**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.

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**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**

Cobalt-60 is used in Medicine for the treatment of cancer. Cobalt 60 is a β emitter but also emits high energy gamma radiation, making it suitable to penetrate and kill abnormal cells. Cobalt 60 has a half life of 5 years which means it emitts a good consistent amount of radiation but the ~~machine~~ medical equipment will have a reasonable working life without having to be replaced every 2 years etc.

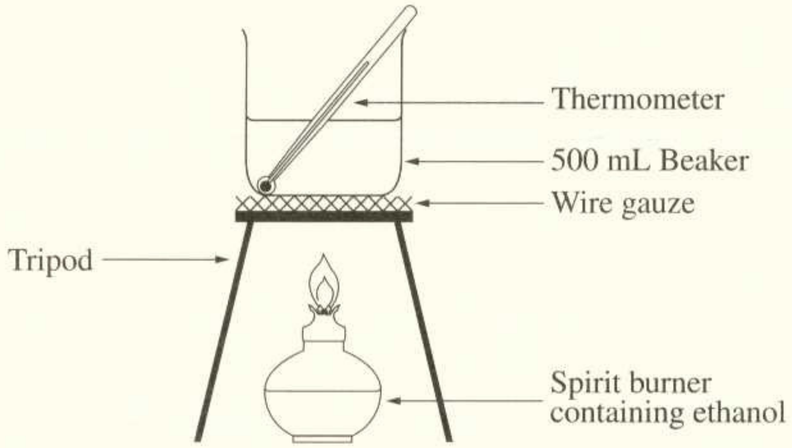
**Marks**

**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 |
| Initial temperature of water | = | 19.0°C |
| Final temperature of water | = | 59.0°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 produced in combustion was lost to the air, and in heating the equipment (~~bunsen~~ beaker, tripod, etc.) along with the water.

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

An insulating surrounding could have been placed around the whole appratus to minimise heat lost to air. The water should be stirred to ensure the water heats evenly.

**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**

$\Delta T = 40°K$

$\Delta H = -mC.\Delta T$

$= -0.250 kg \times 4.18 \times 10^3 J kg^{-1} K^{-1} \times 40 K$

$= -4.180 \times 10^4 J$

$CH_3CH_2OH$

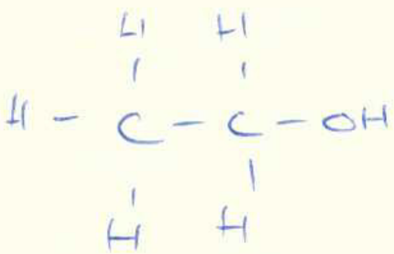
∴ molar heat of combustion

$= -4.180 \times 10^4 J \times \frac{1 kJ}{1000 J} \times \left(2.3 g \times \frac{1 mol}{46.07 g}\right)^{-1}$

$= 837 kJ mol^{-1}$

**End of Question 17**

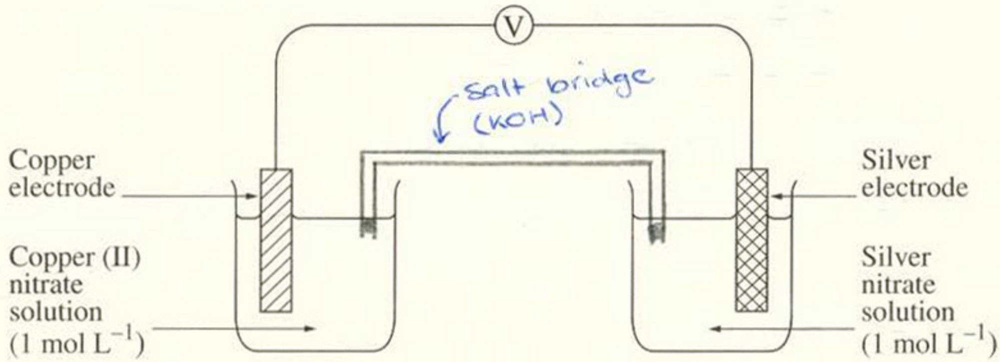
**Please turn over**



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**

redn: $Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$ 0.80V

oxdn: $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$ -0.34V

$\therefore E^\ominus_{cell} = 0.80 - 0.34V$

$= 0.46V$

(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.

In the spontaneous equation for this cell copper is oxidised $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$. $\therefore$ in a electrolytic cell this will be reversed

$Cu^{2+} + 2e^- \longrightarrow Cu(s)$ $E^\ominus = 0.34V$

This will occur preferentially to ~~that~~ the ~~red~~ reduction of water. So we see $Cu^{2+}$ will precipitate as solid Cu(s) onto the copper electrode, increasing its mass.