



NUI Galway
OÉ Gaillimh

Semester 1 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; O: 16.00

Molar volume at STP= 22.4 dm³, Avogadro's Number 6.02 x 10²³,

R=0.08206 dm³ atm/mol K

Section A

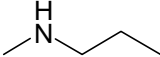
1. **Answer each of the following:**
- (i) 5-tert-butyl-benzene-1,3-diol was found to contain 72.3% C, 8.5% H the remainder being O. What is its empirical formula? **[7 Marks]**
- (ii) If the molecular mass of the above compound is 166.2 amu what is its molecular formula? **[3 Marks]**
- (iii) Write a chemical formula for each of the following:
(a) Calcium chloride
(b) Copper(II)sulfate
(c) Sodium nitrate
(d) Ammonium chloride **[8 Marks]**
- (iv) Balance the following equation, showing your reasoning.
 $C_9H_{12}O_6 + C_2H_6O \rightarrow C_{15}H_{24}O_6 + H_2O$ **[7 Marks]**
2. **Answer each of the following:**
- (i) Write a brief explanation of
(a) Boyle's law
(b) Why one mole of all gases occupies 22.4L at STP **[2x4 Marks]**
- (ii) A 1.86 g sample of gas occupies 3.4 L at 0.56 atm pressure and 76°C
(a) calculate its volume at STP. **[7 Marks]**
(b) What is its molecular mass? **[7 Marks]**
(c) Given the molecules of the gas contains at least one carbon, identify the gas. **[3 Marks]**

Section B


3. **Answer each of the following:**
- (i) Write out the electronic configuration of the following species.
(a) Silicon, (b) Potassium, (c) Oxygen, (d) Ca^{2+} . **[8 marks]**
- (ii) Discuss, with reference to the electronic configurations above, what compound is likely to form when potassium and oxygen react. **[4 Marks]**
- (iii) Explain the observation that water boils at 100°C whereas methane which has a similar molecular mass boils at -164 °C **[7 Marks]**
- (iv) Explain the shape of the following molecules
(a) CH_4 , (b) H_2O **[6 Marks]**

4. **Answer each of the following:**
- (i) Explain the factors which can affect the rate of a reaction. **[6 Marks]**
- (ii) Write a balanced equation for the reaction of H_2SO_4 and $\text{Mg}(\text{OH})_2$. **[4 Marks]**
- (iii) 13 cm^3 of a 0.1 M solution of $\text{Mg}(\text{OH})_2$ are reacted with 24 cm^3 of a 0.3 M solution of H_2SO_4 . Given this information calculate the following:
- (a) Which is the limiting reagent?
- (b) How many moles of the excess reagent are left unreacted at the end of the reaction?
- (c) What is the concentration of the excess reagent at the end of the reaction? **[15 Marks]**

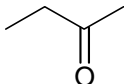
Section C

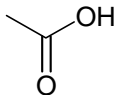
5. **Answer each of the following:**
- (i) Draw structural formulae showing all the atoms of *both* of the following: (a) 3-ethyldec-1-yne (b) 3-chloro-cyclohexene. **[8 marks]**
- (ii) Name each molecule and indicate the functional group present in the following molecules (a)-(f): **[2x6 marks]**
- 

(a)

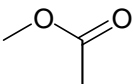


(b)




(c)
- 

(d)



(e)



(f)
- (iii) Describe the structural features of amino acids and peptides **[5 marks]**

6. **Answer each of the following:**
- (a) What is the K_{eq} for the synthesis of ammonia (Haber process)
- $$4\text{NH}_3(\text{g}) + 7\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g}) + \text{heat}$$
- [5 Marks]**
- (b) Describe in your own words Le Chatelier's principle **[5 Marks]**
- (c) Discuss the Haber process in the context of Le Chatelier's principle with respect to the following headings
- Temperature
 - Catalysis
 - Pressure
 - Removal of product as it is formed
- [15 Marks]**

Section D

7. Write an essay on the chemistry of the ozone layer (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 greenhouse gases and global warming (the essay should discuss the chemistry of the subject and include structures of the chemicals involved and their role etc) **[25 marks]**