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.

    In industry Cobalt 60 is used in thickness gauges. Gamma rays from Cobalt 60 are passed over a material usually a metal and the amount of radiation that passes through is measured. The thicker the metal the less radiation will pass. This is a good method because it can find abnormalities in the metal. Cobalt 60 is used because it has a relatively medium length half life and it emits the correct amount of radiation. If a Substance with a Shorter half life was used then the radioisotope would have to be replaced frequently. If a radioisotope with a longer half life was used then it may not emit enough radiation. An alpha or beta emitter would not be used because these would not penetrate thick metal

3

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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:

Thermometer
500 mL Beaker
Wire gauze
Tripod
Spirit burner containing ethanol
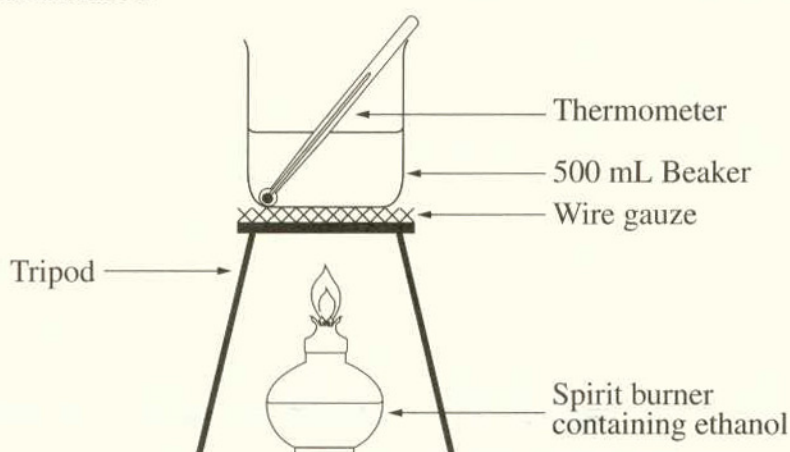
Lab data:

|		
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 can be lost ch ~~temperature~~ surroundings, so the value got from experiment is lower than expected in book.

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

- put a box under the spirit burner, so the flame gets closer to the beaker.
- The thermometer should not touch the wall of beaker, it should be hold vertically into beaker. (see diagram left)

clamp
box
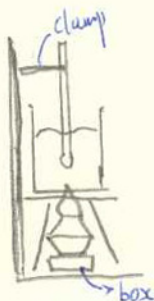
C_2H_5OH)

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

$\Delta m = 221.4 - 219.1 = 2.3$ g   molar mass of ethanol $= 12 \times 2 + 6 + 16 = 46$ ~~mol~~ g mol$^-$

$\Delta T = 59 - 19 = 40\ ^\circ C$

Mass of water $= 250$ g

$\Delta H = m\ C \Delta T = 250 \times 40 \times 4.18 = 41800$ J

$\therefore$ heat per gram $= 41800 / 2.3 = 18173.91$ J mol$^-$

$\therefore$ heat per mol $= 18173.91 \times (46) = 835999.86$ J mol$^-$

$\doteq 836000$ J mol$^-$

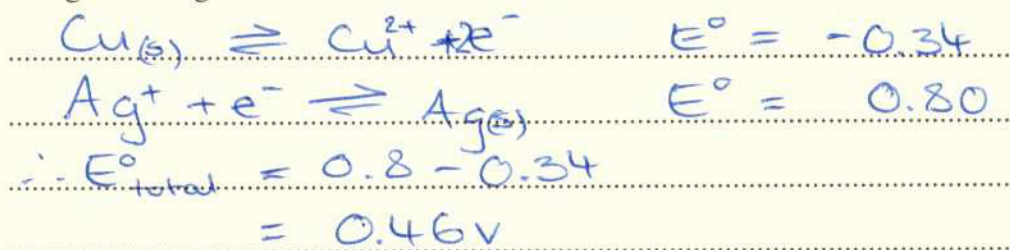**End of Question 17**

Please turn over

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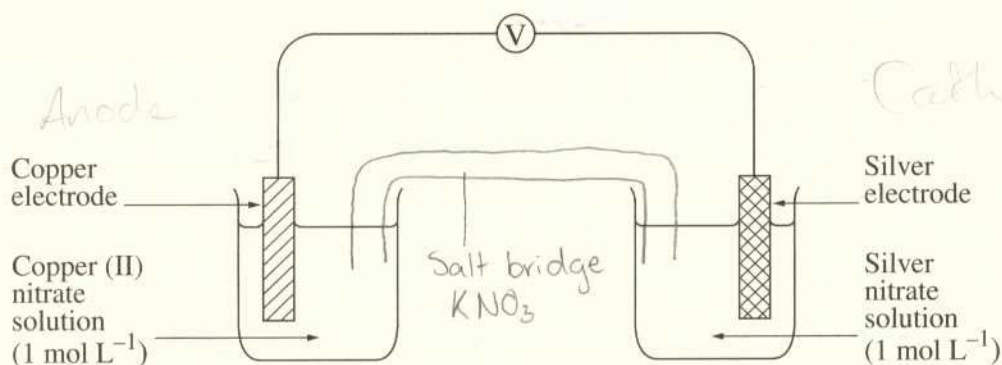
(a)   Complete the above diagram by drawing a salt bridge.   1

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

$$Cu_{(s)} \rightleftharpoons Cu^{2+} + 2e^- \qquad E^° = -0.34$$
$$Ag^+ + e^- \rightleftharpoons Ag_{(s)} \qquad E^° = 0.80$$
$$\therefore E^°_{total} = 0.8 - 0.34$$
$$= 0.46 V$$

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

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

      Putting electricity into the cell would reverse the reaction direction, making the copper act prefferentially as the Cathode. The electrons being fed into the copper electrode would make ~~Meting~~ Cu²⁺ ions ~~return~~ be reduced to Cu(s), by the equation Cu²⁺ + 2e⁻ ⇌ Cu(s), thus increasing the mass of the copper electrode.

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