



NUI Galway
OÉ Gaillimh

Autumn Examinations 2010 / 2011

Exam Code(s) 1MR, 1HF, 1BP, 1EG, 1BEE, 1BN, 1BEI, 1BSE
Exam(s) 1st Science, 1st Engineering

Module Code(s) CH110
Module(s) Fundamentals of Chemistry

External Examiner(s) Professor Richard Taylor
Internal Examiner(s) Professor P.V. Murphy
*Dr. P. O'Leary

INSTRUCTIONS: Answer Four questions: one question must be attempted from each section (A, B, C and D)

Separate Answer Books are not required for each section.

All questions carry 25 marks distributed as shown.

Leave the front page of the Answer Book blank and clearly list on it the numbers of the questions attempted.

Duration 2hrs
No. of Pages 4 (including this front page)
Department(s) Chemistry

Requirements Log Tables

All questions carry equal marks.

Atomic masses: H: 1.01; C: 12.01; N: 14.01; O: 16.00

Molar volume at STP= 22.4 dm³, Avogadro's Number 6.02 x 10²³,
R=0.08206 dm³ atm/mol K²

Section A


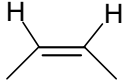
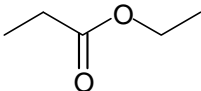
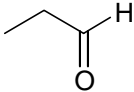
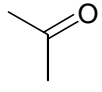
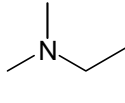
1. **Answer each of the following:**
- (i) When analysed a 5g sample of an unknown compound was found to contain 3.475g carbon, 0.365g hydrogen and 1.16g oxygen. What is its empirical formula? **[7 Marks]**
 - (ii) If its molecular mass is 138.14 amu what is its molecular formula **[3 Marks]**
 - (iii) Write a chemical formula for each of the following:
 - (a) magnesium oxide
 - (b) Copper(I)nitrate
 - (c) potassium sulfate
 - (d) Ammonium hydroxide **[8 Marks]**
 - (iv) Balance the following equation **[7 Marks]**
$$\text{C}_6\text{H}_{14}\text{O}_4 + \text{C}_3\text{H}_6\text{O} \rightarrow \text{C}_{12}\text{H}_{22}\text{O}_4 + \text{H}_2\text{O}$$
2. **Answer each of the following:**
- (i) Explain the following equations (the explanation should include the meaning of the symbols as well as the overall meaning)
 - (a) $P_1V_1/T_1 = P_2V_2/T_2$
 - (b) $PV=nRT$ **[8 Marks]**
 - (ii) A research study is to be conducted using a 0.22g sample of ammonia (NH₃). In advance of this work the following information is required
 - (a) Calculate its volume at STP. **[7 Marks]**
 - (b) Calculate its volume at 2.35 atm pressure and 59°C. **[7 Marks]**
 - (c) How many hydrogen atoms are in the sample? **[3 Marks]**

Section B

3. **Answer each of the following:**
- (i) Write out the electronic configuration of the following species.
 - (a) Fluorine (b) Sulfur (c) Calcium (d) Al³⁺ **[9 marks]**
 - (ii) Discuss with reference to the electronic configurations above what compound is likely to form when calcium and fluorine react. **[4 Marks]**
 - (iii) Is the bonding in the following molecules covalent, ionic or polar covalent? In each case explain your answer
 - (a) H₂O, (b) Br₂, (c) CH₄ **[12 Marks]**

4. **Answer each of the following:**
- Draw an energy diagram which shows the progress of a *exothermic* reaction with a large *activation energy*. You should also explain the terms in *italics* above. **[5 Marks]**
 - Explain the effect of adding a catalyst to such a reaction **[3 Marks]**
 - Write a balanced equation for the reaction of HCl and Mg(OH)₂. **[5 Marks]**
 - 12 cm³ of a 0.1 M solution of Mg(OH)₂ are reacted with 22 cm³ of a 0.3 M solution of HCl. Given this information calculate the following:
 - How many moles of Mg(OH)₂ and HCl were present in the solutions? **[4 Marks]**
 - Which is the limiting reagent? **[2 Marks]**
 - How much of the non limiting reagent is left at the end of the reaction and what is its concentration? **[6 Marks]**

Section C

5. **Answer each of the following:**
- Draw structural formulae showing all the atoms of *both* of the following: (a) 1-chloro-2-methyloctane (b) 4-methylhexan-2-one. **[8 marks]**
 - Name each molecule and indicate the functional group present in the following molecules (a)-(f): **[2×6 marks]**
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 - Describe the structural features of DNA **[5 marks]**

6. **Answer each of the following:**

- (i) What is the K_{eq} for the reaction of carbon dioxide to give carbon monoxide and oxygen shown below?



[5 Marks]

- (ii) Describe in your own words Le Chatelier's principle **[4 Marks]**

- (iii) Discuss the reaction in the context of Le Chatelier's principle with respect to the following headings

- Temperature
- Catalysis
- Pressure
- Removal of product as it is formed

[16 Marks]

Section D

7. Write an essay which explains how the harmful radiation from the sun is removed by the atmosphere before it reaches earth (the essay should discuss the chemistry of the subject and include structures of the chemicals involved and their role etc). **[25 marks]**
8. Write an essay on global warming and the hydrogen economy (the essay should discuss the chemistry of the subject and include structures of the chemicals involved and their role etc). **[25 marks]**