

Ollscoil na hÉireann, Gaillimh
THE NATIONAL UNIVERSITY OF IRELAND, GALWAY

AUTUMN EXAMINATIONS, 2002

FIRST MARINE SCIENCE EXAMINATION
FIRST HEALTH AND SAFETY SYSTEMS EXAMINATION

CHEMISTRY

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Time allowed: Two hours

Use a separate answer book for *Section C*

Answer *four* questions, one from each section.

All questions carry equal marks.

Atomic masses (a.m.u.): H = 1.008, C=12.001, O = 15.999.

Section A

1

- (a) Write balanced chemical equations for each of the following: **[3 marks each]**
- (i) the reaction of sodium metal with liquid water
 - (ii) the combustion of methane
 - (iii) the reaction of nitric acid with magnesium hydroxide
 - (iv) the formation of sulfuric acid from sulfur dioxide, oxygen and water
 - (v) the formation of ozone from oxygen
- (b) Vinegar contains acetic acid. The percent composition is 40% C, 6.7% H, and 53.3% O. What is the empirical formula of acetic acid? **[5 marks]**
- (c) If the molecular weight of acetic acid is 60 gmol^{-1} , determine the molecular structure of acetic acid and draw a structure **[5 marks]**

2

- (a) Discuss, including an illustration, the first law of thermodynamics **[12 marks]**
- (b) Explain what is meant by enthalpy change. Draw a graph to illustrate the enthalpy change in an exothermic reaction. **[13 marks]**

Section B

3

- Answer (a) *or* (b)

(a)

Define, giving examples, the terms (i) atomic number, (ii) isotope, (iii) mass number, (iv) relative atomic mass. Explain why relative atomic mass is usually not a whole number. **[12 marks]**

Describe the main features (i) the ionic bond and (ii) the covalent bond and give an example of each. **[13 marks]**

- (b) Write nuclear reactions to describe the following:
- (i) beta minus decay of the 40 isotope of potassium [6 marks]
 - (ii) positron emission from the 11 isotope of carbon [6 marks]
 - (iii) alpha decay of the 238 isotope of uranium [6 marks]
 - (iv) radon gas decay [7 marks]

4

- (a) Define, giving examples and showing equations where appropriate, what is meant by (i) pH, (ii) pOH, (iii) strong acid, (iv) weak acid, (v) strong base. [15 marks]
- (b) Calculate the pH of a solution made by mixing 20 cm³ 0.1M H₂SO₄ with 30 cm³ 0.2M NaOH. [10 marks]

Section C

5

- (a) Draw structural formulae showing all of the atoms of *each* of the following: methane, *trans*-1,2-dichloroethene, benzene and ethyl acetate. [16 marks]
- (b) Draw **any** single molecule containing an aromatic, alcohol and ketone functional groups. [9 marks]

- 6 Write chemical reaction schemes for *each* of the following:

- (i) light initiated bromination of propane. [6 marks]
- (ii) the nitration of benzene. [6 marks]
- (iii) the reaction of a Grignard reagent with acetone followed by hydrolysis. [7 marks]
- (iv) the hydrogenation of cyclohexene. [6 marks]

Section D

7

- (a) Discuss the main dissolved constituents of seawater. [12 marks]
- (b) Outline how magnesium metal is recovered from seawater. [13 marks]

- 8 Discuss the chemistry of *each* of the following:

- (a) The greenhouse effect [12 marks]
- (b) Eutrophication of water [13 marks]