2001 HIGHER SCHOOL CERTIFICATE EXAMINATION

Chemistry

Section I (continued)

Part B – 60 marks
Attempt Questions 16–27
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Marks

Question 16 (3 marks)

Radioisotopes are used in industry, medicine and chemical analysis. For ONE of these fields, relate the use of a named radioisotope to its properties. **3**

Iodine-131 is used in medicine. It is used for thyroid imaging. It is suitable because iodine is already present in thyroid and therefore our body treats it like a normal substance consequently taking part in the biochemical reactions. It's half life is short which means it will be reduced to harmless levels very quickly.

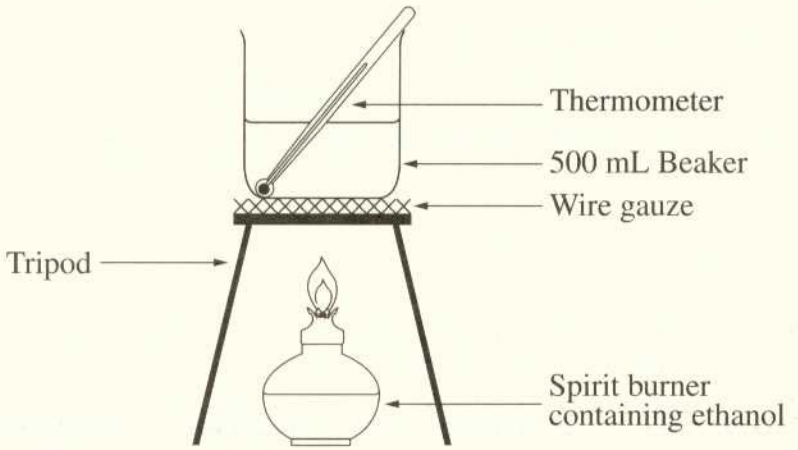
Marks

Question 17 (6 marks)

Students were asked to perform a first-hand investigation to determine the molar heat of combustion of ethanol.

The following extract is from the practical report of one student.

Apparatus used:



Lab data:

Mass of water	=	250.0 g
Initial mass of burner	=	221.4 g
Final mass of burner	=	219.1 g (→ 2.3 g)
Initial temperature of water	=	19.0°C
Final temperature of water	=	59.0°C (→ 40°C)

(a) After completing the calculations correctly, the student found that the answer did not agree with the value found in data books. Suggest ONE reason for this. **1**

The heat energy given off may have been absorbed by the surroundings and apparatus such as the gauze mat

(b) Propose TWO adjustments that could be made to the apparatus or experimental method to improve the accuracy of the results. **2**

- The 500 mL beaker could be exchanged for a copper tin, dark in colour so all heat is absorbed.
- The gauze mat removed and the spirit burner made closer to the tin.

Question 17 continues on page 11

Marks

Question 17 (continued)

(c) Calculate the molar heat of combustion of ethanol, using the student's data. **3**

Δ heat $= -mC\Delta T$

$\Delta H = 0.2500 \times 4.18 \times 10^3 \times 40$

$\Delta H = 41800$ J omitted

$\therefore n_{Ethanol} = \frac{2.3}{(2\times 12.01 + 5\times 1.008 + 16)}$

$n = 0.051$ moles of Ethanol

$\therefore$ 41800 J / 0.051 moles

$\therefore$ 41800 J / 0.051 moles.

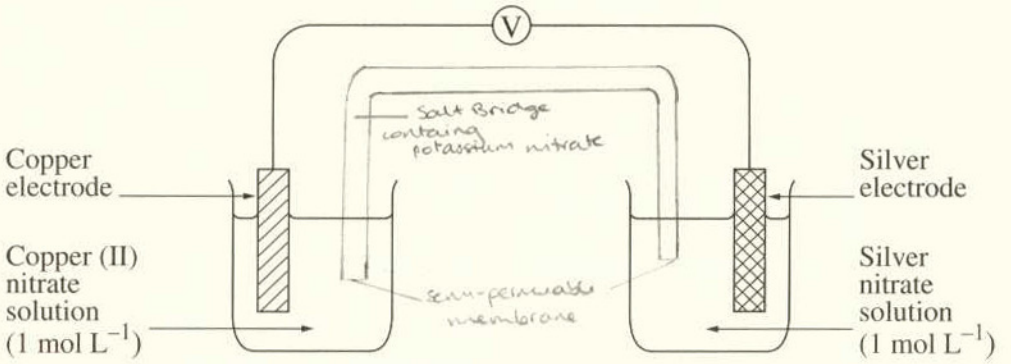
End of Question 17

Please turn over

Marks

Question 18 (6 marks)

A galvanic cell was made by connecting two half-cells. One half-cell was made by putting a copper electrode in a copper (II) nitrate solution. The other half-cell was made by putting a silver electrode in a silver nitrate solution. The electrodes were connected to a voltmeter as shown in the diagram.



(a) Complete the above diagram by drawing a salt bridge. **1**

(b) Using the *standard potentials* table in the data sheet, calculate the theoretical voltage of this galvanic cell. **2**

Anode: $Cu \rightarrow Cu^{2+} + 2e^-$ -0.34V ✓ Cathode: $Ag^+ + e^- \rightarrow Ag$ 0.8V ✓

$H_2O \rightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$ -1.23V $H_2O + e^- \rightarrow \frac{1}{2}H_2 + OH^-$ -0.83V

Theoretical voltage: $0.8 - 0.34$

$= 0.46$V

(c) A student removes the voltmeter from the circuit and replaces it with an electrical generator. The generator causes the copper electrode to increase in mass. **3**

Explain, using an equation, why the copper electrode will increase in mass.

when an electric generator replaces the voltmeter, this becomes an electrochemical cell. the silver electrode is now the anode and the copper electrode is the cathode. At the cathode, reduction occurs, meaning Cu^{2+} ions become solid copper on the electrode. ($Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$), so the electrode increases in mass.