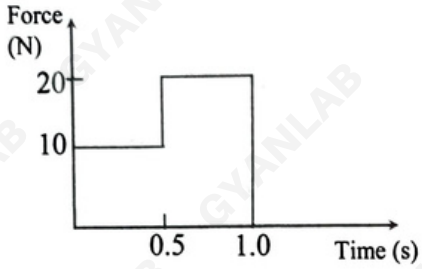
MHT CET – 2021

22nd September (Shift - 2)

Section I

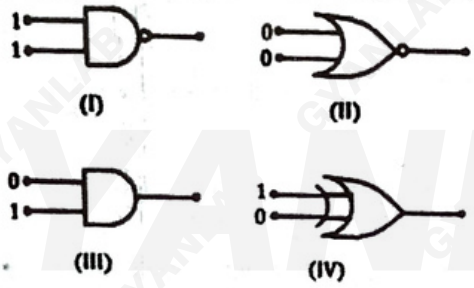
PHYSICS

1. Force is applied to a body of mass 2 kg at rest on a frictionless horizontal surface as shown in the force against time (F – t) graph. The speed of the body after 1 second is



(A) 7.5 m/s (B) 12.5 m/s (C) 10 m/s (D) 15 m/s

2. Which of the following gates will give an output '1' for the given inputs?



(A) II and III (B) I and IV (C) I and III (D) II and IV

3. For a common–emitter amplifier, the voltage gain is 40. Its input and output impedances are 100Ω and 400 Ω, respectively. The power gain of the CE amplifier will be

(A) 450 (B) 400 (C) 300 (D) 500

4. A tuning fork of frequency 'n' is held near the open end of tube which is closed at the other end and the lengths are adjusted until resonance occurs. The first resonance occurs at length L_1 and immediate next resonance occurs at length L_2. The speed of sound in air is

(A) $n(L_2 - L_1)$ (B) $\frac{n(L_2 - L_1)}{2}$ (C) $2n(L_2 - L_1)$ (D) $\frac{n(L_2 + L_1)}{2}$

5. In parallel plate capacitor, electric field between the plates is 'E'. If the charge on the plates is 'Q' then the force on each plate is

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

6. A particle with position vector $\vec{r}$ has a linear momentum $\vec{P}$. Which one of the following statements is true in respect of its angular momentum 'L' about the origin?

(A) $\vec{L}$ acts along $\vec{P}$.

(B) L is maximum when $\vec{P}$ is perpendicular to $\vec{r}$.

(C) $\vec{L}$ acts along $\vec{r}$.

(D) L is maximum when $\vec{P}$ and $\vec{r}$ are parallel.

7. A ball rises to the surface of a liquid with constant velocity. The density of the liquid is four times the density of the material of the ball. The viscous force of the liquid on the rising ball is greater than the weight of the ball by a factor of
(A) 4 (B) 3 (C) 2 (D) 5

8. A particle having a charge 100 e is revolving in a circular path of radius 0.8 m with 1. r.p.s The magnetic field produced at the centre of the circle in SI unit is (μ_0 = permeability of vacuum, e = 1.6×10^{-19}C)
(A) $10^{-17}\ \mu_0$ (B) $10^{-3}\mu_0$ (C) $10^{-7}\ \mu_0$ (D) $10^{-11}\ \mu_0$

9. Two satellites of same mass are launched in circular orbits at heights 'R' and '2R' above the surface of the earth. The ratio of their kinetic energies is (R = radius of the earth)
(A) 1: 3 (B) 3 : 2 (C) 4 : 9 (D) 9 : 4

10. The emissive power of sphere of area 0.04 m^2 is 0.7 k cal s^{-1} m^{-2}. The amount of heat radiated in 20 second is
(A) 2.8 k cal s^{-1} m^{-2} (B) 0.28 k cal s^{-1} m^{-2}
(C) 5.6 k cal s^{-1} m^{-2} (D) 0.56 k cal s^{-1} m^{-2}

11. In a potentiometer experiment, the balancing length for a cell is 240 cm. On shunting the cell with a resistance of 2Ω, the balancing length becomes half the initial balancing length. The internal resistance of the cell is
(A) 1.5 Ω (B) 1 Ω (C) 0.5 Ω (D) 2 Ω

12. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90°, are separated by a distance of
(A) 50 cm (B) 1 cm (C) 25 cm (D) 75 cm

13. In n^{th} Bohr orbit, the ratio of the kinetic energy of an electron to the total energy of it, is
(A) 2 : 1 (B) 1 : −1 (C) +1 : 1 (D) −1 : 2

14. Two spherical conductors of radii 4 cm and 5 cm are charged to the same potential. If 'σ_1' and 'σ_2' be the respective values of the surface density of charge on the two conductors then the ratio $\sigma_1 : \sigma_2$ is
(A) 5 : 4 (B) 3 : 2 (C) 4 : 3 (D) 2: 1

15. Kirchhoff's current and voltage law are respectively based on the conservation of
(A) momentum, charge (B) energy, charge
(C) charge, energy (D) charge, momentum

16. A glass tube of 1m length is filled with water. The water can be drained out slowly from the bottom of the tube. If vibrating tuning fork of frequency 500 Hz is brought at the upper end of the tube then total number of resonances obtained are [Velocity of sound in air is 320 ms^{-1}]
(A) 3 (B) 4 (C) 1 (D) 2

17. The rate of flow of heat through a copper rod with temperature difference 28°C is 1400 cal s^{-1}. The thermal resistance of copper rod will be
(A) $0.05\frac{°C\,s}{cal}$ (B) $0.02\frac{°C\,s}{cal}$ (C) $5\frac{°C\,s}{cal}$ (D) $2\frac{°C\,s}{cal}$

18. A capacitor of capacity 'C' is charged to a potential 'V'. It is connected in parallel to an inductor of inductance 'L'. The maximum current that will flow in the circuit is

(A) $V\sqrt{\frac{L}{C}}$ (B) $V\sqrt{LC}$ (C) $V\sqrt{\frac{C}{L}}$ (D) $\frac{VC^2}{L}$

19. When a photon enters glass from air, which one of the following quantity does not change?

(A) Energy (B) Velocity (C) Wavelength (D) Momentum

20. In Young's double slit experiment using monochromatic light of wavelength 'λ', the maximum intensity of light at a point on the screen is K units. The intensity of light at point where the path difference is $\frac{\lambda}{3}$ is $\left[\cos 60° = \sin 30° = \frac{1}{2}\right]$

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

21. An electron of mass 'm' and charge 'q' is accelerated from rest in a uniform electric field of strength 'E'. The velocity acquired by the electron when it travels a distance 'L' is

(A) $\sqrt{\frac{2qE}{mL}}$ (B) $\sqrt{\frac{2Em}{qL}}$ (C) $\sqrt{\frac{2qEL}{m}}$ (D) $\times\sqrt{\frac{qE}{mL}}$

22. If the terminal speed of a sphere A [density $\rho_A = 7.5$ kg m^{-3}] is 0.4 ms^{-1}, in a viscous liquid [density $\rho_L = 1.5$ kg m^{-3}], the terminal speed of sphere B [density $\rho_B = 3$ kg m^{-3}] of the same size in the same liquid is

(A) 0.3 ms^{-1} (B) 0.1 ms^{-1} (C) 0.2 ms^{-1} (D) 0.4 ms^{-1}

23. A particle connected to the end of a spring executes S.H.M. with period 'T_1'. While the corresponding period for another spring is 'T_2'. If the period of oscillation with two springs in series is 'T', then

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

24. The change in internal energy of the mass of a gas, when the volume changes from 'V' to '2V' at constant pressure 'P' is (γ = Ratio of Cp to Cv)

(A) $\frac{PV}{(\gamma-1)}$ (B) $\frac{P}{(\gamma-1)}$ (C) PV (D) $\frac{\gamma PV}{(\gamma-1)}$

25. An object is located on a wall, its image of equal size is to be obtained on a parallel wall with the help of a convex lens. The lens is placed at a distance 'd' in front of the second wall. The required focal length of the lens is

(A) less than $\frac{d}{4}$ (B) more than $\frac{d}{4}$ but less than $\frac{d}{2}$

(C) only $\frac{d}{4}$ (D) only $\frac{d}{2}$

26. A child is standing with folded hands at the centre of the platform rotating about its central axis. The kinetic energy of the system is 'K'. The child now stretches his arms so that the moment of inertia of the system becomes double. The kinetic energy of the system now is

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

27. If the pressure of an ideal gas is decreased by 10% isothermally, then its volume will

(A) decrease by 8% (B) decrease by 9%
(C) increase by 8% (D) increase by 11.1%

28. The critical angle for light going from medium 'x' to medium 'Y' is θ. The speed of light in medium 'x' is 'V_x'. The speed of light in medium 'Y' is

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

29. A needle is 7 cm long. Assuming that the needle is not wetted by water, what is the weight of the needle, so that it floats on water?

$\left[\text{T} = \text{surface tension of water} = 70\frac{\text{dyne}}{\text{cm}}\right]$

[acceleration due to gravity = 980 cm s^{-2}]

(A) 1 g wt (B) 5 g wt (C) 3 g wt (D) 7 g wt

30. A driver applies the brakes on seeing the red traffic signal 400 m ahead. At the time of applying the brakes, the vehicle was moving with 15 m/s and retarding at 0.3 m/s^2. The distance covered by the vehicle from the traffic light 1 minute after the application of brakes is

(A) 25 m (B) 360 m (C) 40 m (D) 375 m

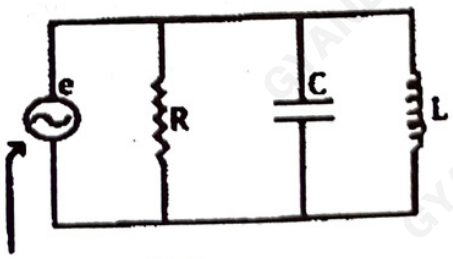
31. An ideal gas having molar mass 'M_0', has r.m.s. velocity 'V' at temperature 'T'. Then

(A) VT^2 = constant (B) $\frac{v^2}{T}$ = constant (C) V^2T = constant (D) V is independent of T

32. A step down transformer is used to reduce the main supply from 'V_1' volt to 'V_2' volt. The primary coil draws a current 'I_1' A and the secondary coil draws 'I_2'A. ($I_1 < I_2$). The ratio of input power to output power is

(A) $\frac{V_1V_2}{I_1I_2}$ (B) $\frac{V_1I_1}{V_2I_2}$ (C) $\frac{I_1I_2}{V_1V_2}$ (D) $\frac{V_1I_2}{V_2I_1}$

33. For the circuit shown below, instantaneous current through inductor 'L' and capacitor 'C' is respectively.



$e = e_0 \sin t$

(A) $\frac{-e_0}{\omega L}\cos\omega t$; $e_0\,\omega c\cos\omega t$

(B) $\frac{-e_0}{\omega L}\sin\omega t$; $\frac{e_0}{\omega C}\cos\omega t$

(C) $\frac{e_0C}{L}\cos\omega t$; $\frac{e_0L}{C}\sin\omega t$

(D) $\frac{-e_0C}{L}\sin\omega t$; $\frac{e_0L}{C}\cos\omega t$

34. The light of wavelength 'λ' is incident on the surface of metal of work function ϕ and emits the electron. The maximum velocity of electron emitted is
[m = mass of electron and h = Planck's constant, c = velocity of light]

(A) $\left[\frac{2(hc-\lambda)}{m\lambda}\right]^{\frac{1}{2}}$ (B) $\left[\frac{2(hc-\phi)\lambda}{mc}\right]$ (C) $\left[\frac{2(hc-\lambda)}{m\lambda}\right]$ (D) $\left[\frac{2(hc-\lambda\phi)}{m\lambda}\right]^{\frac{1}{2}}$

35. A parallel plate capacitor having plates of radius 6 cm has capacitance 100 pF. It is connected to 230 V a.c. supply with angular frequency 300 rad/s. the r.m.s value of current is

(A) 6.9×10^{-6} A (B) 2.3×10^{-5} A (C) 6.9×10^{-5} A (D) 6.9×10^{-7} A

36. At a height 'R' above the earth's surface the gravitational acceleration is
(R = radius of earth, g = acceleration due to gravity on earth's surface)

(A) g (B) $\frac{g}{8}$ (C) $\frac{g}{4}$ (C) $\frac{g}{2}$

37. Two rings of radius 'R' and 'nR' made of same material have the ratio of moment of inertia about an axis passing through its centre and perpendicular to the plane is 1: 8. The value of 'n' is (mass per unit length = λ)

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

38. 'n' waves are produced on a string in 1 second. When the radius of the string is doubled, keeping tension same, the number of waves produced in 1 second for the same harmonic will be

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

39. the magnetic flux (in weber) in a closed circuit of resistance 20Ω varies with time t second according to equation $\phi = 5t^2 - 6t + 9$. The magnitude of induced current at t = 0.2 second is

(A) 0.8 A (B) 1 A (C) 0.2 A (D) 0.4 A

40. If 'E' and 'L' denote the magnitude of total energy and angular momentum of revolving electron in n^{th} Bohr orbit, then

(A) $E \propto L^{-1}$ (B) $E \propto L$ (C) $E \propto L^{-2}$ (D) $E \propto L^2$

41. The magnetic field inside a current carrying toroidal solenoid is 0.2 mT. What is the magnetic field inside the toroid if the current through it is tripled and radius is made $\frac{1}{3}^{rd}$?

(A) 0.2 mT (B) 0.6 mT (C) 0.8 mT (D) 0.9 mT

42. A body of mass 'm' performs linear S.H.M. given by equation $x = P \sin \omega t + Q \sin\left(\omega t + \frac{\pi}{2}\right)$.
The total energy of the particle at any instant is

(A) $\frac{1}{2}m\omega^2 PQ$ (B) $\frac{1}{2}\frac{m\omega^2}{P^2Q^2}$

(C) $\frac{1}{2}m\omega^2\left(P^2+Q^2\right)$ (D) $\frac{1}{2}m\omega^2 p^2Q^2$

43. Two particles A and B having same mass have charge +q and +4q respectively. When they are allowed to fall from rest through same electric potential difference, the ratio of their speeds 'V_A' to 'V_B' will become

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

44. The relative permeability of iron is 2000. Its absolute permeability in SI unit will be $\left(\frac{\mu_0}{4\pi} = 10^{-7} \text{ SI unit}\right)$

(A) $8\pi \times 10^{-7}$ (B) $4\pi \times 10^{-5}$ (C) $8\pi \times 10^{-4}$ (D) $\frac{500}{\pi} \times 10^{-7}$

***45.** Choose the correct statement. In semiconductors valance band and conduction band

(A) is separated by large energy gap.
(B) is separated by small energy gap.
(C) is almost empty.
(D) overlap each other.

***46.** A step down transformer has turns ratio 20:1. If 8 V is applied across 0.4 ohm secondary then the primary current will be

(A) 2 A (B) 1 A (C) 0.5 A (C) 4 A

***47.** Photons of energy 10 eV are incident on a photosensitive surface of threshold frequency 2×10^{15} Hz. The kinetic energy in eV of the photoelectrons emitted is
[Planck's constant $h = 6.63 \times 10^{34}$ Js]

(A) 8.29 eV (B) 6.5 eV (C) 4.2 eV (D) 1.71 eV

***48.** Two radioactive materials X_1 and X_2 have decay constants '5λ' and 'λ' respectively. Initially, they have the same number of nuclei. After time 't', the ratio of number of nuclei of X_1 to that of X_2 is $\frac{1}{e}$. Then t is equal to

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

***49.** If two sources emit light waves of different amplitudes then

(A) brightness of fringes is less.
(B) fringes disappear after short time.
(C) fringe width is less.
(D) there is some intensity of light in the region of destructive interference.

***50.** An ideal gas at 27°C is compressed adiabatically to (8/27) of its original volume. If ratio of specific heats, $\gamma = 5/3$ then the rise in temperature of the gas is

(A) 500 K (B) 125 K
(C) 250 K (D) 375 K

CHEMISTRY

51. Ethers when dissolved in cold concentrated sulphuric acid forms
(A) Alkanoic acids (B) Oxonium salts (C) Alkanols (D) Alkyl hydrogen sulphate

52. The volume of a gas at 0°C is 2 dm^3. What is its volume if temperature is decreased by 272°C?
(A) $\left(\frac{3}{272}\right)dm^3$ (B) $\left(\frac{2}{272}\right)dm^3$ (C) $\left(\frac{4}{273}\right)dm^3$ (D) $\left(\frac{2}{273}\right)dm^3$

53. The major product obtained in the following reaction is

$$\text{Chlorobenzene} + \text{chlorine} \xrightarrow[FeCl_3]{\text{Anhydrous}} \text{product (Major)}$$

(A) 1, 3, 5–trichlorobenzene (B) 1, 4–dichlorobenzene
(C) 1, 2 – dichlorobenzene (D) 1, 3– dichlorobenzene

54. How many moles of urea are present in 5.4 g ? (Molar mass = 60)
(A) 2.9 (B) 0.09 (C) 1.2 (D) 2.4

55. Which among the following is a double ring containing nitrogen base present in nucleic acids?
(A) Thymine (B) Adenine (C) Cytosine (D) Uracil

56. Identify the product 'B' in the following series of reactions.

$$\text{Propan}-1-\text{ol} \xrightarrow[623K]{Al_2O_3} A \xrightarrow[ii)\,H_2O]{i)\,conc.H_2SO_4} B$$

(A) Propanal (B) Propan–2–ol (C) Propene (D) Propanone

57. Conversion of benzene diazonium chloride to chlorobenzene in presence of CuCl/HCl is known as
(A) Sandmeyer reaction (B) Mendius reaction
(C) Gattermann reaction (D) Hofmann degradation

58. Which among the following compounds in <u>NOT</u> a colourless gas?
(A) CIF (B) IF_7 (C) IF_3 (D) CIF_3

59. Solubility product of AgBr is 4.9×10^{-13}. What is its solubility?
(A) 2.4×10^{-7} mol dm^{-3} (B) 3.2×10^{-7} mol dm^{-3}
(C) 4.9×10^{-7} mol dm^{-3} (D) 7.0×10^{-7} mol dm^{-3}

60. Which element from following is radioactive?
(A) Pr (B) Nd (C) Pm (D) Sm

61. Which among the following statements about $[Ni(CN)_4]^{2-}$ is <u>NOT</u> true?
(A) In this electrons are paired prior to hybridization.
(B) Oxidation state of Ni is +6.
(C) Ni undergoes dsp^2 hybridization.
(D) It is a square planar complex.

62. Formation of $NO_{2(g)}$ from $N_{2(g)}$ and $O_{2(g)}$ is an endothermic process. Which of the following is true for this reaction?
(A) $\Delta H = 0$ (B) $\Delta H < 0$ (C) $\Delta H = \Delta U$ (D) $\Delta H > 0$

63. Identify reducing agent in following reaction

$$H_2O_{2(aq)} + ClO^-_{4(aq)} \rightarrow ClO^-_{2(aq)} + O_{2(g)}$$

(A) $ClO^-_{2(aq)}$ (B) $H_2O_{2(aq)}$ (C) $ClO^-_{4(aq)}$ (D) $O_{2(g)}$

64. Identify the type of unit cell that has particles at the centre of each face in addition to the particles at eight corners of a cube?
(A) Face centred cubic unit cell (B) Hexagonal unit cell
(C) Simple cubic unit cell (D) Body centred cubic unit cell

65. Identify product 'B' in following reaction.

$$\text{Cumene} \xrightarrow[\Delta]{KMnO_4, KOH} A \xrightarrow{H_3O+} B$$

(A) Benzoic acid (B) Benzophenone (C) Phenol (D) Benzaldehyde

66. Which of the following is NOT a correct mathematical equation for Ostwald dilution law?
(A) $\alpha = \sqrt{\frac{K_a}{c}}$ (B) $K = \frac{\alpha^2}{V}$ (C) $K = \alpha^2 c$ (D) $\alpha = \sqrt{\frac{K_a}{V}}$

67. How many Faraday of electricity is required to deposit 0.8 g of calcium at cathode by the electrolysis of $CaCl_2$?
(Molar mass of Ca = 40 g mol^{-1})
(A) 4 F (B) 0.04 F (C) 2.5 F (D) 2 F

68. Identify lowest positive charge developed (indicated by ∂, ∂_1, ∂_2, ∂_3) due to inductive effect in following compounds.

$$CH_3 - \overset{\partial_3}{C}H_2 \rightarrow \overset{\partial_2}{C}H_2 \rightarrow \overset{\partial_1}{C}H_2 \rightarrow \overset{\partial}{Cl}$$

(A) ∂_2 (B) ∂_3 (C) ∂ (D) ∂_1

69. What is rate constant of a first order reaction if 0.08 mole of reactant reduces to 0.02 mole in 23.03 minute?
(A) 0.2303 min^{-1} (B) 1.6021 min^{-1} (C) 0.4031 min^{-1} (D) 0.06021 min^{-1}

70. Which element from following lanthanoids has half-filled f– orbital in observed and expected electronic configuration?
(A) Eu (B) Sm (C) Ce (D) Pm

71. How many atoms of niobium are present in 2.43 g if it forms bcc structure with density 9 g cm^{-3} and volume of unit cell 2.7×10^{-23} cm^3?
(A) 3.01×10^{23} (B) 4.1×10^{22} (C) 5.0×10^{22} (D) 2.0×10^{22}

72. Identify the reagent R used in following conversion.

$$\text{Glucose} \xrightarrow{R} \text{n-hexane}$$

(A) HI, Δ (B) NH_2OH (C) HCN (D) HNO_3

73. Buna–S is obtained from

(A) Styrene and 2–chloro–1,3–butadiene
(B) Adipic acid and hexamethylene diamine
(C) Styrene and butadiene
(D) Glycine and ε–amino caproic acid

74. 5 g sucrose (molar mass = 342) is dissolved in 100 g of solvent, decreases the freezing point by 2.15 K. What is cryoscopic constant of solvent?

(A) 14.7 K kg mol^{-1} (B) 2.15 K kg mol^{-1} (C) 4.30 K kg mol^{-1} (D) 7.35 K kg mol^{-1}

75. What is Henry's law constant if solubility of a gas in water at 298 K and 1 bar pressure is 7×10^{-4} mol L^{-1}?

(A) 2.0×10^{-5} mol L^{-1} bar^{-1}
(B) 7.0×10^{-4} mol L^{-1} bar^{-1}
(C) 3.5×10^{-3} mol L^{-1} bar^{-1}
(D) 3.1×10^{-5} mol L^{-1} bar^{-1}

76. A weak monobasic acid is 10% dissociated in 0.05 M solution. What is its percentage dissociation in 0.10 M solution?

(A) 5.27% (B) 7.17 % (C) 10.3 % (D) 4.5 %

77. What is the conductivity of 0.02 M KCl solution if cell constant is 1.29 cm^{-1} with resistance 645 Ω?

(A) 5.0×10^{-3} Ω^{-1} cm^{-1}
(B) 2.0×10^{-3} Ω^{-1} cm^{-1}
(C) 8.3×10^{-3} $\Omega^{-1}cm^{-1}$
(D) 2.5×10^{-3} Ω^{-1} cm^{-1}

78. The major product obtained in the following reaction is

(A) 4–Iodo–4–methylhexane
(B) 4–Iodo–3–methylhexane
(C) 3–Iodo–3–methylhexane
(D) 3–Iodo–4–methylhexane

79. Which of the following statements is NOT true for a reaction having rate law $r = k[H_2][I_2]$?

(A) The reaction is first order in H_2
(B) Overall order of reaction is 1
(C) The reaction is first order in I_2
(D) Overall order of reaction is 2

80. Identify the product 'B' in following reaction.

$$2\,CH_3CHO \xrightarrow{\text{dil.NaOH}} A \xrightarrow[-H_2O]{\Delta} B$$

(A) But–3–enal
(B) 3–Hydroxyl butanal
(C) But–2–enal
(D) 4–Hydroxyl butanal

81. Identify the correct decreasing order of precipitation power of flocculating ion added, from following.

(A) $Al^{3+} > Na^{+} > Ba^{2+}$ (B) $Ba^{2+} > Al^{3+} > Na^{+}$

(C) $Al^{3+} > Ba^{2+} > Na^{+}$ (D) $Na^{+} > Ba^{2+} > Al^{3+}$

82. Identify use of argon from following.

(A) In supersonic wind tunnels

(B) For magnetic resonance imaging

(C) For producing inert atmosphere in welding

(D) For production of lasers

83. Which of the following is an example of copolymer?

(A) Polyvinyl chloride (B) Nylon–6

(C) Buna–S (D) Polyethylene

84. Which of the following is likely to undergo racemization during alkaline hydrolysis?

(A) $CH_3 - CH_2 - \underset{\displaystyle Cl}{\underset{|}{C}}H - CH_2 - CH_3$ (B) $(CH_3)_3C - CH_2 - Cl$

(C) $CH_3 - \underset{\displaystyle Cl}{\underset{|}{C}}H - CH_3$ (D) $CH_3 - CH_2 - \underset{\displaystyle Cl}{\underset{|}{C}}H - CH_3$

85. What is enthalpy of formation of NH_3 if bond enthalpies are as $(N \equiv N) = 941$ kJ, $(H - H) = 436$ kJ, $(N - H) = 389$ kJ?

(A) –84.5 kJ (B) –21.25 kJ (C) –42.5 kJ (D) –63.45 kJ

86. Which of the following alkyl halide is treated with sodium metal to obtain 2,2,3,3 – tetramethyl butane?

(A) tert-Butyl bromide (B) n-Propyl bromide

(C) sec-Butyl bromide (D) n-Butyl bromide

87. Electrical conductance due to all the ions in 1 cm^3 of given solution is called as

(A) Molar conductivity (B) Resistivity

(C) Conductivity (D) Electrical conductance

88. For the reaction $N_{2(g)} + 3H_{2(g)} \rightarrow 2\,NH_{3(g)}$,

what is the relation between $\frac{d[N_2]}{dt}$ and $\frac{d[H_2]}{dt}$?

(A) $3\frac{d[H_2]}{dt} = \frac{d[N_2]}{dt}$ (B) $\frac{d[H_2]}{dt} = 3\frac{d[N_2]}{dt}$

(C) $3\frac{d[H_2]}{dt} = 2\frac{d[N_2]}{dt}$ (D) $\frac{d[H_2]}{dt} = \frac{d[N_2]}{dt}$

89. Identify the polymer used in making floor tiles.

(A) PETE (B) PVC (C) HDPE (D) LDPE

90. Which of the following formulae is used to obtain depression in freezing point?

(A) $\Delta T_f = \frac{T_f^\circ}{T_f}$ (B) $\Delta T_f = T_f^\circ - T_f$ (C) $\Delta T_f - T_f = T_f^\circ$ (D) $\Delta T_f = \frac{T_f}{T_f^\circ}$

91. How many tetrahedral voids are present in 0.4 mole of a compound that forms hcp structure?

(A) 4.8×10^{23} (B) 3.011×10^{23} (C) 1.2×10^{23} (D) 2.4×10^{23}

92. Pure dihydrogen (99.5%) is obtained by the electrolysis of

(A) $NaOH_{(aq)}$ using Zn electrode
(B) pure water
(C) dil. H_2SO_4 using cadmium electrodes
(D) warm barium hydroxide using Ni electrodes

93. Which among following functional groups exhibits – R effect?

(A) – CO – (B) – Br (C) – OR (D) – NHR

94. Which among the following compounds has highest melting point?

(A) Phenol (B) p–Nitrophenol (C) p–Cresol (D) o–Nitrophenol

95. Identify compound from following having highest basic strength.

(A) $CH_3CH_2NH_2$ (B) NH_3 (C) $(CH_3)_2NH$ (D) $C_6H_5NH_2$

96. Which of the following alkenes on oxidation by $KMnO_4$ in dil. H_2SO_4 forms adipic acid?

(A) Hex–3–ene (B) Hex–1–ene (C) Hex–2–ene (D) Cyclohexene

97. What is the difference between ΔH and ΔU for reaction given below at 298 K?

$(R = 8.314\ JK^{-1}\ mol^{-1}$

$2C_6H_{6(\ell)} + 15O_{2(g)} \rightarrow 12CO_{2(g)} + 6H_2O_{(\ell)}$

(A) –2.72 kJ (B) –7.43 kJ (C) –7.8 kJ (D) –3.72 kJ

98. What is the energy of an electron in stationary state corresponding to n = 2?

(A) -1.45×10^{-18} J (B) -0.545×10^{-18} J
(C) -3.45×10^{-18} J (D) -2.5×10^{-18} J

99. Identify the molecule having dipole moment.

(A) BF_3 (B) CCl_4 (C) $CHCl_3$ (D) CH_4

100. Identify homoleptic complex from following.

(A) $[Co(NH_3)_6]^{3+}$ (B) $[Co(NH_3)_5Cl]SO_4$
(C) $[Co(NH_3)_4Cl_2]^+$ (D) $[Co(H_2O)(NH_3)_5]I_3$

Section II

MATHEMATICS

101. Let $f(x) = x + a\sqrt{2}\sin x$, $0 \le x < \frac{\pi}{4}$

$= 2x\cot x + b$, $\frac{\pi}{4} \le x < \frac{\pi}{2}$

$= a\cos 2x - b\sin x$, $\frac{\pi}{2} \le x \le \pi$

If $f(x)$ is continuous for $0 \le x \le \pi$, then

(A) $a = \frac{\pi}{6}, b = \frac{\pi}{12}$ (B) $a = \frac{-\pi}{6}, b = \frac{-\pi}{12}$ (C) $a = \frac{-\pi}{6}, b = \frac{\pi}{12}$ (D) $a = \frac{\pi}{6}, b = \frac{-\pi}{12}$

102. The area of triangle with vertices (1, 2, 0), (1, 0, a) and (0, 3, 1) is $\sqrt{6}$ sq. units, then the values of 'a' are

(A) −8, 1 (B) 2, −4 (C) −2, 4 (D) 8, −1

103. If $A = \begin{bmatrix} 5a & -b \\ 3 & 2 \end{bmatrix}$ and A adj $A = AA^T$, then $5a + b =$

(A) 13 (B) 4 (C) −1 (D) 5

104. The numbers can be formed using the digits 1, 2, 3, 4, 3, 2, 1 so that odd digits always occupy odd places in ____ ways.

(A) 9 (B) 18 (C) 6 (D) 3

105. If $y = \tan^{-1}\sqrt{\frac{1+\cos x}{1-\cos x}}$, then $\frac{dy}{dx} =$

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

106. Following data shows the information about marks obtained in Physics, Chemistry, Mathematics and Biology by 100 students in a class. Then _____ subject shows the highest variability in marks

	Physics	Chemistry	Mathematics	Biology
Mean	20	25	23	27
S.D.	3	2	4	5

(A) Mathematics (B) Chemistry (C) Biology (D) Physics

107. If G(4, 3, 3) is the centroid of the triangle ABC whose vertices are A(a, 3, 1), B(4, 5, b) and C(6, c, 5), then the values of a, b, c are

(A) $a = 1, b = 2, c = 3$ (B) $a = 3, b = 2, c = 1$ (C) $a = 2, b = 1, c = 3$ (D) $a = 2, b = 3, c = 1$

108. The d.r.s. of the normal to the plane passing through the origin and the line of intersection of the planes $x + 2y + 3z = 4$ and $4x + 3y + 2z = 1$ are

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

109. The degree of the differential equation whose solution is $y^2 = 8a(x + a)$, is

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

110. If the sum of slopes of lines represented by $ax^2 + 8xy + 5y^2 = 0$ is twice their product, then $a =$

(A) -4 (B) 5 (C) -2 (D) -8

111. In ΔABC, with usual notations $\frac{b\sin B - c\sin C}{\sin(B-C)} =$

(A) b (B) C (C) a (D) $a + b + c$

112. Two circles centred at (2, 3) and (4, 5) intersects each other. If their radii are equal, then the equation of the common chord is

(A) $x + y + 1 = 0$ (B) $x + y - 1 = 0$ (C) $x + y - 7 = 0$ (D) $x + y + 7 = 0$

113. The function $f(x) = \frac{\lambda \sin x + 6\cos x}{2\sin x + 3\cos x}$ is increasing, if

(A) $\lambda > 2$ (B) $\lambda < 4$ (C) $\lambda \geq 4$ (D) $\lambda > 1$

114. If $f(x) = x^2 + ax + b$ has minima at $x = 3$ whose value is 5, then the values of a and b are respectively.

(A) $-6, -14$ (B) $-6, 14$ (C) $14, -6$ (D) $6, 14$

115. The area bounded by the parabola $y^2 = x$ and the line $x + y = 2$ in the first quadrant is

(A) $\frac{7}{6}$ sq. units (B) $\frac{1}{6}$ sq. units (C) $\frac{2}{3}$ sq. units (D) $\frac{6}{7}$ sq. units

116. If $2\cos\theta = x + \frac{1}{x}$, then $2\cos 3\theta =$

(A) $x^3 - \frac{1}{x^3}$ (B) $\left(x + \frac{1}{x}\right)^3$ (C) $x + \frac{1}{x}$ (D) $x^3 + \frac{1}{x^3}$

117. For an invertible matrix A, if $A(\text{adj } A) = \begin{bmatrix} 20 & 0 \\ 0 & 20 \end{bmatrix}$, then $|A| =$

(A) -200 (B) 200 (C) -2 (D) 20

118. $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} \frac{\text{cosec } x \cdot \cot x}{1 + \text{cosec}^2 x}\, dx =$

(A) $\frac{\pi}{4} - \tan^{-1} 2$ (B) $\tan^{-1} 1$ (C) $\tan^{-1} 2$ (D) $\tan^{-1}\left(\frac{1}{3}\right)$

119. A spherical raindrop evaporates at a rate proportional to its surface area. If its radius originally is 3mm. and 1 hour later has been reduced to 2 mm, then the expression of radius r of the raindrop at any time t is (where $0 \leq t < 3$)

(A) $r = t + 5$ (B) $r = t - 5$ (C) $r = 3 - t$ (D) $r = t + 3$

120. The differential equation of all parabolas having vertex at the origin and axis along positive Y–axis is

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

121. If the vectors $2\hat{i} - \hat{j} - \hat{k}$; $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + \lambda\hat{j} + 5\hat{k}$ are coplanar, then the value of λ is

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

122. $\lim\limits_{x\to 2}(x-1)^{\frac{1}{3x-6}} =$

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

123. Given p : A man is a judge, q : A man is honest

If S1 : If a man is a judge, then he is honest S2 : If a man is a judge, then he is not honest

S3 : A man is not a judge or he is honest S4 : A man is a judge and he is honest

Then

(A) $S_2 \equiv S_3$ (B) $S_1 \equiv S_2$ (C) $S_2 \equiv S_4$ (D) $S_1 \equiv S_3$

124. If $2\tan^{-1}(\cos x) = \tan^{-1}(2\operatorname{cosec} x)$, then the value of x is

(A) $\frac{\pi^c}{6}$ (B) $\frac{\pi^c}{4}$ (C) $\frac{\pi^c}{3}$ (D) $\frac{\pi^c}{12}$

125. $\int \frac{\tan^4\sqrt{x}.\sec^2\sqrt{x}}{\sqrt{x}}dx =$

(A) $\frac{-5}{2}\left[\tan\sqrt{x}\right]^5 + c$ (B) $\left[\tan\sqrt{x}\right]^5 + c$ (C) $\frac{2}{5}\left[\tan\sqrt{x}\right]^5 + c$ (D) $\frac{5}{2}\left[\tan\sqrt{x}\right]^5 + c$

126. The line $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$ lies in the plane $x + 3y - \alpha z + \beta = 0$, then value of $\alpha\beta$ is

(A) 42 (B) 1 (C) −42 (D) −2

127. The statement pattern $(p \wedge q) \wedge [(p \wedge q) \vee (\sim p \wedge q)]$ is equivalent to

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

128. If the points P(4, 5, x), Q(3, y, 4) and R(5, 8, 0) are collinear, then the value of $x + y$ is

(A) 6 (B) 7 (C) 4 (D) 5

129. The particular solution of the differential equation $\frac{dy}{dx} = \frac{y+1}{x^2-x}$, when $x = 2$ and $y = 1$ is

(A) $xy = 4x - 6$ (B) $xy = 2x - 2$ (C) $xy = x - 2$ (D) $xy = -x + 4$

130. The distribution function F(X) of discrete random variable X is given by

X	1	2	3	4	5	6
F (X = x)	0.2	0.37	0.48	0.62	0.85	1

Then P [X = 4] + P [X = 5] =

(A) 0.14 (B) 0.85 (C) 0.37 (D) 0.23

131. The general solution of $\frac{dy}{dx} = \frac{x+y}{x-y}$ is

(A) $\tan^{-1}\frac{x}{y} + \frac{1}{2}\log\left|x^2+y^2\right| = c$ (B) $\tan^{-1}\frac{y}{x} + \frac{1}{2}\log\left|x^2+y^2\right| = c$

(C) $\tan^{-1}\frac{y}{x} - \frac{1}{2}\log\left|x^2+y^2\right| = c$ (D) $\tan^{-1}\frac{x}{y} - \frac{1}{2}\log\left|x^2+y^2\right| = c$

132. A line drawn from a point A $(-2, -2, 3)$ and parallel to the line $\frac{x}{-2} = \frac{y}{2} = \frac{z}{-1}$ meets the YOZ-plane in point P, then the co-ordinates of the point P are

(A) $(0, 4, -4)$ (B) $(0, 2, 2)$ (C) $(0, -2, 2)$ (D) $(0, -4, 4)$

133. First bag contains 3 red and 5 black balls and second bag contains 6 red and 4 black balls. A ball is drawn from each bag. The probability that one ball is red and the other is black, is

(A) $\frac{41}{80}$ (B) $\frac{21}{40}$ (C) $\frac{3}{20}$ (D) $\frac{3}{8}$

134. If $A = \begin{bmatrix} 1 & 2 & 1 \\ -1 & 1 & 3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 2 \\ -3 & 1 \\ 0 & 2 \end{bmatrix}$, then $(AB)^{-1}$

(A) $\begin{bmatrix} 5 & -6 \\ -4 & 5 \end{bmatrix}$ (B) $\begin{bmatrix} 5 & 6 \\ 4 & 5 \end{bmatrix}$ (C) $\begin{bmatrix} -5 & 6 \\ -4 & 5 \end{bmatrix}$ (D) $\begin{bmatrix} -5 & -6 \\ -4 & -5 \end{bmatrix}$

135. With usual notations, in any ΔABC, if $a \cos B = b \cos A$, then the triangle is

(A) an isosceles triangle (B) an equilateral triangle
(C) a right angled triangle (D) a scalene triangle

136. A fair coin is tossed 4 times. If X is a random variable which indicates number of heads, then $P[X < 3] =$

(A) $\frac{10}{16}$ (B) $\frac{1}{16}$ (C) $\frac{12}{16}$ (D) $\frac{11}{16}$

137. If the line joining two points A (2, 0) and B (3, 1) is rotated about A in anticlockwise direction through an angle of 15°, then the equation of the line in new position is

(A) $y = 3x - 6$ (B) $y = \sqrt{3}x - 2\sqrt{3}$ (C) $y = -\sqrt{3}x + 2\sqrt{3}$ (D) $y = \frac{1}{\sqrt{3}}x - \frac{2}{\sqrt{3}}$

138. The common region of the solution of the inequations $x + y \geq 5$, $y \leq 4$, $x \geq 2$, $x, y \geq 0$ is

(A) unbounded and non-origin side (B) unbounded and origin side
(C) bounded and origin side (D) bounded and non-origin side

139. If the mean and variance of a binomial distribution are 4 and 2 respectively, then probability of getting 2 heads is

(A) $\frac{28}{256}$ (B) $\frac{37}{256}$ (C) $\frac{128}{256}$ (D) $\frac{219}{256}$

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

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

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

141. If $x^y \cdot y^x = 16$, then $\frac{dy}{dx}$ at (2, 2) is

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

142. $\int_0^2 |2x-3|\,dx =$

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

143. $\int \cos^{-1} x\,dx =$

(A) $x\cos^{-1}x+\sqrt{1-x^2}+c$ (B) $-x\cos^{-1}x+\sqrt{1+x^2}+c$

(C) $x\cos^{-1}x-\sqrt{1+x^2}+c$ (D) $x\cos^{-1}x-\sqrt{1-x^2}+c$

144. $\int \frac{1}{\cos x+\sqrt{3}\sin x}\,dx =$

(A) $2\log\left[\tan\left(\frac{x}{2}+\frac{\pi}{12}\right)\right]+c$ (B) $\frac{1}{2}\log\left[\tan\left(\frac{x}{2}-\frac{\pi}{12}\right)\right]+c$

(C) $\frac{1}{2}\log\left[\tan\left(\frac{x}{2}+\frac{\pi}{12}\right)\right]+c$ (D) $2\log\left[\tan\left(\frac{x}{2}-\frac{\pi}{12}\right)\right]+c$

145. If $f(x) = [8x] - 3$, where [x] is greatest integer function of x, then $f(\pi) =$,
(where $\pi = 3.14$)

(A) 21 (B) 25 (C) 23 (D) 22

146. If lines represented by the equation $px^2 - qy^2 = 0$ are distinct, then

(A) $pq < 0$ (B) $p + q = 0$ (C) $pq > 0$ (D) $pq = 0$

147. The slant height of a right circular cone is 3 cm. The height of the cone for maximum volume is

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

148. If ω is the complex cube root of unity, then $(3 + 5\omega + 3\omega^2)^2 + (3 + 3\omega + 5\omega^2)^2 =$

(A) -1 (B) 0 (C) 4 (D) -4

***149.** Let $a : \sim(p \wedge \sim r) \vee (\sim q \vee s)$ and $b : (p \vee s) \leftrightarrow (q \wedge r)$.
If the truth values of p and q are true and that of r and s are false, then the truth values of a and b are respectively

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

***150.** If $\int_0^a \sqrt{\frac{a-x}{x}}\,dx = \frac{k}{2}$, then $k =$

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