MHT CET – 2021

21st September (Shift - 2)

Section I

PHYSICS

1. Under isothermal conditions, two soap bubbles of radii 'r_1' and 'r_2' combine to form a single soap bubble of radius 'R'. The surface tension of soap solution is (P = outside pressure)

(A) $\frac{P\left(R^3+r_1^3+r_2^3\right)}{4\left(r_1^2-r_2^2+R^2\right)}$ (B) $\frac{P^2+r_1^2+r_2^2}{4\left(r_1^2+r_2^2+R^2\right)}$ (C) $\frac{P\left(R^3-r_1^3-r_2^3\right)}{4\left(r_1^2+r_2^2-R^2\right)}$ (D) $\frac{P\left(R^2-r_1^2-r_2^2\right)}{4\left(r_1^3+r_2^3-R^3\right)}$

2. Two identical parallel plate air capacitors are connected in series to a battery of emf 'V'. If one of the capacitor is inserted in liquid of dielectric constant 'K' then, potential difference of the other capacitor will become

(A) $\frac{K-1}{KV}$ (B) $\frac{K+1}{KV}$ (C) $\left(\frac{KV}{K+1}\right)$ (D) $\frac{KV}{K-1}$

3. In LCR series resonant circuit, at resonance, voltage across 'L' and 'C' will cancel each other because they are

(A) 90° out of phase. (B) 90° in phase (C) 180° in phase (D) 180° out of phase.

4. Two coherent sources of wavelength 'λ' produce steady interference pattern. The path difference corresponding to 10^{th} order maximum will be

(A) 9.5 λ (B) 10.5 λ (C) 9 λ (D) 10 λ

5. In a capillary tube having area of cross-section A, water rises to a height 'h'. If cross-sectional area is reduced to $\frac{A}{9}$, the rise of water in the capillary tube is

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

6. Water rises upto a height 10 cm in a capillary tube. It will rise to a height which is much more than 10 cm in a very long capillary tube if the apparatus is kept.

(A) on the surface of the moon. (B) at the north pole.
(C) in a lift moving up with an acceleration. (D) on the equator.

7. A moving coil galvanometer is converted into an ammeter, reading upto 0.04 A by connecting a shunt of resistance '3r' across it and then into an ammeter reading upto 0.8A, when a shunt of resistance 'r' is connected across it. What is the maximum current which can be sent through this galvanometer if no shunt is used?

(A) 0.02 A (B) 0.04 A (C) 0.08 A (D) 0.01 A

8. The inductive reactance of a coil is RΩ. If the inductance of a coil is doubled and frequency of a.c. supply is also doubled then the new inductive reactance will be

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

9. For a body of mass 'm', the acceleration due to gravity at a distance 'R' from the surface of the earth is $\left(\frac{g}{4}\right)$. Its value at a distance $\left(\frac{R}{2}\right)$ from the surface of the earth is (R = radius of the earth, g = acceleration due to gravity)

(A) $\left(\frac{g}{8}\right)$ (B) $\left(\frac{9g}{4}\right)$ (C) $\left(\frac{4g}{9}\right)$ (D) $\left(\frac{g}{2}\right)$

10. What is the ratio of the velocity of sound in hydrogen $\left(\gamma=\frac{7}{5}\right)$ to that in helium $\left(\gamma=\frac{5}{3}\right)$ at the same temperature? (Molecular weight of hydrogen and helium is 2 and 4 respectively.)

(A) $\frac{\sqrt{42}}{5}$ (B) $\frac{5}{\sqrt{42}}$ (C) $\frac{\sqrt{21}}{5}$ (D) $\frac{5}{\sqrt{21}}$

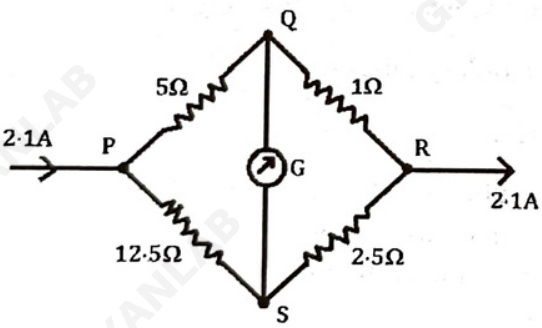
11. A particle performs rotational motion with an angular momentum 'L'. If frequency of rotation is doubled and its kinetic energy becomes one fourth, the angular momentum becomes.

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

12. Equation of two simple harmonic waves are given by $Y_1 = 2\sin 8\pi\left(\frac{t}{0.2}-\frac{x}{2}\right)m$ and $Y_2 = 4\sin 8\pi\left(\frac{t}{0.16}-\frac{x}{1.6}\right)m$ then both waves have

(A) same period (B) same frequency (C) same wavelength. (D) same velocity.

13. A current through 1 Ω resistance in the following circuit is



(A) 1.8 A (B) 1.2 A (C) 1.5 A (D) 1 A

14. Three bodies P, Q and R have masses 'm' kg, '2m' kg and '3m' kg respectively. If all the bodies have equal kinetic energy, then greater momentum will be for body/bodies.

(A) Q (B) R (C) P and Q (D) P

15. Equal volumes of two gases are kept in different containers having densities in the ratio 1:16. They exert equal pressures on the wall of their respective containers. Then the ratio of their r.m.s. velocities is

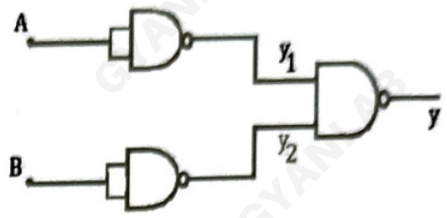
(A) 16 : 1 (B) 1 : 8 (C) 4 : 1 (D) 1 : 12

16. In Young's experiment, fringes are obtained on a screen placed at a distance 75 cm from the slits. When the separation between two narrow slits is doubled, then the fringe width is decreased. In order to obtain the initial fringe width, the screen should be moved through.

(A) 150 cm away from the slits.
(B) 75 cm towards the slits.
(C) 75 cm away from slits.
(D) 150 cm towards the slits.

17. Combination of NAND gates is shown in the figure. It is equivalent to

(A) AND gate
(B) NOR gate
(C) OR gate
(D) X-OR gate



18. A molecule of mass 'm' moving with velocity 'v' makes 5 elastic collisions with a wall of container per second. The change in momentum of the wall per second in 5 collisions will be

(A) 10 mv (B) 5 mv (C) $\frac{1}{5}$ mv (D) $\frac{1}{10}$ mv

19. In thermodynamics, for an isochoric process, which one of the following statement is INCORRECT?

(A) Energy exchanged is used to do work and also to change internal energy.
(B) No work is done in the process.
(C) It is a constant volume process.
(D) Temperature of the system changes during the process.

20. The ratio of energy required to raise a satellite of mass 'm' to height 'h' above the earth's surface to that required to put it into the orbit at same height is [R = radius of earth]

(A) $\frac{h}{R}$ (B) $\frac{2h}{R^2}$ (C) $\frac{3h}{R^2}$ (D) $\frac{2h}{R}$

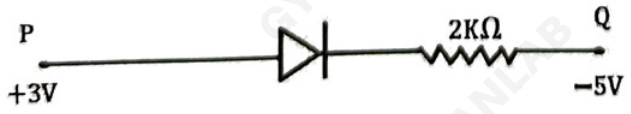
21. When a piece of polythene is rubbed with wool, a negative charge of 4×10^{-7} C is developed on the polythene. The number of electrons transferred from wool to polythene is [e = 1.6×10^{-19}C]

(A) 1.5×10^{12} (B) 3.5×10^{13} (C) 2.5×10^{13} (D) 2.5×10^{12}

22. Ratio centripetal acceleration for an electron revolving in 3rd and 5th Bohr orbit of hydrogen atom is

(A) 425 : 18 (B) 625 : 81 (C) 125 : 27 (D) 221 : 36

23. In an ideal junction diode, the current flowing through PQ is



(A) 2×10^{-3} A (B) 2×10^{-2} A (C) 4×10^{-3} A (D) 10^{-3} A

24. LED is manufactured using zinc selenide then it emits.
(A) infrared radiations (B) yellow light (C) blue light (D) green light.

25. If 'E' is the kinetic energy per mole of an ideal gas and 'T' is the absolute temperature, then the universal gas constant is given as
(A) $\frac{2T}{3E}$ (B) $\frac{2E}{3T}$ (C) $\frac{3T}{2E}$ (D) $\frac{3E}{2T}$

26. A child is sitting on a swing which performs S.H.M. It has minimum and maximum heights from ground 0.75 cm and 2 m respectively. Its maximum speed will be $\left[g = 10\frac{m}{s^2}\right]$
(A) $\sqrt{1.25}$ m/s (B) $\sqrt{12.5}$ m/s (C) 5 m/s (D) 25 m/s

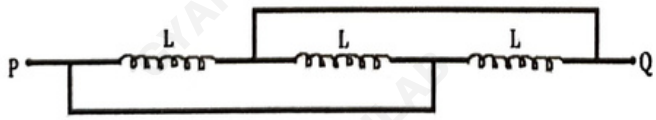
27. The north pole of a long horizontal bar magnet is being brought towards closed circuit consisting of a coil. The direction of induced current produced in it is
(A) anticlockwise. (B) horizontal. (C) vertical (D) clockwise.

28. The wave number of the last line of the Balmer series in the hydrogen spectrum will be $\left(\text{Rydberg's constant, } R = \frac{10^7}{m}\right)$
(A) $16 \times 10^4\ m^{-1}$ (B) $8 \times 10^5\ m^{-1}$ (C) $36 \times 10^7\ m^{-1}$ (D) $25 \times 10^5\ m^{-1}$

29. The refractive index of glass is 1.5 and that of water is 1.33. The critical angle for a ray of light going from glass to water is
(A) $\sin^{-1}\left(\frac{4}{7}\right)$ (B) $\sin^{-1}\left(\frac{5}{8}\right)$ (C) $\sin^{-1}\left(\frac{8}{9}\right)$ (D) $\sin^{-1}\left(\frac{2}{3}\right)$

30. A, B and C are three parallel conductors of equal lengths carrying currents I, I and 2I respectively. Distance between A and B is 'x' and that between B and C is also 'x'. F_1 is the force exerted by conductor B on A. F_2 is the force exerted by conductor C on A. Current I in A and I in B are in same direction and current 2I in C is in opposite direction. Then
(A) $F_1 = F_2$ (B) $F_2 = 2R_1$ (C) $F_1 = 2R_2$ (D) $F_1 = -F_2$

31. Three pure inductors each of inductance 6H are connected as shown in the figure. Their equivalent inductance between the points 'P' and 'Q' is



(A) 0.5 H (B) 18 H (C) 6.3 H (D) 2 H

32. A body at rest falls through a height 'h' with velocity 'V'. If it has to fall down further for its velocity to become three times, the distance travelled in that interval is
(A) 8 h (B) 6 h (C) 4 h (D) 12 h

33. A convex lens is dipped in a liquid whose refractive index is equal to refractive index of lens material. Then its focal length will

(A) increase (B) remain unchanged (C) become infinite (D) become zero.

34. Photoemission from metal surface takes place for frequencies 'ν_1' and 'ν_2' of incident rays ($\nu_1 > \nu_2$). Maximum kinetic energy of photoelectrons emitted is in the ratio 1 : K. The threshold frequency of metallic surface is

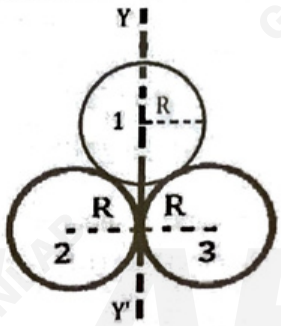
(A) $\frac{K\nu_2 - \nu_1}{K-1}$ (B) $\frac{\nu_1 - \nu_2}{K-1}$ (C) $\frac{\nu_2 - \nu_1}{K}$ (D) $\frac{K\nu_1 - \nu_2}{K-1}$

35. The angle of banking 'θ' for a meter gauge railway line is given by $\theta = \tan^{-1}\left(\frac{1}{20}\right)$.

What is the elevation of the outer rail above the inner rail?

(A) 20 cm (B) 10 cm (C) 0.2 cm (D) 5 cm

36. Three rings each of mass 'M' and radius 'R' are arranged as shown in the figure. The moment of inertia of system about axis YY′ will be



(A) $5\ MR^2$

(B) $\frac{7}{2}MR^2$

(C) $\frac{3}{2}MR^2$

(D) $3\ MR^2$

37. The instantaneous value of an alternating current is given by $i = 50 \sin(100\ \pi t)$. It will achieve a value of 25 A after a time interval of ($\sin 30° = 0.5$)

(A) $\frac{1}{300}$S (B) $\frac{1}{100}$S (C) $\frac{1}{200}$S (D) $\frac{1}{600}$S

38. A proton and alpha particle are accelerated through the same potential difference. The ratio of the de-Broglie wavelength of proton to that of alpha particle will be (mass of alpha particle is four times mass of proton.)

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

39. Two rods of same length and material are joined end to end. They transfer heat in 8 second. When they are joined in parallel they transfer same amount of heat in same conditions in time

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

40. A pendulum clock is running fast. To correct its time, we should

(A) reduce the mass of the bob. (B) reduce the amplitude of oscillation.

(C) increase the length of the pendulum. (D) reduce the length of the pendulum.

41. A pipe closed at one end has length 0.8 m. At its open end 0.5 m long uniform string is vibrating in its 2nd harmonic and it resonates with the fundamental frequency of the pipe. If the tension in the wire is 50 N and the speed of sound is 320 m/s, the mass of the string is

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

42. Two coherent sources 'P' and 'Q' produce interference at point 'A' on the screen, where there is a dark band which is formed between 4^{th} and 5^{th} bright band. Wavelength of light used is 6000Å. The path difference PA and QA is

(A) 3.6×10^{-4} cm (B) 3.2×10^{-4} cm (C) 2.4×10^{-4} cm (D) 2.7×10^{-4} cm

43. The equation of simple harmonic wave produced in the string under tension 0.4 N is given by $y = 4 \sin (3x + 60\ t)$ m. The mass per unit length of the string is

(A) 10^{-3} kg m^{-1} (B) 10^{-5} kg m^{-1} (C) 10^{-3} g cm^{-1} (D) 10^{-5} g cm^{-1}

44. A condenser of capacity 'C_1' is charged to potential 'V_1' and then disconnected. Uncharged capacitor of capacity 'C_2' is connected in parallel with 'C_1'. The resultant potential 'V_2' is

(A) $\frac{V_1C_2}{C_1}$ (B) $\frac{C_2}{C_1+C_2}$ (C) $\frac{C_1V_1}{C_2}$ (D) $\frac{C_1V_1}{C_1+C_2}$

45. In a step up transformer, which one of the following statements is correct?

(A) Number of turns in the secondary coil is less than in primary coil.

(B) Voltage in secondary coil is less than voltage is primary coil.

(C) Current in the primary coil is more than current in the secondary coil.

(D) Current in the primary coil is equal to current in the secondary coil.

46. Magnetic moment of revolving electron of charge (e) and mass (m) in terms of angular momentum (L) of electron is

(A) $\frac{eL}{8m}$ (B) $\frac{eL}{4m}$ (C) $\frac{eL}{2m}$ (D) $\frac{eL}{m}$

47. A particle is performing S.H.M. with maximum velocity 'v'. If the amplitude is tripled and periodic time is doubled then maximum velocity will be

(A) 1.5 v (B) 3 v (C) 2 v (D) v

48. A big water drop is divided into 8 equal droplets. ΔP_s and ΔP_B be the excess pressure inside a smaller and bigger drop respectively. The relation between ΔP_s and ΔP_B is

(A) $\Delta P_B = \Delta P_S$ (B) $\Delta P_B = \frac{1}{2}\Delta P_S$ (C) $\Delta P_B = \frac{1}{4}\Delta P_S$ (D) $\Delta P_B = 2\ \Delta P_S$

***49.** A hollow metal sphere has a radius 'r'. The potential difference between a point on its surface and at a point at a distance '3r' from its centre is 'V'. The electric intensity at the distance '3r' from the centre of the sphere will be

(A) $\frac{V}{3r}$ (B) 3Vr (C) $\frac{V}{r}$ (D) $\frac{V}{6r}$

***50.** The magnetic flux near the axis and inside the air core solenoid of length 60 cm carrying current 'I' is 1.57×10^{-6} Wb. Its magnetic moment will be [$\mu_0 = 4\pi \times 10^{-7}$, SI unit and cross-sectional area is very small as compared to length of solenoid.]

(A) 1 Am^2 (B) 0.25 Am^2 (C) 0.5 Am^2 (D) 0.75 Am^2

CHEMISTRY

51. When 1 mole of gas is heated at constant volume, the temperature rises form 273 K to 546 K. If heat supplied to the gas is x J, then find the correct statement from following.

(A) $Q = \Delta U = x$ J, $W = 0$
(B) $Q = W = x$ J, $\Delta V = 0$
(C) $\Delta V = 0$, $Q = W = -x$ J
(D) $Q = -W = x$ J, $\Delta V = 0$

52. Oxidation state of iodine in I_3^- is

(A) $-(1/3)$ (B) $+4$ (C) $+5$ (D) -3

53. What is the total number of atoms in BCC crystal lattice having 1.8×10^{20} unit cells?

(A) 9.0×10^{20} (B) 1.8×10^{20} (C) 3.6×10^{20} (D) 7.2×10^{20}

54. Identify the product B in the following sequence of reactions?

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

(A) Propan-2-ol
(B) Propan-1-ol
(C) Isopropyl hydrogen sulphate
(D) Propene

55. What is the volume occupied by 16 g methane gas at STP?

(A) 1140 cm^3 (B) 22400 cm^3 (C) 214 cm^3 (D) 12.4 cm^3

56. The $[OH^-]$ in a solution is 1×10^{-12} mol dm^{-3}. What is the concentration of H^+ ions?

(A) 0.1 mol dm^{-3} (B) 1.0 mol dm^{-3} (C) 2.0 mol dm^{-3} (D) 0.01 mol dm^{-3}

57. Which among the following statements is true for Galvanic cell?

(A) The anode is negative and cathode is positive.
(B) Electrical energy is converted into chemical energy.
(C) The anode is positive and cathode is negative.
(D) Oxidation takes place at positive electrode and reduction takes place at negative electrode.

58. Identify the product (X) formed in the following reaction.

$$C_6H_5OH + CH_3COOH \overset{H+}{\rightleftharpoons} X$$

(A) $C_6H_5O - CO - CH_3$
(B) $C_6H_5 - CH_3$
(C) $C_6H_5 - O - CH_3$
(D) $C_6H_5 - COO - CH_3$

59. Which of the following is <u>NOT</u> true for alkaline earth metals?

(A) Their divalent ions have inert gas configuration.
(B) They are more electropositive than alkali metals
(C) Alkaline earth metals are silvery white and soft.
(D) Their compounds are diamagnetic and colourless.

60. Which of the following is <u>NOT</u> formed when a mixture of methyl bromide and n-propyl bromide is treated with sodium metal in dry ether?

(A) Butane (B) Propane (C) Ethane (D) Hexane

61. Which element among the following is ferromagnetic?

(A) Ni (B) Cu (C) Sc (D) Zn

62. Which of following enzymes is useful in conversion of glucose to fructose?

(A) Invertase (B) Glucose isomerase (C) Amylase (D) Proteases

63. Which of the following reagents is used in the reaction shown below?

$$\text{Benzoyl chloride} \xrightarrow{?} \text{Benzaldehyde}$$

(A) DIBAl–H (B) $SnCl_2/HCl$ (C) $H_2/Pd - BaSO_4$ (D) Dimethyl cadmium

64. What is vapour pressure of a solution when 2 mol of a non-volatile solute are dissolved in 20 mol of water? (P_1^0 = 32 mm Hg)

(A) 29.1 mm Hg (B) 12 mm Hg (C) 6 mm Hg (D) 9 mm Hg

65. Which among following amines has lowest pK_b values?

(A) $CH_3CH_2NH_2$ (B) $(CH_3CH_2)_2NH$ (C) $(CH_3CH_2)_3N$ (D) $C_6H_5NH_2$

66. Which of following elements forms crosslinks in vulcanization of SBR rubber?

(A) P (B) O (C) S (D) N

67. What will be the concentration of solution of electrolyte if it's molar conductivity and conductivity are respectively 230 Ω^{-1} cm^2 mol^{-1} and 0.0115 Ω^{-1} cm^{-1} at 298 K?

(A) 0.04 M (B) 0.03 M (C) 0.01 M (D) 0.05 M

68. Identify cationic complex from following.

(A) $Na_3[AlF_6]$ (B) $[Pt(NH_3)_2Cl_2]$ (C) $K_4[Fe(CN)_6]$ (D) $[PtBr_2(NH_3)_4]Br_2$

69. Which property from following is NOT exhibited by interstitial compounds?

(A) Their melting points are higher than pure metal.
(B) Their densities are less than parent metal.
(C) Their chemical properties are different than parent metal.
(D) These are hard and good conductors of heat and electricity.

70. Which among the following salt solution in water shows pH greater than 7?

(A) Sodium acetate (B) Sodium sulphate (C) Copper sulphate (D) Ammonium chloride

71. What is the percentage of unoccupied volume in BCC structure?

(A) 32 % (B) 74 % (C) 26 % (D) 68 %

72. What type of isomers are the ethoxy ethane and methoxy propane?

(A) Tautomers (B) Metamers (C) Position isomers (D) Functional group isomers

73. What is the value of $\Delta H - \Delta U$ for the formation of 2 moles of ammonia from $H_{2(g)}$ and $N_{2(g)}$?

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

74. What is the density of an element (At. mass 100 g mol^{-1}) having BCC structure with edge length 400 pm?

(A) 3.2 g cm^{-3} (B) 8.2 g cm^{-3} (C) 5.18 g cm^{-3} (D) 4.8 g cm^{-3}

75. In which of the following salts, the solubility increases appreciably with increase in temperature?

(A) KBr (B) NaBr (C) NaCl (D) KCl

76. What is effective atomic number of cobalt in $[Co(NH_3)_6]^{3+}$ if Co(Z = 27) ?

(A) 30 (B) 33 (C) 27 (D) 36

77. Which among the following is NOT an example of one-Dimensional nanostructure?

(A) Nano shells (B) Nanowires (C) Nanotubes (D) Fibres

78. For a first order reaction, intercept of the graph between $\log \frac{[A]_0}{[A]_t}$ (Y-axis) and conc. (X-axis) is equal to

(A) $-\frac{k}{2.303\,K}$ (B) $-\log [A]_0$ (C) zero (D) $\frac{2.303}{K}$

79. The pH of 0.005 M KOH is 9.95. Calculate the $[OH^-]$?

(A) 6.71×10^{-4} M (B) 1.12×10^{-4} M (C) 4.45×10^{-5} M (D) 8.91×10^{-5} M

80. Which of the following reactions is a Wurtz – Fittig reaction?

(A) $C_6H_5Cl + CH_3Cl + 2Na \xrightarrow[\text{ether}]{\text{dry}} C_6H_5 - CH_3 + 2NaCl$

(B) $C_2H_5Cl + CH_3Cl + 2Na \xrightarrow[\text{ether}]{\text{dry}} C_3H_8 + 2NaCl$

(C) $2C_2H_5Cl + 2Na \xrightarrow[\text{ether}]{\text{dry}} C_2H_5 - C_2H_5 + 2Na\,Cl$

(D) $2C_6H_5Cl + 2Na \xrightarrow[\text{ether}]{\text{dry}} C_6H_5 - C_6H_5 + 2NaCl$

81. Which among the following noble gases reacts with fluorine to give crystalline fluorides?

(A) Ne (B) He (C) Xe (D) Ar

82. Identify the name of following reaction.

$$\text{Toluene} + \text{chromyl chloride} \xrightarrow{CS_2} \text{complex} \xrightarrow{H_3O^+} \text{Benzaldehyde}$$

(A) Stephen reaction
(B) Rosenmund reaction
(C) Etard reaction
(D) Wolf-Kishner reaction

83. What is the half-life of a first order reaction if time required to decrease concentration of reactant from 1.0 M to 0.25 M is 10 hour?

(A) 12 hour (B) 4 hour (C) 5 hour (D) 10 hour

84. Which among the following is obtained as major product x in the reaction stated below?

$$\text{Anisole} \xrightarrow[\text{conc}\cdot H_2SO_4]{\text{conc}\cdot HNO_3} x$$

(A) 2, 4, 6-Trinitro anisole
(B) 4–Nitro anisole
(C) 2–Nitro anisole
(D) 3–Nitro anisole

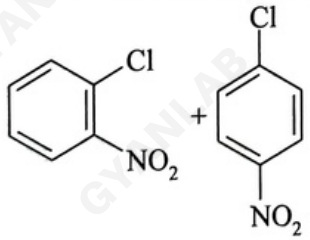
85. Which among the following statements about ozone depletion is <u>NOT</u> true?

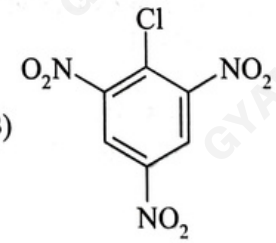
(A) Depletion of ozone is most pronounced over Antarctica.
(B) Freons used in aerosol that enters into atmosphere causes depletion of ozone layer.
(C) Nitrogen oxide released from cars causes ozone depletion.
(D) Due to ozone depletion less amount of UV radiations reaches to earth surface.

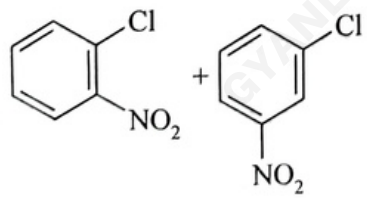
86. Which free radical initiator is used for polymerization of tetrafluoro ethylene?

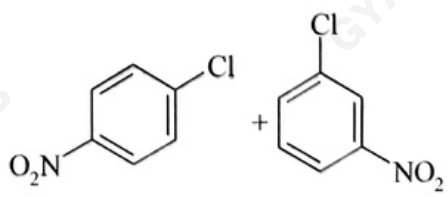
(A) Zinc acetate
(B) Titanium tetrachloride
(C) Ammonium persulphate
(D) Acetyl peroxide

87. Chlorobenzene on heating with concentrated HNO_3 in presence of concentrated H_2SO_4 gives

(A) 

(B) 

(C) 

(D) 

88. What is the boiling point of 0.5 molal aqueous solution of sucrose if 0.1 molal aqueous solution of glucose boils at 100.16°C?
(A) 100.32°C (B) 100.80°C (C) 100.16°C (D) 100.62°C

89. Identify the product formed when tertiary butyl bromide reacts with alcoholic NH_3 solution?
(A) 2-Methylpropene (B) But-2-ene (C) But-1-ene (D) 2-Methylpropan-1-ol

90. Which among the following gases is adsorbed to greater extent at similar conditions of temperature and pressure if the adsorbent remains same?
(A) N_2 (B) Cl_2 (C) H_2 (D) O_2

91. What is the rate of disappearance of B in following reaction?
$2A + B \rightarrow 3C$, if rate of appearance of C is 1.3×10^{-4} mol L^{-1} s^{-1}.
(A) 4.33×10^{-5} mol L^{-1} s^{-1} (B) 8.6×10^{-5} mol L^{-1} s^{-1}
(C) 2.6×10^{-4} mol L^{-1} s^{-1} (D) 5.2×10^{-5} mol L^{-1} s^{-1}

92. Which reagent oxidizes glucose to saccharic acid?
(A) dil. HNO_3 (B) NH_2OH (C) HCN (D) Br_2 water

93. Two moles of an ideal gas are expanded isothermally from 15 dm^3 to 20 dm^3. If the amount of work done is -6 dm^{-3} bar, find external pressure needed to obtain this work.
(A) 1.2×10^5 Pa (B) 3.2 Pa (C) 8.1×10^4 Pa (D) 2.4 Pa

94. Which from following statements is NOT correct for heterolysis?
(A) In this electron rich and electron deficient species are formed.
(B) Heterolysis of methyl bromide forms methyl carbocation.
(C) It occurs when bonded atoms have different electronegativity.
(D) Movement of a single electron from a shared pair of covalent bond occurs.

95. Which among the following molecules exhibits strong London forces?
(A) neo-pentane (B) n-pentane (C) isobutane (D) isopentane

96. What is the number of moles of electrons passed when current of 5 ampere is passed through a solution of $FeCl_3$ for 20 minutes?
(A) 6.25×10^{-2} (B) 1.56×10^{-2} (C) 3.12×10^{-2} (D) 4.25×10^{-2}

97. What is the formal charge of oxygen atom in carbon monoxide?
(A) +2 (B) +1 (C) −1 (D) zero

98. Which isomer of C_6H_{14} has highest boiling point?
(A) Hexane (B) 3-Methylpentane (C) 2-Methylpentane (D) 2,2-Dimethylbutane

99. What is the wavelength for a wave having frequency 50 Hz?
(A) 1.6×10^6 m (B) 6×10^{-2} m (C) 6×10^6 m (D) 15×10^2 m

100. Identify the product formed when benzoyl chloride is reduced by hydrogen using palladium catalyst poisoned with barium sulphate?
(A) Chlorobenzene (B) Benzyl alcohol (C) Benzene (D) Benzaldehyde

Section II

MATHEMATICS

101. If $(m + 3n)(3m + n) = 4h^2$, then the acute angle between the lines represented by $mx^2 + 2hxy + ny^2 = 0$ is

(A) $\frac{\pi^c}{3}$ (B) $\frac{\pi^c}{6}$ (C) $\tan^{-1}\left(\frac{3}{2}\right)$ (D) $\tan^{-1}\left(\frac{1}{2}\right)$

102. I : $y' = \frac{y+x}{x}$; II : $y' = \frac{x^2+y}{x^3}$; III : $y' = \frac{2xy}{y^2-x^2}$

S1 : Differential equations given by I and II are homogeneous differential equations.
S2 : Differential equations given by II and III are homogeneous differential equations.
S3 : Differential equations given by I and III are homogeneous differential equations.
(A) only S1 is valid (B) both S1 and S2 are valid
(C) only S3 is valid (D) only S2 is valid.

103. The differential equation of the family of circles touching y-axis at the origin is

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

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

104. The mean of five observations is 4 and their variance is 5.2. If three of these observations are 1, 2 and 6, then the other two are

(A) 2 and 9 (B) 3 and 8 (C) 4 and 7 (D) 5 and 6

105. If $\bar{a} = \hat{i} + 2\hat{j} - 3\hat{k}, \bar{b} = 3\hat{i} - \hat{j} + 2\hat{k}, \bar{c} = \hat{i} + 3\hat{j} + \hat{k}$ and $\bar{a} + \lambda\bar{b}$ is perpendicular to $\bar{c}$, then $\lambda =$

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

106. If p is the length of the perpendicular from origin to the line whose intercepts on the axes are a and b, then $\frac{1}{a^2} + \frac{1}{b^2} =$

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

107. The abscissa of the points, where the tangent to the curve $y = x^3 - 3x^2 - 9x + 5$ is parallel to X-axis are

(A) $x = 1$ and -1 (B) $x = 1$ and -3 (C) $x = -1$ and 3 (D) $x = 0$ and 1

108. $\int \frac{1}{x^{\frac{1}{2}} + x^{\frac{1}{3}}} dx =$

(A) $\sqrt{x} - \sqrt[3]{x} + \sqrt[6]{x} - \log|\sqrt[6]{x} + 1| + c$ (B) $2\sqrt{x} - 3\sqrt[3]{x} + 6\sqrt[6]{x} - 6\log|\sqrt[6]{x} + 1| + c$

(C) $2\sqrt{x} + 3\sqrt[3]{x} + 6\sqrt[6]{x} + 6\log|\sqrt[6]{x} + 1| + c$ (D) $\sqrt{x} + \sqrt[3]{x} + \sqrt[6]{x} + \log|\sqrt[6]{x} + 1| + c$

109. If $A = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then adj A =

(A) $\begin{bmatrix} -\cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(D) $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

110. $\int \left[\sin|\log x| + \cos|\log x|\right] dx =$

(A) $\sin|\log x| + c$

(B) $\cos|\log x| + c$

(C) $x\cos|\log x| + c$

(D) $x\sin|\log x| + c$

111. $\int_5^{10} \frac{dx}{(x-1)(x-2)} =$

(A) $\log\left|\frac{27}{32}\right|$

(B) $\log\left|\frac{3}{4}\right|$

(C) $\log\left|\frac{8}{9}\right|$

(D) $\log\left|\frac{32}{27}\right|$

112. The direction cosines ℓ, m, n of the line $\frac{x+2}{2} = \frac{2y-5}{3}; z = -1$ are

(A) $\ell = \pm\frac{1}{\sqrt{5}}, m = 0, n = \pm\frac{2}{\sqrt{5}}$

(B) $\ell = \pm\frac{3}{5}, m = \pm\frac{4}{5}, n = 0$

(C) $\ell = \pm\frac{4}{5}, m = \pm\frac{3}{5}, n = 0$

(D) $\ell = \pm\frac{1}{\sqrt{3}}, m = \pm\frac{1}{\sqrt{3}}, n = \pm\frac{1}{\sqrt{3}}$

113. An urn contains 9 balls of which 3 are red, 4 are blue and 2 are green. Three balls are drawn at random from the urn. The probability that the three balls have difference colours is

(A) $\frac{1}{14}$

(B) $\frac{3}{14}$

(C) $\frac{1}{7}$

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

114. If $\frac{\pi}{2} < \theta \le \pi$ and $|\bar{a}| = 5, |\bar{b}| = 13, |\bar{a} \times \bar{b}| = 25$, then the value of $\bar{a} \cdot \bar{b}$ is

(A) -12

(B) 60

(C) -60

(D) -13

115. Equation of the plane passing through the point (2, 0, 5) and parallel to the vectors $\hat{i} - \hat{j} + \hat{k}$ and $3\hat{i} + 2\hat{j} - \hat{k}$ is

(A) $x - 4y - z + 3 = 0$

(B) $x + 4y + 5z - 27 = 0$

(C) $x - 4y - 5z + 23 = 0$

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

116. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & a & 1 \end{bmatrix}$ and $A^{-1} = \frac{1}{2}\begin{bmatrix} 1 & -1 & 1 \\ -8 & 6 & 2c \\ 5 & -3 & 1 \end{bmatrix}$, then values of a and c are respectively

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

117. For all real x, the minimum value of the function $f(x) = \frac{1-x+x^2}{1+x+x^2}$ is

(A) $\frac{1}{3}$ (B) 0 (C) 3 (D) 1

118. The objective function $z = 4x + 5y$ subjective to $2x + y \geq 7$; $2x + 3y \leq 15$; $y \leq 3$, $x \geq 0$; $y \geq 0$ has minimum value at the point.

(A) on the line $2x + 3y = 15$ (B) on X-axis
(C) on Y-axis (D) origin

119. The co-ordinates of the point $P \equiv (1, 2, 3)$ and $O \equiv (0, 0, 0)$, then the direction cosines of $\overline{OP}$ are

(A) $\frac{1}{\sqrt{14}}, \frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}$ (B) $\frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}, \frac{1}{\sqrt{6}}$ (C) $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$ (D) $\frac{2}{\sqrt{29}}, \frac{3}{\sqrt{29}}, \frac{4}{\sqrt{29}}$

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

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

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

(A) $2x + y + z = 0$ (B) $x + y + z = 0$
(C) $x + 2y - 3z = 35$ (D) $x + 3y + z = 14$

122. If the lines $x^2 - 4xy + y^2 = 0$ make angles α and β with positive direction of X-axis, then $\cot^2\alpha + \cot^2\beta =$

(A) 14 (B) 16 (C) 18 (D) 20

123. It is observed that 25% of the cases related to child labour reported to the police station are solved. If 6 new cases are reported, then the probability that at least 5 of them will be solved is

(A) $\frac{19}{1024}$ (B) $\frac{19}{4096}$ (C) $\left(\frac{1}{4}\right)^6$ (D) $\frac{19}{2048}$

124. For $X \sim B(n, p)$, if $p = 0.6$, $E(X) = 6$, then $Var(X) =$

(A) 6.6 (B) 24 (C) 2.4 (D) 6

125. The equation of a line passing through (3, –1, 2) and perpendicular to the lines $\bar{r} = (\hat{i}+\hat{j}-\hat{k})+\lambda(2\hat{i}-2\hat{j}+\hat{k})$ and $\bar{r} = (2\hat{i}+\hat{j}-3\hat{k})+\mu(\hat{i}-2\hat{j}+2\hat{k})$ is

(A) $\frac{x-3}{2}=\frac{y+1}{3}=\frac{z-2}{2}$ (B) $\frac{x-3}{3}=\frac{y+1}{2}=\frac{z-2}{2}$

(C) $\frac{x+3}{2}=\frac{y+1}{3}=\frac{z-2}{2}$ (D) $\frac{x-3}{2}=\frac{y+1}{2}=\frac{z-2}{3}$

126. $f(x) = \frac{\sqrt{1+px}-\sqrt{1-px}}{x}$, if $1 \le x < 0$

$= \frac{2x+1}{x-2}$, if $0 \le x \le 1$

is continuous in the interval [–1, 1], then p =

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

127. The function $f(x) = \log(1+x) - \frac{2x}{2+x}$ is increasing on

(A) $(-\infty, \infty)$ (B) $(-5, \infty)$ (C) $(-\infty, 0)$ (D) $(-1, \infty)$

128. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$, then A^{-1} =

(A) $\left(\frac{1}{2}\right)\begin{bmatrix} 0 & 1 & 2 \\ 3 & 2 & 1 \\ 4 & 2 & 3 \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{2} & \frac{-1}{2} & \frac{1}{2} \\ -4 & 3 & -1 \\ \frac{5}{2} & \frac{-3}{2} & \frac{1}{2} \end{bmatrix}$

(C) $\begin{bmatrix} \frac{1}{2} & -1 & \frac{5}{2} \\ 1 & -6 & 3 \\ 1 & 2 & -1 \end{bmatrix}$ (D) $\left(\frac{1}{2}\right)\begin{bmatrix} 1 & -1 & -1 \\ -8 & 6 & -2 \\ 5 & -3 & 1 \end{bmatrix}$

129. The equation of circle with centre at (2, –3) and the circumference 10π units is

(A) $x^2 + y^2 - 4x + 6y - 12 = 0$ (B) $x^2 + y^2 - 4x - 6y - 12 = 0$

(C) $x^2 + y^2 + 4x + 6y + 12 = 0$ (D) $x^2 + y^2 - 4x + 6y + 12 = 0$

130. If $y = 2\sin x + 3\cos x$ and $y + A\frac{d^2y}{dx^2} = B$, then the values of A, B are respectively

(A) 0, 1 (B) 0, –1 (C) –1, 0 (D) 1, 0

131. The number of solutions of $\cos 2\theta = \sin\theta$ in $(0, 2\pi)$ are

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

132. If $y = \tan^{-1}\left[\frac{1}{1+x+x^2}\right] + \tan^{-1}\left[\frac{1}{x^2+3x+3}\right], x > 0$, then $\frac{dy}{dx} =$

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

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

133. If $z(2 - i) = (3 + i)$, then $z^{38} =$, (where $z = x + iy$)

(A) $-(2^{19})i$ (B) $2^{19}i$ (C) $-(2^{19})$ (D) 2^{19}

134. The area bounded by the parabola $y^2 = x$, the straight line $y = 4$ and Y axis is

(A) $2\sqrt{7}$ sq. units (B) $\frac{64}{3}$ sq. units

(C) $\frac{16}{3}$ sq. units (D) $7\sqrt{2}$ sq. units

135. If $\sin^{-1}\left(\frac{3}{5}\right) + \cos^{-1}\left(\frac{12}{13}\right) = \sin^{-1}\alpha$, then $\alpha =$

(A) $\frac{56}{65}$ (B) $\frac{61}{65}$ (C) $\frac{63}{65}$ (D) $\frac{62}{65}$

136. If $\lim\limits_{x\to 5} \frac{x^k - 5^k}{x-5} = 500$, then the value of k, where $k \in N$ is

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

137. The logical statement $(p \to q) \wedge (q \to \sim p)$ is equivalent to

(A) $\sim p$ (B) p (C) q (D) $\sim q$

138. For a set of five true or false questions, no student has written the all correct answers and no two students have given the same sequence of answers. The maximum number of students in the class for this to be possible is

(A) 30 (B) 31 (C) 32 (D) 16

139. The general solution of the differential equation.

$\left(\frac{y}{x}\right)\cos\left(\frac{y}{x}\right)dx - \left[\left(\frac{x}{y}\right)\sin\left(\frac{y}{x}\right) + \cos\left(\frac{y}{x}\right)\right]dy = 0$ is

(A) $y^2 \sin\left(\frac{y}{x}\right) = k$ (B) $x\sin\left(\frac{y}{x}\right) = k$

(C) $\sin\left(\frac{y}{x}\right) = k$ (D) $y\sin\left(\frac{y}{x}\right) = k$

140. If the half life period of a substance is 5 years, then the total amount of the substance left after 15 years, when initial amount is 64 gms is

(A) 8 gms (B) 16 gms (C) 2 gms (D) 32 gms

141. A bakerman sells 5 types of cakes. Profit due to sale of each type of cake is respectively ₹ 2, ₹ 2.5, ₹ 3, ₹ 1.5 and ₹ 1. The demands for these cakes are 20%, 5%, 10 %, 50% and 15% respectively, then the expected profit per cake is

(A) ₹ 1.725 (B) ₹ 0.01725 (C) ₹ 0.1725 (D) ₹ 17.25

142. If m is order and n is degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^5 + 4\frac{\left(\frac{d^2y}{dx^2}\right)}{\left(\frac{d^3y}{dx^3}\right)} + \left(\frac{d^3y}{dx^3}\right) = x^2 - 1$, then

(A) $m = 3, n = 1$ (B) $m = 3, n = 2$ (C) $m = 3, n = 3$ (D) $m = 3, n = 5$

143. If $\theta + \phi = \alpha$ and $\tan\theta = k\tan\phi$ (where $K > 1$), then the value of $\sin(\theta - \phi)$ is

(A) $k\tan\phi$ (B) $\sin\alpha$ (C) $\left(\frac{k-1}{k+1}\right)\sin\alpha$ (C) $k\cos\phi$

144. With usual notations, perimeter of a triangle ABC is 6 times the arithmetic mean of sine of its angles. If $a = 1$, then measure of angle A =

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

145. If $p \rightarrow (\sim p \vee q)$ is false, then the truth values of p and q are, respectively

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

146. If $|\bar{a} \times \bar{b}|^2 + (\bar{a} \cdot \bar{b})^2 = 144$ and $|\bar{a}| = 4$, then $|\bar{b}| =$

(A) 8 (B) 12 (C) 3 (D) 16

147. Let $A = \{10, 11, 12, 14, 26\}$ and let $f : A \rightarrow N$ be such that f(a) = highest prime factor of a, where $a \in A$, then range of f =

(A) {5, 7, 13} (B) {5, 7, 11, 13} (C) {3, 5, 7, 11, 13} (D) {3, 7, 11, 13}

148. If $\int \frac{5\tan x}{\tan x - 2} dx = x + a\log|\sin x - 2\cos x| + c$, then a = (Where c is constant of integration)

(A) 1 (B) –2 (C) –1 (D) 2

149. The area of the parallelogram with vertices A (1, 2, 3), B(1, 3, a), C(3, 8, 6) and D(3, 7, 3) is $\sqrt{265}$ sq. units, then a =

(A) –5, 2 (B) 6 (C) –6, 0 (D) 6, 0

150. If $y = \tan^{-1}\left\{\frac{a\cos x - b\sin x}{b\cos x + a\sin x}\right\}$, then $\frac{dy}{dx}$

(A) $\frac{1}{1+x^2}$ (B) $\frac{1}{\sqrt{1-x^2}}$ (C) –1 (D) None of these