MHT CET – 2021

22nd September (Shift - 1)

Section I

PHYSICS

1. Two rotating bodies P and Q of masses 'm' and '2m' with moment of inertia I_P and I_Q ($I_Q > I_P$) have equal Kinetic energy of rotation. If L_P and L_Q be their angular momenta respectively then
(A) $L_Q = 0$ (B) $L_Q = L_P$ (C) $L_Q < L_P$ (D) $L_Q > L_P$

2. A sound wave is travelling with a frequency of 50 Hz. The phase difference between the two points in the path of a wave is $\frac{\pi}{3}$. The distance between those two points is (Velocity of sound in air = 330 m/s)
(A) 1.1 m (B) 0.6 m (C) 2.2 m (D) 1.7 m

3. A logic gate which gives output 'HIGH' only when its two input terminals are at different logic levels with respect to each other is
(A) NOR gate (B) OR gate (C) AND gate (D) X–OR gate

4. A circular coil of radius 'R' has 'N' turns of a wire. The coefficient of self induction of the coil will be (μ_0 = permeability of free space)
(A) $\frac{\mu_0 N\pi R^2}{2}$ (B) $\frac{\mu_0 N\pi R}{4}$ (C) $\frac{\mu_0 N^2\pi R}{2}$ (D) $\frac{\mu_0 N\pi R}{2}$

5. An a.c. source of angular frequency 'ω' is fed across a resistor 'R' and a capacitor 'C' in series. The current registered is I. If now the frequency of source is changed to $\frac{\omega}{3}$ (but maintaining the same voltage), the current in the circuit is found to be halved. The ratio of reactance to resistance at the original frequency 'ω' will be
(A) $\sqrt{\frac{2}{5}}$ (B) $\sqrt{\frac{1}{5}}$ (C) $\sqrt{\frac{4}{5}}$ (D) $\sqrt{\frac{3}{5}}$

6. A transverse wave given by $y = 2 \sin (0.01x + 30 t)$ moves on a stretched string from one end to another end in 0.5 second. If 'x' and 'y' are in cm and 't' is in second, then the length of the string is
(A) 6 m (B) 9 m (C) 12 m (D) 15 m

7. The translational kinetic energy of the molecules of a gas at absolute temperature (T) can be doubled
(A) by increasing T to 4T (B) by increasing T to 2T
(C) by decreasing T to T/2 (D) by increasing T to $\sqrt{2}$T

8. When a light of wavelength 'λ' falls on the emitter of a photocells, maximum speed of emitted photoelectrons is 'V'. If the incident wavelength is changed to $\frac{2\lambda}{3}$, maximum speed of emitted photoelectrons will be
(A) less than $V(1.5)^{1/2}$ (B) $\sqrt{V}$
(C) grater than $V(1.5)^{\frac{1}{2}}$ (D) V

9. A polyatomic gas ($\gamma = 4/3$) is compressed to $\left(\frac{1}{8}\right)^{th}$ of its volume adiabatically. If its initial pressure is P_0, its new pressure will be

(A) $2P_0$ (B) $8\ P_0$ (C) $6\ P_0$ (D) $16\ P_0$

10. If ω_1 is angular velocity of hour hand of clock and ω_2 is angular velocity of the earth, then the ratio $\omega_1:\omega_2$ is

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

11. A wire of length 1 m is moving at a speed of 2 m/s perpendicular homogenous magnetic field of 0.5 T. The ends of the wire are joined to resistance 6Ω. The rate at which work is being done to keep the wire moving at that speed is

(A) $\frac{1}{3}$ W (B) $\frac{1}{6}$ W (C) $\frac{1}{12}$ W (D) 1 W

12. In Young's double slit experiment, the 10th maximum of wavelength 'λ_1' is at a distance of 'Y_1' from the central maximum . When the wavelength of the source is changed to 'λ_2', 5th maximum is at a distance 'Y_2' from the central maximum. The ratio $\frac{Y_1}{Y_2}$ is

(A) $\frac{2\lambda_1}{\lambda_2}$ (B) $\frac{\lambda_2}{2\lambda_1}$ (C) $\frac{2\lambda_2}{\lambda_1}$ (D) $\frac{\lambda_1}{2\lambda_2}$

13. A mass 0.4 kg performs S.H.M. with a frequency $\frac{16}{\pi}$ Hz. At a certain displacement it has kinetic energy 2 J and potential energy 1.2 J. The amplitude of oscillation is

(A) 0.15 m (B) 0.125 m (C) 0.075 m (D) 0.1 m

14. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. If the escape velocity from the earth is 'V_e', then the escape velocity from the planet is

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

15. A biconvex lens ($R_1 = R_2 = 30$ cm) has focal length equal to the focal length of concave mirror. The radius of curvature of concave mirror is

[Refractive index of material of lens = 1.6]

(A) 30 cm (B) 40 cm (C) 50 cm (D) 20 cm

16. In an a.c. circuit, a resistance R = 40 Ω and an inductance 'L' are connected in series. If the phase angle between voltage and current is 45°, then the value of the inductive reactance is (tan 45° = 1)

(A) 50 Ω (B) 40 Ω (C) 10 Ω (D) 20 Ω

17. A pipe open at both ends of length 1.5 m is dipped in water such that the second overtone of vibrating air column is resonating with a tuning fork of frequency 330 Hz. If speed of sound in air is 330 m/s then the length of the pipe immersed in water is (Neglect end correction)

(A) 0.35 m (B) 0.25 m (C) 0.55 m (D) 0.45 m

18. Choose the FALSE statement from the following.
(A) Generally, in conductors the valence and conducting bands overlap.
(B) The resistivity of a semiconductor increases with increase in temperature
(C) The conductivity of a semiconductor increase with increase in temperature
(D) Substances with energy gap of the order of 10 eV are insulators

19. A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between the two bridges when a mass of 9 kg is suspended from the wire. When this mass is replaced by a mass M, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value of 'M' is

(A) 5 kg (B) 12.5 kg (C) $\frac{1}{25}$ kg (D) 25 kg

20. If the temperature of the sun is doubled, the rate of energy received by the earth will be increased by a factor
(A) 8 (B) 2 (C) 4 (D) 16

21. Water rises in a capillary tube of radius 'r' up to a height 'h'. The mass of water in a capillary is 'm'. The mass of water that will rise in a capillary tube of radius $\frac{'r'}{3}$ will be

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

22. In a wheatstone's bridge, three resistances P, Q and R are connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balanced is

(A) $\frac{P}{Q}=\frac{2R}{S_1+S_2}$ (B) $\frac{P}{Q}=\frac{R(S_1+S_2)}{2S_1S_2}$ (C) $\frac{P}{Q}=\frac{R(S_1+S_2)}{S_1S_2}$ (D) $\frac{P}{Q}=\frac{R(S_1S_2)}{S_1+S_2}$

23. If a current flowing in a coil is reduced to half of its initial value, the relation between the new energy (E_2) and the original energy (E_1) stored in the coil will be

(A) $E_2=\frac{E_1}{4}$ (B) $E_2=\frac{E_1}{2}$ (C) $E_2=E_1$ (D) $E_2=4E_1$

24. The critical angle for light going from medium A into medium B is θ. The speed of light in the medium A is V_A. What is the speed of light in the medium B?

(A) $V_A \sin\theta$ (B) $V_A \tan\theta$ (C) $\frac{V_A}{\tan\theta}$ (D) $\frac{V_A}{\sin\theta}$

25. Which of the following statements is true?
(ΔU = increase in internal energy, dW = work done by the system)
(A) In an adiabatic process $\Delta U = dW$ (B) In an adiabatic process $\Delta U = -dW$
(C) In an isothermal process $\Delta U = -dW$ (D) In an isothermal process $\Delta U = dW$

26. The frequency of the output signal of an LC oscillator circuit is 'F' Hz with a capacitance of 0.1 μF. If the value of the capacitor is increased to 0.2 μF, then the frequency of the output signal will be

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

27. A solid sphere of mass 'M' and radius 'R' is rotating about its diameter. A solid cylinder of same mass and same radius is also rotating about its geometrical axis with an angular speed twice that of the sphere. The ratio of the kinetic energy of rotation of the sphere to that of the cylinder is

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

28. When a battery is connected to the two ends of a diagonal of a square conductor frame of side 'a', the magnitude of magnetic field at the centre will be (μ_0 = permeability of free space)

(A) $\frac{\mu_0}{\sqrt{2}\pi a}$ (B) $\frac{\sqrt{2}\,\mu_0}{\pi a}$ (C) $\frac{\mu_0}{\pi a}$ (D) zero

29. A car of mass 'm' moving with velocity 'u' on a straight road in a straight line, doubles its velocity in time t. The power delivered by the engine of a car for doubling the velocity is

(A) $\frac{3mu^2}{2t}$ (B) $\frac{mu^2}{2t}$ (C) $\frac{2mu^2}{t}$ (D) $\frac{3mu^2}{t}$

30. A bob of a simple pendulum of mass 'm' is displaced through 90° from mean position and released. When the bob is at lowest position, the tension in the string is

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

31. Let 'W_1' be the work done in blowing a soap bubble of radius 'r' from soap solution at room temperature. The soap solution is now heated and second soap bubble of radius '2r' is blown from the heated soap solution. If 'W_2' is the work done in forming this bubble then

(A) $W_2 = 2W_1$ (B) $W_2 = 4W_1$ (C) $W_2 > 4W_1$ (D) $W_2 < 4W_1$

32. A cylindrical rod is having temperatures θ_1 and θ_2 at its ends. The rate of heat flow is 'Q' J s^{-1}. All the linear dimensions of the rod are doubled by keeping the temperatures constant. What is the new rate of flow of heat?

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

33. Two concentric coplanar circular loops of radii 'r_1' and 'r_2' respectively carry currents 'i_1' and 'i_2' in opposite directions (one clockwise and other anticlockwise). The magnetic induction at the centre of the loops is half that due to 'i_1' alone at the centre. If $r_2 = 2r_1$, the value of $\frac{i_2}{i_1}$

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

34. The Kirchhoff's current law and voltage law are respectively based upon the conservation of

(A) charge, energy (B) charge, momentum
(C) energy, charge (D) momentum, charge

35. The permeability of a metal is 0.1256 TmA^{-1}. Its relative permeability will be $\left(\frac{\mu_0}{4\pi} = 10^{-7}\text{ SI unit}\right)$ $(\pi = 3.14)$

(A) 10^5 (B) 3×10^5 (C) 2×10^6 (D) 10^4

36. The angular displacement of body performing circular motion is given by $\theta = 5 \sin\frac{\pi t}{6}$. The angular velocity of the body at t = 3 second will be $\left[\sin\frac{\pi}{2} = 1, \cos\frac{\pi}{2} = 0\right]$

(A) $5\frac{\text{rad}}{\text{s}}$ (B) $1\frac{\text{rad}}{\text{s}}$ (C) $2.5\frac{\text{rad}}{\text{s}}$ (D) zero $\frac{\text{rad}}{\text{s}}$

37. A single slit diffraction pattern is formed with white light. For what wavelength of light the 3rd secondary maximum in diffraction pattern coincides with the 2nd secondary maximum in the pattern of red light of wavelength 6000 Å ?

(A) 4500 Å (B) 3500 Å (C) 4000 Å (D) 5000 Å

38. A point charge Q is placed at the centre of the line joining two equal point charges +q and +q. The value of Q if the system of the charges is in equilibrium, is

(A) $\frac{-q}{2}$ (B) $-\frac{9}{4}$ (C) $\frac{+q}{4}$ (D) $\frac{+q}{2}$

39. If the charge on the capacitor is increased by 2 C. the energy stored in it incrases by 21%. Total original charge on the capacitor is

(A) 10 C (B) 5 C (C) 20 C (D) 15 C

40. A nucleus breaks into two nuclear parts, which have their velocity ratio 2:1. The ratio of their nuclear radii will be

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

41. A body performing uniform circular motion of radius 'R' has frequency 'n'. It centripetal acceleration is

(A) $8\pi^2 nR^2$ (B) $4\pi^2 n^2 R$ (C) $4\pi^2 n^2 R^2$ (D) $8\pi^2 n^2 R$

42. For a gas molecule with 6 degrees of freedom, which one of the following relation between gas constant 'R' and molar specific heat 'C_v' is correct?

(A) $R = \frac{C_v}{3}$ (B) $R = \frac{5C_v}{4}$ (C) $R = \frac{C_v}{2}$ (D) $R = \frac{3C_v}{4}$

43. When the battery across the plates of a charged condenser is disconnected and a dielectric slab is introduced between its plates then the energy stored

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

44. The width of central maximum of a diffraction pattern on a single slit does not depend upon

(A) frequency of light used (B) width of the slit
(C) distance between slit and source (D) wavelength of light used

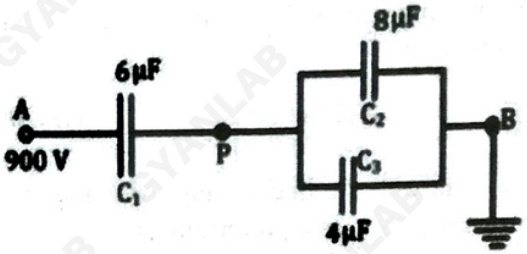
45. If the amplitude of linear S.H.M. is decreased then

(A) its period and total energy will increase.
(B) its period will increase and total energy will decrease
(C) its period and total energy will decrease.
(D) its period will not change but total energy will decrease

46. In an n–p–n transistor 200 electrons enter the emitter in 10^{-8} second. If 1% electrons are lost in the base, then the current that enters the emitter and the current amplification factor are respectively [$e = 1.6 \times 10^{-19}$ C]

(A) 2×10^{-10} A and 49
(B) 3.2×10^{-9} A and 99
(C) 1.6×10^{-19} A and 90
(D) 1.7×10^{-11} A and 70

47. In the given figure potential at point 'A' is 900 volt and point 'B' is earthed. What will be the potential at point 'P'?



(A) 900 V
(B) 100 V
(C) 300 V
(D) 600 V

48. Kinetic energy of a proton is equal to energy 'E' of a photon. Let 'λ_1' be the de–Broglie wavelength of proton and 'λ_2' is the wavelength of photon. If $\frac{\lambda_1}{\lambda_2} \alpha E^n$, then the value of 'n' is

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

49. A drop of liquid of density 'ρ' is floating half immersed in a liquid of density 'd'. If 'T' is the surface tension, then the diameter of the drop of the liquid is

(A) $\sqrt{\frac{6T}{g(2\rho - d)}}$
(B) $\sqrt{\frac{T}{g(2\rho - d)}}$
(C) $\sqrt{\frac{2T}{g(2\rho - d)}}$
(D) $\sqrt{\frac{12T}{g(2\rho - d)}}$

***50.** Assuming the atom is in the ground state, the expression for the magnetic field at a point nucleus in hydrogen atom due to circular motion of electron is [μ_0 = permeability of free space, m = mass of electron, ϵ_0 = permittivity of free space, h = Planck's constant]

(A) $\frac{\mu_0 e^7 \pi m^2}{8 \epsilon_0^3 h^5}$
(B) $\frac{\mu_0 e^5 \pi^2 m^2}{8 \epsilon_0^2 h^4}$
(C) $\frac{\mu_0 e^5 \pi m^3}{8 \epsilon_0^3 h^5}$
(D) $\frac{\mu_0 e^7 \pi^2 m^2}{8 \epsilon_0^3 h^5}$

CHEMISTRY

51. What is the number of octahedral and tetrahedral voids presents respectively in 0.25 mole of a substance having hcp structure?
(A) 3.011×10^{23}, 1.50×10^{23}
(B) 6.011×10^{23}, 3.011×10^{23}
(C) 3.011×10^{23}, 6.022×10^{23}
(D) 1.50×10^{23}, 3.011×10^{23}

52. For a reaction A → product, rate constant is 2×10^{-2} s^{-1}. The initial concentration of A is 1.0 mol dm^{-3}. What is the value of $\log \frac{1}{[A]_t}$ after 100 seconds?
(A) 0.430 mol dm^{-3}
(B) 0.135 mol dm^{-3}
(C) 0.270 mol dm^{-3}
(D) 0.868 mol dm^{-3}

53. When tert-butyl bromide is heated with silver fluoride, the major product obtained is
(A) 1–Fluorobutane
(B) 2-Fluoro–2–methylpropane
(C) 2–Fluoro–2–methylpropene
(D) 2– Fluorobutane

54. What are the final products obtained by ozonolysis of propene?
(A) 2 molecules of acetaldehyde
(B) acetone
(C) 2 molecules of formaldehyde
(D) formaldehyde and acetaldehyde

55. The vapour pressure of a solvent decreases by 2.5 mm Hg by adding a solute. What is the mole fraction of solute? (Vapour pressure of pure solvent is 250 mm Hg)
(A) 0.88 (B) 0.01 (C) 0.1 (D) 0.99

56. Which element from following belongs to oxygen family?
(A) Ba (B) Se (C) Rb (D) Ca

57. Which among following statements is <u>NOT</u> true for neoprene?
(A) It is resistant to petroleum
(B) It is obtained from styrene
(C) It is a synthetic rubber
(D) It is a condensation polymer

58. The common name of Benzene–1,2–diol is
(A) Pyrogallol (B) Resorcinol (C) Catechol (D) Quinol

59. Identify the correct pair of mineral and its formula from following.
(A) Baryte – $MgSO_4 . 7 H_2O$
(B) Cryolite – Na_3AlF_6
(C) Galena – ZnS
(D) Epsom salt – $CaSO_4 . 2H_2O$

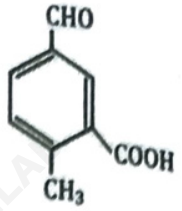
60. Which element from following exhibits various different oxidation states from +2 to +7?
(A) Mn (B) Cr (C) V (D) Ni

61. Which among following compounds has highest boiling point?
(A) $C_4H_9NH_2$ (B) C_2H_5COOH (C) $CH_3(CH_2)_2CH_2OH$ (D) $C_2H_5CH(CH_3)_2$

62. The dissociation constant of weak monobasic acid is 2.7×10^{-5}. If degree of dissociation of acid is 3×10^{-2}, what is the concentration of acid?
(A) 0.24 M (B) 0.03 M (C) 0.3 M (D) 0.11 M

63. Identify order of reaction if it's rate constant is x sec^{-1}.
(A) 3 (B) 2 (C) 0 (D) 1

64. What is IUPAC name of following compound?



(A) 3–Carboxy–4–methyl benzaldehyde
(B) 5–Carboxy–4–methyl benzaldehyde
(C) 3–Formyl–6–methyl benzoic acid
(D) 5–Formyl–2–methyl benzoic acid

65. Enthalpy of formation of methane is –75 kJ/mol. What is the enthalpy change for formation of 24 g of methane?
(A) – 112.5 kJ (B) –75 kJ (C) –150 kJ (D) –130 kJ

66. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-8}. What is it's solubility in mol dm^{-3}?
(A) 2.8×10^{-4} (B) 1.6×10^{-5} (C) 2.0×10^{-3} (D) 4.0×10^{-4}

67. Which among the following is true for chemisorption?
(A) Heat of adsorption is in the range of 20–40 kJ mol^{-1}.
(B) It is multimolecular layered.
(C) van der Waals forces are involved.
(D) It is favoured at high temepreature up to certain limit.

68. Identify 'A' in following reaction.

$$A \xrightarrow{\text{Dimethyl cadmium}} \text{propanone} + \text{cadmium chloride}$$

(A) Ethyl chloride (B) Ethylidene dichloride
(C) Ethanoyl chloride (D) Ethylene dichloride

69. What is the resistance of 0.01 M KCl solution if its conductivity is 200 ohm^{-1} cn^{-1} and cell constant is 1 cm^{-1}?
(A) 1×10^{-3} ohm (B) 5×10^{-3} ohm (C) 4×10^{-3} ohm (D) 2×10^{-3} ohm

70. Which of the following concepts is NOT of valence bond theory?
(A) Covalent character of bond
(B) Shielding effect of electrons
(C) Delocalisation of electron over the two nuclei
(D) Combination of atomic orbitals to give molecular orbitals

71. Which among the following is a pair of dicarboxylic acids?
(A) Glutaric acid and Malonic acid (B) Succinic acid and Valeric acid
(C) Oxalic acid and Caproic acid (D) Propionic acid and Adipic acid

72. What is the number of N atoms present in EDTA?
(A) 2 (B) 3 (C) 4 (D) 1

73. Which is C–terminal residue in glycyl alanine?
(A) Alanine (B) Glutamine (C) Arginine (D) Glycine

74. The expansion of gas having no opposing force is called as
(A) free expansion (B) reversible expansion
(C) adiabatic expansion (D) isothermal expansion

75. Molar conductivity of 0.04 M $BaCl_2$ solution is 230 Ω^{-1} cm^2 mol^{-1} at 27°C. What is it's conductivity?
(A) 2.3×10^{-3} Ω^{-1} cm^{-1} (B) 9.2×10^{-3} $\Omega^{-1}cm^{-1}$
(C) 6.9×10^{-3} Ω^{-1} cm^{-1} (D) 4.6×10^{-3} Ω^{-1} cm^{-1}

76. 1 mole of an ideal gas expands isothermally and reversibly by decreasing pressure form 210 kPa to 105 kPa at 300 K. What is the work done? ($R = 8.314\ JK^{-1}\ mol^{-1}$)
(A) 1960 J (B) 864 J (C) 1296 J (D) 1729 J

77. What is the mass of potassium chloride produced when 12.25 g potassium chlorate undergo decomposition? (At mass: K = 39, Cl = 35.5, O = 16)
(A) 16.0 g (B) 14.9 g (C) 7.45 g (D) 4.25 g

78. What type of hybridization is present in Ni of $[Ni(Cl)_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ respectively?
(A) dsp^2 and dsp^2 (B) sp^3 and dsp^2 (C) dsp^2 and sp^3 (D) sp^3 and sp^3

79. What is the molar mass of a metal having density 8.57 g cm^{-3} and edge length 3.3 Å? (packing efficiency = 68%)
(A) 63 g mol^{-1} (B) 93 g mol^{-1} (C) 29 g mol^{-1} (D) 39 g mol^{-1}

80. The wavelength of blue light is 480 nm. What is frequency of this light?
(A) 4.8×10^9 Hz (B) 2.25×10^{14} Hz (C) 6.25×10^{14} Hz (D) 5.25×10^9 Hz

81. Identify the reagent used in following conversion.
Chloroethane $\xrightarrow{A}$ Nitro ethane
(A) Sodium nitrite (B) Silver nitrite (C) Potassium nitrite (D) Potassium cyanide

82. Which of the following polymers is obtained from ε-caprolactum?
(A) Polyacrylonitrile (B) Neoprene (C) Terylene (D) Nylon–6

83. Identify correct composition of water gas from following.
(A) $CO_{(g)} + H_2O_{(g)}$ (B) $NO_{(g)} + 2H_{2(g)}$ (C) $CO_{2(g)} + 3H_{2(g)}$ (D) $CO_{(g)} + H_{2(g)}$

84. Identify the major product formed when 2–Methylhexan–3–ol is heatd with concentrated sulphuric acid.
(A) 
(B) 
(C) 
(D) 

85. For the reaction $2A + 2B \rightarrow 2C + D$
if $r = k[A]^2\ [B]^0$, then rate of reaction is
(A) inversely poportional to square of concentration of A
(B) independent of concentration of A
(C) independent of concentration of B
(D) directly proportional to concentration of B

86. What is the difference in molar mass of a member of homologous series from it's neighboring members in gram per mole?
(A) 14 (B) 18 (B) 30 (4) 25

87. Identify N and C terminal of ∝-amino acid respectively in following polypeptide fragment.
Ala–Gly–Ser–Tyr–Gly
(A) Gly and Tyr (B) Gly and Gly (C) Ala and Ser (D) Ala and Gly

88. Which from following formulae is a correct formula to determine percent atom economy?

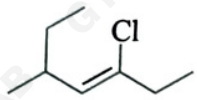
(A) % Atom economy = Formula weight of product × 100

(B) % Atom economy = Sum of formula weight of all reactants × 100

(C) $\%\ \text{Atom economy} = \frac{\text{Formula weight of desired product}}{\text{Sum of formula weight of all reactants}} \times 100$

(D) $\%\ \text{Atom economy} = \frac{\text{Sum of formula weight of all reactants}}{\text{Formula weight of desired product}} \times 100$

89. What is IUPAC name of following compound?



(A) 5-Chloro-3-methylhept-4-ene (B) 3-Chloro-5-methylhept-3-ene
(C) 3-Chloro-5-ethylhex-3-ene (D) 4-Chloro-2-ethylhex-3-ene

90. Identify reductant in following reaction.

$H_2S + NO_2 \rightarrow H_2O + NO + S$

(A) H_2S (B) NO_2 (C) NO (D) S

91. What is the value of critical temepreature of water?

(A) 647 K (B) 312 K (C) 346 K (D) 493 K

92. Identify the compound from following having lowest boiling point.

(A) n–$C_4H_9NH_2$ (B) $C_2H_5CH(CH_3)_2$ (C) $C_2H_5N(CN_3)_2$ (D) $(C_2H_5)_2NH$

93. Which among the following isomers of C_4H_9OH has lowest boiling point?

(A) Isobutyl alcohol (B) n-Butyl alcohol (C) tert-Butyl alcohol (D) sec-Butyl alcohol

94. Which of the following salt solutions is highly acidic?

(A) Ammonium acetate (B) Ammonium cynide (C) Sodium chloride (D) Ammonium nitrate

95. Molal depression constant for a liquid is 2.77°C kg mol^{-1}, in Kelvin scale it's value is

(A) 275.77 K kg mol^{-1} (B) 271.77 K kg mol^{-1} (C) 2.77 K kg mol^{-1} (D) 27.7 K kg mol^{-1}

96. Which among the following statement is <u>NOT</u> true about homologous series of organic compounds?

(A) Each member of a series differs by two carbon atoms and two H atoms from neighbouring member.

(B) All memebers have similar chemical properties.

(C) All members of series have same type of carbon skeleton.

(D) All members of series are represented by same general formula.

97. If 6 g of solute dissolved in 100 g of water lowers the freezing point by 0.93 K. What is molar mass of solute? (K_f = 1.86 K kg mol^{-1})

(A) 120 g mol^{-1} (B) 60 g mol^{-1} (C) 90 g mol^{-1} (D) 180 g mol^{-1}

98. Which from following electrolytes, molar conductivity is determined using Kohlrausch theory?

(A) KCl (B) Na_2SO_4 (C) CH_3COOH (D) HCl

99. How many lattice points are present in a face centred cubic unit cell?

(A) 8 (B) 17 (C) 14 (D) 9

100. Which block elements from following are known as transition elements?

(A) f–block (B) s–block (C) p–block (D) d–block

Section II

MATHEMATICS

101. A polygon has 44 diagonals. Then the number of sides of the polygon are

(A) 11 (B) 12 (C) 10 (D) 13

102. If $x = 1 + 2i$, then the value of $x^3 + 7x^2 - x + 16$ is

(A) $-17 - 24i$ (B) $-17 + 24i$ (C) $17 - 24i$ (D) $17 + 24i$

103. If $y^2 = ax^2 + bx + c$, where a, b, c are constants, then $y^3 \frac{d^2y}{dx^2}$ is equal to

(A) function of y (B) function of both x and y

(C) constant (D) function of x

104. The equation of a circle that passes through the origin and cut off intercepts -2 and 3 on the X–axis and Y–axis respectively is

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

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

105. Let $f(x) = |x| + 3$, if $x \le -3$

$= -2x$, if $-3 < x < 3$

$= 6x + 2$, if $x \ge 3$, then

(A) f(x) is discontinuous at both $x = -3$ as well as $x = 3$

(B) f(x) is continuous at $x = -3$ but discontinuous at $x = 3$

(C) f(x) is continuous at $x = -3$ as well as $x = 3$

(D) f(x) of discontinuous at $x = -3$ but f(x) is continuouse at $x = 3$

106. The particular solution of the diffrential equation $y(1 + \log x) = (\log x^x) \frac{dy}{dx}$, when $y(e) = e^2$ is

(A) $2ex\log x - y = e^2$ (B) $3\ ex\log yx - y = 2e^2$

(C) $ex\log x + y = 2e^2$ (D) $ex\log x - y = 0$

107. If statements p and q are true and r and s are false, then truth values of $\sim (p \to q) \leftrightarrow (r \wedge s)$ and $(\sim p \to q) \wedge (r \leftrightarrow s)$ are respectively.

(A) F, F (B) T, T (C) T, F (D) F, T

108. Bismath has half life period of 5 days. A sample originally has a mass of 1000 mg, then the mass of Bismath after 30 days is

(A) 16.625 mg (B) 13.625 mg (C) 14.625 mg (D) 15.625 mg

109. In ΔABC, with usual notations, $2ab \sin \frac{1}{2}(A + B - C) =$

(A) $a^2 - b^2 - c^2$ (B) $a^2 + b^2 - c^2$ (C) $a^2 + b^2 + c^2$ (D) $a^2 - b^2 + c^2$

110. $\tan 3A . \tan 2A . \tan A =$

(A) $\tan 3A + \tan 2A - \tan A$ (B) $\tan 3A - \tan 2A - \tan A$

(C) $\tan 3A + an\ 2a + \tan A$ (D) $\tan 3A - \tan 2A + \tan A$

111. If slope of one of the lines $ax^2 + 2hxy + by^2 = 0$ is twice that of the other, then h^2: ab is

(A) 8 : 7 (B) 7 : 8 (C) 9 : 8 (D) 8 : 9

112. The general solution of $\sin^{-1}\left(\frac{dy}{dx}\right) = x + y$ is

(A) $\tan(x + y) - \sec(x + y) = x^2 + c$ (B) $\tan(x + y) + \sec(x + y) = x^2 + c$

(C) $\tan(x + y) + \sec(x + y) = x + c$ (D) $\tan(x + y) - \sec(x + y) = x + c$

113. If $A = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 2 & 3 \\ 1 & 2 & 1 \end{bmatrix}$, then the value of determinant of A^{-1} is

(A) -6 (B) $\frac{-1}{6}$ (C) $\frac{1}{36}$ (D) 36

114. Solution of the differential equation $y' = \frac{(x^2 + y^2)}{xy}$, where $y(1) = -2$ is given by

(A) $y^2 = 4x^2 \log x^2 + x^2$ (B) $y^2 = x^2 \log x - x^2$

(C) $y^2 = x \log x^2 + 4x^2$ (D) $y^2 = x^2 \log x^2 + 4x^2$

115. The Cartesian equation of a line is $3x + 1 = 6y - 2 = 1 - z$, then its vector equation is

(A) $\bar{r} = \left(\frac{-1}{3}\hat{i} + \frac{1}{3}\hat{j} + \hat{k}\right) + \lambda\left(2\hat{i} - \hat{j} - 6\hat{k}\right)$ (B) $\bar{r} = \left(-\hat{i} + 2\hat{j} - \hat{k}\right) + \lambda\left(3\hat{i} + 6\hat{j} - \hat{k}\right)$

(C) $\bar{r} = \left(\frac{-1}{3}\hat{i} + \frac{1}{3}\hat{j} + \hat{k}\right) + \lambda\left(2\hat{i} - \hat{j} + 6\hat{k}\right)$ (D) $\bar{r} = \left(\frac{-1}{3}\hat{i} + \frac{1}{3}\hat{j} + \hat{k}\right) + \lambda\left(2\hat{i} + \hat{j} - 6\hat{k}\right)$

116. The position vector of the point of inersection of the medians of a triangle, whose vertices are A(1, 2, 3), B(1, 0, 3) and C(4, 1, –3) is

(A) $6\hat{i} + 3\hat{j} + 3\hat{k}$ (B) $2\hat{i} + \hat{j} + \hat{k}$ (C) $3\hat{i} + \hat{j} + \hat{k}$ (D) $\hat{i} + \hat{j} + \hat{k}$

117. $\int_{-\pi}^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx =$

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

118. $\int e^x \left(\frac{x - 1}{x^2}\right) dx =$

(A) $\frac{-e^x}{x^2} + c$ (B) $\frac{-e^x}{x} + c$ (C) $\frac{e^x}{x^2} + c$ (D) $\frac{e^x}{x} + c$

119. Area of the triangle formed by the lines $y^2 - 9xy + 18x^2 = 0$ and $y = 9$ is

(A) $\frac{27}{3}$ sq. units (B) $\frac{27}{2}$ sq. units (C) $\frac{27}{4}$ sq. units (D) 27 sq. units

120. The point on the curve $y^2 = 2(x - 3)$ at which the normal is parallel to the line $y - 2x + 1 = 0$ is

(A) $\left(\frac{-1}{2}, -2\right)$ (B) $\left(\frac{3}{2}, 2\right)$ (C) $(5, 2)$ (D) $(5, -2)$

121. For two events A and B, $P(A \cup B) = \frac{5}{6}$, $P(A) = \frac{1}{6}$, $P(B) = \frac{2}{3}$, then A and B are

(A) independent (B) mutually exhaustive
(C) mutually exclusive (D) complementary

122. A rectangle of maximum area is inscribed in an ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, then its dimensions are

(A) $4\sqrt{2}, 6\sqrt{2}$ (B) $\sqrt{2}, 5\sqrt{2}$ (C) $4\sqrt{2}, 5\sqrt{2}$ (D) $4\sqrt{2}, \sqrt{2}$

123. The area bounded between the curve $x^2 = y$ and the line $y = 4x$ is

(A) $\frac{32}{3}$ sq. units (B) $\frac{8}{3}$ sq. units (C) $\frac{1}{3}$ sq. units (D) $\frac{16}{3}$ sq. units

124. $\lim\limits_{x \to 0} \frac{\cos(mx) - \cos(nx)}{x^2} =$

(A) $\frac{m^2 - n^2}{2}$ (B) $m^2 - n^2$ (C) $\frac{n^2 - m^2}{2}$ (D) $n^2 - m^2$

125. The area of the parallelogram whose diagonals are represented by the vectors $\bar{a} = 3\hat{i} - \hat{j} - 2\hat{k}$ and $\bar{b} = -\hat{i} + 3\hat{j} - 3\hat{k}$ is

(A) $\sqrt{266}$ sq. units (B) $\frac{1}{2}\sqrt{266}$ sq. units (C) 266 sq. units (D) 122 sq. units

126. If $\bar{a} + \bar{b} + \bar{c} = \bar{0}$ with $|\bar{a}| = 3, |\bar{b}| = 5$ and $|\bar{c}| = 7$, then angle between $\bar{a}$ and $\bar{b}$ is

(A) $\left(\frac{\pi}{3}\right)^c$ (B) $\left(\frac{4\pi}{3}\right)^c$ (C) $\left(\frac{2\pi}{3}\right)^c$ (D) π^c

127. The plane $\frac{x}{2} + \frac{y}{3} + \frac{z}{4} = 1$ cuts the X–axis at A, Y–axis at B and Z–axis at C, then the area of $\Delta ABC =$

(A) $\sqrt{71}$ sq. units (B) $\sqrt{29}$ sq. units (C) $\sqrt{41}$ sq. units (D) $\sqrt{61}$ sq. units

128. A random variable X has following disribution

X = x	1	2	3	4	5	6
P(X = x)	k	3k	5k	7k	8k	k

Then $P(2 \le x < 5) =$

(A) $\frac{7}{25}$ (B) $\frac{3}{5}$ (C) $\frac{24}{25}$ (D) $\frac{23}{25}$

129. A sperical snow ball is forming so that its volume is increasing at the rate of 8 cm^3/sec. Find the rate of increase of radius when radius is 2 cm.

(A) π cm/sec. (B) $\frac{1}{8\pi}$ cm/sec. (C) 2π cm/sec. (D) $\frac{1}{2\pi}$ cm/sec.

130. If $|\bar{u}| = 2$ and $\bar{u}$ makes angles of $60°$ and $120°$ with axes OX and OY in the origin, then $\bar{u} =$

(A) $\hat{i} + \hat{j} + \sqrt{2}\,\hat{k}$ (B) $2\left(\hat{i} + \hat{j} \pm \sqrt{2}\hat{k}\right)$ (C) $2\left(\hat{i} - \hat{j} + \sqrt{2}\hat{k}\right)$ (D) $2\left(\hat{i} - \hat{j} \pm \sqrt{2}\hat{k}\right)$

131. If $A = \begin{bmatrix} k & 2 \\ -2 & -k \end{bmatrix}$, then A^{-1} does not exists if $k =$

(A) 3 (B) ± 2 (C) 0 (D) ± 1

132. If in ΔABC, with usual notations, the angles are in A.P., then $\frac{a}{c} \sin 2C + \frac{c}{a} \sin 2A =$

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

133. A coin is tossed three times. If X denotes the absolute difference between the number of heads and the number of tails, then $P(X = 1) =$

(A) $\frac{1}{6}$ (B) $\frac{1}{2}$ (C) $\frac{2}{3}$ (D) $\frac{3}{4}$

134. The maximum value of $z = 10x + 25y$ subject to $0 \le x \le 3$, $0 \le y \le 3$, $x + y \le 5$ occurs at the point.

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

135. The expression $[(p \wedge \sim q) \vee q] \vee (\sim p \wedge q)$ is equaivalent to

(A) $p \vee q$ (B) $p \wedge q$ (C) $p \to q$ (D) $p \leftrightarrow q$

136. If a plane meets the axes X, Y, Z in A, B, C respectively such that centroid of ΔABC is (1, 2, 3), then the equation of the plane is

(A) $x + 2y + 3z = 1$ (B) $x + \frac{y}{2} + \frac{z}{3} = 3$ (C) $\frac{x}{3} + \frac{y}{6} + \frac{z}{9} = 1$ (D) $\frac{x}{4} + \frac{y}{8} + \frac{z}{12} = 1$

137. The sum of three numbers is 6. Thrice the third number when added to the first number gives 7. On adding three times first number to the sum of second and third number we get 12. The product of these numbers is

(A) 20 (B) 3 (C) $\frac{20}{3}$ (D) $\frac{5}{3}$

138. $\tan^{-1}\left(\tan\frac{5\pi}{6}\right) + \cos^{-1}\left(\cos\frac{13\pi}{6}\right) =$

(A) 0 (B) 3π (C) $\frac{-\pi}{6}$ (D) $\frac{\pi}{6}$

139. The value of $\int_0^1 \tan^{-1}\left(\frac{2x-1}{1+x-x^2}\right) dx$ is

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

140. If $x = \frac{1-t^2}{1+t^2}$ and $y = \frac{2at}{1+t^2}$, then $\frac{dy}{dx} =$

(A) $\frac{a\left(t^2+1\right)}{2t}$ (B) $\frac{a\left(t^2-1\right)}{t}$ (C) $\frac{a\left(1-t^2\right)}{2t}$ (D) $\frac{a\left(t^2-1\right)}{2t}$

141. $\int \sin^{-1}\left(\frac{2x}{1+x^2}\right)dx =$ (where $|x|<1$)

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

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

142. The domain of the function $f(x) = \sqrt{x-1} + \sqrt{6-x}$ is

(A) $[1, \infty)$ (B) $[1, 6]$ (C) $(-\infty, 6)$ (D) $(-\infty, 6]$

143. The differential equation of all family of lines $y = mx + \frac{4}{m}$ obtained by eliminating the arbitrary constant m is

(A) $y\left(\frac{dy}{dx}\right) = 4$ (B) $x\left(\frac{dy}{dx}\right)^2 + y\left(\frac{dy}{dx}\right) + 4 = 0$

(C) $x\left(\frac{dy}{dx}\right) + 4 = 0$ (D) $x\left(\frac{dy}{dx}\right)^2 - y\left(\frac{dy}{dx}\right) + 4 = 0$

144. If the variance of the data 2, 4, 5, 6, 8, 17 is 23.33, then the variance of 4, 8, 10, 12, 16, 34 will be

(A) 93.32 (B) 25.33 (C) 23.23 (D) 48.66

145. If $y = \tan^{-1}\left(\sqrt{\frac{1+\sin x}{1-\sin x}}\right)$, $0 \le x < \frac{\pi}{2}$, then $\frac{dy}{dx}$ at $x = \frac{\pi}{6}$ is

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

146. A random variable $X \sim B(n, p)$, if values of mean and variance of X are 18 and 12 respectively, then n =

(A) 54 (B) 18 (C) 12 (D) 55

147. The shortest distance between lines $\bar{r} = \left(2\hat{i} - \hat{j}\right) + \lambda\left(2\hat{i} + \hat{j} - 3\hat{k}\right)$ and $\bar{r} = \left(\hat{i} - \hat{j} + 2\hat{k}\right) + \mu\left(2\hat{i} + \hat{j} - 5\hat{k}\right)$ is

(A) $\frac{1}{\sqrt{5}}$ (B) 3 units (C) $\sqrt{5}$ units (D) 2 units

148. The equation of perpendicular bisector of the line segment joining A(−2, 3) and B (6, −5) is

(A) $x + y = 3$ (B) $x + y = 1$ (C) $x - y = -1$ (D) $x - y = 3$

149. If $\bar{a}, \bar{b}, \bar{c}$ are mutually perpendicular vectors having magnitudes 1, 2, 3 respectively, then $\left[\bar{a}+\bar{b}+\bar{c} \quad \bar{b}-\bar{a} \quad \bar{c}\right] =$

(A) 12 (B) 18 (C) 0 (D) 6

150. $\int \frac{\sec^8 x}{\operatorname{cosec} x}dx =$

(A) $\frac{\sec^8 x}{8} + c$ (B) $\frac{\sec^6 x}{6} + c$ (C) $\frac{\sec^7 x}{7} + c$ (D) $\frac{\sec^9 x}{9} + c$