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**

Cobalt-60 is used in medicine to irradiate cancer cells. The radioisotope is effective due to its ability to release gamma radiation which destroys cancer cells. Gamma radiation is strong enough to kill cancer cells but and not damage the tooth of the patient.

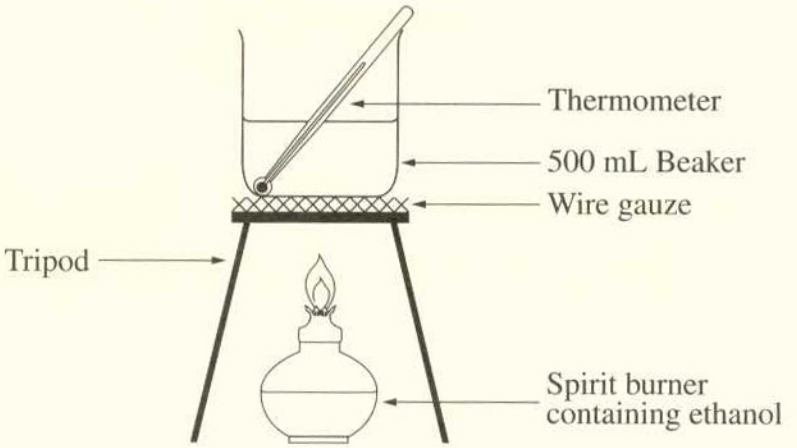
Marks

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

Because the ~~spirit~~ burner was too far away from the Beaker & hence too much heat was lost to the surroundings

(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**

Because the thermometer was sitting against the beaker above the ~~wire gauze~~ (instead of just touching the ~~ethanol~~ water) so temperature was wrong.

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

Hold the thermometer up by a retort stand and a boss head plus clamp so it is only touching the water. Place some ~~heat~~ heating ~~mats~~ underneath the ethanol spirit burner so as it is closer to the beaker and not as much heat is lost.

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**

Initial temp = 19.0°C Initial mass = 221.4 g

Final temp = 59.0°C Final mass = 219.1 g

∴ Δtemp = 59 − 19 ∴ Δmass = 221.4 − 219.1

= 40°C = 2.3 g

moles of ethanol used = $\frac{2.3}{12.01 + 6 \times 1.008 + 16 + 1.008}$

= 0.049 moles

∴ molar heat of combustion = $\frac{\Delta temp}{moles\ burnt}$

= $\frac{40}{0.049}$

= 816.3°C

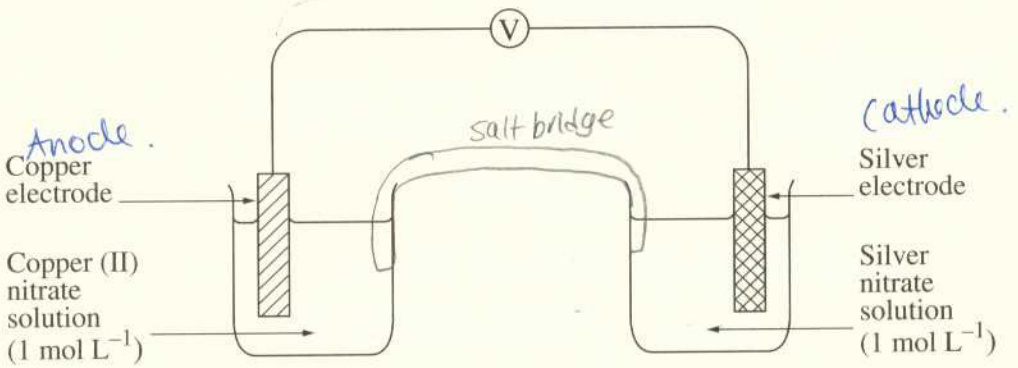
End of Question 17

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**

$Ag^+ + e^- \longrightarrow Ag(s)$ 0.80V

$Cu \longrightarrow Cu^{2+} + 2e^-$ −0.34V

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.

Ag^+ reduces to Ag solids and electrons transfer to the anode in where oxidation of Cu occurs: $Cu \longrightarrow Cu^{2+} + 2e^-$ Overall reaction is $2Ag_{(aq)} + Cu \longrightarrow Cu^{2+} + 2Ag(s)$. The electrons of the cathode electrode which is Ag silver is transfered to the anode and cover the copper electrode with silver solids. i.e. $Ag^+ + e^- \longrightarrow Ag(s)$