MHT CET 2021 PCM Sep 20 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 2021**, 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.

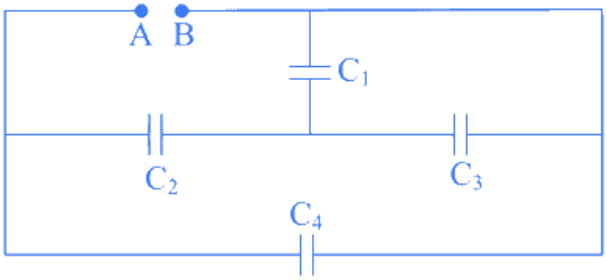
(v) Correct answers earn **1 mark in Physics and Chemistry** and **2 marks in Mathematics**.

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

1. A perfect gas of volume 10 litre n compressed isothermally to a volume of 1 litre. The rms speed of the molecules will

(A) decrease 5 times (B) remain unchanged
(C) increase 5 times (D) increase 10 times

2. In the arrangement of the capacitors as shown in figure, each capacitor is of 6 μF, then equivalent capacity between points A and B is



(A) 12 μF (B) 6 μF
(C) 4 μF (D) 10 μF

3. The relation obeyed by a perfect gas during an adiabatic process is $PV^{3/2}$. The initial temperature of the gas is 'T'. When the gas is compressed to half of its Initial volume, the final temperature of the gas is

(A) $2\sqrt{2}$ T (B) 4 T
(C) $\sqrt{2}$ T (D) 2 T

4. What is the additional energy that should be supplied to a moving electron to reduce its de Broglie wavelength from 1 nm to 0.5 nm ?

(A) Four times its initial energy. (B) Five times its initial energy.
(C) Two times its initial energy. (D) Three times its initial energy.

5. A convex lens of focal length T is used to form an image whose size is one fourth that of size of the object. Then the object distance is

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

6. A particle at rest starts moving with a constant angular acceleration of 4 rad/s^2 in a circular path. At what time the magnitude of its centripetal acceleration and tangential acceleration will be equal?

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

7. A metal conductor of length 1 m rotates vertically about one of its ends at an angular velocity of 5 rad/s. If horizontal component of earth's magnetic field is 0.2×10^{-4} T, then the e.m.f. developed between the two ends of the conductor is

(A) 5 μV (B) 50 mV
(C) 5 mV (D) 50 μV

8. A black rectangular surface of area 'A' emits energy 'E' per second at 27°C. If length and breadth is reduced to $(1/3)^{rd}$ of its initial value and temperature is raised to 327°C then energy emitted per second becomes

(A) $\frac{20E}{9}$ (B) $\frac{8E}{9}$
(C) $\frac{16E}{9}$ (D) $\frac{4E}{9}$

9. A disc of radius 0.4 metre and mass 1 kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration is 10 rad s^{-2}. The tangential force applied to the rim of the disc is

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

10. The output of an 'OR' gate is 'one'

(A) only when both inputs are 'one'. (B) only when both inputs are 'zero'.
(C) only when either input is 'zero'. (D) if either or both inputs are 'one'.

11. A monoatomic gas is suddenly compressed to $(1/8)^{th}$ of its initial volume adiabatically. The ratio of the final pressure to initial pressure of the gas is ($\gamma = 5/3$)

(A) 32 (B) 8
(C) $\frac{40}{3}$ (D) $\frac{24}{5}$

12. In the case of insulators, a band gap and conduction band is respectively

(A) very high empty.
(B) very low, partially filled
(C) very high, completely filled
(D) very low, empty.

13. In a single slit diffraction pattern, the distance between the first minimum on the left and the first minimum on the right is 5 mm. The screen on which the diffraction pattern is obtained is at a distance of 80 cm from the slit. The wavelength used is 6000 $\overset{o}{\text{A}}$. The width of the silt is

(A) 0.096 mm
(B) 0.576 mm
(C) 0.192 mm
(D) 0.384 mm

14. A conducting rod of length 1 m has area of cross-section 10^{-3} m^2. One end is immersed in baiting water (100°C) and the other end in Ice (0°C). If coefficient of thermal conductivity of rod is 96 cal/sm°C and latent heat for ice is 8×10^{-4}cal/kg then the amount of ice which will melt in one minute is

(A) 5.4×10^{-3} kg
(B) 7.2×10^{-3} kg
(C) 1.8×10^{-3} kg
(D) 3.6×10^{-3} kg

15. Which one of the following statements is true?

(A) The sound waves in air are longitudinal while the light waves in air are transverse.
(B) Both light and sound waves in air are transverse.
(C) Both light and sound waves in air are longitudinal.
(D) The sound waves are transverse and light waves are longitudinal.

16. A particle executes S.H.M. of period $\frac{2\pi}{\sqrt{3}}$ second along a straight line 4 cm long. The displacement of the particle at which the velocity is numerically equal to the acceleration is

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

17. Two consecutive harmonics of an air column in a pipe closed at one end are of frequencies 150 Hz and 250 Hz. The fundamental frequency of an air column is

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

18. Two masses 'm_a' and 'm_b' moving with velocities 'v_a' and 'v_b' opposite directions collide elastically. Alter the collision 'm_a' and 'm_b' move with velocities and 'v_b' and 'v_a' respectively, then the ratio $m_a : m_b$ is

(A) $\frac{v_a+v_b}{v_a-v_b}$
(B) $\frac{1}{2}$
(C) 1
(D) $\frac{v_a-v_b}{v_a+v_b}$

19. A sample of radioactive element contains 8×10^{16} active nuclei. The halt-life of the element is 15 days. The number of nuclei decayed after 60 days is

(A) 7.5×10^{16}
(B) 2.0×10^{16}
(C) 0.5×10^{16}
(D) 4.0×10^{16}

20. In Young's double slit experiment, with a source of light having wavelength $6300\,\overset{o}{\text{A}}$, the first maxima will occur when the

(A) path difference is $9200\overset{o}{A}$
(B) phase difference is n radian
(C) phase difference is $\frac{\pi}{2}$ radian.
(D) path difference is $6300\overset{o}{A}$

21. What should be the radius of water drop so that excess pressure inside it is 72 Nm^{-2} ? (The surface tension of water 7.2×10^{-2} Nm^{-1})

(A) 1 mm
(B) 2 mm
(C) 8 mm
(D) 4 mm

22. A body of density V is dropped from (at rest) height 'h' into a lake of density 'δ' $(\delta > \rho)$. The maximum depth to which the body sinks before returning to float on the surface is [Neglect all dissipative forces]

(A) $\frac{(\delta-\rho)}{2h\rho}$
(B) $\frac{2h\rho}{(\delta-\rho)}$
(C) $\frac{h\rho}{2(\delta-\rho)}$
(D) $\frac{h\rho}{(\delta-\rho)}$

23. A parallel plate air capacitor is charged upto 100 V. A plate 2 mm thick is inserted between the plates. Then to maintain the same potential difference, the distance between the plates is increased by 1.6 mm. The dielectric constant of the thick plate is

(A) 4 (B) 5

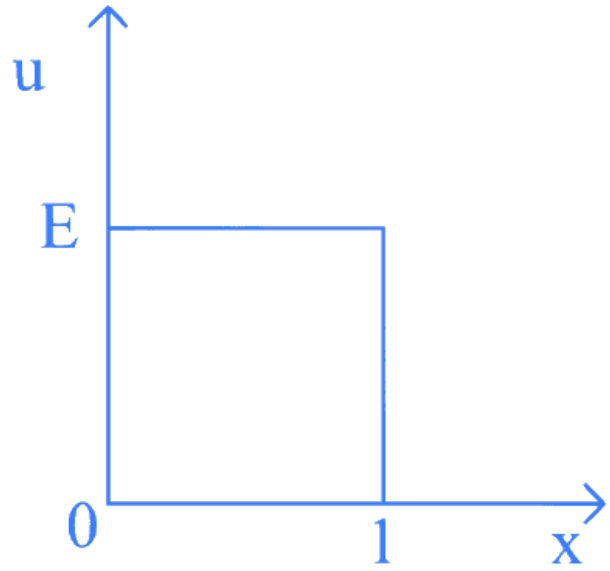
(C) 2 (D) 3

24. A uniformly charged semicircular arc of radius 'r' has linear charge density (λ), is the electric field at its centre? ($\in_0$ = permittivity of free space)

(A) $\frac{\lambda}{4\vartheta_0 r}$ (B) $\frac{2\pi\vartheta_0}{\lambda}$

(C) $\frac{\lambda}{4\vartheta_0}$ (D) $\frac{2\vartheta_0}{\lambda}$

25. The P.E. 'U' of a moving particle of mass 'm' varies with 'x'-axis as shown in figure. The de-Broglie wavelength or the particle in the regions $0 \leq x \leq 1$ and $x > 1$ are λ_1 and λ_2 respectively. II the total energy of the particle is 'nE', then the ratio λ_1/λ_2 is



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

(C) $\sqrt{\frac{n}{n-1}}$ (D) $\sqrt{\frac{n(n-1)}{n}}$

26. An inductive coil has a resistance of 100 Ω. When an a.c. signal of frequency 1000 Hz is applied to the coil the voltage leads the current by 45°. The inductance of the coil is ($\tan 45^\circ = 1$)

(A) $\frac{0.25}{2\pi}$H (B) $\frac{0.05}{\pi}$H

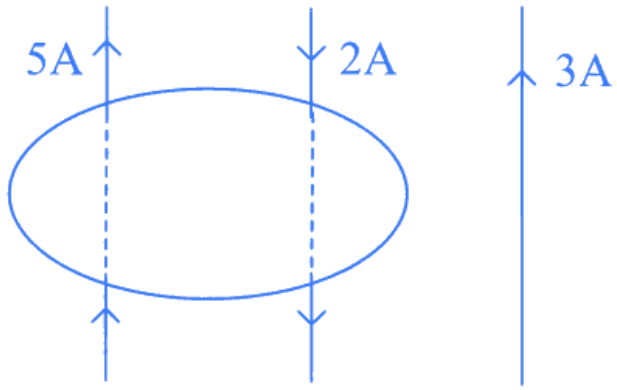
(C) $\frac{0.25}{\pi}$H (D) $\frac{0.5}{\pi}$H

27. The ratio of radii of gyration of a circular ring and circular disc of the same mass and radius, about an axis passing through their centres and perpendicular to their planes is

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

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

28. Two wires carrying currents 5 A and 2 A are enclosed in a circular loop as shown in the figure. Another wire carrying a current of 3 A is situated outside the loop. The value of $\oint \vec{B}\,\vec{dl}$ around the loop is (μ_0 = permeability of free space, $\vec{dl}$ is the length of the element on the Amperion loop)



(A) $4\mu_0$ (B) $2\mu_0$

(C) $3\mu_0$ (D) μ_0

29. A particle is suspended from a vertical spring which is executing S.H.M. of frequency 5 Hz. The spring is unstretched at the highest point of oscillation. Maximum speed of the particle is ($g = 10\ m/s^2$)

(A) $\frac{1}{\pi}$m/s (B) $\frac{1}{4\pi}$m/s

(C) $\frac{1}{2\pi}$m/s (D) π m/s

30. Photoelectrons are emitted when photons of energy 4.2 eV are incident on a photosensitive metallic sphere of radius 10 cm and work function 2.4 eV. The number of photoelectrons emitted before the emission is stopped is

$$\left[\frac{1}{4\pi\epsilon_0} = 9\times10^9\right.$$

SI unit;

$$\left. e = 1.6\times10^{-19}C\right]$$

(A) 1.25×10^6 (B) 1.25×10^2

(C) 1.25×10^8 (D) 1.25×10^4

31. A cricket player hit a ball like a projectile but the fielder caught the ball after 2 second. The maximum height reached by a ball is (g = 10 m/s^2)

(A) 2 m (B) 5 m

(C) 4 m (D) 3 m

32. In an ideal step down transformer, out of the following quantities, which quantity increases in the secondary coil?

(A) Power (B) Voltage

(C) Current (D) Frequency

33. An air column in a pipe, which is closed at one end will be in resonance with a vibrating tuning fork of frequency 264 Hz for various lengths. Which one of the following lengths is not possible? (V = 330 m/s)

(A) 62.50 cm (B) 93.75 cm

(C) 156.25 cm (D) 31.25 cm

34. The surface energy of a liquid drop is 'U'. It splits up into 512 equal droplets. The surface energy becomes

(A) 8 U (B) 6 U

(C) 4 U (D) 2 U

35. A rectifier is used to

(A) convert a.c. to d.c. (B) amplify a weak signal

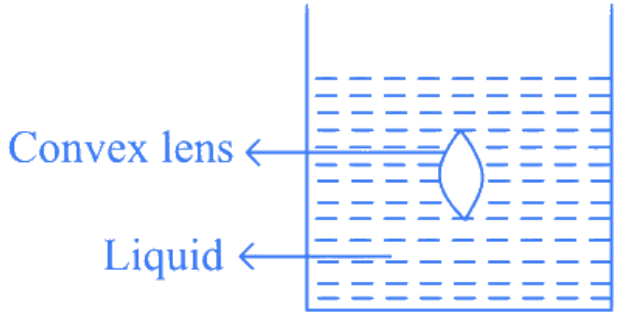
(C) generate intermittent voltage (D) convert d.c. to a.c.

36. Two stars 'P' and 'Q' emit yellow and blue light respectively. The relation between their temperatures (T_P and T_Q) is

(A) $T_P = T_Q$ (B) $T_P = \frac{T_Q}{2}$

(C) $T_P > T_Q$ (D) $T_P < T_Q$

37. Inside a vessel filled with liquid a converging lens is placed as shown in figure. The lens has focal length 15 cm when in air and has refractive index $\frac{3}{2}$. If the liquid has refractive index $\frac{9}{5}$, the focal length of lens in liquid is



(A) 15 cm (B) −60 cm

(C) 90 cm (D) −45 cm

38. A metal wire of length 2500 m is kept in east-west direction, at a height of 10 m from the ground. If it falls freely on the ground then the current induced in the wire is (Resistance of wire $= 25\sqrt{2}\ \Omega, g = 10\ m/s^2$ and Earth's horizontal component of magnetic field

$$\left. B_H = 2\times10^{-5}\ T\right)$$

(A) 0.2 A (B) 0.02 A

(C) 0.01 A (D) 2 A

39. A body is projected from earth's surface with thrice the escape velocity from the surface of the earth. What will be its velocity when it will escape the gravitational pull?

(A) $2\ V_e$ (B) $4\ V_e$

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

40. The depth at which acceleration due to gravity becomes $\frac{g}{n}$ is [R = radius of earth, g = acceleration due to gravity, n = integer]

(A) $\frac{R(n-1)}{n}$ (B) $\frac{(n-1)}{nR}$

(C) $\frac{Rn}{(n-1)}$ (D) $\frac{n}{R(n-1)}$

41. A series LCR circuit with resistance (R) 500 ohm is connected to an a.c. source of 250 V. When only the capacitance is removed, the current lags behind the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60°. The impedance of the circuit is

$$\left(\tan\frac{\pi}{3}=\sqrt{3}\right)$$

(A) $\frac{500}{\sqrt{3}}\Omega$ (B) $500\sqrt{3}\Omega$

(C) 250Ω (D) 500Ω

42. The gyromagnetic ratio of an electron in an hydrogen atom, according to Bohr model is

(A) decreases with the quantum number 'n'. (B) independent of which orbit it is in.

(C) negative (D) positive

43. A body performs S.H.M. under the action of force 'F_1' with period 'T_1' second. If the force is changed to 'F_2' it performs S.H.M. with period 'T_2' second. If both forces 'F_1' and 'F_2' act simultaneously in the same direction on the body, the period in second will be

(A) $\frac{T_1+T_2}{T_1T_2}$ (B) $\frac{T_1^2+T_2^2}{T_1T_2}$

(C) $\frac{T_1T_2}{\sqrt{T_1^2+T_2^2}}$ (D) $\frac{T_1T_2}{T_1+T_2}$

44. Beats are produced by waves

$$y_1 = a\sin 2000\pi t$$

and

$$y_2 = a\sin 2008\pi t$$

. The number of beats heard per second is

(A) 4 (B) 1

(C) zero (D) 8

45. In Young's double slit experiment, the intensity at a point where the path difference is

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

[λ is wavelength of light used] is 'I'. If 'I_0' is the maximum intensity then

$$\frac{I}{I_0}$$

is equal to

$$\left[\cos\frac{\pi}{4}=\sin\frac{\pi}{4}=\frac{1}{\sqrt{2}}\right]$$

(A) 3 : 2 (B) 2 : 3

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

46. The magnetic field at the centre of a current carrying circular coil of area 'A' is 'B'. The magnetic moment of the coil is ($\mu_0 =$ permeability of free space)

(A) $\frac{2BA^{3/2}}{\mu_0\sqrt{\pi}}$ (B) $\frac{BA^{3/2}}{\mu_0\pi}$

(C) $\frac{\mu_0\sqrt{\pi}}{2BA^2}$ (D) $\frac{2BA^2}{\mu_0\sqrt{\pi}}$

47. A galvanometer has resistance 'G' Ω and 'I_g' is current flowing through it which produces full scale deflection. 'S_1' is the value of shunt which converts it into an ammeter of range 0 to '3I' and 'S_2' is the shunt value which converts it into an ammeter of range 0 to '4I', the ratio $S_2 : S_1$ is

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

(C) $\frac{3}{4}$ (D) $\frac{4I-I_g}{3I-I_g}$

48. In potentiometer experiment, null point is obtained at a particular point for a cell on potentiometer wire 'x' cm long. If length of potentiometer wire is increased by few centimeter without changing the cell, the balancing length will [Driving source is not changed]

(A) will net change. (B) increase

(C) decrease (D) become zero

49. A hollow charged metal sphere has radius 'R'. If the potential difference between its surface and a point at a distance '5 R' from the centre is V, then magnitude of electric field Intensity at a distance '5R' from the centre of sphere is

(A) $\frac{V}{2R}$ (B) $\frac{V}{20R}$

(C) 10VR (D) 20VR

50. The relation between magnetic moment 'M' of revolving electron and principle quantum number 'n' is

(A) $M \propto \frac{1}{n}$ (B) $M \propto n$

(C) $M \propto n^2$ (D) $M \propto n^3$

51. What are the formulae of the compounds formed when lanthanoids (Ln) react with nitrogen and halogen respectively?

(A) LnN and LnX_3 (B) LnN_3 and LnX

(C) $(Ln)_2N_3$ and LnX_2 (D) LnN and LnX

52. Identify 'A' in the following reaction.

$$A \xrightarrow{\text{Na/dry ether}} \text{3,4-diethyl-3,4-dimethylhexane} + 2NaCl$$

(A) 3-Chloro-3-methylpentane (B) 3-Chloro-2-methylpentane

(C) 2-Chloro-3-methylpentane (D) 2-Chloro-2-methylpentane

53. For the reaction $2NO + Cl_2 \rightarrow 2NOCl$
What is the relation between

$$\frac{d[NO]}{dt}$$

and

$$\frac{d[NOCl]}{dt}$$

?

(A) $\frac{d[NO]}{dt} = 2\frac{d[NOCl]}{dt}$ (B) $\frac{d[NO]}{dt} = \frac{d[NOCl]}{dt}$

(C) $\frac{1}{4}\frac{d[NO]}{dt} = \frac{d[NOCl]}{dt}$ (D) $4\frac{d[NO]}{dt} = \frac{d[NOCl]}{dt}$

54. What type of hybridization is exhibited by $[CoF_6]^{3-}$?

(A) sp^3 (B) sp^3d^2

(C) dsp^2 (D) d^2sp^3

55. Which among the following is NOT the use of SO_2 gas?

(A) As a preservative (B) In manufacture of H_2SO_4

(C) With conc. H_2SO_4 it forms oleum (D) As an antichlor

56. Glucose and gluconic acid on oxidation with dilute nitric acid forms saccharic acid. This reaction confirms that glucose contains

(A) four primary alcoholic groups. (B) two primary alcoholic groups.

(C) one primary alcoholic groups. (D) five hydroxyl groups.

57. Identify $-I$ effect causing group from following.

(A) $-COOR$ (B) $-CH_3$

(C) $-C_2H_5$ (D) $-C_3H_7$

58. Which from following instruments is used to determine the crystal structure?

(A) Scanning electron microscope (B) FTIR spectrophotometer

(C) X-ray diffractometer (D) Transmission electron microscope

59. Solubility of AgCl is 7.2×10^{-7} mol dm^{-3}. What is it's solubility product?

(A) 3.6×10^{-13} (B) 7.2×10^{-14}

(C) 2.59×10^{-14} (D) 5.18×10^{-13}

60. Identify compound A used in following reaction.
Benzoic acid

$$\xrightarrow[\Delta]{A}$$

Benzoyl chloride + Phosphorous oxychloride + Hydrogen chloride

(A) $SOCl_2$ (B) PCl_3

(C) HCl (D) PCl_5

61. In a first order reaction concentration of reactant decreases from 20 m mol to 10 m mol in 1.151 min. What is rate constant?

(A) 1.15 min^{-1} (B) 3.0 min^{-1}

(C) 5.50 min^{-1} (D) 0.60 min^{-1}

62. Which among following compounds is a primary amine?

(A) Ethyl methyl propyl amine (B) Hexamethylene diamine

(C) Diphenyl amine (D) N, N-Dimethyl aniline

63. Which among following properties of lanthanoids is NOT true?

(A) These are good conductors of heat and electricity.
(B) These are strongly paramagnetic.
(C) These all are non-radioactive.
(D) These have coordination number greater than 6 .

64. How many total voids are present in 1 mole of compound that forms hcp structure?

(A) 1.806×10^{24}
(B) 1.204×10^{24}
(C) 3.011×10^{23}
(D) 6.022×10^{23}

65. Identify neutral complex from following.

(A) $Na_3[AlF_6]$
(B) $[Co(NO_2)_3(NH_3)_3]$
(C) $[Cu(NH_3)_4]^{2+}$
(D) $[Fe(CN)_6]^{4-}$

66. How many molecules of methyl iodide are required to obtain tetramethyl ammonium iodide from dimethyl amine?

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

67. Which of the following processes does NOT involve use of dihydrogen?

(A) Gasification of coal
(B) Formation of vanaspati ghee
(C) Preparation of HCl
(D) Preparation of metal hydride

68. Which of the following compounds does NOT exhibit optical isomerism?

(A) 2-Iodo-3-methylbutane
(B) 3-Iodohexane
(C) 2-Iodopentane
(D) 2-Iodo-2-methylbutane

69. What is the value of 'x' in order to balance the following redox reaction by ion electron method?

$$xH_2O_2 + ClO_4 \rightarrow xO_2 + ClO_2 + 2H_2O$$

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

70. Which among the following carbohydrates is a trisaccharide?

(A) Ribose
(B) Raffinose
(C) Glycogen
(D) Stachyose

71. "Mass can neither be created nor destroyed" is the statement of

(A) Gay Lussac Law of gaseous volume
(B) Law of definite proportion
(C) Law of conservation of mass
(D) Law of multiple proportions

72. What is bond angle O-S-O in SO_2 molecule?

(A) 107°
(B) 180°
(C) 90°
(D) 119.5°

73. Which of the following bonds has highest bond enthalpy?

(A) N-N in NH_3
(B) O=O in O_2
(C) C-H in CH_4
(D) N≡N in N_2

74. Which of the following compounds is optically inactive?

(A) 2-Chloro-2-methylbutane
(B) 3-Chlorohexane
(C) 2-Chloro-3-methylbutane
(D) 2-Chloropentane

75. Which type of reaction order is followed by radioactive processes?

(A) 0
(B) 1
(C) 2
(D) 1.5

76. What is the total number of Bravais lattices present in seven types of crystal system?

(A) 12
(B) 7
(C) 10
(D) 14

77. Which among the following aqueous salt solution is used in conductivity cell to determine cell constant?

(A) $AgNO_3$
(B) $ZnSO_4$
(C) KCl
(D) $CuSO_4$

78. Calculate heat of formation of HCl gas from following reaction.

$$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}; \Delta H = -194 \text{ kJ}$$

(A) -143 kJ mol^{-1}
(B) -286 kJ mol^{-1}
(C) -92 kJ mol^{-1}
(D) -97 kJ mol^{-1}

79. What is the value of frequency of radiation when transition occurs between two stationary states that differ in energy by ΔE ?

(A) $v = \frac{2\pi}{h}$
(B) $v = \frac{h}{\Delta E}$
(C) $v = \frac{\Delta E}{h}$
(D) $v = \frac{h}{2\pi}$

80. What is molar concentration of weak monobasic acid if dissociation constant is 5×10^{-8} and undergoes 0.5% dissociation?

(A) 0.03 M
(B) 0.002 M
(C) 0.001 M
(D) 0.005 M

81. A substance containing hydrogen and releasing H^+ in aqueous medium is acid. Identify theory suggesting this concept, from following.

(A) Ostwald theory
(B) Bronsted-Lowry theory
(C) Arrhenius theory
(D) Lewis theory

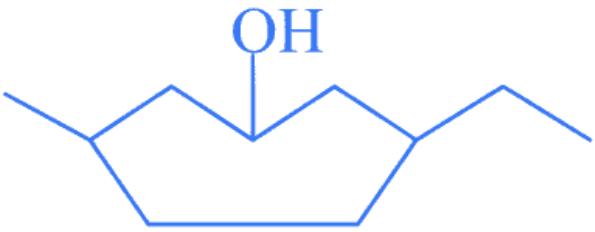
82. What is the molar conductivity of 0.05M solution of sodium hydroxide, if it's conductivity is $0.0118\ S\ cm^{-1}$ at 298 K ?

(A) $236\ S\ cm^2\ mol^{-1}$
(B) $423\ S\ cm^2\ mol^{-1}$
(C) $354\ S\ cm^2\ mol^{-1}$
(D) $590\ S\ cm^2\ mol^{-1}$

83. Which among the following compounds has highest boiling point?

(A) Hexanal
(B) Propanal
(C) Ethanal
(D) Pentanal

84. What is IUPAC name of the following compound?



(A) 3-Methyl-6-ethyl cycloheptanol
(B) 3-Ethyl-6-methyl cycloheptanol
(C) 3-Ethyl cycloheptanol
(D) 1-Ethyl-5-methyl cycloheptan-3-ol

85. What is molar mass of metal with BCC structure having density $10\ g\ cm^{-3}$ and edge length 200 pm?

(A) $90.2\ g\ mol^{-1}$
(B) $24.1\ g\ mol^{-1}$
(C) $48.0\ g\ mol^{-1}$
(D) $60.5\ g\ mol^{-1}$

86. Calculate difference between ΔH and ΔU for following reaction at 25°C ?

$C_2H_{6(g)} + 3.5O_2 \rightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ ($R = 8.314\ J\ K^{-1}\ mol^{-1}$)

(A) −9.3 kJ
(B) −3.1 kJ
(C) −6.2 kJ
(D) −16.10 kJ

87. What is cryoscopic constant of water if 5 g of glucose in 100 g of water has depression in freezing point 2.15 K ? (Molar mass of glucose = 180)

(A) $7.74\ K\ kg\ mol^{-1}$
(B) $0.52\ K\ kg\ mol^{-1}$
(C) $1.32\ K\ kg\ mol^{-1}$
(D) $3.86\ K\ kg\ mol^{-1}$

88. Which of the following pairs of alkenes is an example of position isomers?

(A) But-1-ene and 2-methylprop-1-ene
(B) But-1-ene and 2-methylbut-1-ene
(C) But-1-ene and but-2-ene
(D) But-2-ene and 2-methylprop-1-ene

89. Which of the following polymers is used in the preparation of cinema films?

(A) Semisynthetic polymers
(B) Synthetic polymers
(C) Plant polymers
(D) Animal polymers

90. In carbinol system isobutyl alcohol is named as

(A) Ethyl methyl carbinol
(B) Isobutyl carbinol
(C) Isopropyl carbinol
(D) Diethyl carbinol

91. Which among the following is strongest acid?

(A) Chloroacetic acid
(B) Fluoroacetic acid
(C) Bromoacetic acid
(D) Iodoacetic acid

92. Identify the isomerism exhibited by methoxyethane and propan-1-ol.

(A) Position isomerism
(B) Chain isomerism
(C) Functional group isomerism
(D) Metamerism

93. Which of the following statements is correct for boiling point of a liquid?

(A) Temperature at which a liquid boils at any pressure.

(B) Temperature at which solid is in equilibrium with its liquid.

(C) Temperature at which vapour pressure equals the applied pressure.

(D) Temperature at which applied pressure is greater than vapour pressure of liquid.

94. Henry's law constant for CH_3Br is $0.16\ mol\ L^{-1}bar^{-1}$ at $298\ K$. What pressure is required to have solubility of $0.08\ mol\ L^{-1}$?

(A) 0.24 bar

(B) 1.6 bar

(C) 0.5 bar

(D) 4.0 bar

95. Identify negatively charged sol from following.

(A) sol of clay

(B) $Fe_2O_3 \cdot xH_2O$

(C) TiO_2 sol

(D) Haemoglobin

96. Which of the following monomer is used for preparation of Nylon-6?

(A) Isobutylene

(B) Hexamethylene diammonium adipate

(C) Caprolactum

(D) Acrylonitrile

97. Keeping temperature constant the pressure of $11.2\ dm^3$ of a gas was increased from 105 kPa to 420 kPa. What is the new volume of gas?

(A) $1.4\ dm^3$

(B) $7.0\ dm^3$

(C) $5.6\ dm^3$

(D) $2.8\ dm^3$

98. The change in internal energy of a system depends upon

(A) initial and final states of a system

(B) path followed by system

(C) total energy of final state only

(D) number of steps involved in system

99. How many faraday of electricity is required to produce 10 g of calcium metal (molar mass = $40\ g\ mol^{-1}$) from calcium ions?

(A) 1.5 F

(B) 2.0 F

(C) 0.50 F

(D) 1.0 F

100. Identify the product formed in the following reaction,

$$CH_3 - CH = CH - CH_2 - CHO \xrightarrow[(ii)\ H_2O^+]{(i)\ LiAlH_4}$$

Products

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

(B) $CH_3 - (CH_2)_3 - CH_2 - OH$

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

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

101.

$$\sin^{-1}[\sin(-600^\circ)] + \cot^{-1}(-\sqrt{3}) =$$

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$ (D) $\frac{7\pi}{6}$

102. If m is order and n is degree of the differential equation

$$y = \frac{dp}{dx} + \sqrt{a^2p^2 - b^2}$$

, where

$$p = \frac{dy}{dx}$$

, then the value of $m + n$ is

(A) 2 (B) 3

(C) 4 (D) 5

103. The surface area of a spherical balloon is increasing at the rate 2 cm^2/sec. Then rate of increase in the volume of the balloon is , when the radius of the balloon is 6 cm.

(A) 4 cm^3/sec. (B) 16 cm^3/sec.

(C) 36 cm^3/sec. (D) 6 cm^3/sec.

104. The p.m.f. of a random variable X is

$$P(X = x) = \frac{1}{2^5}\binom{5}{x}, x = 0,1,2,3,4,5 = 0$$

then

(A) $P(X \leq 2) < P(X \geq 3)$

(B) $P(X \leq 2) > P(X \geq 3)$

(C) $P(X \leq 2) = 2P(X \geq 3)$

(D) $P(X \leq 2) = P(X \geq 3)$

105. $\bar{a}, \bar{b}, \bar{c}$ are vectors such that

$$|a| = 5, |b| = 4, |c| = 3$$

and each is perpendicular to the sum of the other two, then

$$|a + b + c|^2 =$$

(A) 60 (B) 12

(C) 47 (D) 50

106. If

$$\frac{n!}{2!(n-2)!}$$

and

$$\frac{n!}{4!(n-4)!}$$

are in the ratio 2 : 1, then

$$n =$$

(A) 6 (B) 4

(C) 5 (D) 3

107. p : It rains today
q : I am going to school
r : I will meet my friend
s : I will go to watch a movie.
Then symbolic form of the statement "If it does not rain today or I won't go to school, then I will meet my friend and I will go to watch a movie" is

(A) $\sim (p \vee q) \rightarrow (r \vee s)$ (B) $(p \wedge q) \rightarrow (r \vee s)$

(C) $\sim (p \wedge q) \rightarrow (r \wedge s)$ (D) $(\sim p \wedge q) \rightarrow (r \wedge s)$

108. If

$$a = \lim_{n \to \infty} \frac{1 + 2 + 3 + \ \ldots \ + n}{n^2}$$

and

$$b = \lim_{n \to \infty} \frac{1^2 + 2^2 + 3^2 + \ \ldots \ + n^2}{n^3}$$

, then

(A) a = b (B) 2a = 3b

(C) a = 2b (D) 3a = 2b

109. If ω is complex cube root of unity and

$$(1 + \omega)^7 = A + B\omega$$

, then values of A and B are, respectively

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

(C) 1, 0 (D) -1, 1

110. If

$$[\bar{a}\bar{b}\bar{c}] = 4$$

, then the volume (in cubic units) of the parallelopiped with $\bar{a} + 2\bar{b}, \bar{b} + 2\bar{c}$ and $\bar{c} + 2\bar{a}$ as coterminal edges, is

(A) 32 (B) 16

(C) 9 (D) 36

111. The variance of the following probability distribution is,

x	0	1	2
P(X)	$\frac{9}{16}$	$\frac{3}{8}$	$\frac{1}{16}$

(A) $\frac{1}{8}$ (B) $\frac{5}{8}$
(C) $\frac{1}{4}$ (D) $\frac{3}{8}$

112. The general solution of the differential equation

$$\cos x \cdot \sin y dx + \sin x \cdot \cos y dy = 0$$

is

(A) $\sin x + \sin y = c$ (B) $\sin x \cdot \sin y = c$
(C) $\cos x + \cos y = c$ (D) $\cos x \cdot \cos y = c$

113. $\bar{a}, \bar{b}$ and $\bar{c}$ are three vectors such that

$$a + b + c = 0$$

and

$$|a| = 3, |b| = 5, |c| = 7$$

, then the angle between $\bar{a}$ and $\bar{b}$ is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{2}$
(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$

114.

$$\int \sec^4 x \cdot \tan^4 x dx = \frac{\tan^m x}{m} + \frac{\tan^n x}{n} + c$$

(where c is constant of integration), then m + n =

(A) 8 (B) 12
(C) 10 (D) 16

115. The x-intercept of a line passing through the points

$$\left(\frac{-1}{2}, 1\right)$$

and (1, 2) is :

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

116. The Cartesian equation of the line passing through the points A(2, 2, 1) and B(1, 3, 0) is

(A) $\frac{x+2}{1} = \frac{y+2}{-1} = \frac{z+1}{-1}$ (B) $\frac{x-2}{-1} = \frac{y-2}{1} = \frac{z-1}{-1}$
(C) $\frac{x+2}{-1} = \frac{y+2}{1} = \frac{z+1}{-1}$ (D) None of these

117. If the variance of the numbers $2, 3, 11$ and x is

$$\frac{49}{4}$$

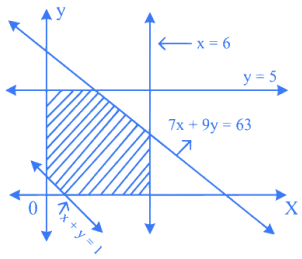
, then the values of x are

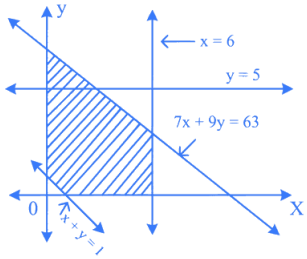
(A) $6, \frac{14}{3}$ (B) $4, \frac{13}{5}$
(C) $6, \frac{16}{3}$ (D) $6, \frac{14}{5}$

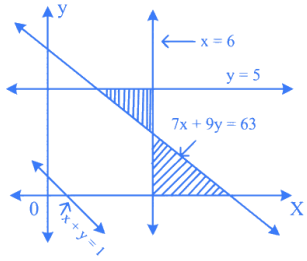
118. The differential equation of an ellipse whose major axis is twice its minor axis, is

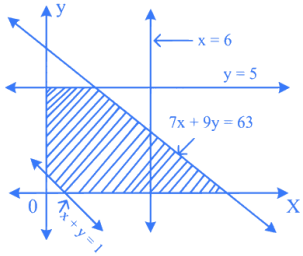
(A) $x + 4y\frac{dy}{dx} = 0$ (B) $x - 4y\frac{dy}{dx} = 0$
(C) $x + 2y\frac{dy}{dx} = 0$ (D) None of these

119. The solution set for the system of linear inequations $x + y \geq 1; 7x + 9y \leq 63; y \leq 5; x \leq 6, x \geq 0$ and $y \geq 0$ is represented graphically in the figure. What is the correct option?

(A)


(B)


(C)


(D)


120.

$$\cos^{-1}\left(\frac{4}{5}\right)+\cos^{-1}\left(\frac{12}{13}\right)=$$

(A) $\cos^{-1}\left(\frac{24}{25}\right)$ (B) $\cos^{-1}\left(\frac{33}{65}\right)$

(C) $\cos^{-1}\left(\frac{5}{13}\right)$ (D) $\cos^{-1}\left(\frac{3}{5}\right)$

121. The co-factors of the elements of second column of

$$\begin{bmatrix}1 & -1 & 2\\ 3 & 2 & 1\\ -1 & 3 & 4\end{bmatrix}$$

are

(A) $-13,6,5$ (B) $13,5,6$

(C) $13,-6,-5$ (D) $-13,-6,5$

122. The Cartesian equation of the plane

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

is

(A) $x+y+z=0$

(B) $5x+2y+3z=3$

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

(D) $5x-2y-3z-7=0$

123. The principal solutions of

$$\sqrt{3}\ \sec x+2=0$$

are

(A) $\frac{\pi}{6},\frac{5\pi}{6}$ (B) $\frac{5\pi}{6},\frac{7\pi}{6}$

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

124.

$$\int \mathrm{cosec}(x-a)\mathrm{cosec}\,x\,dx=$$

(A) $\mathrm{cosec}a\cdot\log[\sin(x-a)\mathrm{cosec}x]+c$

(B) $\mathrm{cosec}a\log[\sin(x-a)\sin x]+c$

(C) $\sin a\cdot\log[\sin(x-a)\sin x]+c$

(D) $\mathrm{cosec}a\cdot\log[\mathrm{cosec}(x-a)\sin x]+c$

125. If

$$f(x)=2x^3-15x^2-144x-7$$

, then $f(x)$ is strictly decreasing in

(A) $(-8,3)$ (B) $(-3,8)$

(C) $(3,8)$ (D) $(-8,-3)$

126. The equation of the plane that contains the line of intersection of the planes.

$$x+2y+3z-4=0$$

and

$$2x+y-z+5=0$$

and is perpendicular to the plane

$$5x+3y-6z+8=0$$

is

(A) $14x+7y-7z-4=0$

(B) $33x+45y+50z-41=0$

(C) $-33x+45y-50z+41=0$

(D) $5x+31y+50z-41=0$

127. If the sum of mean and variance of a binomial distribution for 5 trials is 1.8, then probability of a success is

(A) 0.2 (B) 0.6

(C) 0.4 (D) 0.8

128.

$$y=\sqrt{e^{\sqrt{x}}}$$

, then

$$\frac{dy}{dx}=$$

(A) $\frac{e^{\sqrt{x}}}{4\sqrt{x}}$ (B) $\frac{e^{\sqrt{x}}}{4x}$

(C) $\frac{e^{\frac{\sqrt{x}}{2}}}{4\sqrt{x}}$ (D) $\frac{e^{\sqrt{x}}}{2\sqrt{x}}$

129. If area of the parallelogram with $\bar{a}$ and $\bar{b}$ as two adjacent sides is 20 square units, then the area of the parallelogram having $3\overline{a}+\overline{b}$ and $2\overline{a}+3\overline{b}$ as two adjacent sides in square units is

(A) 105 (B) 120

(C) 75 (D) 140

130. If

$$f(x)=\frac{4^{x-\pi}+4^{x-\pi}-2}{(x-\pi)^2}$$

, for $x\neq\pi$, is continuous at

$$x=\pi$$

, then k =

(A) 2log2 (B) $(\log 2)^2$

(C) $-(\log 2)^2$ (D) $8(\log 2)^2$

131. The equation of tangent to the circle

$$x^2+y^2=64$$

at the point

$$\mathrm{P}\left(\frac{2\pi}{3}\right)$$

is

(A) $x-\sqrt{3}y-16=0$ (B) $\sqrt{3}x+y-16=0$

(C) $x+\sqrt{3}y+16=0$ (D) $x-\sqrt{3}y+16=0$

132. If

$$2f(x) - 3f\left(\frac{1}{x}\right) = x$$

, then

$$\int_1^e f(x)dx =$$

(A) $-(\frac{2+e^2}{5})$ (B) $\frac{2+e}{5}$

(C) $\frac{2+e^2}{5}$ (D) $\frac{2-e^2}{5}$

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

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

(C) $\frac{1}{4\pi}$ m/min (D) $\frac{2}{\pi}$ m/min

134. If the equation

$$3x^2 - kxy - 3y^2 = 0$$

represents the bisectors of angles between the lines

$$x^2 - 3xy - 4y^2 = 0$$

, then value of k is

(A) -6 (B) -10

(C) 6 (D) 10

135. The general solution of

$$\left(x\frac{dy}{dx} - y\right)\sin\frac{y}{x} = x^3e^x$$

is

(A) $e^x(x-1) + \cos\frac{y}{x} + c = 0$

(B) $xe^x + \cos\frac{y}{x} + c = 0$

(C) $e^x(x+1) + \cos\frac{y}{x} + c = 0$

(D) $ex^x - \cos\frac{y}{x} + c = 0$

136. The area bounded by the parabola

$$y = x^2$$

and the line

$$y = x$$

is

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

(C) $\frac{2}{3}$ sq. units (D) $\frac{1}{6}$ sq. units

137. If

$$y = \sin^{-1}\left[\cos\sqrt{\frac{1+x}{2}}\right] + x^x$$

, then

$$\frac{dy}{dx}$$

at

$$x = 1$$

is

(A) $\frac{5}{4}$ (B) $\frac{-1}{4}$

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

138. Negation of $(p \wedge q) \rightarrow (\sim p \vee r)$ is

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

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

139. If

$$A^{-1} = \begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 5 & 5 \end{bmatrix}$$

, then

$$A =$$

(A) $\begin{bmatrix} -5 & 20 & -2 \\ -1 & 3 & 0 \\ 3 & -11 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} -5 & 20 & 2 \\ -1 & 3 & 0 \\ 3 & 11 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} -5 & 20 & 2 \\ 1 & 3 & 0 \\ 3 & 11 & -1 \end{bmatrix}$

(D) $\begin{bmatrix} -5 & 20 & -2 \\ 1 & 3 & 0 \\ 3 & 11 & 1 \end{bmatrix}$

140. The joint equation of pair of lines through the origin and making an equilateral triangle with the line

$$y = 3$$

is

(A) $x^2 + 3y^2 = 0$ (B) $3x^2 - y^2 = 0$

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

141. If

$$\bar{r} = -4\hat{i} - 6\hat{j} - 2\hat{k}$$

is a linear combination of the vectors

$$\bar{a} = -\hat{i} + 4\hat{j} + 3\hat{k}$$

and

$$\bar{b} = -8\hat{i} - \hat{j} + 3\hat{k}$$

, then

(A) $\bar{r} = \frac{-4}{3}\bar{a} + \frac{2}{3}\bar{b}$ (B) $\bar{r} = \frac{4}{3}\bar{a} + \frac{2}{3}\bar{b}$

(C) $\bar{r} = \frac{-1}{3}\bar{a} + \frac{2}{3}\bar{b}$ (D) $\bar{r} = \frac{1}{3}\bar{a} - \frac{1}{3}\bar{b}$

142. If

$$A^{-1} = \begin{bmatrix} 2 & -3 \\ -1 & 2 \end{bmatrix}$$

and

$$B^{-1} = \begin{bmatrix} 1 & 0 \\ -3 & 1 \end{bmatrix}$$

, then

$$(AB)^{-1} =$$

(A) $\begin{bmatrix} 2 & 7 \\ 3 & -1 \end{bmatrix}$ (B) $\begin{bmatrix} 2 & -7 \\ -3 & 11 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & -3 \\ -7 & 11 \end{bmatrix}$ (D) $\begin{bmatrix} 2 & 3 \\ 7 & -11 \end{bmatrix}$

143. Two unbiased dice are thrown. Then the probability that neither a doublet nor a total of 10 will appear is

(A) $\frac{1}{12}$ (B) $\frac{1}{36}$

(C) $\frac{2}{9}$ (D) $\frac{7}{9}$

144. The population of a city increases at a rate proportional to the population at that time. If the population of the city increase from 20 lakhs to 40 lakhs in 30 years, then after another 15 years the population is

(A) $10\sqrt{2}$ lakhs (B) $40\sqrt{2}$ lakh

(C) $30\sqrt{2}$ lakhs (D) None of these

145. Let

$$A = [a, b, c, d], B = [1,2,3]$$

. Relation R_1, R_2, R_3, R_4 are as follows :

$$R_1 = [(a, 1), (b, 2), (c, 1), (d, 2)]$$

$$R_2 = [(a, 1), (b, 1), (c, 1), (d, 1)]$$

$$R_3 = [(a, 2), (b, 3), (c, 2), (d, 2)]$$

$$R_4 = [(a, 1), (b, 2), (a, 2), (d, 3)]$$, then

(A) only R_3 and R_4 are not functions (B) only R_1 and R_2 are not functions.

(C) only R_3 is not a function. (D) only R_4 is not a function.

146. If

$$\cos x = \frac{24}{25}$$

and x lies in first quadrant, then

$$\sin\frac{x}{2} + \cos\frac{x}{2} =$$

(A) $\frac{6}{5\sqrt{2}}$ (B) $\frac{8}{5\sqrt{2}}$

(C) $\frac{7}{5\sqrt{2}}$ (D) $\frac{1}{5\sqrt{2}}$

147. If

$$\int_2^e \left[\frac{1}{\log x} - \frac{1}{(\log x)^2}\right] dx = a + \frac{b}{\log 2}$$

, then

(A) $a = -e, b = 2$ (B) $a = e, b = -2$

(C) $a = e, b = 2$ (D) $a = -e, b = -2$

148. The vector equation of the line whose Cartesian equations are y = 2 and 4x − 3z + 5 = 0 is

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

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

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

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

149.

$$\int \frac{2x^2 - 1}{x^4 - x^2 - 20} dx =$$

(A) $\frac{1}{\sqrt{5}}\log|\frac{x+\sqrt{5}}{x-\sqrt{5}}| + \tan^{-1}(\frac{x}{2}) + c$

(B) $\frac{1}{2\sqrt{5}}\log|\frac{x+\sqrt{5}}{x-\sqrt{5}}| + \tan^{-1}(\frac{x}{2}) + c$

(C) $\frac{1}{2\sqrt{5}}\log|\frac{x-\sqrt{5}}{x+\sqrt{5}}| + \frac{1}{2}\tan^{-1}(\frac{x}{2}) + c$

(D) $\frac{1}{2}\log|\frac{x-\sqrt{5}}{x+\sqrt{5}}| + \frac{1}{2}\tan^{-1}(\frac{x}{2}) + c$

150. If

$$x = a(t + \sin t), y = a(1 - \cos t)$$

, then

$$\frac{dy}{dx} =$$

(A) $\tan\frac{t}{2}$ (B) $-\frac{1}{2}$tant

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

- End of Question Paper -