

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

SPRING EXAMINATIONS, 2002

FIRST MEDICAL EXAMINATION

CHEMISTRY

Professor I. Fleming, FRS
Professor R.N. Butler
Dr. A.V. Savage
Dr. F. Aldabbagh

Time allowed: *Three* hours

Use a separate answer book for *Section C*

Answer *five* questions of which no more than two may be from any one section.

All questions carry equal marks.

Atomic masses (amu): H = 1.008, C=12.001, O = 15.999.

Universal Gas Constant, $R = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$

Section A

1

- (a) Discuss briefly how the properties of a solvent are affected by the addition of solute. **[5 marks]**
- (b) Cholesterol is very soluble in ether. If 0.868 g of cholesterol dissolved in 4.44 g of diethyl ether ($\text{C}_4\text{H}_{10}\text{O}$) lowers the vapour pressure of ether from 53.29 kPa to 51.37 kPa at 17.9 °C, what must be the molecular weight of cholesterol? **[10 marks]**
- (c) Draw the structure of cholesterol. **[5 marks]**

2

- (a) Draw graphs showing the Maxwell Boltzmann distribution of molecular speeds for any gas at two different temperatures. **[4 marks]**
- (b) Define and give an expression for Dalton's Law of Partial Pressures. **[4 marks]**
- (c) At 17°C and $1.00 \times 10^2 \text{ kPa}$, a 25.0 dm^3 sample of an anaesthetic gas contains 0.35 moles of gas A and 0.61 moles of gas B. Are these the only components of the gas mixture? **[6 marks]**
- (d) What are the partial pressures of the two gases A and B? **[6 marks]**

3

- (a) Discuss Le Chatelier's principle in relation to the oxygen-hemoglobin equilibrium. **[10 marks]**
- (b) Write a short note on enzymes. **[5 marks]**
- (c) Discuss the factors that affect enzyme activity. **[5 marks]**

4

- (a) Discuss the relationship between Gibbs free energy, enthalpy and entropy. **[8 marks]**
- (b) Write a balanced chemical equation for the oxidation of carbon monoxide to carbon dioxide. **[2 marks]**
- (c) Draw a free energy diagram for this reaction **[4 marks]**
- (d) Calculate the standard free energy of this reaction and comment on your answer
 ΔG°_f for CO = $-137.17 \text{ kJ mol}^{-1}$ and for CO₂ = $-394.36 \text{ kJ mol}^{-1}$ **[6 marks]**

Section B**5**

- (a) Write notes on (i) atomic orbitals and (ii) quantum numbers. **[10 marks]**
- (b) Write the ground state electronic configuration and four quantum numbers for the electrons in an atom of chromium. **[10 marks]**

6

- (a) Write notes on **four** of the following:
- (i) Isotope **[3 marks]**
 - (ii) Belt of stability **[3 marks]**
 - (iii) Magic numbers of nucleons **[3 marks]**
 - (iv) Half-life **[3 marks]**
 - (v) Nuclear fission **[3 marks]**
- (b) A sample to be used for medical imaging is labelled with ^{18}F , which has a half-life of 110 min. What percentage of the original activity in the sample will remain after 300 min? **[8 marks]**

7

Discuss, giving examples, each of the following:

- (i) ionic bond **[3 marks]**
- (ii) covalent bond **[3 marks]**
- (iii) polar covalent bond **[5 marks]**
- (iv) hydrogen bond **[5 marks]**
- (v) dative (co-ordinate) covalent bond **[4 marks]**