



Previous Year Solved Question Paper
of

G.A.T.E. (XL) 2003

LIFE SCIENCES

XL: Chemistry

Examination

(Original Question Paper with Answer Key)

GRADUATE APTITUDE TEST IN ENGINEERING



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I : Chemistry (Compulsory)

[Useful data: Planck's constant, $h = 6.63 \times 10^{-34}$ Js; Mass of electron = 9.1×10^{-31} kg;
Rydberg constant = 109677 cm^{-1} ; $\pi = 3.142$]

Q.1 – 10 carry one mark each

- Q.1 In ice, each oxygen atom of water molecule is
- (A) bonded only covalently to two hydrogen atoms
 - (B) bonded covalently to two hydrogen atoms and hydrogen-bonded to two other hydrogen atoms
 - (C) hydrogen-bonded to four hydrogen atoms
 - (D) bonded only covalently to four hydrogen atoms
- Q.2 I_2 exists in the solid form under normal temperature and pressure. The principal intermolecular forces holding together iodine molecules in solid is
- (A) covalent
 - (B) metallic
 - (C) ionic
 - (D) van der Waals
- Q.3 Burning of phosphorus in the presence of air produces a highly hygroscopic white compound, which reacts with water to yield
- (A) H_3PO_4
 - (B) H_3PO_2
 - (C) $\text{H}_4\text{P}_2\text{O}_7$
 - (D) $\text{H}_4\text{P}_2\text{O}_6$
- Q.4 The minimum uncertainty in the speed of an electron in a one dimensional box of length 10^{-10} m is
- (A) 580 m/s
 - (B) 580 km/s
 - (C) 1160 km/s
 - (D) 5800 km/s
- Q.5 Which one of the following explains the origin of colligative properties correctly?
- (A) Increase of the chemical potential of the liquid solvent due to added solute
 - (B) Reduction of the chemical potential of the liquid solvent due to added solute
 - (C) Influence of the solute on the chemical potential of the solvent vapour
 - (D) Influence of the solute on the chemical potential of the solid solvent
- Q.6 For a zero order reaction, $\text{A} \rightarrow \text{P}$, if the initial concentration of species A is $[\text{A}]_0$, then $t_{1/2}$ can be expressed as
- (A) $[\text{A}]_0/k$
 - (B) $1/k$
 - (C) $2[\text{A}]_0/k$
 - (D) $[\text{A}]_0/2k$
- Q.7 Which one of the following compounds is most acidic?
- (A) Protonated methanol
 - (B) Protonated methylamine
 - (C) Acetic acid
 - (D) Methanol

- Q.8 For a compound to be aromatic, how many π electrons must be in the π cloud?
- (A) An even number of pairs (B) An odd number
(C) An even number (D) An odd number of pairs
- Q.9 Which one of the following alkyl halides would be the most stable in water?
- (A) Cyclopropenyl bromide (B) Cyclopentadienyl bromide
(C) Cyclopropyl bromide (D) Bromobenzene
- Q.10 What starting materials must be used in order to have a 1,4-cyclohexadiene to be the product of a Diels Alder reaction?
- (A) A conjugated diene and an alkene (B) A conjugated diene and an alkyne
(C) A 1,4-diene and an alkyne (D) A 1,2-diene and an alkyne

Q.11 – 30 carry two marks each

- Q.11 The single-bond length between carbon and the elements viz., carbon, nitrogen, oxygen and fluorine follow the order $C-C > C-N > C-O > C-F$. This trend is due to
- (A) increase in electronegativity (B) increase in bond polarity
(C) increase in atomic weight (D) decrease in atomic size
- Q.12 By applying the VSEPR model on the XeF_4 molecule, which one of the following statements is true?
- (A) Has four bonding pairs and a lone pair
(B) Has octahedral geometry and square planar shape
(C) Has square planar geometry and octahedral shape
(D) Has tetrahedral geometry and tetrahedral shape
- Q.13 Which one of the following statements is **NOT** true for borazine and benzene?
- (A) They are isoelectronic
(B) Both are aromatic
(C) Both undergo addition reactions
(D) Both undergo substitution reactions
- Q.14 The action of NH_3 on S_2Cl_2 produces a thermochromic crystalline compound, whose chemical formula is
- (A) S_3N_3Cl (B) S_4N_3Cl
(C) S_2N_2 (D) S_4N_4
- Q.15 The oxidation state of Fe and S in $Na_2[Fe(CO)_4Cl_2]$ and $K_2S_2O_8$, respectively are
- (A) 0 and +5 (B) +2 and +7
(C) +4 and +5 (D) 0 and +4
- Q.16 The structure of $Ni(CO)_4$ is
- (A) square planar (B) trigonal pyramidal
(C) tetrahedral (D) distorted octahedral

- Q.17 The reaction of CuCO_3 with acetic acid produces a blue crystalline compound with its magnetic moment (μ_{eff}) being $\sim 1.4 \text{ B.M./Cu}$. The compound is
- (A) $\text{Cu}(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$ (B) $\text{Cu}_2\text{CO}_3(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$
 (C) $\text{Cu}(\text{CH}_3\text{COO})_2$ (D) $\text{Cu}_2(\text{CH}_3\text{COO})_2 \cdot 2\text{H}_2\text{O}$
- Q.18 The limiting ionic conductivities of Mg^{2+} and Cl^- in H_2O at 298 K are 10.60 and $7.635 \text{ mS m}^2 \text{ mol}^{-1}$, respectively. The limiting molar conductivity (in $\text{mS m}^2 \text{ mol}^{-1}$) of MgCl_2 in H_2O at 298 K is
- (A) 18.235 (B) 25.870
 (C) 28.835 (D) 60.893
- Q.19 The longest wavelength transition in the Balmer series of atomic hydrogen is
- (A) 656.5 nm (B) 6564.7 nm
 (C) 15233 nm (D) 65647 nm
- Q.20 In a liquid vapour phase boundary, a plot of \ln vapour pressure against the reciprocal of temperature would yield as slope
- (A) $\Delta_{\text{vap}}H/R$ (B) $-\Delta_{\text{vap}}H/R$
 (C) $\Delta_{\text{vap}}H/\Delta_{\text{vap}}V$ (D) $\Delta_{\text{vap}}H/R^2$
- Q.21 For a first order reaction, $\text{A} \rightarrow \text{P}$, the time required to complete 80% of the reaction is
- (A) $\ln 1.25/k$ (B) $\ln 8/k$
 (C) $\ln 5/k$ (D) $\ln 80/k$
- Q.22 If the molar enthalpy and entropy of fusion of water are 6.01 kJ/mol and 22.0 J/mol K , respectively, the ΔG for the melting of ice at 10°C is
- (A) -6220 kJ/mol (B) -214 kJ/mol
 (C) -5.79 kJ/mol (D) -0.22 kJ/mol
- Q.23 When steady state approximation is applied in enzyme kinetics, which one of the following statements is correct with regard to the concentration of the enzyme substrate complex, $[\text{ES}]$
- (A) $d[\text{ES}]/dt = 0$ (B) $d[\text{ES}]/dt = \text{constant}$
 (C) $[\text{ES}] = 0$ (D) $d[\text{ES}]/dt = \text{infinity}$
- Q.24 The wavelength possessed by a cricket ball of mass 1 kg, travelling with a velocity of 40 m/s is
- (A) $1.66 \times 10^{-38} \text{ m}$ (B) $1.66 \times 10^{-35} \text{ m}$
 (C) $2.65 \times 10^{-32} \text{ m}$ (D) $1.66 \times 10^{-33} \text{ m}$
- Q.25 Which one of the following reaction sequences will convert toluene to *para*-chlorobenzoic acid?
- (A) (i) Cl_2/light , (ii) hot KMnO_4/H^+
 (B) (i) hot KMnO_4/H^+ , (ii) $\text{Cl}_2/\text{FeCl}_3$
 (C) (i) $\text{Cl}_2/\text{FeCl}_3$, (ii) hot KMnO_4/H^+
 (D) (i) *N*-Chlorosuccinimide, (ii) hot KMnO_4/H^+

- Q.26 For 2,3-dibromobutane, which one of the following statement is true?
- (A) (2S, 3S) and (2R, 3S) is a pair of diastereomers; (2R, 3R) and (2S, 3S) is a pair of enantiomers
- (B) (2S, 3S) and (2R, 3S) is a pair of diastereomers; (2R, 3S) and (2S, 3R) is a pair of enantiomers
- (C) (2R, 3R) and (2S, 3S) is a pair of diastereomers; (2S, 3S) and (2R, 3S) is a pair of enantiomers
- (D) (2R, 3R) and (2S, 3S) is a pair of diastereomers; (2R, 3R) and (2S, 3S) is a pair of enantiomers
- Q.27 When *trans*-1-bromo-2-methylcyclohexane reacts with methoxide ion, what products are formed under S_N2 and S_N1 conditions?
- (A) S_N2 and S_N1 both form *cis* and *trans*-1-methoxy-2-methylcyclohexane
- (B) S_N2 forms *cis*-1-methoxy-2-methylcyclohexane, and S_N1 forms *cis* and *trans*-1-methoxy-2-methylcyclohexane
- (C) S_N2 forms *cis*-1-methoxy-2-methylcyclohexane, and S_N1 forms 1-methoxy-1-methylcyclohexane
- (D) S_N2 forms *cis*-1-methoxy-2-methylcyclohexane, and S_N1 forms *trans*-1-methoxy-2-methylcyclohexane
- Q.28 What product(s) is (are) formed when HBr is eliminated from (2S, 3S)-2-bromo-3-phenylbutane in an E2 reaction?
- (A) (Z)-2-phenyl-2-butene
- (B) (Z) and (E)-2-phenyl-2-butene
- (C) (E)-2-phenyl-2-butene
- (D) (E)-3-methyl-3-phenyl-1-butene
- Q.29 The major product that would be formed in a Diels Alder reaction between (E)-penta-1,3-diene (*trans*-1-methyl-1,3-butadiene) and methyl acrylate is
- (A) 1,2-product (*ortho*) with Me and CO₂Me *cis* to each other
- (B) 1,2-product (*ortho*) with Me and CO₂Me *trans* to each other
- (C) 1,3-product (*meta*) with Me and CO₂Me *cis* to each other
- (D) 1,3-product (*meta*) with Me and CO₂Me *trans* to each other
- Q.30 How many resonance structure contributors can be written for the carbocation intermediate formed when phenol undergoes electrophilic substitution in the *ortho*, *meta*, and *para* positions?
- (A) *ortho*:3, *meta*:3 and *para*:4
- (B) *ortho*:3, *meta*:3 and *para*:3
- (C) *ortho*:4, *meta*:3 and *para*:4
- (D) *ortho*:3, *meta*:4 and *para*:3

End of Section I

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