2, 3)$ in a plane is

$$\left(-\frac{7}{3}, -\frac{4}{3}, -\frac{1}{3}\right)$$

. Thus, the point _____ lies on this plane.

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

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

117. If

$$\alpha = 3\sin^{-1}\frac{6}{11}$$

and

$$\beta = 3\cos^{-1}\left(\frac{4}{9}\right)$$

, where the inverse trigonometric functions take only the principal values, then the correct option is

(A) $\cos\beta > 0$ (B) $\sin\beta < 0$

(C) $\cos(\alpha + \beta) > 0$ (D) $\cos\alpha < 0$

118.

The value of $\sec^2\left(\tan^{-1} 2\right) + \text{cosec}^2\left(\cot^{-1} 3\right)$ is

(A) 4 (B) 9

(C) 2 (D) 15

119. The value of

$$\tan\left(\frac{\pi}{8}\right)$$

is _____.

(A) $\sqrt{2} - 1$ (B) $1 - \sqrt{2}$

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

120. A plane is parallel to two lines, whose direction ratios are $1, 0, -1$ and $-1, 1, 0$ and it contains the point $(1, 1, 1)$. If it cuts co-ordinate axes (X, Y, Z - axes resp.) at A, B, C, then the volume of the tetrahedron OABC is _____ cu. units.

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

(C) $\frac{9}{2}$ (D) 27

121. The domain of the function given by

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

is

(A) $0 < x \leq 1$ (B) $0 \leq x \leq 1$

(C) $-\infty < x \leq 0$ (D) $-\infty < x < 1$

122. If

$$f(x) = xe^{x(1-x)}, x \in R$$

, then $f(x)$ is

(A) increasing in $[-\frac{1}{2}, 1]$ (B) decreasing R

(C) increasing in R (D) decreasing in $[-\frac{1}{2}, 1]$

123. The solution of the differential equation

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

is

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

(B) $x - y = c(xy)$, where c is a constant of integration.

(C) $x + y = c(1 + xy)$, where c is a constant of integration.

(D) $y - x = c(1 + xy)$, where c is a constant of integration.

---

124. If $\bar{a}, \bar{b}, \bar{c}$ are three vectors such that

$$a \cdot (b + c) + b \cdot (c + a) + c \cdot (a + b) = 0$$

and

$$|a| = 1$$

,

$$|\bar{b}| = 8$$

and

$$|\bar{c}| = 4$$

, then $|\bar{a} + \bar{b} + \bar{c}|$ has the value _____.

(A) 81

(B) 9

(C) 5

(D) 4

---

125. Let

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

and

$$\bar{b} = \hat{i} + \hat{j}$$

. If $\bar{c}$ is a vector such that

$$a \cdot c = |c|, |c - a| = 2\sqrt{2}$$

and the angle between $(\bar{a} \times \bar{b})$ and $\bar{c}$ is

$$\frac{\pi}{6}$$

, then $|(\bar{a} \times \bar{b}) \times \bar{c}|$ is

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

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

(C) 1

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

126.

$$\int_{-1}^{3} \left(\cot^{-1}\left(\frac{x}{x^2+1}\right) + \cot^{-1}\left(\frac{x^2+1}{x}\right) \right) dx =$$

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

(B) π

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

(D) (2π)

---

127. If

$$P = \begin{bmatrix} 1 & \alpha & 3 \\ 1 & 3 & 3 \\ 2 & 4 & 4 \end{bmatrix}$$

is the adjoint of a 3×3 matrix A and

$$|A| = 4$$

, then value of α is

(A) 4

(B) 11

(C) 5

(D) 0

---

128. If

$$f(x) = \begin{cases} \frac{\sqrt{1+mx} - \sqrt{1-mx}}{x}, & -1 \le x < 0 \\ \frac{2x+1}{x-2} & , 0 \le x \le 1 \end{cases}$$

is continuous in the interval $[-1, 1]$, then m is equal to

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

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

(C) -1

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

---

129. The area of the region bounded by the parabola

$$y = x^2$$

and the curve

$$y = |x|$$

is

(A) $\frac{1}{2}$ sq. units

(B) $\frac{1}{3}$ sq. units

(C) $\frac{1}{4}$ sq. units

(D) $\frac{1}{6}$ sq. units

---

130. Derivative of

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

w.r.t. $\cos^{-1} x^2$ is

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

(B) -1

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

(D) 1

---

131. A binomial random variable X satisfies

$$9.p(X = 4) = p(X = 2)$$

when

$$n = 6$$

. Then p is equal to

(A) $\frac{1}{4}$

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

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

(D) $\frac{1}{5}$

---

132. If in $\triangle ABC$, with usual notations,

$$a \cdot \cos^2\frac{C}{2} + c\cos^2\frac{A}{2} = \frac{3b}{2}$$

, then

(A) a, b, c are in G.P.

(B) a, b, c are in H.P.

(C) a, b, c are in A.P.

(D) a, b, c are in Arithmetico Geometric Progression

133. The lines

$$\frac{x-1}{3}=\frac{y+1}{2}=\frac{z-1}{5}$$

and

$$\frac{x+2}{4}=\frac{y-1}{3}=\frac{z+1}{2}$$

(A) intersect each other and point of intersection is $(2,1,3)$

(B) intersect each other and point of intersection is $(3,2,4)$

(C) intersect each other and point of intersection is $(-2,3,3)$

(D) do not intersect.

134. A curve passes through the point

$$\left(1,\frac{\pi}{6}\right)$$

. Let the slope of the curve at each point (x,y) be

$$\frac{y}{x}+\sec\left(\frac{y}{x}\right), x>0$$

, then, the equation of the curve is

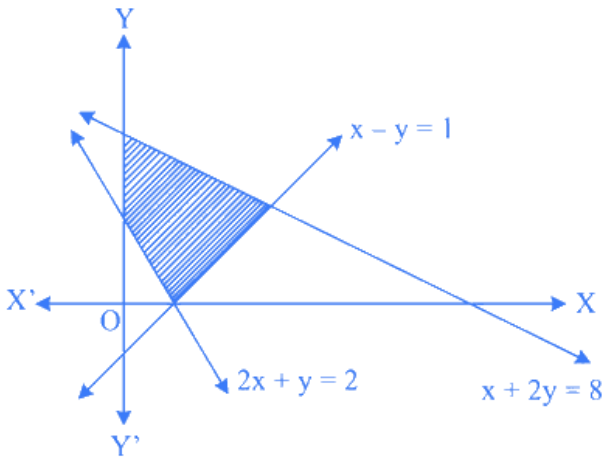
(A) $\sin(\frac{y}{x})=\log(x)+\frac{1}{2}$

(B) $\text{cosec}(\frac{y}{x})=\log(x)+2$

(C) $\sec(\frac{2y}{x})=\log(x)+2$

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

135. For the following shaded area, the linear constraints except $x,y\geq 0$ are



(A) $2x+y\leq 2, x-y\leq 1, x+2y\leq 8$

(B) $2x+y\geq 2, x-y\leq 1, x+2y\leq 8$

(C) $2x+y\geq 2, x-y\geq 1, x+2y\leq 8$

(D) $2x+y\geq 2, x-y\geq 1, x+2y\geq 8$

136. Let $\omega\neq 1$ be a cube root of unity and S be the set of all non-singular matrices of the form

$$\begin{bmatrix}1 & a & b\\ \omega & 1 & c\\ \omega^2 & \omega & 1\end{bmatrix}$$

where each of a,b and c is either ω or ω^2, then the number of distinct matrices in the set S is

(A) 2 (B) 6

(C) 4 (D) 8

137. The value of

$$2\tan^{-1}\frac{1}{2}+\tan^{-1}\frac{1}{7}$$

(A) $\tan^{-1}(\frac{17}{31})$ (B) $\tan^{-1}(\frac{19}{31})$

(C) $\tan^{-1}(\frac{31}{17})$ (D) $\tan^{-1}(\frac{31}{19})$

138.

$$\int\frac{e^x(1+x)}{\cos^2(e^x\cdot x)}dx=$$

(A) $-\cot(e^x)+c$, where c is a constant of integration.

(B) $\tan(x\cdot e^x)+c$, where c is a constant of integration.

(C) $\tan(e^x)+c$, where c is a constant of integration.

(D) $-\cot(x\cdot e^x)+c$, where c is a constant of integration.

139. In a triangle ABC, with usual notations, if

$$m\angle A=60^\circ, b=8, a=6$$

and

$$B=\sin^{-1}x$$

, then x has the value

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

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

140. If variance of $x_1,x_2\ldots\ldots,x_n$ is σ_x^2, then the variance of $\lambda x_1,\lambda x_2,\ldots\ldots,\lambda x_n(\lambda\neq 0)$ is

(A) $\lambda\cdot\sigma_x$ (B) $\lambda\cdot\sigma_x^2$

(C) $\lambda^2\cdot\sigma_x$ (D) $\lambda^2\cdot\sigma_x^2$

141. If

$$a=\hat{i}+\hat{j},\quad b=2\hat{j}-\hat{k}$$

and

$$r\times a=b\times a, r\times b=a\times b$$

, then the value

$$\frac{r}{|r|}$$

is

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

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

142. If

$$z = x + iy$$

and

$$z^{1/3} = p + iq$$

, where $x, y, p, q \in R$ and

$$i = \sqrt{-1}$$

, then value of

$$\left(\frac{x}{p} + \frac{y}{q}\right)$$

is

(A) $p^2 - q^2$ (B) $4(p^2 - q^2)$

(C) $p^2 + q^2$ (D) $4(p^2 + q^2)$

143. If

$$\int \frac{dx}{x\sqrt{1-x^3}} = k\log\left(\frac{\sqrt{1-x^3}-1}{\sqrt{1-x^3}+1}\right) + c$$

, (where c is a constant of integration), then value of k is

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

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

144. The statement pattern $p \rightarrow \sim (p \wedge \sim q)$ is equivalent to

(A) q (B) $(\sim p) \vee q$

(C) $(\sim p) \wedge q$ (D) $(\sim p) \vee (\sim q)$

145. a and b are the intercepts made by a line on the co-ordinate axes. If

$$3a = b$$

and the line passes through $(1, 3)$, then the equation of the line is

(A) $x + 3y = 10$ (B) $3x + y = 6$

(C) $x - 3y + 8 = 0$ (D) $3x - 2y + 3 = 0$

146. Let $\bar{a}, \bar{b}$ and $\bar{c}$ be three unit vectors such that

$$\bar{a} \times (\bar{b} \times \bar{c}) = \frac{\sqrt{3}}{2}(\bar{b} + \bar{c})$$

. If $\bar{b}$ is not parallel to $\bar{c}$, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{5\pi}{6}$ (B) $\frac{2\pi}{3}$

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

147. The vector equation of the line

$$2x + 4 = 3y + 1 = 6z - 3$$

is

(A) $\bar{r} = (2\hat{i} + \frac{1}{3}\hat{j} + \frac{1}{2}\hat{k}) + \lambda(3\hat{i} + 2\hat{j} + \bar{k})$

(B) $\bar{r} = (-2\hat{i} - \frac{1}{3}\hat{j} + \frac{1}{2}\hat{k}) + \lambda(3\hat{i} + 2\hat{j} + \hat{k})$

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

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

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

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

(C) $\cos^{-1}(\frac{1}{3})$ (D) $\cos^{-1}(\frac{2}{7})$

149.

$$\int \frac{\log(\cot x)}{\sin 2x} dx =$$

(A) $-\log(\cot x)^2 + c$, where c is constant of integration.

(B) $2(\log(\cot x))^2 + c$, where c is constant of integration.

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

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

150.

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

(A) -2 (B) -1

(C) 1 (D) 2

- End of Question Paper -