Mock Test-$\boxed{4}$

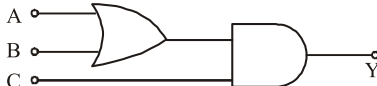## General Instructions

- *This question booklet contains 150 Multiple Choice Questions (MCQs).*
  Section-A: Physics & Chemistry - 50 Questions each and
  Section-B: Mathematics - 50 Questions.
- *Choice and sequence for attempting questions will be as per the convenience of the candidate.*
- *Read each question carefully.*
- *Determine the one correct answer out of the four available options given for each question.*
- *Each question with correct response shall be awarded one (1) mark. There shall be no negative marking.*
- *No mark shall be granted for marking two or more answers of same question, scratching or overwriting.*
- *Duration of paper is 3 Hours.*

SECTION-A

PHYSICS

1. The dimensional formula of angular velocity is
   (a) $[MLT^{-1}]$
   (b) $[M^0L^0T]$
   (c) $[ML^0T^{-2}]$
   (d) $[M^0L^0T^{-1}]$

2. A ball of mass 150 g, moving with an acceleration 20 m/s², is hit by a force, which acts on it for 0.1 sec. The impulsive force is
   (a) 0.5 N (b) 0.1 N (c) 0.3 N (d) 1.2 N

3. When the base current in a transistor is changed from 30 µA to 80 µA, the collector current is changed from 1.0 mA to 3.5 mA. Find the current gain β.
   (a) 30 (b) 40 (c) 45 (d) 50

4. In an L.C.R. series a.c. circuit, the current
   (a) is always in phase with the voltage
   (b) always lags the generator voltage
   (c) always leads the generator voltage
   (d) None of these

5. For an A.M. wave, the maximum and minimum amplitude is found to be 20V and 4V. Find the modulation index(m).
   (a) 3/5 (b) 5/3 (c) 2/3 (d) 3/2

6. Let V and E denote the gravitational potential and gravitational field at a point. It is possible to have
   (a) $V = 0$ and $E = 0$
   (b) $V = 0$ and $E \neq 0$
   (c) $V \neq 0$ and $E = 0$
   (d) All of the above

7. To get output 1 for the following circuit, the correct choice for the input is

   (a) A = 0, B = 1, C = 0 (b) A = 1, B = 0, C = 0
   (c) A = 1, B = 1, C = 0 (d) A = 1, B = 0, C = 1

8. The Poisson's ratio of a material is 0.5. If a force is applied to a wire of this material, there is a decrease in the cross-sectional area by 4%. The percentage increase in the length is :
   (a) 1% (b) 2% (c) 2.5% (d) 4%

9. If two waves of same frequency and same amplitude, on superposition, produce a resultant disturbance of the same amplitude, the wave differ in phase by
   (a) π (b) $2\pi/3$ (c) $\pi/2$ (d) $\pi/3$

10. A hoop rolls down an inclined plane. The fraction of its total kinetic energy that is associated with rotational motion is
    (a) 1 : 2 (b) 1 : 3 (c) 1 : 4 (d) 2 : 3

11. An unpolarised beam of intensity $2a^2$ passes through a thin polaroid. Assuming zero absorption in the polaroid, the intensity of emergent plane polarised light will be

    (a) $2a^2$ (b) a^2 (c) $\sqrt{2}\,a^2$ (d) $\dfrac{a^2}{\sqrt{2}}$

12. Demagnetisation of magnets can be done by
    (a) rough handling
    (b) heating
    (c) magnetising in the opposite direction
    (d) All the above

13. The Kirchhoff's first law ($\Sigma i = 0$) and second law ($\Sigma iR = \Sigma E$), where the symbols have their usual meanings, are respectively based on
   (a) conservation of charge, conservation of momentum
    (b) conservation of energy, conservation of charge
    (c) conservation of momentum, conservation of charge
    (d) conservation of charge, conservation of energy

14. At $10°$ C the value of the density of a fixed mass of an ideal gas divided by its pressure is x. At $110°C$ this ratio is:
    (a) x
    (b) $\dfrac{383}{283}x$
    (c) $\dfrac{10}{110}x$
    (d) $\dfrac{283}{383}x$

15. The capacitor, whose capacitance is 6, 6 and $3\mu F$ respectively are connected in series with 20 volt line. Find the charge on $3\mu F$.
    (a) $30\,\mu C$
    (b) $60\,\mu C$
    (c) $15\,\mu C$
    (d) $90\,\mu C$
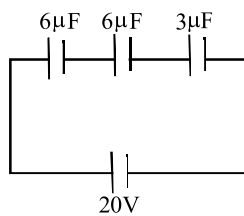
16. At what distance from a long straight wire carrying a current of 12 A will the magnetic field be equal to 3×10^{-5} Wb/m^2?
    (a) 8×10^{-2} m
    (b) 12×10^{-2} m
    (c) 18×10^{-2} m
    (d) 24×10^{-2} m

17. If N_0 is the original mass of the substance of half-life period $t_{1/2} = 5$ years, then the amount of substance left after 15 years is
    (a) $N_0/8$ (b) $N_0/16$ (c) $N_0/2$ (d) $N_0/4$

18. A rectangular coil of 100 turns and size 0.1 m × 0.05 m is placed perpendicular to a magnetic field of 0.1 T. The induced e.m.f. when the field drops to 0.05 T in 0.05s is
   (a) 0.5V (b) 1.0V (c) 1.5V (d) 2.0V

19. The fundamental radio antenna is a metal rod which has a length equal to
    (a) λ in free space at the frequency of operation
    (b) $\lambda/2$ in free space at the frequency of operation
    (c) $\lambda/4$ in free space at the frequency of operation
    (d) $3\lambda/4$ in free space at the frequency of operation

20. A particle is moving in a circular path of radius a, with a constant velocity v as shown in the figure. The centre of circle is marked by 'C'. The angular momentum from the origin O can be written as:
    (a) $va\,(1 + \cos 2\theta)$
    (b) $va\,(1 + \cos \theta)$
    (c) $va \cos 2\theta$
    (d) va
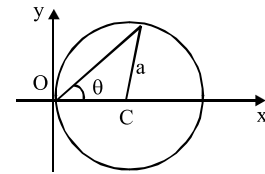
21. A bullet of mass 'a' and velocity 'b' is fired into a large block of wood of mass 'c'. The bullet gets embedded into the block of wood. The final velocity of the system is
   (a) $\dfrac{b}{a+b} \times c$
    (b) $\dfrac{a+b}{c} \times a$
    (c) $\dfrac{a}{a+c} \times b$
    (d) $\dfrac{a+c}{a} \times b$

22. A rain drop of radius 0.3 mm has a terminal velocity in air = 1 m/s. The viscosity of air is 8×10^{-5} poise. The viscous force on it is
    (a) 45.2×10^{-4} dyne (b) 101.73×10^{-5} dyne
    (c) 16.95×10^{-4} dyne (d) 16.95×10^{-5} dyne

23. The plots of intensity versus wavelength for three black bodies at temperatures T_1, T_2 and T_3 respectively are as shown. Their temperature are such that
    (a) $T_1 > T_2 > T_3$
    (b) $T_1 > T_3 > T_2$
    (c) $T_2 > T_3 > T_1$
    (d) $T_3 > T_2 > T_1$
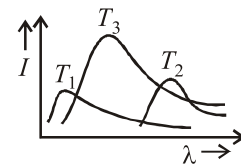
24. The ratio of intensities of two waves is 9 : 1. They are producing interference. The ratio of maximum and minimum intensities will be
    (a) $10:8$ (b) $9:1$ (c) $4:1$ (d) $2:1$

25. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (v_p) whose radius and mean density are twice as that of earth is :
    (a) $1:2$
    (b) $1:2\sqrt{2}$
    (c) $1:4$
    (d) $1:2$

26. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period T, then, which of the following does not change with time?
(a) aT/x (b) $aT + 2\pi v$
(c) aT/v (d) $a^2T^2 + 4\pi^2v^2$

27. If in a circular coil A of radius R, current I is flowing and in another coil B of radius 2R a current 2I is flowing, then the ratio of the magnetic fields B_A and B_B, produced by them will be
(a) 1 (b) 2 (c) 1/2 (d) 4

28. The Young's modulus of the material of a wire is $2 \times 10^{10}\,\text{Nm}^{-2}$. If the elongation strain is 1%, then the energy stored in the wire per unit volume in Jm^{-3} is
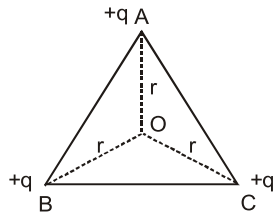(a) 10^6 (b) 10^8 (c) 2×10^6 (d) 2×10^8

29. ABC is an equilateral triangle. Charges $+q$ are placed at each corner as shown as fig. The electric intensity at centre O will be
(a) $\dfrac{1}{4\pi\epsilon_o}\dfrac{q}{r}$

(b) $\dfrac{1}{4\pi\epsilon_o}\dfrac{q}{r^2}$

(c) $\dfrac{1}{4\pi\epsilon_o}\dfrac{3q}{r^2}$

(d) zero

30. A spring of spring constant 5×10^3 N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is
(a) 18.75 J (b) 25.00 J (c) 6.25 J (d) 12.50 J

31. A ray is incident at an angle of incidence i on one surface of a prism of small angle A and emerges normally from the opposite surface. If the refractive index of the material of prism is μ, the angle of incidence i is nearly equal to
(a) $\dfrac{A}{\mu}$ (b) $\dfrac{A}{2\mu}$ (c) μA (d) $\dfrac{\mu A}{2}$

32. Two particles of mass m_1 and m_2 ($m_1 > m_2$) attract each other with a force inversely proportional to the square of the distance between them. If the particles are initially held at rest and then released, the centre of mass will
(a) move towards m_1 (b) move towards m_2
(c) remains at rest (d) None of these

33. Six vectors, $\vec{a}$ through $\vec{f}$ have the magnitudes and directions indicated in the figure. Which of the following statements is true?
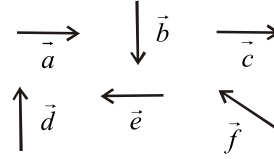
(a) $\vec{b} + \vec{c} = \vec{f}$ (b) $\vec{d} + \vec{c} = \vec{f}$
(c) $\vec{d} + \vec{e} = \vec{f}$ (d) $\vec{b} + \vec{e} = \vec{f}$

34. When the current in a coil changes from 8 amp to 2 amp in 3×10^{-2} seconds, the emf induced in the coil is 2 volt. The self inductance of the coil is
(a) 10 mH (b) 20 mH (c) 5 mH (d) 1 mH

35. At a certain place, horizontal component is $\sqrt{3}$ times the vertical component. The angle of dip at this place is
(a) 0 (b) $\pi/3$ (c) $\pi/6$ (d) $\pi/8$

36. Four curves A, B, C and D are drawn in the figure for a given amount of a gas. The curves which represent adiabatic and isothermal changes are
(a) C and D respectively
(b) D and C respectively
(c) A and B respectively
(d) B and A respectively
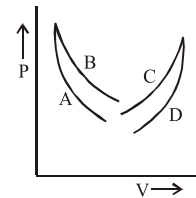
37. In Young's experiment, the distance between the slits is reduced to half and the distance between the slit and screen is doubled, then the fringe width
(a) will not change
(b) will become half
(c) will be doubled
(d) will become four times

38. Two thin, long, parallel wires, separated by a distance 'd' carry a current of 'i' A in the same direction. They will
(a) repel each other with a force of $\mu_0 i^2/(2\pi d)$
(b) attract each other with a force of $\mu_0 i^2/(2\pi d)$
(c) repel each other with a force of $\mu_0 i^2/(2\pi d^2)$
(d) attract each other with a force of $\mu_0 i^2/(2\pi d^2)$

39. If specific resistance of a potentiometer wire is $10^{-7}\,\Omega$m, the current flow through it is 0.1 A and the cross-sectional area of wire is 10^{-6} m^2 then potential gradient will be
(a) 10^{-2} volt/m (b) 10^{-4} volt/m
(c) 10^{-6} volt/m (d) 10^{-8} volt/m

40. A thin liquid film formed between a U-shaped wire and a light slider supports a weight of 1.5×10^{-2} N (see figure). The length of the slider is 30 cm and its weight negligible. The surface tension of the liquid film is

    (a) $0.0125 \, \text{Nm}^{-1}$

    (b) $0.1 \, \text{Nm}^{-1}$

    (c) $0.05 \, \text{Nm}^{-1}$

    (d) $0.025 \, \text{Nm}^{-1}$
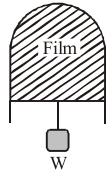
41. A car is negotiating a curved road of radius R. The road is banked at an angle θ. the coefficient of friction between the tyres of the car and the road is μ_s. The maximum safe velocity on this road is :

    (a) $\sqrt{gR^2\left(\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$ (b) $\sqrt{gR\left(\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$

    (c) $\sqrt{\dfrac{g}{R}\left(\dfrac{\mu_s + \tan\theta}{1 - \mu_2 \tan\theta}\right)}$ (d) $\sqrt{\dfrac{g}{R^2}\left(\dfrac{\mu_s + \tan\theta}{1 - \mu_s \tan\theta}\right)}$

42. Two capillary of length L and 2L and of radius R and 2R are connected in series. The net rate of flow of fluid through them will be (given rate to the flow through single capillary, $X = \dfrac{\pi P R^4}{8\eta L}$)

   (a) $\dfrac{8}{9}X$ (b) $\dfrac{9}{8}X$ (c) $\dfrac{5}{7}X$ (d) $\dfrac{7}{5}X$

43. Sound waves of length λ travelling with velocity v in a medium enter into another medium in which their velocity is 4 v. The wavelength in 2nd medium is

    (a) 4λ (b) λ (c) $\lambda/4$ (d) 16λ

44. At $t < 0$, the capacitor is charged and the switch is opened. At $t = 0$ the switch is closed. The shortest time T at which the charge on the capacitor will be zero is given by :

    (a) $\pi\sqrt{LC}$ (b) $\dfrac{3}{2}\pi\sqrt{LC}$

    (c) $\dfrac{\pi}{2}\sqrt{LC}$ (d) $2\pi\sqrt{LC}$
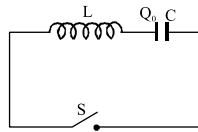
45. A block of mass 0.1kg is held against a wall applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is:

    (a) 2.5 N (b) 0.98 N

    (c) 4.9 N (d) 0.49 N

46. When ultraviolet light of energy 6.2 eV incidents on a aluminimum surface, it emits photoelectrons. If work function for aluminium surface is 4.2 eV, then kinetic energy of emitted electrons is

    (a) 3.2×10^{-19} J (b) 3.2×10^{-17} J

    (c) 3.2×10^{-16} J (d) 3.2×10^{-11} J

47. An object is placed at a distance of 40 cm in front of a concave mirror of focal length 20 cm. The image produced is

    (a) real, inverted and smaller in size

    (b) real, inverted and of same size

    (c) real and erect

    (d) virtual and inverted

48. Two simple pendulums of length 1 m and 4 m respectively are both given small displacement in the same direction at the same instant. They will be again in phase after the shorter pendulum has completed number of oscillations equal to :

    (a) 2 (b) 7 (c) 5 (d) 3

49. The ionisation potential of H-atom is 13.6 V. When it is excited from ground state by monochromatic radiations of 970.6 Å, the number of emission lines will be (according to Bohr's theory)

    (a) 10 (b) 8 (c) 6 (d) 4

50. A particle moves in a circle of radius 30 cm. Its linear speed is given by : $v = 2t$, where t in second and v in m/s. Find out its radial and tangential acceleration at t = 3 sec respectively.

    (a) 220 m/sec^2, 50 m/sec^2

    (b) 110 m/sec^2, 5 m/sec^2

    (c) 120 m/sec^2, 2 m/sec^2

   (d) 110 m/sec^2, 10 m/sec^2

CHEMISTRY

51. Which of the following statements is true?
    (a) $HClO_4$ is a weaker acid than $HClO_3$
    (b) HNO_3 is a stronger acid than HNO_2
    (c) H_3PO_3 is a stronger acid than H_2SO_3
    (d) In aqueous medium HF is a stronger acid than HCl

52. How many unit cells are present in a cube-shaped ideal crystal of NaCl of mass 1.00 g?
    [Atomic masses : Na = 23, Cl = 35.5]
    (a) 2.57×10^{21} unit cells
    (b) 5.14×10^{21} unit cells
    (c) 1.28×10^{21} unit cells
    (d) 1.71×10^{21} unit cells

53. How many primary carbon atoms are there in $CH_3CH_2CH(CH_3)C(CH_3)_2CH_2CH_2CH_3$?
    (a) 3   (b) 4   (c) 5   (d) 6

54. $CH_3CHO \xrightarrow[5\,°C]{10\%\ NaOH} \xrightarrow{\Delta} \xrightarrow[Ni]{H_2} (A)$;

    Product (A) of the reaction is:
    (a) Propanol   (b) Ethanol
    (c) Butanol   (d) Pentanol

55. Excess of copper in toxic proportions in plants and animals can be removed by chelating with
    (a) EDTA   (b) ethane-1, 2-amine
    (c) oxalate ion   (d) D-penicillamine

56. $3A \to 2B$, rate of reaction $\dfrac{d[B]}{dt}$ is equal to

    (a) $-\dfrac{3}{2}\dfrac{d[A]}{dt}$ (b) $-\dfrac{2}{3}\dfrac{d[A]}{dt}$

    (c) $-\dfrac{1}{3}\dfrac{d[A]}{dt}$ (d) $+2\dfrac{d[A]}{dt}$

57. In the given pairs of alkyl-halide, in which pair the first compound is more reactive than second compound towards S_N2 reaction?
    (a) $(CH_3)_2CHBr$ or $CH_3 — CH_2 — CH_2 — Br$
    (b) $CH_3 — CH_2 — CH_2 — Br$ or $CH_3 — CH_2 — CH_2 — I$

    (c) $Ph — Br$ or $CH_3 — CH_2 — CH_2 — Br$
    (d) $CH_2 = CH — CH_2 — Cl$
    or $H_2C = CH — Cl$

58. In a cubic closed packed structure of mixed oxides, the lattice is made up of oxide ion, 20% of tetrahedral voids are occupied by divalent X^{2+} ions and 50% of the octahedral voids are occupied by trivalent Y^{3+} ions. The formula of the oxide is
    (a) $X.Y_2O_4$ (b) $X_4Y_5O_{10}$
    (c) $X_5Y_4O_{10}$ (d) X_2YO_4

59. What is X and Y in the given reactions ?
    $2X_2(g) + 2H_2O(l) \to 4H^+(aq) + 4X^-(aq) + O_2(g)$
    $Y_2(g) + H_2O(l) \to HY(aq) + HOY(aq)$
    (a) $X = Cl, Y = F$ (b) $X = Cl, Y = Br$
    (c) $X = F, Y = Cl$ (d) $X = I, Y = F$

60. The structural feature which distinguishes proline from natural α-amino acids?
    (a) Proline is optically inactive
    (b) Proline contains aromatic group
    (c) Proline is a dicarboxylic acid
    (d) Proline is a secondary amine

61. Ethyl alcohol is used as a preservative for chloroform because it
    (a) prevents aerial oxidation of chloroform
    (b) prevents decomposition of chloroform
    (c) decomposes phosgene to CO and Cl_2
    (d) removes phosgene by converting it to ethyl carbonate

62. A compound of a metal ion $M^{x+} (Z = 24)$ has a spin only magnetic moment of $\sqrt{15}$ Bohr magnetons. The number of unpaired electrons in the compound are
    (a) 2   (b) 4   (c) 5   (d) 3

63. Specific conductance of 0.1 M HNO_3 is 6.3×10^{-2} $ohm^{-1}\,cm^{-1}$. The molar conductance of the solution is
(a) $100\,ohm^{-1}\,cm^2$ (b) $515\,ohm^{-1}\,cm^2$
(c) $630\,ohm^{-1}\,cm^2$ (d) $6300\,ohm^{-1}\,cm^2$

64. 2-Butyne contains :
(a) sp hybridised carbon atoms only
(b) sp^3 hybridised carbon atoms only
(c) Both sp and sp^2 hybridised carbon atoms
(d) Both sp and sp^3 hybridised carbon atoms

65. The reducing power of divalent species decreases in the order
(a) $Ge > Sn > Pb$ (b) $Sn > Ge > Pb$
(c) $Pb > Sn > Ge$ (d) None of these

66. Assuming that water vapour is an ideal gas, the internal energy change (ΔU) when 1 mol of water is vapourised at 1 bar pressure and 100°C, (given : molar enthalpy of vapourisation of water at 1 bar and 373 K $= 41\,kJ\,mol^{-1}$ and $R = 8.3\,J\,mol^{-1}\,K^{-1}$) will be
(a) $41.00\,kJ\,mol^{-1}$ (b) $4.100\,kJ\,mol^{-1}$
(c) $3.7904\,kJ\,mol^{-1}$ (d) $37.904\,kJ\,mol^{-1}$

67. The molecule having smallest bond angle is :
(a) H_2O (b) H_2S (c) NH_3 (d) H_2Te

68. A galvanic cell is composed of two hydrogen electrodes, one of which is a standard one. In which of the following solutions should the other electrode be immersed to get maximum e.m.f. :
(a) 0.1 M HCl   (b) $0.1\,M\,H_2SO_4$
(c) $0.1\,M\,NH_4OH$ (d) 0.01 MHCOOH

69. The following set of reactions are used in refining zirconium.

$Zr\ (impure)\ +\ 2I_2 \xrightarrow{\ 523K\ } ZrI_4 \xrightarrow{\ 1800K\ } Zr$ (pure) $+ 2I_2$

This method is known as
(a) Distillation
(b) Liquation
(c) Hall-Heroult method
(d) Van Arkel method

70. Buna-N synthetic rubber is a copolymer of :
(a) $H_2C = CH - CH = CH_2$ and $H_5C_6 - CH = CH_2$
(b) $H_2C = CH - CN$ and $CH_2 = CH - CH = CH_2$
(c) $H_2C = CH - CN$ and $H_2C = CH - \underset{\underset{CH_3}{|}}{C} = CH_2$
(d) $H_2C = CH - \underset{\underset{Cl}{|}}{C} = CH_2$ and $H_2C = CH - CH = CH_2$

71. By which one of the following reaction ketones cannot be prepared?
(a) Hydration of alkynes
(b) Hydrolysis of gem-dihalides
(c) Dry distillation of calcium carboxylates
(d) Stephen's reaction

72. The number of ions produced by the complex $[Cr(NH_3)_4Cl_2]ClO_3$ is
(a) 2   (b) 3   (c) 4   (d) 6

73. Saline hydrides react explosively with water, such fires can be extinguished by
(a) water   (b) carbon dioxide
(c) sand   (d) None of these

74. Which of the following is not a disproportionation reaction?
(a) $P_4 + 5OH^- \longrightarrow H_2PO_2^- + PH_3$
(b) $Cl_2 + OH^- \longrightarrow Cl^- + HClO$
(c) $2H_2O_2 \longrightarrow 2H_2O + O_2$
(d) $PbO_2 + H_2O \longrightarrow PbO + H_2O_2$

75. When bromination of aniline is carried out by protecting $-NH_2$. The product is
(a) o-bromoaniline
(b) 2, 4, 6 tribromoaniline
(c) p-bromoaniline
(d) mixture of o-and p-bromoanilines

76. In the following sequence of reactions,

$$CH_3CH_2OH \xrightarrow{P+I_2} A \xrightarrow[\text{ether}]{Mg} B \xrightarrow{HCHO}$$
$$C \xrightarrow{H_2O} D$$
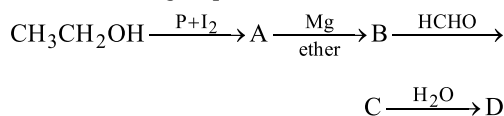
the compound D is
(a) propanal
(b) butanal
(c) *n*-butyl alcohol
(d) *n*-propyl alcohol.

77. Which of the following statements about a catalyst is/are true ?

(a) A catalyst accelerates the reaction by bringing down the free energy of activation.
(b) A catalyst also takes part in the reaction mechanism.
(c) A catalyst makes the reaction more feasible by making the ΔG^o more negative.
(d) A catalyst makes the equilibrium constant of the reaction more favourable for the forward reaction.

78. The reaction $A \rightarrow B$ follows first order kinetics. The time taken for 0.8 mole of A to produce 0.6 mole of B is 1 hour. What is the time taken for conversion of 0.9 mole of A to produce 0.675 mole of B?
(a) 2 hours
(b) 1 hour
(c) 0.5 hour
(d) 0.25 hour

79. When salicylic acid is treated with acetic anhydride we get
(a) aspirin
(b) paracetamol
(c) salol
(d) none of these

80. Identify incorrect statement :
(a) Cu_2O is colourless.
(b) Copper (I) compounds are colourless except when colour results from charge transfer.
(c) Copper (I) compounds are diamagnetic.
(d) Cu_2S is black.

81. Which of the following compound is used for preparation of melamine formaldehyde polymer ?

(a)

(b)

(c)

(d)
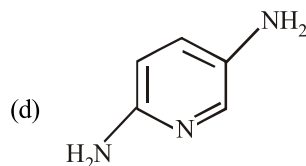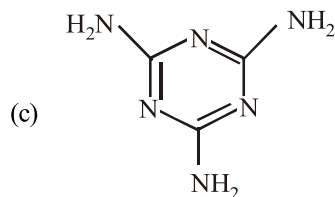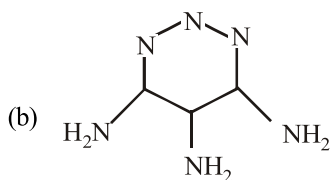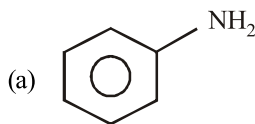
82. A match box exhibits
(a) cubic geometry
(b) monoclinic geometry
(c) tetragonal geometry
(d) orthorhombic geometry.

83. The nodal plane in the π-bond of ethene is located in
(a) the molecular plane.
(b) a plane parallel to the molecular plane.
(c) a plane perpendicular to the molecular plane which bisects the carbon - carbon σ -bond at right angle.
(d) a plane perpendicular to the molecular plane which contains the carbon - carbon σ -bond.

84. If the elevation in boiling point of a solution of non-volatile, non-electrolytic and non associating solute in a solvent ($K_b = x$ K kg mol^{-1}) is y K, then the depression in freezing point of solution of same concentration would be (K_f of the solvent $= z$ K kg mol^{-1})

(a) $\dfrac{2xz}{y}$
(b) $\dfrac{yz}{x}$
(c) $\dfrac{xz}{y}$
(d) $\dfrac{yz}{2x}$

85. Na_2SO_3 and $NaHCO_3$ may be distinguished by treating their aqueous solution with :
(a) MgO
(b) $MgSO_4$
(c) litmus solution.
(d) dil. acid

86. Two separate bulbs contain ideal gases A and B. The density of gas A is twice that of gas B. The molecular mass of A is half that of gas B. The two gases are at the same temperature. The ratio of the pressure of A to that of gas B is :
(a) 2
(b) 1/2
(c) 4
(d) 1/4

87. The migration of colloidal solute particles in a colloidal solution, when an electric current is applied to the solution is known as:
(a) Brownian movement
(b) Electroosmosis
(c) Electrophoresis
(d) Electrodialysis

88. Arrange Ce^{+3}, La^{+3}, Pm^{+3} and Yb^{+3} in increasing order of their ionic radii.
(a) $Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$
(b) $Ce^{+3} < Yb^{+3} < Pm^{+3} < La^{+3}$
(c) $Yb^{+3} < Pm^{+3} < La^{+3} < Ce^{+3}$
(d) $Pm^{+3} < La^{+3} < Ce^{+3} < Yb^{+3}$.

89. Which of the following will be most stable diazonium salt $RN_2^+X^-$?
(a) $CH_3N_2^+X^-$
(b) $C_6H_5N_2^+X^-$
(c) $CH_3CH_2N_2^+X^-$
(d) $C_6H_5CH_2N_2^+X^-$

90. The equilibrium constant for the following general reaction is 10^{30}. Calculate $E°$ for the cell at 298 K.

$$2X_2(s) + 3Y^{2+}(aq) \longrightarrow 2X_2^{3+}(aq) + 3Y(s)$$

(a) $+0.105$ V
(b) $+0.2955$ V
(c) 0.0985 V
(d) -0.2955 V

91. Flux is used to :
(a) Remove silica.
(b) Remove silica and undesirable metal oxides.
(c) Remove all impurities from ores.
(d) Reduce metal oxide.

92. The rate of reaction between A and B increases by a factor of 100, when the concentration of A is increased 10 folds, the order of reaction with respect to A is
(a) 10 (b) 1 (c) 4 (d) 2

93. Phenacetin is used as
(a) antipyretic
(b) antiseptic
(c) antimalarial
(d) tranquillizer

94. The correct order of magnetic moments (spin only values in B.M.) among is
(a) $[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$
(b) $[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$
(c) $[MnCl_4]^{2-} > [CoCl_4]^{2-} > [Fe(CN)_6]^{4-}$
(d) $[Fe(CN)_6]^{4-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$
(Atomic nos. : Mn = 25, Fe = 26, Co = 27)

95. Which one of the following is a non-steroidal hormone?
(a) Estradiol
(b) Prostaglandin
(c) Progesterone
(d) Estrone

96. All form ideal solution except
(a) C_6H_6 and $C_6H_5CH_3$
(b) C_2H_6 and C_2H_5I
(c) C_6H_5Cl and C_6H_5Br
(d) C_2H_5I and C_2H_5OH.

97. An aromatic ether is not cleaved by HI even at 525 K. The compound is
(a) $C_6H_5OCH_3$
(b) $C_6H_5OC_6H_5$
(c) $C_6H_5OC_3H_7$
(d) Tetrahydrofuran

98. In $CH_3CH_2CH_2I$, the C–I bond is formed by the overlapping of
(a) $2sp^3 - 2p_z$ orbitals
(b) $2sp^3 - 3p_z$ orbitals
(c) $2sp^3 - 4p_z$ orbitals
(d) $2sp^3 - 5p_z$ orbitals

99. Among the following compounds, the increasing order of their basic strength is :
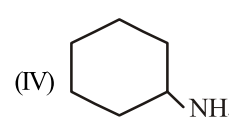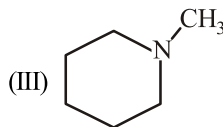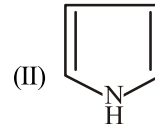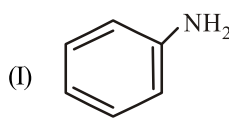
(a) (I) < (II) < (IV) < (III)
(b) (I) < (II) < (III) < (IV)
(c) (II) < (I) < (IV) < (III)
(d) (II) < (I) < (III) < (IV)

100. $MF + XeF_4 \longrightarrow$ 'A' (M^+ = Alkali metal cation)
The state of hybridisation of the central atom in 'A' and shape of the species are:
(a) sp^3d, TBP
(b) sp^3d^3, distorted octahedral
(c) sp^3d^3, pentagonal planar
(d) No compound formed at all

MATHEMATICS

1. In a battle 70% of the combatants lost one eye, 80% an ear, 75% an arm, 85% a leg, x% lost all the four limbs. The minimum value of x is
   (a) 10
   (b) 12
   (c) 15
   (d) None of these

2. The relation R defined on the set A = $\{1, 2, 3, 4, 5\}$ by R = $\{(x, y) : |x^2 - y^2| < 16\}$ is given by
   (a) $\{(1, 1), (2, 1), (3, 1), (4, 1), (2, 3)\}$
   (b) $\{(2, 2), (3, 2), (4, 2), (2, 4)\}$
   (c) $\{(3, 3), (3, 4), (5, 4), (4, 3), (3, 1)\}$
   (d) None of these

3. If $f(x + y) = f(x) + 2y^2 + kxy$ and $f(a) = 2, f(b) = 8$, then $f(x)$ is of the form
   (a) $2x^2$
   (b) $2x^2 + 1$
   (c) $2x^2 - 1$
   (d) x^2

4. Which pairs of function is identical ?
   (a) $f(x) = \sqrt{x^2}$, $g(x) = x$
   (b) $f(x) = \sin^2 x + \cos^2 x$; $g(x) = 1$
   (c) $f(x) = \dfrac{x}{x}, g(x) = 1$
   (d) None of these

5. If $A = 1 + r^a + r^{2a} + r^{3a} + ...\infty$
   and $B = 1 + r^b + r^{2b} + r^{3b} + ...\infty$, then $\dfrac{a}{b}$ is equal to
   (a) $\log_B (A)$
   (b) $\log_{1-B}(1 - A)$
   (c) $\log_{\frac{B-1}{B}}\left(\dfrac{A-1}{A}\right)$
   (d) None of these

6. The bisector of the acute angle formed between the lines $4x - 3y + 7 = 0$ and $3x - 4y + 14 = 0$ has the equation :
   (a) $x + y + 3 = 0$
   (b) $x - y - 3 = 0$
   (c) $x - y + 3 = 0$
   (d) $3x + y - 7 = 0$

7. Two circles $S_1 = x^2 + y^2 + 2g_1 x + 2f_1 y + c_1 = 0$ and $S_2 = x^2 + y^2 + 2g_2 x + 2f_2 y + c_2 = 0$ cut each other orthogonally, then :
   (a) $2g_1 g_2 + 2f_1 f_2 = c_1 + c_2$
   (b) $2g_1 g_2 - 2f_1 f_2 = c_1 + c_2$
   (c) $2g_1 g_2 + 2f_1 f_2 = c_1 - c_2$
   (d) $2g_1 g_2 - 2f_1 f_2 = c_1 - c_2$

8. A point is selected at random from the interior of a circle. The probability that the point is close to the centre, then the boundary of the circle, is
   (a) $\dfrac{3}{4}$
   (b) $\dfrac{1}{2}$
   (c) $\dfrac{1}{4}$
   (d) None of these

9. The xy-plane divides the line joining the points $(-1, 3, 4) (2, -5, 6)$
   (a) internally in the ratio 2 : 3
   (b) externally in the ratio 2 : 3
   (c) internally in the ratio 3 : 2
   (d) externally in the ratio 3 : 2

10. $\lim\limits_{x \to 0} \left(\dfrac{a^x + b^x + c^x}{3}\right)^{\lambda/x}$; $(a, b, c, \lambda > 0)$ is equal to–
    (a) 1; if $\lambda = 1$
    (b) abc; if $\lambda = 1$
    (c) abc ; if $\lambda = 1/3$
    (d) $(abc)^{2/3}$; if $\lambda = 2$

11. Solution of $2^x + 2^{|x|} \geq 2\sqrt{2}$ is
    (a) $(-\infty, \log_2(\sqrt{2} + 1))$
    (b) $(0, \infty)$
    (c) $\left(\dfrac{1}{2}, \log_2(\sqrt{2} - 1)\right)$
    (d) $(-\infty, \log_2(\sqrt{2} - 1)] \cup \left[\dfrac{1}{2}, \infty\right)$

12. The number of seven digit integers, with sum of the digits equal to 10 and formed by using the digits 1, 2 and 3 only, is
    (a) 55
    (b) 66
    (c) 77
    (d) 88

13. For positive numbers x, y, z the numerical value of the determinant $\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 3 & \log_y z \\ \log_z x & \log_z y & 5 \end{vmatrix}$ is
    (a) 0
    (b) log x log y log z
    (c) 1
    (d) 8

14. Negation of the statement $(p \wedge r) \rightarrow (r \vee q)$ is

(a) $\sim (p \wedge r) \rightarrow \sim (r \vee q)$

(b) $(\sim p \vee \sim r) \vee (r \vee q)$

(c) $(p \wedge r) \wedge (r \wedge q)$

(d) $(p \wedge r) \wedge (\sim r \wedge \sim q)$

15. If $f(x) = \begin{cases} \dfrac{\sqrt{1+kx} - \sqrt{1-kx}}{x} & \text{for } -1 \le x < 0 \\ 2x^2 + 3x - 2, & \text{for } 0 \le x \le 1 \end{cases}$ is

continuous at x = 0, then k =

(a) –4 (b) –3 (c) –2 (d) –1

16. The area enclosed between the curve

$y = \log_e(x + e)$ and the coordinate axes is

(a) 1 (b) 2 (c) 3 (d) 4

17. The differential equation of the family of curves for which the length of the normal is equal to a constant k, is given by:

(a) $y^2 \dfrac{dy}{dx} = k^2 - y^2$

(b) $\left(y \dfrac{dy}{dx}\right)^2 = k^2 - y^2$

(c) $y \left(\dfrac{dy}{dx}\right)^2 = k^2 + y^2$

(d) $\left(y \dfrac{dy}{dx}\right)^2 = k^2 + y^2$

18. $\displaystyle\int \dfrac{x^{n-1}}{x^{2n} + a^2} dx =$

(a) $\dfrac{1}{na} \tan^{-1}\left(\dfrac{x^n}{a}\right) + C$ (b) $\dfrac{n}{a} \tan^{-1}\left(\dfrac{x^n}{a}\right) + C$

(c) $\dfrac{n}{a} \sin^{-1}\left(\dfrac{x^n}{a}\right) + C$ (d) $\dfrac{n}{a} \cos^{-1}\left(\dfrac{x^n}{a}\right) + C$

19. The sum of the rational terms in the expansion of

$(\sqrt{2} + 3^{1/5})^{10}$ is equal to

(a) 40 (b) 41 (c) 42 (d) 0

20. Let R be a relation defined by a R b, a ≥ b where a and b are real number then R is :

(a) reflexive, symmetric and transitive

(b) reflexive, transitive but not symmetric

(c) symmetric, transitive but not reflexive

(d) neither transitive nor reflexive but symmetric

21. If $y = m \log x + nx^2 + x$ has its extreme values at $x = 2$ and $x = 1$, then $2m + 10n =$

(a) –1 (b) –4 (c) –2 (d) –3

22. If ABCDEF is a regular hexagon and

$\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF} = k\overrightarrow{AD}$, then find the value of k.

(a) 2 (b) 3 (c) 4 (d) 5

23. The projection of line joining (3, 4, 5) and (4, 6, 3) on the line joining (–1, 2, 4) and (1, 0, 5) is –

(a) $\dfrac{4}{3}$ (b) $\dfrac{2}{3}$ (c) $\dfrac{8}{3}$ (d) $\dfrac{1}{3}$

24. If $x + iy = \dfrac{3}{\cos\theta + i\,\sin\theta + 2}$ then $4x - x^2 - y^2$

reduces to :

(a) 2 (b) 3 (c) 4 (d) 5

25. The matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$ is

(a) idempotent matrix (b) involutory matrix

(c) nilpotent matrix (d) None of these

26. If $x = \exp\left\{ \tan^{-1}\left(\dfrac{y - x^2}{x^2}\right)\right\}$, then $\dfrac{dy}{dx}$ equals

(a) $2x\,[1 + \tan(\log x)] + x\,\sec^2(\log x)$

(b) $x\,[1 + \tan(\log x)] + \sec^2(\log x)$

(c) $2x\,[1 + \tan(\log x)] + x^2\,\sec^2(\log x)$

(d) $2x\,[1 + \tan(\log x)] + \sec^2(\log x)$

27. The value of $\displaystyle\int_{e^{-1}}^{e} \dfrac{dt}{t(1+t)}$ is equal to

(a) 0 (b) $\log\left(\dfrac{e}{1+e}\right)$

(c) $\log\left(\dfrac{1}{1+e}\right)$ (d) $\log(1+e)$

28. A coin is tossed thrice. If E be the event of showing at least two heads and F be the event of showing head in the first throw, then find $P\left(\dfrac{E}{F}\right)$.

(a) $\dfrac{4}{3}$ (b) $\dfrac{3}{4}$ (c) $\dfrac{1}{4}$ (d) $\dfrac{1}{2}$

29. An aeroplane flying horizontally 1 km above the ground is observed at an elevation of 60° and after 10 s the elevation is observed to be 30°. The uniform speed of the aeroplane in kilometre per hour is

(a) $60\sqrt{3}$ (b) 240

(c) $240\sqrt{3}$ (d) 480

30. If the nth term of an arithmetic progression is $3n + 7$, then what is the sum of its first 50 terms?
(a) 3925 (b) 4100 (c) 4175 (d) 8200

31. Let A (1, k), B(1, 1) and C (2, 1) be the vertices of a right angled triangle with AC as its hypotenuse. If the area of the triangle is 1 square unit, then the set of values which 'k' can take is given by
(a) $\{-1, 3\}$ (b) $\{-3, -2\}$
(c) $\{1, 3\}$ (d) $\{0, 2\}$

32. If the ellipse $\dfrac{x^2}{4}+\dfrac{y^2}{1}=1$ meet the ellipse $\dfrac{x^2}{1}+\dfrac{y^2}{a^2}=1$ in four distinct points and $a = b^2 - 10b + 25$ then which of the following is true ?
(a) $4 < b < 6$ (b) $b < 4$
(c) $b > 6$ (d) Both (b) and (c)

33. Let $f(x)=\sqrt{x-1}+\sqrt{x+24-10\sqrt{x-1}}$; $1 < x < 26$ be real valued function. Then $f'(x)$ for $1 < x < 26$ is

(a) 0   (b) $\dfrac{1}{\sqrt{x-1}}$

(c) $2\sqrt{x-1}-5$ (d) None of these

34. In a test of Statistics marks were awarded out of 40. The average of 15 students was 38. Later it was decided to give marks out of 50. The new average marks will be
(a) 40   (b) 47.5   (c) 95   (d) 41.5

35. If all the solutions of $a^{\cos x} + a^{-\cos x} = 6\,(a > 1)$ are real, then the set of values of a is :
(a) $[3+2\sqrt{2}, +\infty)$ (b) $(6\ 12)$
(c) $[1\ \ \ 3+2\sqrt{2}\,]$ (d) None of these

36. Four couples (husband and wife) decide to form a committee of four members. Find the number of different committees that can be formed in which no couple finds a place.
(a) 12   (b) 14   (c) 16   (d) 24

37. Let $f:(4, 6) \to (6, 8)$ be a function defined by $f(x) = x + \left[\dfrac{x}{2}\right]$ (where [.] denotes the greatest integer function), then $f^{-1}(x)$ is equal to

(a) $x - \left[\dfrac{x}{2}\right]$ (b) $-x - 2$

(c) $x - 2$ (d) $\dfrac{1}{x+\left[\frac{x}{2}\right]}$

38. If $f(x)=\begin{cases} xe^{-\left(\frac{1}{|x|}+\frac{1}{x}\right)} & , x \neq 0 \\ 0 & , x = 0 \end{cases}$ then f(x) is

(a) discontinuous every where
(b) continuous as well as differentiable for all x
(c) continuous for all x but not differentiable at $x = 0$
(d) neither differentiable nor continuous at $x = 0$

39. Let f be a positive function if
$$I_1 = \int_{1-k}^{k} xf\{x(1-x)\}\,dx \text{ and } I_2 = \int_{1-k}^{k} f\{x(1-x)\}\,dx$$
where $2k - 1 > 0$, then $I_1 : I_2$ is equal to

(a) 2   (b) k   (c) $\dfrac{1}{2}$ (d) 1

40. For any vector $\vec{a}$, the value of $(\vec{a} \times \hat{i})^2 + (\vec{a} \times \hat{j})^2 + (\vec{a} \times \hat{k})^2$ is equal to

(a) $3\vec{a}^2$ (b) $\vec{a}^2$ (c) $2\vec{a}^2$ (d) $4\vec{a}^2$

41. For the LPP Min $z = x_1 + x_2$ such that inequalities $5x_1 + 10x_2 \geq 0$, $x_1 + x_2 \leq 1$, $x_2 \leq 4$ and $x_1, x_2 \geq 0$

(a) There is a bounded solution
(b) There is no solution
(c) There are infinitie solution
(d) None of these

42. There are n letters and n addressed envelopes, the probability that all the letters are not kept in the right envelope, is

(a) $\dfrac{1}{n!}$

(b) $1 - \dfrac{1}{n!}$

(c) $1 - \dfrac{1}{n}$

(d) None of these

43. $\displaystyle\int \dfrac{dx}{x\sqrt{1-x^3}} = a \ln\left(\dfrac{\sqrt{1-x^3}+b}{\sqrt{1-x^3}+1}\right) + k$, then :

(a) $b = 1, a = 1$

(b) $b = -1$, and $a = \dfrac{1}{3}$

(c) $b = 1$, $a = -\dfrac{2}{3}$

(d) $b = 1$ and $a = -\dfrac{1}{3}$

44. A point on the parabola $y^2 = 18x$ at which the ordinate increases at twice the rate of the abscissa is

(a) $\left(\dfrac{9}{8}, \dfrac{9}{2}\right)$

(b) $(2, -4)$

(c) $\left(\dfrac{-9}{8}, \dfrac{9}{2}\right)$

(d) $(2, 4)$

45. Which of the following is the greatest?
(a) $^{31}C_0{}^2 - {}^{31}C_1{}^2 + {}^{31}C_2{}^2 - \ldots - {}^{31}C_{31}{}^2$
(b) $^{32}C_0{}^2 - {}^{32}C_1{}^2 + {}^{32}C_1{}^2 - \ldots + {}^{32}C_{32}{}^2$
(c) $^{32}C_0{}^2 + {}^{32}C_1{}^2 + {}^{32}C_2{}^2 - \ldots + {}^{32}C_{32}{}^2$
(d) $^{34}C_0{}^2 - {}^{34}C_1{}^2 + {}^{34}C_2{}^2 - \ldots + {}^{34}C_{32}{}^2$

46. If $\tan^{-1}\dfrac{x}{\pi} < \dfrac{\pi}{3}$, $x \in N$, then the maximum value of x is

(a) 2

(b) 5

(c) 7

(d) None of these

47. If A is a square matrix such that $(A - 2I)(A + I) = O$, then $A^{-1} =$

(a) $\dfrac{A - I}{2}$

(b) $\dfrac{A + I}{2}$

(c) $2(A - I)$

(d) $2A + I$

48. The integral factor of differential equation

$(x^2 + 1)\dfrac{dy}{dx} + 2xy = x^2 - 1$ is

(a) $x^2 + 1$

(b) $\dfrac{2x}{x^2 + 1}$

(c) $\dfrac{x^2 - 1}{x^2 + 1}$

(d) None of these

49. Area bounded by the curves $y = e^x$, $y = e^{-x}$ and the straight line x = 1 is (in sq. units)

(a) $e + \dfrac{1}{e}$

(b) $e + \dfrac{1}{e} + 2$

(c) $e + \dfrac{1}{e} - 2$

(d) $e - \dfrac{1}{e} + 2$

50. The distance from the point (3, 4, 5) to the point where the line $\dfrac{x-3}{1} = \dfrac{y-4}{2} = \dfrac{z-5}{2}$ meets the plane $x + y + z = 17$ is

(a) 1
(b) 2
(c) 3
(d) $\sqrt{2}$