

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

SUMMER EXAMINATIONS, 2002

FIRST MARINE SCIENCE EXAMINATION
FIRST HEALTH AND SAFETY SYSTEMS EXAMINATION

CHEMISTRY

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Time allowed: *Two hours*

Answer *four* questions, one from each section.

Use a separate answer book for *Section C*

All questions carry equal marks.

Atomic masses (a.m.u.): H = 1.008, C = 12.001, O = 15.999, Mg = 24.305.

F , Faraday constant = 96,485 C mol⁻¹

Section A

1

- (a) Write a chemical formula for each of the following:
Lithium sulphate, sodium phosphate, aluminium sulphate, calcium nitrate,
ammonium carbonate **[10 marks]**
- (b) Antifreeze (ethylene glycol) is composed of 38.7% C, 9.7% H, and 51.6% O.
Its molar mass is 62.1 g mol⁻¹.
- (i) What is the empirical formula of ethylene glycol? **[8 marks]**
- (ii) What is the molecular formula of ethylene glycol? **[4 marks]**
- (iii) Draw a possible structure for ethylene glycol. **[3 marks]**

2

- (a) Draw a heating curve and compare the properties of gases, liquids and solids. **[10 marks]**
- (b) Write a note on Charles's Law **[5 marks]**
- A large natural-gas storage tank is arranged so that the pressure is maintained at 225 kPa. On a cold day in December when the temperature is -5°C the volume of the gas in the tank is 900 dm³. What will be the volume on a hot day in July when the temperature is 31°C? Comment on your answer.

[10 marks]

Section B**3**

- (a) Discuss the evidence which led to the Bohr model of the atom. [13 marks]
- (b) Discuss *three* examples of the relationship between electronic structure and properties of elements. [12 marks]

4

- (a) Discuss Faraday's First and Second Laws of Electrolysis. [8 marks]
- (b) Write a note on the electrolysis of magnesium chloride [8 marks]
- (c) What mass of Mg metal is deposited at the cathode during the electrolysis of molten MgCl_2 if a current of 0.10 A passes through the solution for 30 min? [9 marks]

Section C**5**

- (a) Draw structural formula showing all of the atoms of each of the following: ethyne, *cis*-but-2-ene, propanol and ethanoic acid. [16 marks]
- (b) Draw **any** single molecule containing an aromatic ring, aldehyde and alkyl chloride functional groups. [9 marks]

6

- (a) Draw the most stable conformation of cyclohexane. [6 marks]
- (b) Contrast and compare the physical properties of methane, hexane, cyclohexane and methanol. Briefly discuss the reasons for the differences. [13 marks]
- (c) Show hydrogen bonding between methanol molecules. [6 marks]

Section D**7** Discuss the chemistry of each of the following:

- (a) Dissolved oxygen in natural waters [4 marks]
- (b) Biological oxygen demand [4 marks]
- (c) Chemical oxygen demand [4 marks]
- (d) Hard water [4 marks]
- (e) Water purification [9 marks]

8 Discuss the chemistry of each of the following:

- (a) (i) The nitrogen cycle and (ii) pollution by oxides of nitrogen [12 marks]
- (b) Acid rain: causes and consequences [13 marks]