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 to diagnose and somehmes treat thyroid diseases. I-131 has a half-life of 8 days which means that it is readily removed from the body. I-131 can be injected into the blood stream/body. It moves towards the thyroid gland (like normal iodine) and through emmision of gamma and beta particles thyroid diseases can be detected.

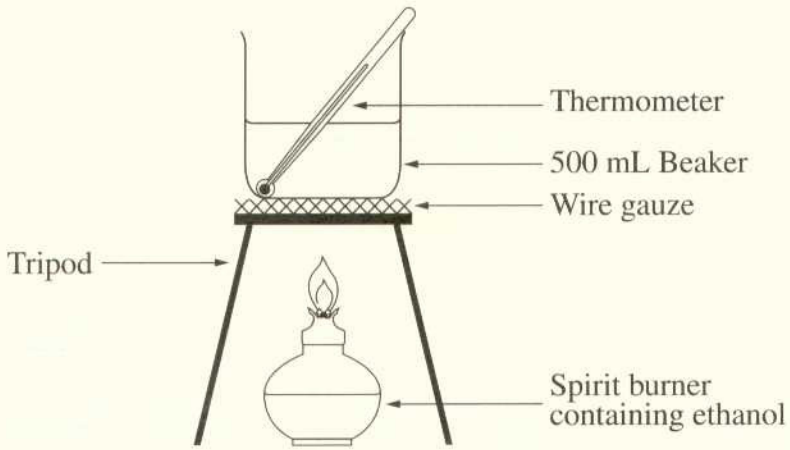
Marks

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**

Some of the heat of combustion may have been lost to surroundings & equipment.

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

The set up could be surrounded by a ceramic or other heat sheild to minimise heat lost & water could be gently stired with thermometer to insure better dispersion of the heat through the water & more accurate reading of temp.

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**

$\Delta H = mc\Delta t$ $m = 0.250\,kg$, $c = 4.18 \times 10^3$ $\Delta t = 40$

$\Delta H = 0.250 \times 4.18 \times 10^3 \times 40$

$= 41\,800$ J

$= 41.800$ KJ for 2.3g Ethanol

$2.3 \div (2 \times 12.01 + 6 \times 1 + 16) = 5.00 \times 10^{-2}$ moles ethanol (Molar mass Ethanol)

$\Delta H_{1mol} = 1 \div 5.00 \times 10^{-2} \times 41.8 = -836$ KJ

∴ Molar heat of combustion for ethanol = 836KJ mol^{-1} given out.

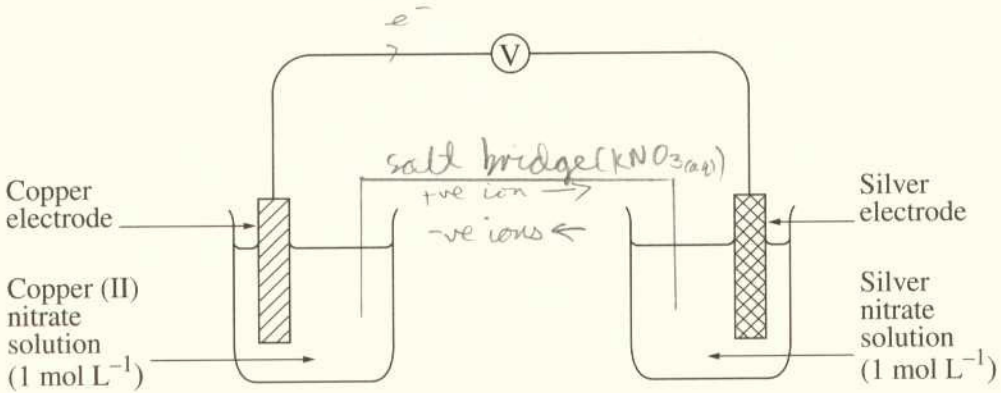
End of Question 17

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**

$Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$ $-0.34V$

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

$\therefore$ EMF $= +0.46V$

(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.

As an electrolytic cell is set up, reversing the above reactions, hence copper ions in solution is reduced to copper solid i.e $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ This makes the copper electrode the cathode and these copper solids coat onto the electrode hence the electrode increased in mass