VITEEE 2007 Question Paper

PART - I (PHYSICS)

1. 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) $\mu_B\sqrt{35}$

2. Indicate which one of the following statements is NOT CORRECT ?

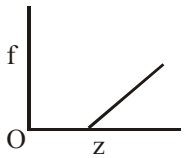
   (a) Intensities of reflections from different crystallographic planes are equal

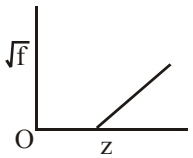
   (b) According to Bragg's law higher order of reflections have high θ values for a given wavelength of radiation

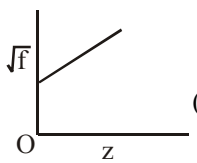
   (c) For a given wavelength of radiation there is a smallest distance between the crystallographic planes which can be determined

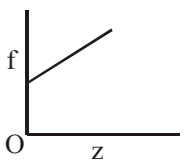
   (d) Bragg's law may predict a reflection from a crystallographic plane to be present but it may be absent due to the crystal symmetry

3. Identify the graph which correctly represents the Moseley's law

   (a) 

   (b) 

   (c) 

   (d) 

4. Assuming f to be the 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

5. The velocity of a particle at which the kinetic energy is equal to its rest energy is

   (a) $\left(\frac{3c}{2}\right)$ (b) $3\frac{c}{\sqrt{2}}$

   (c) $\frac{(3c)^{\frac{1}{2}}}{2}$ (d) $\frac{c\sqrt{3}}{2}$

6. One electron and one proton is accelerated by equal potential. Ratio in their deBroglie wavelength is

   (a) 1 (b) $\frac{m_e}{m_p}$

   (c) $\frac{m_p}{m_e}$ (d) $\sqrt{\frac{m_e}{m_p}}$

7. Two electrons one moving in opposite direction with speeds 0.8c and 0.4c where c is the speed of light in vacuum. Then the relative speed is about

   (a) 0.4c (b) 0.8c

   (c) 0.9c (d) 1.2 c

8. A photo-sensitive material would emit electrons if excited by photons beyond a threshold. To overcome the threshold, one would increase

   (a) the voltage applied to the light source

   (b) the intensity of light

   (c) the wavelength of light

   (d) the frequency of light

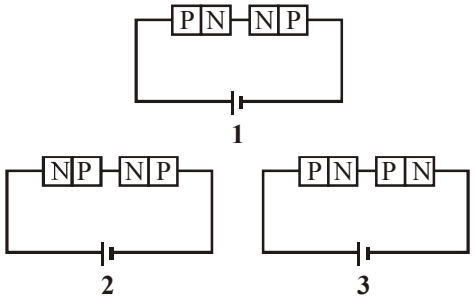
9. The radius of nucleus is
   (a) proportional to its mass number
   (b) inversely proportional to its mass number
   (c) proportional to the cube root of its mass number
   (d) not related to its mass number

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

11. 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

12. 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

13. 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) in circuits 2 and 3
   (b) in circuits 1 and 2
   (c) in circuits 1 and 3
   (d) in none of the circuit

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

15. Identify the logic gate from the following TRUTH table

Inputs		Output
A	**B**	**Y**
0	0	1
0	1	0
1	0	0
1	1	0

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

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

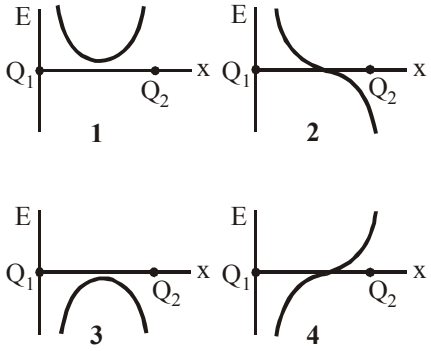
17. Radar waves are sent towards a moving airplane and the reflected waves are received. When the airplane is moving towards the radar, the wavelength of the wave
   (a) decrease
   (b) increase
   (c) remains the same
   (d) sometimes increase or decrease

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

19. 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

20. The antenna current of an AM transmitter is 8A when only the carrier is sent, but it increases to 8.93A 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%

21. Two point like charges Q1 and Q2 of whose strength are equal in absolute value are placed at a certain distance from each other. Assuming the field strength to be posiive in the positive direction of x-axis the signs of the charges Q1 and Q2 for the graphs (field strength versus distance) shown in Figures 1,2,3 and 4 are



(a) Q1 positive, Q2 negative; both positive; Q1 negative, Q2 positive; both negative

(b) Q1 negative, Q2 positive;Q1 positive, Q2 negative; both positive; both negative

(c) Q1 positive, Q2 negative; both negative; Q1 negative, Q2 positive; both positive

(d) Both positive; Q1 positive, Q2 negative; Q1 negative, Q2 positive; both negative

22. ABCD is a rectangle. At corners B, C and D of the rectangle are placed charges + 10×10^{-12}C, -20×10^{-12}C and 10×10^{-12}C respectively. Calculate the potential at the fourth corner. The side AB = 4cm and BC = 3cm

(a) 1.65 V (b) 0.165 V

(c) 16.5 V (d) 2.65 V

23. 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

24. The electric field intensity E, due to an electric dipole of moment $\vec{p}$, at a point on the equatorial line is

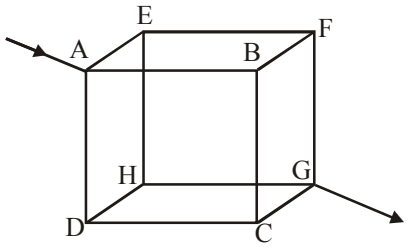
(a) parallel to the axis of the dipole and opposite to the direction of the dipole moment $\vec{p}$

(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 toward it

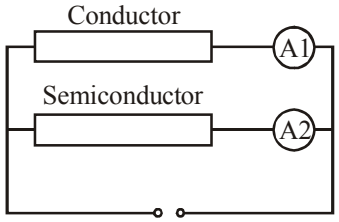
25. Twelve wires of each of resistance 6 ohms are connected to form a cube as shown in the figure. The current enters at a corner A and leaves at the diagonally opposite corner G. The joint resistance across the corners A and G are



(a) 12 ohms (b) 6 ohms

(c) 3 ohms (d) 5 ohms

26. A conductor and a semi-conductor are connected in parallel as shown in the figure. At a certain voltage both ammeters registers the same current. If the voltage of the DC source is increased then



(a) the ammeter connected to the semiconductor will register higher current than the ammeter connected to the conductor

(b) the ammeter connected to the conductor will register higher current than the ammeter connected to the semiconductor

(c) the ammeters connected to both semiconductor and conductor will register the same current

(d) the ammeter connected to both semiconductor and conductor will register no change in the current

27. A uniform copper wire of length 1m and cross-sectional area $5\times10^{-7}m^2$ carries a current of 1A. Assuming that there are 8×10^{28} free electrons/m^3 in copper, how long will an electron take to drift from one end of the wire to the other

(a) 0.8×10^3s (b) 1.6×10^3s

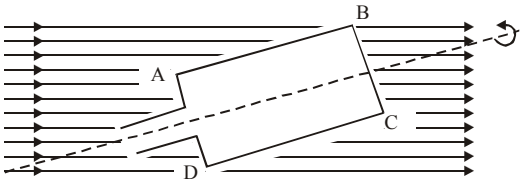
(c) 3.2×10^3s (d) 6.4×10^3s

28. The temperature coefficient of resistance of a wire is 0.00125/K. At 300K 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

29. 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 degrees to the magnetic field

(b) perpendicular to the magnetic field

(c) inclined at 45 degrees to the magnetic field

(d) parallel to the magnetic field

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

(a) neutral temperature $t_n = -a/b$

(b) temperature of inversion $t_i = -2a/b$

(c) thermo-electric power $p = a + bt$

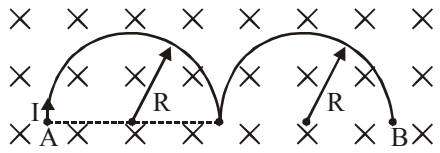
(d) $t_n = a/b$

31. 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) 10^7Hz (b) 10^5Hz

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

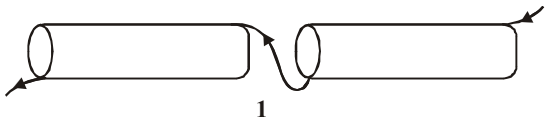
32. A wire AB, in the shape of two semicircular segments of radius R each and carrying a current I, is placed in a uniform magnetic field B directed into the page (see figure). The magnitude of the force due to the field B on the wire AB is



(a) zero (b) 4 RIB

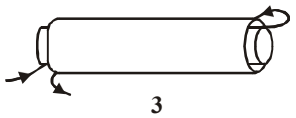
(c) $\pi R^2 I B$ (d) $2\pi R I B$

33. 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 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



1

2

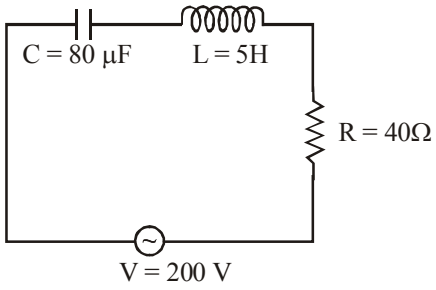


3

(a) $0, 4L_0, 2L_0$ (b) $4L_0, 2L_0, 0$

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

34. From figure shown below a series LCR circuit connected to a variable frequency 200V source. L = 5H, C = 80 μF and R = 40 Ω . Then the source frequency which drive the circuit at resonance is



(a) 25 Hz (b) $\frac{25}{\pi}$ Hz

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

35. If the coefficient of mutual induction of the primary and secondary coils of an induction coil is 5H and a current of 10A is cut off in 5×10^{-4} second, 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}

36. A voltage of peak value 283 V and varying frequency is applied to a series L, C, R combination in which R = 3 ohm, L=25 mH and C= 400μF. 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

37. Four independent waves are represented by equations

(1) $X_1 = a_1\sin\omega t$ (3) $X_2 = a_2\sin2\omega t$

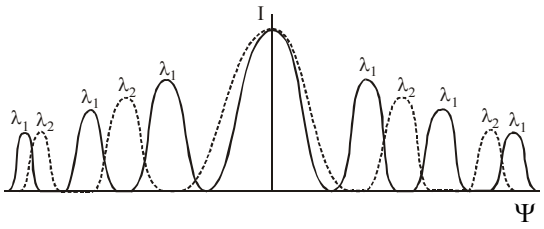
(2) $X_3 = a_1\sin\omega_1 t$ (4) $X_4 = a_1\sin(\omega t+\delta)$

Interference is possible between waves represented by equations

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

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

38. 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

39. 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 the

(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

40. 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

PART - II (CHEMISTRY)

41. The catalyst used in Rosenmund reaction is

(a) Zn / Hg (b) Pd / $BaSO_4$

(c) Raney Ni (d) Na in Ethanol

42. $(CH_2CO)_2O + RMgX \xrightarrow{H_2O} ?$

(a) $ROOC(CH_2)COOR$

(b) $RCOCH_2CH_2COOH$

(c) RCOOR

(d) RCOOH

43. Identify, which of the below does not possess any element of symmetry?
(a) (+)– Tartaric acid
(b) Carbon tetrachloride
(c) Methane
(d) Mesotartatric acid

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

45. $HOOC-(CH_2)_4-COOH+2C_2H_5OH \xrightarrow[\text{Toluene}]{H_2SO_4} C_2H_5OOC-CH_2-COOC_2H_5$

The purpose of using toluene here is
(a) to make both substances (acid & alcohol) miscible
(b) that the product is insoluble in toluene
(c) that the reactants are insoluble in water
(d) because of the formation of low boiling azotrope

46. 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

47. 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) $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2$

48. 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

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

50. $C_6H_5CHO \xrightarrow[H_2,Ni]{NH_3} ?$
(a) $C_6H_5NH_2$ (b) $C_6H_5NHCH_3$
(c) $C_6H_5CH_2NH_2$ (d) $C_6H_5NHC_6H_5$

51. In $TeCl_4$ the central atom tellurium involves
(a) sp^3 hybridization
(b) sp^3d hybridization
(c) sp^3d^2 hybridization
(d) dsp^2 hybridization

52. The purple colour of $KMnO_4$ is due to the transition
(a) C.T. (L→M) (b) C.T. (M→L)
(c) d – d (d) p –d

53. 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) $^{144}_{56}Ba$

54. AgCl dissolves in a solution of NH_3 but not in water because
(a) NH_3 is a better solvent than H_2O
(b) Ag^+ forms a complex ion with NH_3
(c) NH_3 is a stronger base than H_2O
(d) the dipole moment of water is higher than NH_3

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

56. A coordinate bond is a dative covalent bond. Which of the below is true?
(a) Three atoms form bond by sharing their electrons
(b) Two atoms 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

57. 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) $K_4[Fe(CN)_6]$

58. 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

59. 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) $K_3Cu(CN)_4$

60. 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

61. 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

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

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

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

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

66. Given: $2C(s) + 2O_2(g) \rightarrow 2CO_2(g);$

$\Delta H = -787kJ$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell);\ \Delta H = -286kJ$

$C_2H_2(g) + 2\frac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(\ell)$

$;\Delta H = -1310kJ$

The heat of formation of acetylene is
(a) –1802 kJ (b) +1802 kJ
(c) +237 kJ (d) –800 kJ

67. Given the equilibrium system:
$NH_4Cl(s) \rightarrow NH_4^+(aq) + Cl^-(aq)$
$(\Delta H = +3.5kcal/mol).$
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

68. According to Arrhenius equation, the rate constant (k) is related to temperature (T) as
(a) $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$
(b) $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$
(c) $\ln\frac{k_2}{k_1} = \frac{E_a}{R}\left[\frac{1}{T_1} + \frac{1}{T_2}\right]$
(d) $\ln\frac{k_2}{k_1} = -\frac{E_a}{R}\left[\frac{1}{T_1} + \frac{1}{T_2}\right]$

69. 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 Kc at this temperature is
(a) 64 (b) 16
(c) 0.25 (d) 4

70. For the reaction $H_2(g)+I_2(g)\rightarrow 2HI(g)$, the equilibrium constant Kp changes with
(a) total pressure
(b) catalyst
(c) the amount H_2 and I_2
(d) temperature

71. How long (in hours) must a current of 5.0 amperes be maintained to electroplate 60g of calcium from molten $CaCl_2$?
(a) 27 hours (b) 8.3 hours
(c) 11 hours (d) 16 hours

72. For strong electrolytes the plot of molar conductance vs $\sqrt{C}$ is
(a) parabolic (b) linear
(c) sinusoidal (d) circular

73. 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}

74. The standard reduction potentials at 298K for the following half reactions are given against each
$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$ $E_0 = -0.762$ V
$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$ $E_0 = -0.740$ V
$2H^+(aq) + 2e^- \rightarrow H_2(g)$ $E_0 = 0.00$ V
$Fe^{3+}(aq) + 3e^- \rightarrow Fe^{2+}(aq)$ $E_0 = +0.762$ V
The strongest reducing agent is
(a) Zn(s) (b) Cr(s)
(c) $H_2(g)$ (d) $Fe^{2+}(aq)$

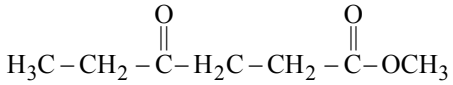
75. The epoxide ring consists of which of the following ?
(a) Three membered ring with two carbon and one oxygen
(b) Four membered ring with three carbon and one oxygen
(c) Five membered ring with four carbon and one oxygen
(d) Six membered ring with five carbon and one oxygen

76. In the Grignard reaction, which metal forms an organometallic bond?
(a) Sodium (b) Titanium
(c) Magnesium (d) Palladium

77. Phenol is less acidic than
(a) p-chlorophenol
(b) p-nitrophenol
(c) p-methoxyphenol
(d) ethanol

78. Aldol condensation is given by
(a) trimethylacetaldehyde
(b) acetaldehyde
(c) benzaldehyde
(d) formaldehyde

79. Give the IUPAC name for



(a) Ethyl-4-oxoheptonate
(b) Methyl-4-oxoheptonate
(c) Ethyl-4-oxohexonate
(d) Methyl-4-oxohexonate

80. 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) Hoffman reaction

PART - III (MATHEMATICS)

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

82. 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) $\sqrt{75}$

83. 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

84. The product of all values of $(\cos\alpha+i\sin\alpha)^{3/5}$ is equal to
(a) 1 (b) $\cos\alpha+i\sin\alpha$
(c) $\cos3\alpha+i\sin3\alpha$ (d) $\cos5\alpha+i\sin5\alpha$

85. The imaginary part of $\dfrac{(1+i)^2}{i(2i-1)}$ is
(a) $\dfrac{4}{5}$ (b) 0
(c) $\dfrac{2}{5}$ (d) $-\dfrac{4}{5}$

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

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

(c) π (d) $\frac{3\pi}{4}$

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

(a) $3y = 5$ (b) $y = 5$
(c) $3y = 25$ (d) $y = 3$

88. If the normal at $(ap^2, 2ap)$ on the parabola $y^2 = 4ax$, meets the parabola again at $(aq^2, 2aq)$, then
(a) $p^2 + pq + 2 = 0$ (b) $p^2 - pq + 2 = 0$
(c) $q^2 + pq + 2 = 0$ (d) $p^2 + pq + 1 = 0$

89. The length of the straight line $x - 3y = 1$ intercepted by the hyperbola $x^2 - 4y^2 = 1$ is

(a) $\sqrt{10}$ (b) $\frac{6}{5}$

(c) $\frac{1}{\sqrt{10}}$ (d) $\frac{6}{5}\sqrt{10}$

90. The curve described parametrically by $x = t^2 + 2t - 1$, $y = 3t + 5$ represents
(a) an ellipse (b) a hyperbola
(c) a parabola (d) a circle

91. 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) $-\frac{3}{4}$

92. 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) $\frac{4}{e^4}$

93. If $(x + y)\sin u = x^2y^2$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

(a) $\sin u$ (b) $\operatorname{cosec} u$
(c) $2 \tan u$ (d) $\tan u$

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

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

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

(c) $\frac{1}{2}$ (d) $\frac{3}{2}$

96. 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) $\frac{4}{\log 2} - \frac{3}{2}$

97. The value of $\int_0^\infty \frac{dx}{\left(a^2 + x^2\right)^7}$ is equal to

(a) $\frac{231}{2047}\left(\frac{1}{a^{13}}\right)$ (b) $\frac{235}{2048}\left(\frac{1}{a^{13}}\right)$

(c) $\frac{232}{2047}\left(\frac{1}{a^{13}}\right)$ (d) $\frac{231}{2048}\left(\frac{1}{a^{13}}\right)$

98. 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) $e^x(1-x)+C$

99. 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

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

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

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

(a) $y=(c_1+c_2x)e^x+\frac{e^{3x}}{8}$

(b) $y=(c_1+c_2x)e^{-x}+\frac{e^{-3x}}{8}$

(c) $y=(c_1+c_2x)e^{-x}+\frac{e^{3x}}{8}$

(d) $y=(c_1+c_2x)e^x+\frac{e^{-3x}}{8}$

102. The solution of the differential equation $ydx+(x-y^3)dy=0$ is

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

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

103. The number of positive integral solutions of the equation $x_1x_2x_3x_4x_5=1050$ is

(a) 1870 (b) 1875

(c) 1865 (d) 1880

104. Let A= {1,2,3,....., 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) $3^n-3(2^n-1)$

105. 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

106. If(G,*) is a group and the order of an element $a\in G$ is 10, then the order of the inverse of a* a is

(a) 10 (b) $\frac{1}{10}$

(c) 5 (d) $\frac{1}{5}$

107. 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) $\frac{5}{17}$ (b) $\frac{4}{17}$

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

108. If $P(A) = \frac{1}{12}$, $P(B) = \frac{5}{12}$ and $P(B/A) = \frac{1}{15}$ then $p(A \cup B)$ is equal to

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

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

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

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

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

110. If X is a poisson variate such that $2P(X = 0) + P(X = 2) = 2P(X = 1)$ then E(X) is equal to

(a) 1 (b) 2

(c) 1.5 (d) 1.75

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

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

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

112. 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

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

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

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

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

(a) –1 (b) 2

(c) –6 (d) 4

115. If $b^2 \ge 4ac$ 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) $b>0, a>0, c<0$

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

(a) 9 (b) 81

(c) 1 (d) 27

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

(a) 0 (b) 2

(c) 4 (d) 6

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

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

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

119. If $\vec{a}$ and $\vec{b}$ are two unit vectors, then the vector $(\vec{a} + \vec{b}) \times (\vec{a} \times \vec{b})$ is parallel to the vector

(a) $\vec{a} + \vec{b}$ (b) $2\vec{a} + \vec{b}$

(c) $\vec{a} - \vec{b}$ (d) $2\vec{a} - \vec{b}$

120. 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