

Cork Institute of Technology

Bachelor of Science (Honours) in Herbal Science – Stage 1

(NFQ Level 8)

Summer 2006

Chemistry

(Time: 3 Hours)

Instructions
Answer SIX questions

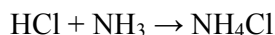
Examiners: Dr. M. Lehane
Ms. U. Cuffe
Ms. O. Allis
Dr. D. Corrigan
Mr. E. Walsh

Q1. (a) Describe what is meant by the following terms:

- i) Enthalpy
- ii) Entropy

(b) Discuss the concept of Gibbs free energy.

(c) Calculate the ΔH value of the reaction:



(ΔH values for $\text{HCl} = -314.4 \text{ kJ}$; $\text{NH}_3 = 80.29 \text{ kJ}$; $\text{NH}_4\text{Cl} = -314.4 \text{ kJ}$)

Q2. (a) Describe, with the aid of a diagram the α - particle bombardment experiment as performed by Rutherford and co-workers and explain what deductions they made about the structure of the atom based on the results.

(b) Explain what is meant by the following terms:

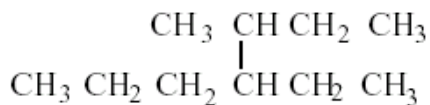
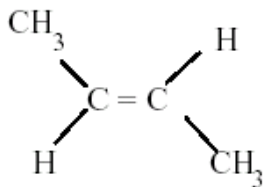
- i) electronic excitation on absorption of energy.
- ii) Hund's rule
- iii) Aufbau principle

(c) Using the Valence Shell Electron Pair Repulsion (VSEPR) theory predict the geometric shapes of the following molecules:

- i) PCl_5
- ii) NO_2^-
- iii) BeH_2
- iv) SF_6
- v) H_2O
- vi) CS_2

- Q3. (a) Explain some of the trends observed for elements in the periodic table.
- (b) Describe, using water as an example, the principle of hydrogen bonding.
- (c) Explain what is meant by the following terms, give examples where appropriate:
- i) ions and atoms
 - ii) electronegativity
 - iii) neutrons and protons
 - iv) acids and bases
 - v) ionic bonding
 - vi) hybridisation
- (d) Write out the electronic configurations of the following elements:
- i) Calcium
 - ii) Bromine
 - iii) Sodium
 - iv) Nitrogen
- Q4. (a) Describe the basis of some of the *separation* techniques used in the laboratory to isolate caffeine from tea.
- (b) Explain the purpose of re crystallisation when trying to purify a solid.
- (c) Explain the purpose of comparing melting point measurements of 'aspirin' synthesised in your practical course with pure aspirin.
- Q5. (a) Explain what is meant by the 'octet rule' and describe how this rule may fail to describe the bonding observed in compounds such as PCl_5 , hence provide a description of the bonding in this compound using the 'valance bond' model.
- (b) The crystal field theory (CFT) provides a convenient means of describing the bonding observed for metal complexes; using the CFT explain the orientation of the 'd' orbitals in octahedral and tetrahedral complexes.

Q6. (a) Give the IUPAC name for each of the following

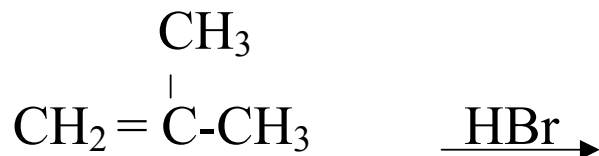


- (b) Taking ethene as an example show how an alkene can be converted to
(i) a haloalkane (ii) an alkane

In each case write a structure for each product.

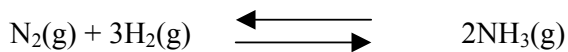
- (c) Explain what is meant by cis-trans isomers and give an example.
(d) State Markownikoff's rule.

For the following reaction write the structure of the dominant product formed according to this rule. Name the product and explain why it is formed



Q7. (a) Explain what is meant by the term Homogeneous Equilibrium.

- (b) Calculate the equilibrium constant (K_c) when the following reaction has reached equilibrium:



On analysis the mixture of gases was found to contain 0.1207M H_2 , 0.0402M N_2 , and 0.00272M NH_3

- (c) Sulphur trioxide decomposes at high temperature in a sealed container.



Initially the $\text{SO}_3(\text{g})$ has a concentration of $6.09 \times 10^{-3}\text{M}$. At equilibrium, the $\text{SO}_3(\text{g})$ concentration is $2.44 \times 10^{-3}\text{M}$.

Calculate the value for K_c