

**CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ**

Semester 2 Examinations 2011/12

Module Title: Organic Chemistry

Module Code: CHEO6001

School : Science

Programme Title:

Bachelor of Science in Analytical & Pharmaceutical Chemistry – Year 1

Bachelor of Science in Analytical Chemistry with Quality Assurance – Year 1

Bachelor of Engineering in Chemical & Biopharmaceutical Engineering – Year 1

Programme Code: SCHEM_7_Y1
 SCHQA_8_Y1
 ECPEN_8_Y1

External Examiner(s): **Dr. C. Roche**

Internal Examiner(s): **Dr. W. Doherty**

Instructions: Answer **FOUR** questions in total

Duration: 2 Hours

Sitting: Summer 2012

Requirements for this examination: **Mathematical Tables**

Note to Candidates: Please check the Programme Title and the Module Title to ensure that you have received the correct examination paper.
If in doubt please contact an Invigilator.

- Q1. Benzil is composed of carbon, hydrogen and oxygen. When 5.26g of Benzil is combusted in excess oxygen 15.40g of carbon dioxide and 2.25g of water are formed.
- (a) Calculate the % Carbon, % Hydrogen and % Oxygen. [15 Marks]
 - (b) What is the empirical formula? [5 Marks]
 - (c) If the molecular weight of Benzil is 210.23g what is the molecular formula? [5 Marks]
- Q2. (a) Draw all structural isomers of methylpent-2-ene and give their IUPAC names. [15 Marks]
- (b) (i) Write the structure of the alcohol formed when pent-1-ene and water react in the presence of a strong acid. [6 Marks]
 - (ii) Is the alcohol produced the Markovnikov or anti-Markovnikov product? [4 Marks]
- Q3. (a) Outline the evidence that suggests that benzene is not a cyclic alkene. [10 Marks]
- (b) Alkylation of benzene occurs via a Friedel-Crafts mechanism. For the reaction of $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$ with benzene:
 - (i) What are the products of this reaction? [3 Marks]
 - (ii) Write a formula for a typical Friedel-Crafts catalyst. [3 Marks]
 - (iii) Outline the mechanism for this reaction. [9 Marks]
- Q4. For the following amines, ammonia (NH_3), methylamine (CH_3NH_2), dimethylamine ($(\text{CH}_3)_2\text{NH}$) and trimethylamine ($(\text{CH}_3)_3\text{N}$)
- (a) Write balanced equations for their reaction with water and identify their respective conjugate acids. [12 Marks]
 - (b) List the above amines from weakest to strongest base and explain your reasoning. [13 Marks]

- Q5. (a) State the Cahn-Ingold-Prelog priority rules. [5 Marks]
(b) Draw the structure of R-2-chlorobutane. [10 Marks]
(c) What are enantiomers? [5 Marks]
(d) What is a racemic mixture? [5 Marks]

- Q6. (a) Explain why aldehydes are more reactive than ketones towards reaction with nucleophiles [8 Marks]
(b) Give a chemical reaction that will
(i) Distinguish a ketone from an aldehyde
(ii) Characterise an aldehyde and a ketone [8 Marks]
(c) Write balanced equations showing how butanal can be used to synthesize
(i) butanol
(ii) butanoic acid [9 Marks]