VITEEE – 2007 QUESTION PAPER

Physics

1. Ionization power and penetration range of radioactive radiation increases in the order :
   (a) γ, β, α and γ, β, α respectively
   (b) γ, β, α and α, β, γ respectively
   (c) α, β, γ and α, β, γ respectively
   (d) α, β, γ and γ, β, α respectively

2. The half-life of a radioactive element is 3.8 days. The fraction left after 19 days will be :
   (a) 0.124   (b) 0.062
   (c) 0.093   (d) 0.031

3. Two identical p-n junctions are connected in series in three different ways as shown below to a battery. The potential drop across the p-n junctions are equal in :
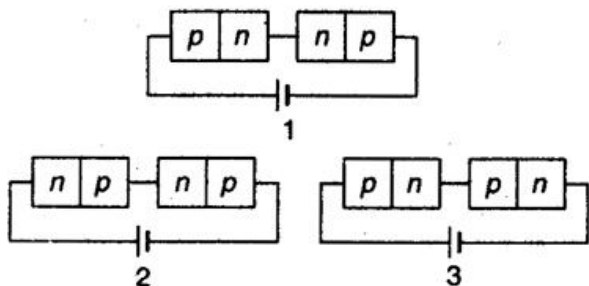
   (a) circuits 2 and 3   (b) circuits 1 and 2
   (c) circuits 1 and 3   (d) none of the circuit

4. The temperature coefficient of a zener mechanism is :
   (a) negative   (b) positive
   (c) infinity   (d) zero

5. Identify the logic gate from the following truth table :

Input		Output
A	B	Y
0	0	1
0	1	0
1	0	0

   (a) NOR gate   (b) NOT gate
   (c) AND gate   (d) NAND gate

6. In Boolean algebra, $\overline{\overline{A} \cdot \overline{B}}$ is equal to :
   (a) $\overline{A} \cdot \overline{B}$ (b) $\overline{A} + \overline{B}$
   (c) $A \cdot B$ (d) $A + B$

7. Radar waves are sent towards a moving aeroplane and the reflected waves are received. When the aeroplane is moving towards the radar, the wavelength of the wave :
   (a) decreases
   (b) increases
   (c) remains the same
   (d) sometimes increases or decreases

8. The transmission of high frequencies in a coaxial cable is determined by :
   (a) $\dfrac{1}{(LC)^{1/2}}$, where L and C are inductance and capacitance
   (b) $(LC)^2$
   (c) the impedance L alone
   (d) the dielectric and skin effect

9. The output stage of a television transmitter is most likely to be a :
   (a) plate-modulated class C amplifier
   (b) grid-modulated class C amplifier
   (c) screen-modulated class C amplifier
   (d) grid-modulated class A amplifier

10. The antenna current of an AM transmitter is 8 A when only the carrier is sent, but it increases to 8.93 A when the carrier is modulated by a single sine wave. Find the percentage modulation.
    (a) 60.1%   (b) 70.1%
    (c) 80.1%   (d) 50.1%

11. Two point like charges Q_1 and Q_2 of whose

Assuming the field strength to be positive in the positive direction of x-axis, the signs of the charges Q_1 and Q_2 for the graphs (field strength *versus* distance) shown in Fig. 1, 2, 3 and 4 are :
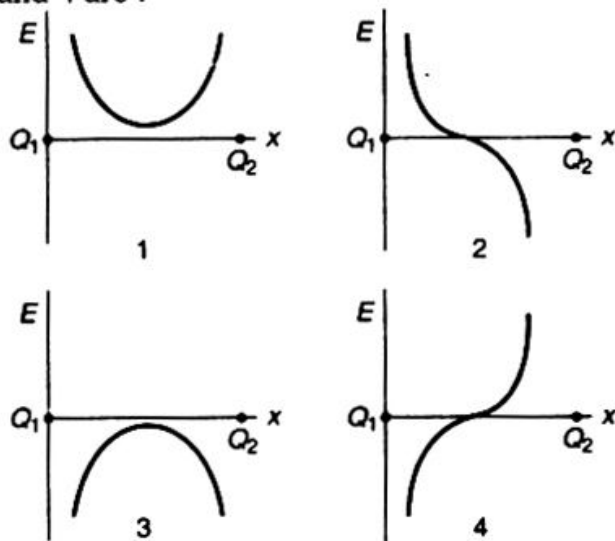
(a) Q_1 positive, Q_2 negative; both positive; Q_1 negative, Q_2 positive; both negative
(b) Q_1 negative Q_2 positive; Q_1 positive, Q_2 negative; both positive; both negative
(c) Q_1 positive, Q_2 negative; both negative; Q_1 negative, Q_2 positive; both positive
(d) both positive; Q_1 positive, Q_2 negative; Q_1 negative, Q_2 positive; both negative

12. *ABCD* is a rectangle. At corners *B*, *C* and *D* of the rectangle are placed charges $+10 \times 10^{-10}$ C, -20×10^{-12} C and 10×10^{-12} C, respectively. Calculate the potential at the fourth corner. (The side *AB* = 4 cm and *BC* = 3 cm)
   (a) 1.65 V   (b) 0.165 V
   (c) 16.5 V   (d) 2.65 V

13. A parallel plate capacitor of capacitance 100 pF is to be constructed by using paper sheets of 1 mm thickness as dielectric. If the dielectric constant of paper is 4, the number of circular metal foils of diameter 2 cm each required for the purpose is :
   (a) 40   (b) 20
   (c) 30   (d) 10

14. The electric field intensity $\vec{E}$, due to an electric dipole of moment $\vec{p}$, at a point on the equatorial line is :
   (a) parallel to the axis of the dipole and opposite to the direction of the dipole moment $\vec{p}$

(b) perpendicular to the axis of the dipole and is directed away from it
(c) parallel to the dipole moment
(d) perpendicular to the axis of the dipole and is directed towards it

15. Twelve wires of each of resistance 6Ω are connected to form a cube as shown in the figure. The current enters at a corner *A* and leaves at the diagonally opposite corner *G*. The joint resistance across the corners *A* and *G* are :

   (a) 12Ω (b) 6Ω
   (c) 3Ω (d) 5Ω
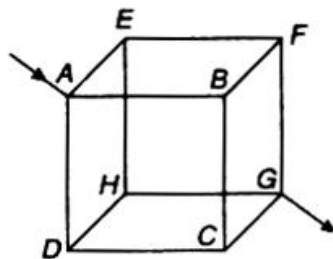
16. A conductor and a semiconductor are connected in parallel as shown in the figure. At a certain voltage both ammeters register the same current. If the voltage of the DC source is increased then the :
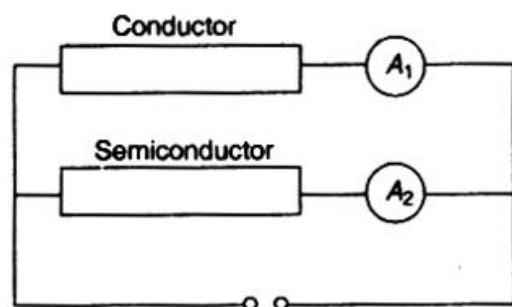
(a) ammeter connected to the semiconductor will register higher current than the ammeter connected to the conductor
(b) ammeter connected to the conductor will register higher current than the ammeter connected to the semiconductor
(c) ammeters connected to both semiconductor and conductor will register the same current
(d) ammeters connected to both semiconductor and conductor will register no change in the current

17. A uniform copper wire of length 1 m and cross-sectional area 5×10^{-7} m^2 carries a current of 1 A. Assuming that there are 8×10^{28} free electron/m^3 in copper, how long will an electron take to drift from one end of the wire to the other?

(a) 0.8×10^3 s (b) 1.6×10^3 s

(c) 3.2×10^3 s (d) 6.4×10^3 s

18. The temperature coefficient of resistance of a wire is 0.00125/K. At 300 K, its resistance is 1 Ω. The resistance of the wire will be 2 Ω at :

(a) 1154 K (b) 1100 K

(c) 1400 K (d) 1127 K

19. A rectangular coil ABCD which is rotated at a constant angular velocity about an horizontal as shown in the figure. The axis of rotation of the coil as well as the magnetic field B are horizontal. Maximum current will flow in the circuit when the plane of the coil is :
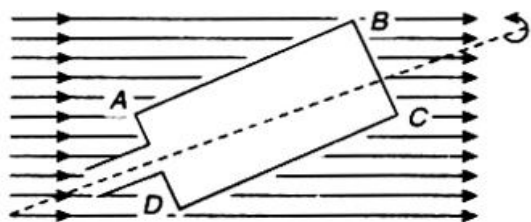
(a) inclined at 30° to the magnetic field

(b) perpendicular to the magnetic field

(c) inclined at 45° to the magnetic field

(d) parallel to the magnetic field

20. If the total emf in a thermocouple is a parabolic function expressed as $E = at + \dfrac{1}{2} bt^2$, which of the following relation does not hold good?

(a) neutral temperature $t_n = -\dfrac{a}{b}$

(b) temperature of inversion, $t_i = \dfrac{-2a}{b}$

(c) thermoelectric power $P = a + bt$

(d) $t_n = \dfrac{a}{b}$

21. The proton of energy 1 MeV describes a circular path in plane at right angles to a uniform magnetic field of 6.28×10^{-4} T. The mass of the proton is 1.7×10^{-27} kg. The cyclotron frequency of the proton is very nearly equal to :

(a) 10^7 Hz (b) 10^5 Hz

(c) 10^6 Hz (d) 10^4 Hz

22. The magnetic field at the centre of a loop of a circular wire of radius r carrying current I may be taken as B_0. If a particle of charge q moving with speed v passes the centre of a semicircular wire, as shown in figure, along the axis of the wire, the force on it due to the current is :
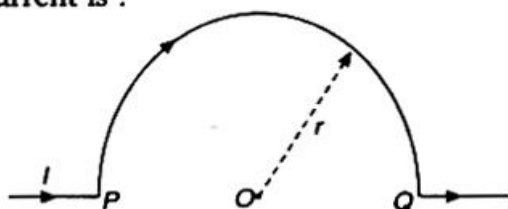

(a) zero (b) $\dfrac{1}{4} B_0 q v$

(c) $\dfrac{1}{2} q B_0 v$ (d) $q B_0 v$

23. There are two solenoids of same length and inductance L but their diameters differ to the extent that one can just fit into the other. They are connected in three different ways in series. (1) They are connected in series but separated by large distance, (2) they are connected in series with one inside the other and senses of the turns coinciding, (3) both are connected in series with one inside the other with senses of the turns opposite as depicted in figures 1, 2 and 3, respectively. The total inductance of the solenoids in each of the case 1, 2 and 3 are respectively :
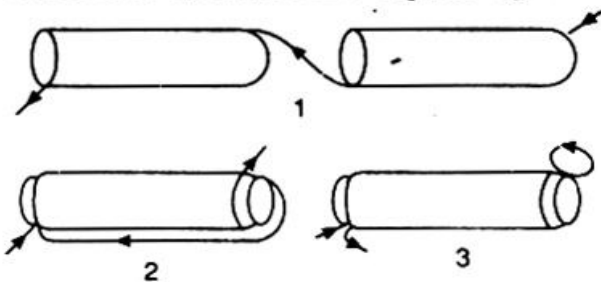
(a) $0, 4L_0, 2L_0$ (b) $4L_0, 2L_0, 0$

(c) $2L_0, 0, 4L_0$ (d) $2L_0, 4L_0, 0$

24. From figure shown below a series L-C-R circuit connected to a variable frequency 200 V source. $L = 5$ H, $C = 80\,\mu$F and $R = 40\,\Omega$. Then the source frequency which drive the circuit at resonance is :
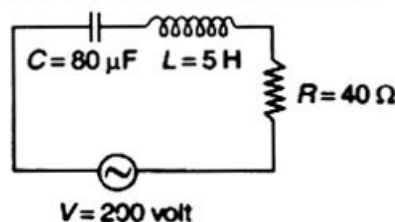
(a) 25 Hz   (b) $\dfrac{25}{\pi}$ Hz

(c) 50 Hz   (d) $\dfrac{50}{\pi}$ Hz

25. If the coefficient of mutual induction of the primary and secondary coils of an induction coil is 5 H and a current of 10 A is cut-off in 5×10^{-4} s, the emf induced (in volt) in the secondary coil is :

(a) 5×10^4 (b) 1×10^5

(c) 25×10^5 (d) 5×10^6

26. A voltage of peak value 283 V and varying frequency is applied to a series L-C-R combination in which $R = 3\,\Omega$, $L = 25$ mH and $C = 400\,\mu$F. The frequency (in Hz) of the source at which maximum power is dissipated in the above, is :

(a) 51.5   (b) 50.7

(c) 51.1   (d) 50.3

27. Four independent waves are represented by equations :

(1) $X_1 = a_1 \sin \omega t$

(2) $X_2 = a_1 \sin 2\omega t$

(3) $X_3 = a_1 \sin \omega_1 t$

(4) $X_4 = a_1 \sin (\omega t + \delta)$

Interference is possible between waves represented by equations :

(a) 3 and 4   (b) 1 and 2

(c) 2 and 3   (d) 1 and 4

28. Following diffraction pattern was obtained using a diffraction grating using two different wavelengths λ_1 and λ_2. With the help of the figure identify which is the longer wavelength and their ratios.
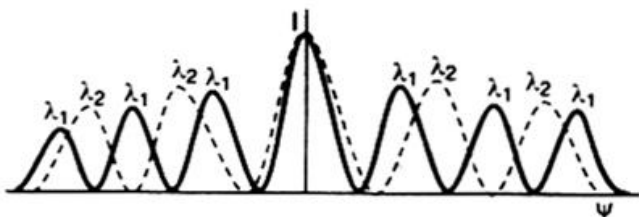
(a) λ_2 is longer than λ_1 and the ratio of the longer to the shorter wavelength is 1.5

(b) λ_1 is longer than λ_2 and the ratio of the longer to the shorter wavelength is 1.5

(c) λ_1 and λ_2 are equal and their ratio is 1.0

(d) λ_2 is longer than λ_1 and the ratio of the longer to the shorter wavelength is 2.5

29. In Young's double slit experiment, the interference pattern is found to have an intensity ratio between bright and dark fringes is 9. This implies that :

(a) the intensities at the screen due to two slits are 5 units and 4 units respectively

(b) the intensities at the screen due to the two slits are 4 units and 1 units, respectively

(c) the amplitude ratio is 7

(d) the amplitude ratio is 6

30. Rising and setting sun appears to be reddish because :

(a) diffraction sends red rays to earth at these times

(b) scattering due to dust particles and air molecules are responsible

(c) refraction is responsible

(d) polarization is responsible

31. The magnetic moment of the ground state of an atom whose open sub-shell is half-filled with five electrons is :

(a) $\sqrt{35}\sqrt{\mu_B}$ (b) $35\mu_B$

(c) $35\sqrt{\mu_B}$ (d) $\mu_B\sqrt{35}$

32. Indicate which one of the following statements is not correct?

(a) Intensities of reflections from different crystallographic planes are equal

(b) According to Bragg's law higher order of reflections have high θ values for a given wavelength of radiation

(c) For a given wavelength of radiation, there is a smallest distance between the crystallographic planes which can be determined

(d) Bragg's law may predict a reflection from a crystallographic plane to be present but it may be absent due to the crystal symmetry

33. Identify the graph which correctly represents the Moseley's law?
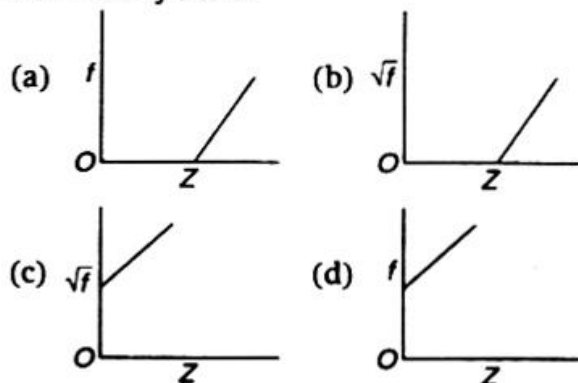
34. Assuming f to be frequency of first line in Balmer series, the frequency of the immediate next (*i.e.*, second) line is :
(a) $0.50 f$ (b) $1.35 f$
(c) $2.05 f$ (d) $2.70 f$

35. The velocity of a particle at which the kinetic energy is equal to its rest energy is :
(a) $\left(\dfrac{3c}{2}\right)$ (b) $3\dfrac{c}{\sqrt{2}}$
(c) $\dfrac{(3c)^{1/2}}{2}$ (d) $\dfrac{c\sqrt{3}}{2}$

36. One electron and one proton is accelerated by equal potential. Ratio in their de-Broglie wavelength is :
(a) 1 (b) $\dfrac{m_e}{m_p}$
(c) $\sqrt{\dfrac{m_p}{m_e}}$ (d) $\sqrt{\dfrac{m_e}{m_p}}$

37. Two electrons are moving in opposite direction with speeds $0.8\,c$ and $0.4\,c$, where c is the speed of light in vacuum. Then the relative speed is about :
(a) $0.4\,c$ (b) $0.8\,c$
(c) $0.9\,c$ (d) $1.2\,c$

38. A photo-sensitive material would emit electrons, if excited by photons beyond a threshold. To overcome the threshold, one would increase the :
(a) voltage applied to the light source
(b) intensity of light
(c) wavelength of light
(d) frequency of light

39. The radius of nucleus is :
(a) proportional to its mass number
(b) inversely proportional to its mass number
(c) proportional to the cube root of its mass number
(d) not related to its mass number

40. Radio carbon dating is done by estimating in specimen the :
(a) amount of ordinary carbon still present
(b) amount of radio carbon still present
(c) ratio of amount of $^{14}C_6$ to $^{12}C_6$ still present
(d) ratio of amount of $^{12}C_6$ to $^{14}C_6$ still present

Chemistry

41. An ion leaves its regular site occupy a position in the space between the lattice sites is called :
(a) Frenkel defect   (b) Schottky defect
(c) impurity defect   (d) vacancy defect

42. The $8 : 8$ type of packing is present in :
(a) MgF_2 (b) $CsCl$
(c) KCl (d) $NaCl$

43. When a solid melts reversibly :
(a) H decreases   (b) G increases
(c) E decreases   (d) S increases

44. Enthalpy is equal to :
(a) $T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_P$ (b) $-T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_P$
(c) $T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_V$ (d) $-T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_V$

45. Condition for spontaneity in an isothermal process is :
(a) $\Delta A + W < 0$ (b) $\Delta G + U < 0$
(c) $\Delta A + U > 0$ (d) $\Delta G - U < 0$

46. Given :
$$2C + 2O_2(g) \longrightarrow 2CO_2(g);$$
$$\Delta H = -787 \text{ kJ}$$
$$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l);$$
$$\Delta H = -286 \text{ kJ}$$
$$C_2H_2(g) + 2\frac{1}{2}O_2(g) \longrightarrow 2CO_2(g) + H_2O(l);$$
$$\Delta H = -1310 \text{ kJ}$$
The heat of formation of acetylene is :
(a) -1802 kJ   (b) $+1802$ kJ
(c) $+237$ kJ   (d) -800 kJ

47. Given the equilibrium system :
$$NH_4Cl(s) \longrightarrow NH_4^+(aq) + Cl^-(aq)$$
$$(\Delta H = +3.5 \text{ kcal/mol}).$$
What change will shift the equilibrium to the right?
(a) Decreasing the temperature
(b) Increasing the temperature

(c) Dissolving NaCl crystals in the equilibrium mixture

(d) Dissolving NH_4NO_3 crystals in the equilibrium mixture

48. According to Arrhenius equation, the rate constant (k) is related to temperature (T) as :

(a) $\ln \dfrac{k_2}{k_1} = \dfrac{E_a}{R}\left[\dfrac{1}{T_1} - \dfrac{1}{T_2}\right]$

(b) $\ln \dfrac{k_2}{k_1} = -\dfrac{E_a}{R}\left[\dfrac{1}{T_1} - \dfrac{1}{T_2}\right]$

(c) $\ln \dfrac{k_2}{k_1} = \dfrac{E_a}{R}\left[\dfrac{1}{T_1} + \dfrac{1}{T_2}\right]$

(d) $\ln \dfrac{k_2}{k_1} = -\dfrac{E_a}{R}\left[\dfrac{1}{T_1} + \dfrac{1}{T_2}\right]$

49. Equivalent amounts of H_2 and I_2 are heated in a closed vessel till equilibrium is obtained. If 80% of the hydrogen can be converted to HI, the K_c at this temperature is :

(a) 64   (b) 16

(c) 0.25   (d) 4

50. For the reaction

$$H_2(g) + I_2(g) \longrightarrow 2HI(g),$$
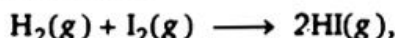
the equilibrium constant K_p changes with:

(a) total pressure

(b) catalyst

(c) the amount H_2 and I_2

(d) temperature

51. How long (in hours) must a current of 5.0 A be maintained to electroplate 60 g of calcium from molten $CaCl_2$?
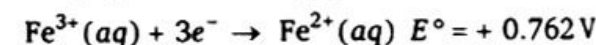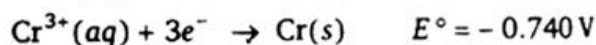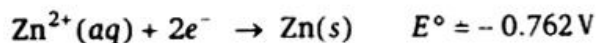
(a) 27 h   (b) 8.3 h

(c) 11 h   (d) 16 h

52. For strong electrolytes the plot of molar conductance vs $\sqrt{C}$ is :

(a) parabolic   (b) linear

(c) sinusoidal   (d) circular

53. If the molar conductance values of Ca^{2+} and Cl^- at infinite dilution are respectively 118.88×10^{-4} m^2 mho mol^{-1} and 77.33×10^{-4} m^2 mho mol^{-1} then that of $CaCl_2$ is (in m^2 mho mol^{-1}) :

(a) 118.88×10^{-4} (b) 154.66×10^{-4}

(c) 273.54×10^{-4} (d) 196.21×10^{-4}

54. The standard reduction potentials at 298 K for the following half reactions are given against each :

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ $E° = -0.762\,V$

$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$ $E° = -0.740\,V$

$2H^+(aq) + 2e^- \rightarrow H_2(g)$ $E° = 0.00\,V$

$Fe^{3+}(aq) + 3e^- \rightarrow Fe^{2+}(aq)$ $E° = +0.762\,V$

The strongest reducing agent is :

(a) $Zn(s)$ (b) $Cr(s)$

(c) $H_2(g)$ (d) $Fe^{2+}(aq)$

55. The epoxide ring consists of which of the following :

(a) three membered ring with two carbon and one oxygen

(b) four membered ring with three carbon and one oxygen

(c) five membered ring with four carbon and one oxygen

(d) six membered ring with five carbon and one oxygen

56. In the Grignard reaction, which metal forms an organometallic bond?

(a) Sodium   (b) Titanium

(c) Magnesium   (d) Palladium

57. Phenol is more acidic than :

(a) p-chlorophenol   (b) p-nitrophenol

(c) o-nitrophenol   (d) ethanol

58. Aldol condensation is given by :

(a) trimethylacetaldehyde

(b) acetaldehyde

(c) benzaldehyde

(d) formaldehyde

59. Give the IUPAC name for

$$H_3C-CH_2-\overset{\overset{O}{\|}}{C}-H_2C-CH_2-\overset{\overset{O}{\|}}{C}-OCH_3$$
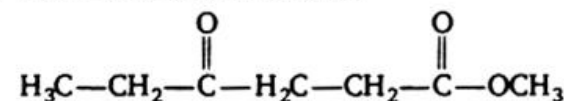
(a) ethyl-4-oxoheptanoate

(b) methyl-4-oxoheptanoate

(c) ethyl-4-oxohexanoate

(d) methyl-4-oxohexanoate

60. In which of the below reaction do we find α, β-unsaturated carbonyl compounds undergoing a ring closure reaction with conjugated dienes?

(a) Perkin reaction

(b) Diels-Alder reaction

(c) Claisen rearrangement

(d) Hofmann reaction

61. The catalyst used in Rosenmund reaction is :
    (a) Zn/Hg
    (b) Pd/BaSO$_4$
    (c) Raney Ni
    (d) Na in ethanol

62. $(CH_2CO)_2O + RMgX \xrightarrow{H_2O}$?
    (a) $ROOC(CH_2)COOR$
    (b) $RCOCH_2CH_2COOH$
    (c) $RCOOR$
    (d) $RCOOH$

63. Identify, which of the below does not possess any element of symmetry?
    (a) (+)(−) tartaric acid
    (b) Carbon tetrachloride
    (c) Methane
    (d) Meso-tartaric acid

64. The weakest acid amongst the following is :
    (a) $ClCH_2COOH$
    (b) $HCOOH$
    (c) FCH_2CH_2COOH
    (d) $CH_2(I)COOH$

65. Urea on slow heating gives :
    (a) $NH_2CONHNO_2$
    (d) $NH_2CONHCONH_2$
    (c) $HCNO$
    (d) $NH_2CONH_2 \cdot HNO_3$

66. Trans esterification is the process of :
    (a) conversion of an aliphatic acid to ester
    (b) conversion of an aromatic acid to ester
    (c) conversion of one ester to another ester
    (d) conversion of an ester into its components namely acid and alcohol

67. The correct sequence of base strengths in aqueous solution is :
    (a) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N$
    (b) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2$
    (c) $(CH_3)_3N > CH_3NH_2 = (CH_3)_2NH$
    (d) $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2$

68. When aqueous solution of benzene diazoniumchloride is boiled, the product formed is :
    (a) $C_6H_5CH_2OH$
    (b) $C_6H_6 + N_2$
    (c) C_6H_5COOH
    (d) C_6H_5OH

69. Carbylamine reaction is given by aliphatic :
    (a) primary amine
    (b) secondary amine
    (c) tertiary amine
    (d) quaternary ammonium salt

70. $C_6H_5CHO \xrightarrow{NH_3}$?
    (a) $(C_6H_5CHN)_2CH \cdot C_6H_5$
    (b) $C_6H_5NHCH_3$
    (c) $C_6H_5CH_2NH_2$
    (d) $C_6H_5NHC_6H_5$

71. In TeCl$_4$, the central atom tellurium involves :
    (a) sp^3 hybridisation
    (b) sp^3d hybridisation
    (c) sp^3d^2 hybridisation
    (d) dsp^2 hybridisation

72. Which of the following compounds volatilises on heating?
    (a) $MgCl_2$
    (b) $HgCl_2$
    (c) $CaCl_2$
    (d) $FeCl_3$

73. A nuclear reaction of $^{235}_{92}U$ with a neutron produces $^{90}_{36}Kr$ and two neutrons. Other element produced in this reaction is :
    (a) $^{137}_{52}Te$
    (b) $^{144}_{55}Cs$
    (c) $^{137}_{56}Ba$
    (d) $^{144}_{56}Ba$

74. AgCl dissolves in a solution of NH$_3$ but not in water because :
    (a) NH$_3$ is a better solvent than H$_2$O
    (b) Ag$^+$ forms a complex ion with NH$_3$
    (c) NH$_3$ is a stronger base than H$_2$O
    (d) the dipole moment of water is higher than NH$_3$

75. Which of the following is hexadentate ligand?
    (a) Ethylene diamine
    (b) Ethylene diamine tetra acetic acid
    (c) 1, 10-phenanthroline
    (d) Acetyl acetonato

76. A coordiante bond is a dative covalent bond. Which of the below is true?
    (a) Three atom form bond by sharing their electrons
    (b) Two atom form bond by sharing their electrons
    (c) Two atoms form bond and one of them provides both electrons
    (d) Two atoms form bond by sharing electrons obtained from third atom

77. Which of the following complex has zero magnetic moment (spin only)?
    (a) $[Ni(NH_3)_6]Cl_2$
    (b) $Na_3[FeF_6]$
    (c) $[Cr(H_2O)_6]SO_4$
    (d) $K_4[Fe(CN)_6]$

78. The IUPAC name of $[Ni(PPh_3)_2Cl_2]^{2+}$ is :
    (a) bis dichloro (triphenylphosphine) nickel (II)

(b) dichloro bis (triphenylphosphine) nickel (II)

(c) dichloro triphenylphosphine nickel (II)

(d) triphenyl phosphine nickel (II) dichloride

79. Among the following the compound that is both paramagnetic and coloured is :

(a) $K_2Cr_2O_7$

(b) $(NH_4)_2[TiCl_6]$

(c) $VOSO_4$

(d) $K_3[Cu(CN)_4]$

80. On an X-ray diffraction photograph the intensity of the spots depends on:

(a) neutron density of the atoms/ions

(b) electron density of the atoms/ions

(c) proton density of the atoms/ions

(d) photon density of the atoms/ions

Mathematics

81. If the normal to the curve $y = f(x)$ at (3, 4) makes an angle $\frac{3\pi}{4}$ with the positive x-axis, then $f'(3)$ is equal to :

(a) -1

(b) $\frac{3}{4}$

(c) 1

(d) $-\frac{3}{4}$

82. The function $f(x) = x^2 e^{-2x}$, $x > 0$. Then the maximum value of $f(x)$ is :

(a) $\frac{1}{e}$

(b) $\frac{1}{2e}$

(c) $\frac{1}{e^2}$

(d) $\frac{4}{e^4}$

83. If $(x + y)\sin u = x^2 y^2$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ is equal to :

(a) $\sin u$

(b) $\operatorname{cosec} u$

(c) $2\tan u$

(d) $3\tan u$

84. The angle between the tangents at those points on the curve $x = t^2 + 1$ and $y = t^2 - t - 6$ where it meets x-axis is :

(a) $\pm\tan^{-1}\left(\frac{4}{29}\right)$

(b) $\pm\tan^{-1}\left(\frac{5}{49}\right)$

(c) $\pm\tan^{-1}\left(\frac{10}{49}\right)$

(d) $\pm\tan^{-1}\left(\frac{8}{29}\right)$

85. The value of $\int_1^4 |x - 3|\, dx$ is equal to :

(a) 2

(b) $\frac{5}{2}$

(c) $\frac{1}{2}$

(d) $\frac{3}{2}$

86. The area of the region bounded by the straight lines $x = 0$ and $x = 2$, and the curves $y = 2^x$ and $y = 2x - x^2$ is equal to :

(a) $\frac{2}{\log 2} - \frac{4}{3}$

(b) $\frac{3}{\log 2} - \frac{4}{3}$

(c) $\frac{1}{\log 2} - \frac{4}{3}$

(d) $\frac{4}{\log 2} - \frac{3}{2}$

87. The value of $\int_0^\infty \frac{dx}{(a^2 + x^2)}$ is equal to :

(a) $\frac{\pi}{2}$

(b) $\frac{\pi}{2a}$

(c) $\frac{\pi}{a}$

(d) $\frac{1}{2a}$

88. The value of the integral $\int e^x \left(\frac{1-x}{1+x^2}\right)^2 dx$ is :

(a) $e^x\left(\frac{1-x}{1+x^2}\right) + c$

(b) $e^x\left(\frac{1+x}{1+x^2}\right) + c$

(c) $\frac{e^x}{1+x^2} + c$

(d) $e^x(1-x) + c$

89. If $x\sin\left(\frac{y}{x}\right)dy = \left[y\sin\left(\frac{y}{x}\right) - x\right]dx$ and $y(1) = \frac{\pi}{2}$, then the value of $\cos\left(\frac{y}{x}\right)$ is equal to :

(a) x

(b) $\frac{1}{x}$

(c) $\log x$

(d) e^x

90. The differential equation of the system of all circles of radius r in the xy plane is :

(a) $\left[1 + \left(\frac{dy}{dx}\right)^3\right]^2 = r^2\left(\frac{d^2y}{dx^2}\right)^2$

(b) $\left[1 + \left(\frac{dy}{dx}\right)^3\right]^2 = r^2\left(\frac{d^2y}{dx^2}\right)^3$

(c) $\left[1+\left(\dfrac{dy}{dx}\right)^2\right]^3 = r^2\left(\dfrac{d^2y}{dx^2}\right)^2$

(d) $\left[1+\left(\dfrac{dy}{dx}\right)^2\right]^3 = r^2\left(\dfrac{d^2y}{dx^2}\right)^3$

91. The general solution of the differential equation $\dfrac{d^2y}{dx^2} + 2\dfrac{dy}{dx} + y = 2e^{3x}$ is given by :

(a) $y = (c_1 + c_2 x)\,e^x + \dfrac{e^{3x}}{8}$

(b) $y = (c_1 + c_2 x)\,e^{-x} + \dfrac{e^{-3x}}{8}$

(c) $y = (c_1 + c_2 x)\,e^{-x} + \dfrac{e^{3x}}{8}$

(d) $y = (c_1 + c_2 x)\,e^x + \dfrac{e^{-3x}}{8}$

92. The solution of the differential equation $y\,dx + (x - y^3)\,dy = 0$ is :

(a) $xy = \dfrac{1}{3} y^3 + c$ (b) $xy = y^4 + c$

(c) $y^4 = 4xy + c$ (d) $4y = y^3 + c$

93. The number of integral solutions of $x_1 + x_2 + x_3 = 0$, with $x_i \geq -5$, is :

(a) $^{15}C_2$ (b) $^{16}C_2$

(c) $^{17}C_2$ (d) $^{18}C_2$

94. Let $A = \{1, 2, 3, \ldots, n\}$ and $B = \{a, b, c\}$, then the number of functions from A to B that are onto is :

(a) $3^n - 2^n$ (b) $3^n - 2^n - 1$

(c) $3(2^n - 1)$ (d) $3^n - 3(2^n - 1)$

95. Everybody in a room shakes hands with everybody else. The total number of hand shakes is 66. The total number of persons in the room is :

(a) 9   (b) 12

(c) 10   (d) 14

96. In a group $G = \{1, 3, 7, 9\}$ under multiplication modulo 10, the inverse of 7 is :

(a) 7   (b) 3

(c) 9   (d) 1

97. A box contains 9 tickets numbered 1 to 9 inclusive. If 3 tickets are drawn from the box one at a time, the probability that they are alternatively either {odd, even, odd} or {even, odd, even} is :

(a) $\dfrac{5}{17}$ (b) $\dfrac{4}{17}$

(c) $\dfrac{5}{16}$ (d) $\dfrac{5}{18}$

98. If $P(A) = \dfrac{1}{12}$, $P(B) = \dfrac{5}{12}$ and $P\left(\dfrac{B}{A}\right) = \dfrac{1}{15}$, then $P(A \cup B)$ is equal to :

(a) $\dfrac{89}{180}$ (b) $\dfrac{90}{180}$

(c) $\dfrac{91}{180}$ (d) $\dfrac{92}{180}$

99. If the probability density function of a random variable X is $f(x) = \dfrac{x}{2}$ in $0 \leq x \leq 2$, then $P(X > 1.5 \mid X > 1)$ is equal to :

(a) $\dfrac{7}{16}$ (b) $\dfrac{3}{4}$

(c) $\dfrac{7}{12}$ (d) $\dfrac{21}{64}$

100. If X follows a binomial distribution with parameters $n = 100$ and $p = \dfrac{1}{3}$, then $P(X = r)$ is maximum when r is equal to :

(a) 16   (b) 32

(c) 33   (d) none of these

101. If $A(\theta) = \begin{bmatrix} 1 & \tan\theta \\ -\tan\theta & 1 \end{bmatrix}$ and $AB = I$, then $(\sec^2\theta)\,B$ is equal to :

(a) $A(\theta)$ (b) $A\left(\dfrac{\theta}{2}\right)$

(c) $A(-\theta)$ (d) $A\left(\dfrac{-\theta}{2}\right)$

102. If $x = -5$ is a root of $\begin{vmatrix} 2x+1 & 4 & 8 \\ 2 & 2x & 2 \\ 7 & 6 & 2x \end{vmatrix} = 0$, then the other roots are :

(a) 3, 3.5   (b) 1, 3.5

(c) 1, 7   (d) 2, 7

103. The simultaneous equations $Kx + 2y - z = 1$, $(K - I)y - 2z = 2$ and $(K + 2)z = 3$ have only one solution when :

(a) $K = -2$ (b) $K = -1$

(c) $K = 0$ (d) $K = 1$

104. If the rank of the matrix $\begin{bmatrix} -1 & 2 & 5 \\ 2 & -4 & a-4 \\ 1 & -2 & a+1 \end{bmatrix}$ is 1, then the value of a is :

(a) -1 (b) 2

(c) -6 (d) 4

105. If $b^2 \geq 4ac$ for the equation $ax^4 + bx^2 + c = 0$, then all the roots of the equation will be real if :

(a) $b > 0, a < 0, c > 0$

(b) $b < 0, a > 0, c > 0$

(c) $b > 0, a > 0, c > 0$

(d) $b > 0, a > 0, c < 0$

106. If $x > 0$ and $\log_3 x + \log_3(\sqrt{x}) + \log_3(\sqrt[4]{x}) + \log_3(\sqrt[8]{x}) + \log_3(\sqrt[16]{x}) + \ldots = 4$, then x equals :

(a) 9   (b) 81

(c) 1   (d) 27

107. The number of real roots of the equation $\left(x + \dfrac{1}{x}\right)^3 + x + \dfrac{1}{x} = 0$ is :

(a) 0   (b) 2

(c) 4   (d) 6

108. If H is the harmonic mean between P and Q, then the value of $\dfrac{H}{P} + \dfrac{H}{Q}$ is :

(a) 2   (b) $\dfrac{PQ}{P+Q}$

(c) $\dfrac{1}{2}$ (d) $\dfrac{P+Q}{PQ}$

109. If $\vec{b}$ is a unit vector, then $(\vec{a} \cdot \vec{b})\vec{b} + \vec{b} \times (\vec{a} \times \vec{b})$ is :

(a) $|\vec{a}|^2\, \vec{b}$ (b) $|\vec{a} \cdot \vec{b}|\, \vec{a}$

(c) $\vec{a}$ (d) $\vec{b}$

110. If θ is the angle between the lines AB and AC where A, B and C are the three points with coordinates $(1, 2, -1)$, $(2, 0, 3)$, $(3, -1, 2)$ respectively, then $\sqrt{462}\,\cos\theta$ is equal to :

(a) 20   (b) 10

(c) 30   (d) 40

111. Let the pairs $\vec{a}, \vec{b}$ and $\vec{c}, \vec{d}$ each determine a plane. Then the planes are parallel, if :

(a) $(\vec{a} \times \vec{c}) \times (\vec{b} \times \vec{d}) = \vec{0}$

(b) $(\vec{a} \times \vec{c}) \cdot (\vec{b} \times \vec{d}) = 0$

(c) $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) = \vec{0}$

(d) $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d}) = 0$

112. The area of a parallelogram with $3\hat{i} + \hat{j} - 2\hat{k}$ and $\hat{i} - 3\hat{j} + 4\hat{k}$ as diagonals is :

(a) $\sqrt{72}$ (b) $\sqrt{73}$

(c) $\sqrt{74}$ (d) $\sqrt{75}$

113. If $\cos x + \cos^2 x = 1$, then the value of $\sin^{12} x + 3\sin^{10} x + 3\sin^8 x + \sin^6 x - 1$, is equal to :

(a) 2   (b) 1

(c) -1 (d) 0

114. The product of all values of $(\cos\alpha + i\sin\alpha)^{3/5}$ is :

(a) 1

(b) $\cos\alpha + i\sin\alpha$

(c) $\cos 3\alpha + i\sin 3\alpha$

(d) $\cos 5\alpha + i\sin 5\alpha$

115. The imaginary part of $\dfrac{(1+i)^2}{i(2i-1)}$ is :

(a) $\dfrac{4}{5}$ (b) 0

(c) $\dfrac{2}{5}$ (d) $-\dfrac{4}{5}$

116. If $\sin^{-1} x + \sin^{-1} y = \dfrac{\pi}{2}$, then $\cos^{-1} x + \cos^{-1} y$ is equal to :

(a) $\dfrac{\pi}{2}$ (b) $\dfrac{\pi}{4}$

(c) π (d) $\dfrac{3\pi}{4}$

117. The equation of a directrix of the ellipse $\dfrac{x^2}{16} + \dfrac{y^2}{25} = 1$ is :

(a) $3y = 5$ (b) $y = 5$

(c) $3y = 25$ (d) $y = 3$