MHT CET – 2021

20th September (Shift - 1)

Section I

PHYSICS

1. A mass 'm_1' is suspended from a spring of negligible mass. A spring is pulled slightly in downward direction and released, mass performs S.H.M. of period 'T_1'. If the mass is increased by 'm_2', the time period becomes 'T_2'. The ratio $\frac{m_2}{m_1}$ is

(A) $\frac{T_1^2 + T_2^2}{T_1^2}$ (B) $\frac{T_1 - T_2}{T_1}$ (C) $\frac{T_2^2 - T_1^2}{T_1^2}$ (D) $\frac{T_1^2 - T_2^2}{T_1^2}$

2. If the charge to ratio of an electron is 'A' C/kg, then the gyromagnetic ratio of an orbital electron in C/kg is

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

3. A parallel plate capacitor filled with oil of a dielectric constant 3 between the plates has capacitance 'C'. If the oil is removed, then the capacitance of the capacitor will be

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

4. In Young's double slit experiment, the 'n^{th}' maximum of wavelength 'λ_1' is at a distance 'y_1' from the central maximum. When the wavelength of the source is changed to 'λ_2', $\left(\frac{n}{2}\right)^{th}$ maximum is at a distance of 'y_2' from its central maximum. The ratio $\frac{y_1}{y_2}$ is

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

5. A perfectly black body emits a radiation at temperature 'T_1' K. If it is to radiate at 16 times this power, its temperature 'T_2' K should be

(A) $8T_1$ (B) $4T_1$ (C) $2T_1$ (D) $16T_1$

6. Two conducting wire loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increasing with time. The induced current in the inner loop is

(A) clockwise
(B) anticlockwise
(C) in a direction which depends on the ratio of the loop radii.
(D) zero

7. Two particles P and Q performs S.H.M. of same amplitude and frequency along the same straight line. At a particular instant, maximum distance between two particles is $\sqrt{2}$ a. The initial phase difference between them is

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

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

8. An electric dipole having dipole moment $P = q \times 2\ell$ is placed in a uniform electric field 'E'. The dipole moment is along the direction of the field. The force acting on it and its potential energy are respectively

(A) qE and minimum
(B) qE and maximum
(C) 2qE and minimum
(D) zero and minimum

9. The frequencies of three tuning forks A, B and C are related as $n_A > n_B > n_C$. When the forks A and B are sounded together, the number of beats produced per second is 'n_1'. When forks A and C are sounded together the number of beats produced per second is 'n_2'. How may beats are produced per second when forks B and C are sounded together?

(A) $n_1 - n_2$ (B) $\frac{n_1 + n_2}{2}$ (C) $n_2 - n_1$ (D) $n_1 + n_2$

10. The magnetic field intensity 'H' at the centre of a long solenoid having 'n' turns per unit length and carrying a current 'I', when no material is kept in it, is

(A) $\frac{I}{n}$ (B) $\frac{n}{I}$ (C) nI (D) n^2I

11. One mole of an ideal gas expands adiabatically at constant pressure such that its temperature $T \propto \frac{1}{\sqrt{V}}$. The value of γ for the gas is $\left(\gamma = \frac{C_p}{C_v}, V = \text{Volume of the gas}\right)$

(A) 1.8 (B) 1.5 (C) 1.3 (D) 1.4

12. On an imaginary linear scale of temperature (called 'W' scale) the freezing and boiling points of water are 39° W and 239° W respectively. The temperature on the new scale corresponding to 39°C temperature on Celsius scale will be

(A) 139°W (B) 78°W (C) 117°W (D) 200°W

13. When a d.c. voltage of 200 V is applied to a coil of self-inductance $\left(\frac{2\sqrt{3}}{\pi}\right)$H, a current of 1A flows through it. But by replacing d.c. source with a.c. source of 200V, the current in the coil is reduced to 0.5A. Then the frequency of a.c. supply is

(A) 100 Hz (B) 60 Hz (C) 75 Hz (D) 50 Hz

14. When light of wavelength 'λ' is incident on a photosensitive surface, photons of power 'P' are emitted. The number of photon 'n' emitted in time 't' is [h = Planck's constant, c = velocity of light in vacuum]

(A) $\frac{hc}{P\lambda t}$ (B) $\frac{P\lambda}{htc}$ (C) $\frac{P\lambda t}{hc}$ (D) $\frac{hP}{\lambda tc}$

15. Air is pushed in a soap bubble to increase its radius from 'R' to '2R'. In this case, the pressure inside the bubble

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

16. The equation of wave is given by $y = 10\sin\left(\frac{2\pi t}{30} + \alpha\right)$. If the displacement is 5 cm at t = 0, then the total phase at t = 7.5 s will be $\left[\sin 30° = \cos 60° = \frac{1}{2}, \cos 30° = \sin 60° = \frac{\sqrt{3}}{2}\right]$

(A) $\frac{\pi}{3}$ rad (B) $\frac{\pi}{2}$ rad (C) $\frac{2\pi}{5}$ rad (D) $\frac{2\pi}{3}$ rad

17. A uniformly charged half ring of a radius 'R' has linear charge density 'σ'. The electric potential at the centre of the half ring is (ϵ_0 = permittivity of free space)

(A) $\frac{\sigma}{6\epsilon_0}$ (B) $\frac{\sigma}{2\epsilon_0}$ (C) $\frac{\sigma}{\epsilon_0}$ (D) $\frac{\sigma}{4\epsilon_0}$

18. A sonometer wire resonants with 4 antinodes between two bridges for a given tuning fork, when 1 kg mass is suspended from the wire. Using same fork, when mass M is suspended, the wire resonates producing 2 antinodes between the two bridges (distance between two bridges is as before). The value of M is

(A) 2.5 kg (B) 3.5 kg (C) 4 kg (D) 1 kg

19. Let 'R_1' and 'R_2' are radii of two mercury drops. A big mercury drop is formed from them under isothermal conditions. The radius of the resultant drop is

(A) $\sqrt{R_1^2+R_2^2}$ (B) $\left(R_1^3+R_2^3\right)^{\frac{1}{3}}$ (C) $\sqrt{R_1^2-R_2^2}$ (D) $\frac{R_1+R_2}{2}$

20. A galvanometer of resistance 50Ω is converted to an ammeter. After shunting, the effective resistance of ammeter is 2.5Ω. The value of shunt is

(A) $\frac{100}{19}\Omega$ (B) $\frac{50}{19}\Omega$ (C) $\frac{25}{19}\Omega$ (D) $\frac{75}{19}\Omega$

21. The electron in hydrogen atom is initially in the third excited state. When it finally moves to ground state, the maximum number of spectral lines emitted are

(A) 3 (B) 4 (C) 5 (D) 6

22. Two different logic gates giving output '0' for the inputs (0, 1) and then for (1, 0) are

(A) 'AND', 'NAND' (B) 'NAND', 'NOR' (C) 'OR', 'AND' (D) 'NOR', 'AND'

23. A straight conductor of length 0.6 M is moved with a speed of 10 ms^{-1} perpendicular to magnetic field of induction 1.2 weber m^{-2}. The induced e.m.f. across the conductor is

(A) 6 V (B) 7.2 V (C) 0.72 V (D) 12 V

24. If the electron in a hydrogen atom moves from ground state orbit to 5th orbit, then the potential energy of the electron

(A) is increased (B) is zero (C) is decreased (D) remains unchanged

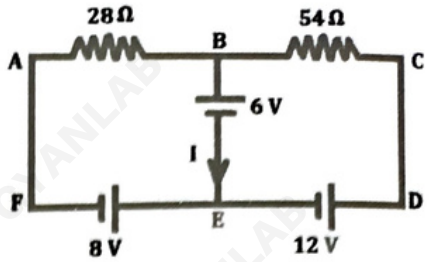
25. A particle of mass 5g is executing S.H.M. with an amplitude 0.3 m and time period $\frac{\pi}{5}$s. The maximum value of the force acting on the particle is

(A) 0.15 N (B) 4 N (C) 5 N (D) 0.3 N

26. The weight of a man in a lift moving upwards with an acceleration 'a' is 620 N. When the lift moves downwards with the same acceleration, his weight is found to be 340 N. The real weight of the man is

(A) 620 N (B) 680 N (C) 380 N (D) 480 N

27. Consider the circuit shown in the figure. The value of current 'I' is



(A) $-\frac{7}{18}$ A

(B) 5A

(C) 3A

(D) –3A

28. Two bodies 'A' and 'B' start from the same point at the same instant and move along a straight line. 'A' moves with uniform acceleration (a) and 'B' moves with uniform velocity (V). They meet after time 't'. The value of 't' is

(A) $\frac{2V}{a}$ (B) $\sqrt{\frac{V}{a}}$ (C) $\frac{a}{2V}$ (D) $\frac{V}{2a}$

29. Light of wavelength 'λ' is incident on a single slit of width 'a' and the distance between slit and screen is 'D'. In diffraction pattern, if slit width is equal to the width of the central maximum then D =

(A) $\frac{a^2}{\lambda}$ (B) $\frac{a}{\lambda}$ (C) $\frac{a^2}{2\lambda}$ (D) $\frac{a}{2\lambda}$

30. An inductor coil wound uniformly has self inductance 'L' and resistance 'R'. The coil is broken into two identical parts. The two parts are then connected in parallel across a battery of 'E' volt of negligible internal resistance. The current through battery at steady state is

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

31. Two wires of same material of radius 'r' and '2r' respectively are welded together end to end. The combination is then used as a sonometer wire under tension 'T'. The joint is kept midway between the two bridges. The ratio of the number of loops formed in the wires such that the joint is a node is

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

32. A ray of light travels from a denser medium to a rarer medium. The reflected and the refracted rays are perpendicular to each other. If 'r' and 'r_1' are the angle of reflection and refraction respectively and 'C' is the critical angle, then the angle of incidence is

(A) $\cot^{-1}(\sin C)$ (B) $\tan^{-1}(\sin C)$

(C) $\sin^{-1}(\tan C)$ (D) $\cos^{-1}(\tan C)$

33. Specific heats of an ideal gas at constant pressure and volume are denoted by C_p and C_v respectively. If $\gamma = \frac{C_p}{C_v}$ and R it's the universal gas constant then C_v is equal to

(A) $\frac{(\gamma-1)}{(\gamma+1)}$ (B) $\frac{(\gamma-1)}{R}$ (C) $R\gamma$ (D) $\frac{R}{(\gamma-1)}$

34. The force required to take away a flat circular plate of radius 2 cm from the surface of water is

$\left[\text{Surface tension of water} = 70\times10^{-3}\,\text{Nm}^{-1}, \pi = \frac{22}{7}\right]$

(A) 4.4×10^{-4} N (B) 8.8×10^{-3} N (C) 6.6×10^{-4} N (D) 11×10^{-3} N

35. The frequency of a given a.c. signal is 'N' Hz. When it is connected to a half wave rectifier, the number of output pulses given by the rectifier in 1 second is

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

36. A convex lens of focal length 'F' produces a real image 'n' times the size of the object. The image distance is

(A) F(n + 1) (B) F(n – 1) (C) $\frac{F}{(N+1)}$ (D) $\frac{F}{(n-1)}$

37. A solid sphere of mass M, radius R has moment of inertia 'I' about its diameter. It is recast into a disc of thickness 't' whose moment of inertia about an axis passing through its edge and perpendicular to its plane remains 'I'. Radius of the disc will be

(A) $\frac{4R}{\sqrt{11}}$ (B) $\frac{3R}{4}$ (C) $\frac{2R}{\sqrt{15}}$ (D) $\frac{2R}{3}$

38. The depth 'd' below the surface of the earth where the value of acceleration due to gravity becomes $\left(\frac{1}{n}\right)$ times the value at the surface of the earth is (R = radius of the earth)

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

39. Silicon and copper are cooled from 300 K to 100 K, the specific resistance (resistivity)

(A) increases in both copper and silicon
(B) decreases in both copper and silicon
(C) decreases in copper and increases in silicon
(D) increases in copper but decreases in silicon

40. Two bodies rotate with kinetic energies 'E_1' and 'E_2'. Moments of inertia about their axis of rotation are 'I_1' and 'I_2'. If $I_1 = \frac{I_2}{3}$ and $E_1 = 27\ E_2$, then the ratio of angular momenta 'L_1' to 'L_2' is

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

41. When a photosensitive surface is irradiated by light of wavelengths 'λ_1' and 'λ_2', kinetic energies of emitted photoelectrons are 'E_1' and 'E_2' respectively. The work function of photosensitive surface is

(A) $\frac{(\lambda_1 E_1 - \lambda_2 E_2)}{(\lambda_2 - \lambda_1)}$ (B) $\frac{(\lambda_1 E_1 + \lambda_2 E_2)}{(\lambda_2 - \lambda_1)}$

(C) $\frac{(\lambda_1 E_2 - \lambda_2 E_1)}{(\lambda_2 - \lambda_1)}$ (D) $\frac{(\lambda_1 E_2 + \lambda_2 E_1)}{(\lambda_2 - \lambda_1)}$

42. An electron (e) moves in circular orbit of radius 'r' with uniform speed 'V'. It produces magnetic field 'B' at the centre of circle. The magnetic field B is (μ_0 = permeability of free space)

(A) $\frac{\mu_0 e}{4\pi}\left(\frac{V}{r^2}\right)$ (B) $\frac{\mu_0 e}{4\pi} Vr^2$ (C) $\frac{\mu_0 e}{4\pi}\left(\frac{V}{r}\right)$ (D) $\frac{\mu_0 e}{4\pi} Vr$

43. The orbital velocity of an artificial satellite in a circular orbit just above the earth's surface is 'V'. For the satellite orbiting at an altitude of half the earth's radius, the orbital velocity is

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

44. An inductor coil takes current 8A when connected to an 100 V and 50 Hz a.c. source. A pure resistor under the same condition takes current of 10A. If inductor coil and resistor are connected in series to an 100 V and 40 Hz a.c. supply, then the current in the series combination of above resistor and inductor is

(A) $\frac{10}{\sqrt{3}}$ A (B) $\frac{5}{\sqrt{2}}$ A (C) $10\sqrt{2}$ A (D) $5\sqrt{2}$ A

45. A disc of radius 0.4 m and mass one kg rotates about an axis passing through its centre and perpendicular to its plane. The angular acceleration of the disc is 10 rad/s^2. The tangential force applied to the rim of the disc is

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

46. For a monoatomic gas, work done at constant pressure is W. The heat supplied at constant volume for the same rise in temperature of the gas is

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

47. In Fraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2m away from the lens. If wavelength of light used is 5000Å then the distance between the first minimum on either side of the central maximum is (θ is small and measured in radian)

(A) 2×10^{-2}m (B) 10^{-1}m (C) 10^{-2}m (D) 10^{-3}m

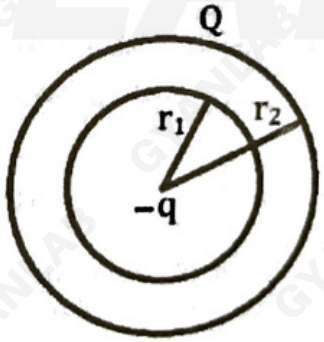
48. A spherical conducting shell of inner radius 'r_1' and outer radius 'r_2' has a charge 'Q'. A charge $-q$ is placed at the centre of the shell. The surface charge density on the inner and outer surface of the shell will be

(A) $\frac{q}{4\pi r_1^2}$ and $\frac{Q-q}{4\pi r_2^2}$

(B) $\frac{q}{4\pi r_1^2}$ and $\frac{Q}{4\pi r_2^2}$

(C) $\frac{-q}{4\pi r_1^2}$ and $\frac{Q+q}{4\pi r_2^2}$

(D) zero and $\frac{Q-q}{4\pi r_2^2}$



***49.** The frequency of a tuning fork is 'n' Hz and velocity of sound in air is 'V' m/s. When the tuning fork completes 'x' vibrations, the distance travelled by the wave is

(A) $\frac{V}{xn}$ (B) $\frac{Vn}{x}$ (C) $\frac{xV}{n}$ (D) $\frac{x}{Vn}$

***50.** A charge of magnitude '2e' and mass '4m' is moving in an electric Field $\vec{E}$. The acceleration imparted to the above charge is

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

CHEMISTRY

51. Which of the following solutions dose not flow in either direction, when separated by semipermeable membrane? (Molar mass: glucose = 180, urea = 60)

(A) 18 g urea dm^{-3} and 18 g glucose dm^{-3} (B) 6 g urea dm^{-3} and 36 g glucose dm^{-3}

(C) 6 g urea dm^{-3} and 24 g glucose dm^{-3} (D) 12 g urea dm^{-3} and 36 g glucose dm^{-3}

52. For the reaction, $3I^-_{(aq)} + S_2O^{2-}_{8(aq)} \longrightarrow I^-_{3(aq)} + 2SO^{2-}_{4(aq)}$, rate of formation of SO^{2-}_4 is 0.022 mol dm^{-3} sec^{-1}. What is rate of formation of $I^-_{3(aq)}$?

(A) 0.022 mol dm^{-3} sec^{-1} (B) 0.11 mol dm^{-3} sec^{-1}

(C) 0.011 mol dm^{-3} sec^{-1} (D) 0.033 mol dm^{-3} sec^{-1}

53. When alcoholic solution of an organic compound is treated with few drops of schiff's reagent, pink colour appears. This confirms the presence of group

(A) –COOH (B) –CHO (C) $-\overset{\overset{O}{\|}}{C}-$ (D) $-CH_2OH$

54. What is O–O bond length in resonance hybrid of ozone?

(A) 131 pm (B) 121 pm (C) 128 pm (D) 148 pm

55. What is the number of unit cells present in 3.9 g of potassium if it crystallizes in BCC Structure?

(A) $\frac{N_A}{10}$ (B) $N_A \times 10$ (C) $2N_A$ (D) $\frac{N_A}{20}$

56. When 2-Methylbut-2-ene is treated with hydrogen chloride, the major product obtained is

(A) 2-Chlorobutane (B) 2-Chloro-2-methylbutane

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

57. Which among the following elements has completely filled 4d-orbital?

(A) Ag (B) Cd (C) Sc (D) Zr

58. Which of the following compounds on reaction with Grignard reagent followed by hydrolysis forms secondary alcohol?

(A) CH_3CHO (B) HCHO (C) $CH_3CH_2COCH_3$ (D) CH_3COCH_3

59. How many water molecules are present in formula of crystalline chloride of lithium?

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

60. The solubility of AgCl in it's solution is 1.25×10^{-5} mol dm^{-3}. What is solubility product of AgCl?

(A) 1.56×10^{-10} (B) 3.50×10^{-6} (C) 1.10×10^{-5} (D) 2.53×10^{-3}

61. The reagent used in Gatterman-Koch formylation of arene is

(A) CO_2, HCl (B) CrO_2Cl_2 (C) CO, HCl (D) DiBAl-H

62. Which among the following statements is true for $[Pt(NH_3)_2Cl_2]$?

(A) It is a neutral complex.

(B) In this complex chlorine atoms are in ionization sphere

(C) The coordination number of Pt in this complex is 2.

(D) The oxidation state of Pt in this complex is +4.

63. What type of crystal structure from following has 52.36% packing efficiency?
(A) FCC (B) BCC (C) Hexagonal cubic (D) Simple cubic

64. The molar conductivity of 0.1 M $BaCl_2$ solution is 106 Ω^{-1} cm^2 mol^{-1} at 25° C. What is it's conductivity?
(A) $1.06 \times 10^{-2}\ \Omega^{-1}\ cm^{-1}$ (B) $5.3 \times 10^{-3}\ \Omega^{-1}\ cm^{-1}$
(C) $3.66 \times 10^{-3}\ \Omega^{-1}\ cm^{-1}$ (D) $2.6 \times 10^{-2}\ \Omega^{-1}\ cm^{-1}$

65. Identify the compound obtained in following reaction?

$$Ar-OH + Cl-\underset{\underset{O}{\|}}{C}-R \xrightarrow{\text{Pyridine}}$$

(A) Ar–Cl (B) $Ar-\underset{\underset{O}{\|}}{C}-OR$ (C) $Ar-O-R$ (D) $R-\underset{\underset{O}{\|}}{C}-OAr$

66. A gas occupies 11.2 dm^3 at 105 kPa. What is it's volume if pressure is increased to 210 kPa?
(A) 22.4 dm^3 (B) 33.6 dm^3 (C) 5.6 dm^3 (D) 16.8 dm^3

67. Identify the use of Buna-N from following.
(A) To obtain decorative laminates (B) To prepare lenses
(C) To prepare adhesives (D) To prepare paints

68. Which from following compounds accepts proton from water molecule according to Bronsted-Lowry theory?
(A) $NaOH_{(aq)}$ (B) $HCl_{(aq)}$ (C) $NH_{3(aq)}$ (D) $NH_4OH_{(aq)}$

69. What amount of oxygen is used at S.T.P. to obtain 9 g water from sufficient amount of hydrogen gas?
(A) 5.6 dm^3 (B) 22.4 dm^3 (C) 16.8 dm^3 (D) 11.2 dm^3

70. A solution of 6 g of solute in 100 g of water boils at 100.52°C. The molal elevation constant of water is 0.52 K kg mol^{-1}. What is molar mass of solute?
(A) 60 g mol^{-1} (B) 120 g mol^{-1} (C) 90 g mol^{-1} (D) 180 g mol^{-1}

71. Which among the following compounds has highest melting point?
(A) tert-Butyl alcohol (B) n-Butyl alcohol
(C) Isobutyl alcohol (D) sec-Butyl alcohol

72. Instantaneous rate of a reaction is $-\frac{1}{2}\frac{d[x]}{dt} = -\frac{d[y]}{dt} = \frac{1}{2}\frac{d[z]}{dt}$, identify the reaction.

(A) $x - 2y \longrightarrow 2z$ (B) $2x + y \longrightarrow 2z$
(C) $2z + y \longrightarrow 2x$ (D) $2x - 2y \longrightarrow z$

73. Which of the following reactions shows work of compression?

(A) $NH_{3(g)} + HCl(g) \longrightarrow NH_4Cl_{(s)}$ (B) $C_2H_{6(g)} \longrightarrow 2C_{(s)} + 3H_{2(g)}$

(C) $2SO_{3(g)} \longrightarrow 2SO_{2(g)} + O_{2(g)}$ (D) $2H_2O_{2(\ell)} \longrightarrow 2H_2O_{(\ell)} + O_{2(g)}$

74. Identify total number carbon atoms present in undecane.
(A) 9 (B) 11 (C) 10 (D) 20

75. What is value of percent atom economy if formula weight of product is 46 u and sum of formula weight of all reactants is 92 u?
(A) 35% (B) 50% (C) 40% (D) 45%

76. Half life for a first order reaction is 6.93 hour. What is the time required for 80% completion of the reaction?
(A) 12 hours (B) 18 hours (C) 6 hours (D) 16 hours

77. What is the number of moles of H atoms required to prepare one mole ethylamine from one mole acetamide?
(A) 2 (B) 4 (C) 3 (D) 1

78. If vapour pressure of pure solvent and solution are 240 and 216 mm Hg respectively then mole fraction of solvent in solution is
(A) 0.9 (B) 0.1 (C) 0.6 (D) 0.4

79. Identify an orbital with the quantum numbers $n = 4$, $\ell = 3$, $m = 0$.
(A) 4f (B) 4p (C) 4s (D) 4d

80. The pH of 0.1 M solution of monobasic acid is 2.34. Calculate the degree of dissociation of the acid.
(A) 3.1×10^{-2} (B) 4.5×10^{-2} (C) 2.18×10^{-2} (D) 2.5×10^{-3}

81. Calculate change in enthalpy when 39 g acetylene is completely burnt with oxygen and enthalpy of combustion of acetylene is −1300 kJ/mol.
(At. mass C = 12, H = 1)
(A) −975 kJ (B) −650 kJ (C) −1950 kJ (D) −1600 kJ

82. Which from following is NOT correct regarding electrolysis?
(A) It helps in refining of metals.
(B) Conversion of electrical energy into chemical energy takes place.
(C) It is useful in electroplating.
(D) Metal is deposited at anode.

83. A conductivity cell shows resistance of 600 ohm. If conductivity of 0.01 M KCl is 0.0015 Ω^{-1} cm^{-1}, what is cell constant?
(A) 0.60 cm^{-1} (B) 0.45 cm^{-1} (C) 0.90 cm^{-1} (D) 0.75 cm^{-1}

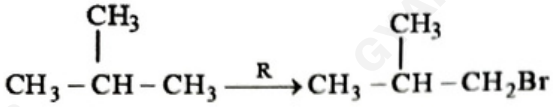
84. An element (molar mass 180) has BCC crystal structure with density 18 g cm^{-3}. What is the edge length of unit cell?
(A) $\sqrt[3]{23.2} \times 10^{-24}$ cm (B) $\sqrt[3]{12.6} \times 10^{-24}$ cm (C) $\sqrt[3]{33.2} \times 10^{-8}$ cm (D) $\sqrt[3]{22.6} \times 10^{-8}$ cm

85. What is the number of allotropes of selenium?
(A) 2 (B) 4 (C) 5 (D) 6

86. Which among the following is a multi-molecular colloid?
(A) Nylon (B) Gold sol (C) Cellulose (D) Soap

87. Which among following statements is NOT true about Gabriel phthalimide synthesis?
(A) In this method formation of N-alkyl phthalimide is involved.
(B) In this method sodiumphthalate is also obtained.
(C) This method is useful for preparation of aromatic amines.
(D) In this method potassium salt of phthalimide is formed as an intermediate product.

88. Identify the reagent R used in following reaction?



(A) HBr/UV light (B) HBr (C) Br_2 (D) Br_2/ UV light

89. Identify highest field strength ligand from following.
(A) H_2O (B) EDTA (C) en (D) S^{--}

90. Which among the following compounds is NOT a carbocyclic compound?
(A) Benzene (B) Naphthalene (C) Pyridine (D) Cyclopentane

91. Identify the glycosidic linkage present in lactose.
(A) $\alpha - 1, 6$ (B) $\alpha - 1, 4$ (C) β - 1, 4 (D) α, β-1, 2

92. Which from following elements of halogen family is in liquid state at room temperature?
(A) Iodine (B) Astatine (C) Bromine (D) Fluorine

93. Which of the following compounds on reaction with ammonical silver nitrate solution forms precipitate of silver?
(A) Ethanal (B) Ethanoic acid (C) Ethanol (D) Ethoxy ethane

94. Which of the following polymers is used in electrophoresis in the form of gel?
(A) Glyptal (B) Buna – N (C) Polyacrylamide (D) PVC

95. An ideal gas on isothermal reversible compression from 10L to 5L performs 1730J of work at 300 K. Calculate number of moles of gas involved in compression? ($R = 8.314\ J\ K^{-1}\ mol^{-1}$)
(A) 2.5 (B) 2 (C) 1 (D) 3

96. Identify the correct statement about properties of interstitial compounds.
(A) Melting point of these compounds is lower than parent metal.
(B) Densities of these compounds are higher than parent metal.
(C) Chemical properties of interstitial compounds are different than parent metal.
(D) Metallic carbides are chemically inert.

97. Which of the following sugar is found in milk?
(A) Sucrose (B) Maltose (C) Lactose (D) Fructose

98. How many chiral carbon atoms are present in 2-Bromo – 3, 4, 5 – trimethylhexane?
(A) 2 (B) 3 (C) 4 (D) 1

99. Which among the following is <u>NOT</u> correct statement about S_N1 reaction?
(A) A more powerful nucleophile favours S_N1 mechanism.
(B) S_N1 reaction proceeds via formation of carbocation intermediate.
(C) S_N1 reaction proceeds more rapidly in polar protic solvent.
(D) The rate of S_N1 mechanism is independent of the nature of nucleophile.

100. Identify reductant in following reaction.

$$C_2O_4^{2-} + MnO_4^- + H^+ \longrightarrow Mn^{2+} + CO_2 + H_2O$$

(A) H^+ (B) H_2O (C) $C_2O_4^{2-}$ (D) MnO_4^-

Section II

MATHEMATICS

101. $\int \tan^{-1}(\sec x + \tan x)\,dx =$

(A) $\frac{\pi x}{4} + \frac{x^2}{4} + c$ (B) $\sin x \cos x + c$ (C) $\frac{\pi x}{2} + \frac{x^2}{2} + c$ (D) $\sin x + \cos x + c$

102. $A(\alpha) = \begin{bmatrix} \cos\alpha & \sin\alpha \\ -\sin\alpha & \cos\alpha \end{bmatrix}$, then $[A^2(\alpha)]^{-1} =$

(A) $A(\alpha)$ (B) $A^2(\alpha)$ (C) $A(-2\alpha)$ (D) $A(2\alpha)$

103. Two dice are rolled simultaneously. The probability that the sum of the two numbers on the dice is a prime number, is

(A) $\frac{5}{11}$ (B) $\frac{5}{12}$ (C) $\frac{7}{12}$ (D) $\frac{7}{11}$

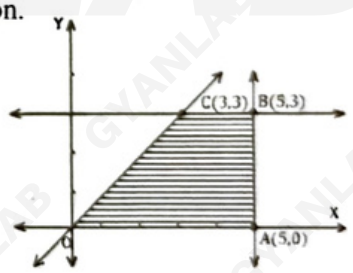
104. If the acute angle between the lines given by $ax^2 + 2hxy + by^2 = 0$ is $\frac{\pi}{4}$, then $4h^2 =$

(A) $(a + 2b)(a + 3b)$ (B) $a^2 + 4ab + b^2$
(C) $a^2 + 6ab + b^2$ (D) $(a - 2b)(2a + b)$

105. A wire of length 20 units is divided into two parts such that the product of one part and cube of the oher part is maximum, then product of these parts is

(A) 5 (B) 75 (C) 15 (D) 70

106. The shaded part of the given figure indicates the feasible region. Then the constraints are



(A) $x, y \geq 0; x - y \geq 0; x \leq 5; y \leq 3$
(B) $x, y \geq 0; x - y \geq 0; x \leq 5; y \geq 3$
(C) $x, y \geq 0; x + y \geq 0; x \geq 5; y \leq 3$
(D) $x, y \geq 0; x - y \geq 0; x \geq 5; y \leq 3$

107. If the volume of a tetrahedron whose conterminous edges are $\bar{a} + \bar{b}$, $\bar{b} + \bar{c}$, $\bar{c} + \bar{a}$ is 24 cubic units, then the volume of parallelopiped whose coterminous edges are $\bar{a}, \bar{b}, \bar{c}$ is

(A) 48 cubic units (B) 144 cubic units (C) 72 cubic units (D) 10 cubic units

108. The joint equation of the pair of lines through the origin and making an equilateral triangle with the line $x = 3$ is

(A) $3x^2 - y^2 = 0$ (B) $\sqrt{3}x^2 - 2xy + y^2 = 0$
(C) $x^2 - 3y^2 = 0$ (D) $x^2 + 2xy - \sqrt{3}y^2 = 0$

109. If 1 is added to first 10 natural numbers, then variance of the numbers so obtained is

(A) 8.25 (B) 3.87 (C) 6.5 (D) 2.87

110. A random variable X has the following probability distribution

X = x	0	1	2	3	4	5	6	7
P[X = x]	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2 + k$

then F(4) =

(A) $\frac{3}{10}$ (B) $\frac{1}{10}$ (C) $\frac{7}{10}$ (D) $\frac{4}{5}$

111. A differential equation for the temperature 'T' of a hot body as a function of time, when it is placed in a bath which is held at a constant temperature of 32° F, is given by (where k is a constant of proportionality)

(A) $\frac{dT}{dt} = kT - 32$ (B) $\frac{dT}{dt} = kT + 32$

(C) $\frac{dT}{dt} = -k(T - 32)$ (D) $\frac{dT}{dt} = 32kT$

112. $\int_0^{\pi/4} \log(1 + \tan x)\,dx$ =

(A) $\frac{\pi}{16}\log 2$ (B) $\frac{\pi}{4}\log 2$ (C) $\frac{\pi}{8}\log 2$ (D) $\pi \log 2$

113. A particle is moving on a straight line. The distance S travelled in time t is given by $S = at^2 + bt + 6$. If the particle comes to rest after 4 seconds at a distance of 16 m. from the starting point, then the acceleration of the particle is.

(A) $\frac{-3}{4}\,m/sec^2$ (B) $\frac{-1}{2}\,m/sec^2$ (C) $-1\ m/sec^2$ (D) $\frac{-5}{4}\,m/sec^2$

114. The negation of a statement '$x \in A \cap B \rightarrow (x \in A$ and $x \in B)$' is

(A) $x \in A \cap B \rightarrow (x \in A$ or $x \in B)$ (B) $x \in A \cap B$ and $(x \notin A$ or $x \notin B)$

(C) $x \in A \cap B$ or $(x \in A$ and $x \in B)$ (D) $x \notin A \cap B$ and $(x \in A$ and $x \in B)$

115. The Cartesian equation of the plane passing through the point (0, 7, −7) and containing the line $\frac{x+1}{-3} = \frac{y-3}{2} = \frac{z+2}{1}$ is

(A) $2x + y - z = 14$ (B) $x + y + z = 0$

(C) $x + 2y + z = 7$ (D) $2x + y + z = 0$

116. If $\bar{e}_1, \bar{e}_2$ and $\bar{e}_1 + \bar{e}_2$ are unit vectors, then the angle between $\bar{e}_1$ and $\bar{e}_2$ is

(A) 150° (B) 120° (C) 90° (D) 135°

117. If $y = \log\tan\left(\frac{x}{2}\right) + \sin^{-1}(\cos x)$, then $\frac{dy}{dx}$ =

(A) cosec x (B) sin x + 1 (C) x (D) cosec x − 1

118. If $\bar{a}, \bar{b}, \bar{c}$ are three vectors which are perpendicular to $\bar{b}+\bar{c}$, $\bar{c}+\bar{a}$ and $\bar{a}+\bar{b}$ respectively, such that $|\bar{a}| = 2$, $|\bar{b}| = 3$, $|\bar{c}| = 4$, then $|\bar{a}+\bar{b}+\bar{c}| =$

(A) 29 (B) 3 (C) 9 (D) $\sqrt{29}$

119. If the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-1}{4}$ and $\frac{x-3}{1} = \frac{y-k}{2} = \frac{z}{1}$ intersect, then the values of k is

(A) $\frac{3}{2}$ (B) $\frac{-3}{2}$ (C) $\frac{-2}{9}$ (D) $\frac{9}{2}$

120. If inverse of $\begin{bmatrix} 1 & 2 & x \\ 4 & -1 & 7 \\ 2 & 4 & -6 \end{bmatrix}$ does not exist, then x =

(A) –3 (B) 2 (C) 3 (D) 0

121. The general solution of the differential equation $\frac{dy}{dx} = \frac{x+y+1}{x+y-1}$ is given by

(A) $y = x \log(x + y) + c$ (B) $x - y = \log(x + y) + c$

(C) $x + y = \log(x + y) + c$ (D) $y = x + \log(x + y) + c$

122. The logical expression $p \wedge (\sim p \vee \sim q) \equiv$

(A) $p \vee q$ (B) $p \wedge q$ (C) F (D) T

123. The parametric equations of a line passing through the points A(3, 4. –7) and B(1, –1, 6) are

(A) $x = 3 + \lambda$, $y = -1 + 4\lambda$, $z = -7 + 6\lambda$

(B) $x = -2 + 3\lambda$, $y = -5 + 4\lambda$, $z = 13 - 7\lambda$

(C) $x = 1 + 3\lambda$, $y = -1 + 4\lambda$, $z = 6 - 7\lambda$

(D) $x = 3 - 2\lambda$, $y = 4 - 5\lambda$, $z = -7 + 13\lambda$

124. The value of $(1 + i)^5 (1 - i)^7$ is

(A) –64 (B) –64 i (C) 64 i (D) 64

125. Rajesh has just bought a VCR from Maharashtra Electronics and the shop offers after sales service contract for Rs. 1000 for the next five years. Considering the experience of VCR users, the following distribution of maintenance expenses for the next five years is formed.

Expenses	0	500	1000	1500	2000	2500	3000
Probability	0.35	0.25	0.15	0.10	0.08	0.05	0.02

The expected value of maintenance cost is

(A) Rs. 800 (B) Rs. 770 (C) Rs. 700 (D) Rs. 900

126. The area of the region bounded by the parabola $x^2 = y$ and the line $y = x$ is

(A) $\frac{1}{2}$ sq. units (B) $\frac{1}{6}$ sq. units (C) $\frac{1}{3}$ sq. units (D) $\frac{5}{6}$ sq. units

127. If $A = \begin{bmatrix} 3 & 2 & 4 \\ 1 & 2 & 1 \\ 3 & 2 & 6 \end{bmatrix}$ and A_{ij} are cofactors of the elements a_{ij} of A, then $a_{11}A_{11} + a_{12}A_{12} + a_{13}A_{13}$ is equal to

(A) 8 (B) 6 (C) 4 (D) 0

128. The general solution of the differential equation $x + y\frac{dy}{dx} = \sec(x^2 + y^2)$ is

(A) $\sin(x^2 + y^2) = 2x + c$ (B) $\sin(x^2 + y^2) + 2x = c$
(C) $\sin(x^2 + y^2) + x = c$ (D) $\cos(x^2 + y^2) = 2x + c$

129. $\lim\limits_{x\to\infty}\left(\sqrt{x^2+5x-7} - x\right) =$

(A) $\frac{7}{2}$ (B) 5 (C) $\frac{5}{2}$ (D) 6

130. The differential equation of all circles which pass through the origin and whose centre lie on Y-axis is

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

131. With usual notations if the angles of a triangle are in the ratio 1 : 2 : 3, then their corresponding sides are in the ratio.

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

132. If $\left(2\hat{i} + 6\hat{i} + 27\hat{k}\right) \times \left(\hat{i} + \lambda\hat{j} + \mu\hat{k}\right) = \bar{0}$, then λ and μ are respectively

(A) $\frac{17}{2}, 3$ (B) $3, \frac{17}{2}$ (C) $3, \frac{27}{2}$ (D) $\frac{27}{2}, 3$

133. If $f(x) = |x|$, for $x \in (-1, 2)$, then f is discontinuous at (where [x] represents floor function)

(A) $x = -1, 0, 1, 2$ (B) $x = -1, 0, 1$ (C) $x = 0, 1$ (D) $x = 2$

134. The angle between a line with direction ratios 2, 2, 1 and a line joining (3, 1, 4) and (7, 2, 12) is

(A) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (B) $\cos^{-1}\left(\frac{1}{3}\right)$ (C) $\cos^{-1}\left(\frac{2}{3}\right)$ (D) $\cos^{-1}\left(\frac{\sqrt{2}}{3}\right)$

135. The equation of the tangent to the curve $y = 4xe^x$ at $\left(-1, \frac{-4}{e}\right)$ is

(A) $6x - \frac{e}{4}y = -5$ (B) $x - \frac{e}{4}y = 0$ (C) $x = -1$ (D) $y = \frac{-4}{e}$

136. The slope of the line through the origin which makes an angle of 30° with the positive direction of Y-axis measured anticlockwise is

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

137. The domain of the function $f(x) = \frac{1}{\sqrt{x+|x|}}$ is

(A) $(-\infty, 0)$ (B) $(2, 5)$ (C) $(0, \infty)$ (D) $(-\infty, \infty)$

138. All the letters of the word 'ABRACADABRA' are arranged in different possible ways.

Then the number of such arrangements in which the vowels are together is

(A) 1200 (B) 1240 (C) 1220 (D) 1260

139. If $\int \frac{1+x^2}{1+x^4} dx = \frac{1}{\sqrt{2}} \tan^{-1}\left[\frac{f(x)}{\sqrt{2}}\right] + c$, then $f(x) =$

(A) $x + \frac{1}{x^2}$ (B) $x - \frac{1}{x^2}$ (C) $x + \frac{2}{x}$ (D) $x - \frac{1}{x}$

140. The value of $\sin 18°$ is

(A) $\frac{4}{\sqrt{5}-1}$ (B) $\frac{\sqrt{5}-1}{4}$ (C) $\frac{\sqrt{5}+1}{4}$ (D) $\frac{4}{\sqrt{5}+1}$

141. If $4\sin^{-1}x + 6\cos^{-1}x = 3\pi$, where $-1 \le x \le 1$, then $x =$

(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) $\frac{-1}{2}$ (D) 0

142. If $h(x) = \sqrt{4f(x)+3g(x)}$, $f(1) = 4$, $g(1) = 3$, $f'(1) = 3$, $g'(1) = 4$, then $h'(1) =$

(A) $\frac{5}{12}$ (B) $\frac{12}{5}$ (C) $\frac{-5}{12}$ (D) $\frac{-12}{7}$

143. If the line $\frac{x+1}{2} = \frac{y-m}{3} = \frac{z-4}{6}$ lies in the plane $3x - 14y + 6z + 49 = 0$, then the value of m is

(A) 3 (B) −5 (C) 5 (D) 2

144. If $x \in \left(0, \frac{\pi}{2}\right)$ and x satisfies the equation $\sin x \cos x = \frac{1}{4}$, then the values of x are

(A) $\frac{\pi}{12}, \frac{5\pi}{12}$ (B) $\frac{\pi}{8}, \frac{3\pi}{8}$ (C) $\frac{\pi}{8}, \frac{\pi}{4}$ (D) $\frac{\pi}{6}, \frac{\pi}{12}$

145. If $x = a\cos\theta$, $y = b\sin\theta$, then $\left[\frac{d^2y}{dx^2}\right]_{\theta=\frac{\pi}{4}} =$

(A) $2\left(\frac{a^2}{b}\right)$ (B) $\sqrt{2}\left(\frac{a^2}{b}\right)$ (C) $-2\sqrt{2}\left(\frac{b}{a^2}\right)$ (D) $2\sqrt{2}\left(\frac{b}{a^2}\right)$

146. $\int\frac{x+\sin x}{1+\cos x}dx =$

(A) $x\tan\left(\frac{x}{2}\right)+c$ (B) $\log(x+\sin x)+c$

(C) $\cot\left(\frac{x}{2}\right)+c$ (D) $\log(1+\cos x)+c$

147. An ice ball melts at the rate which is proportional to the amount of ice at that instant. Half the quantity of ice melts in 20 minutes, x_0 is the initial quantity of ice. If after 40 minutes the amount of ice left is Kx_0, then K =

(A) $\frac{1}{2}$ (B) $\frac{1}{8}$ (C) $\frac{1}{4}$ (D) $\frac{1}{3}$

148. If $\int_0^{\frac{\pi}{2}}\frac{dx}{5+4\sin x} = A\tan^{-1}B$, then A + B =

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

149. If $X \sim B(4, p)$ and $P(X=0) = \frac{16}{81}$, then $P(X=4) =$

(A) $\frac{1}{81}$ (B) $\frac{1}{16}$ (C) $\frac{1}{8}$ (D) $\frac{1}{27}$

150. If the lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to a circle, then the radius of the circle is

(A) $\frac{7}{4}$ units (B) $\frac{3}{4}$ units

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