Centre Number

Chemistry
Section I (continued)

Student Number

Part B – 60 marks
Attempt Questions 16-29
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.

Question 16 (3 marks) **Marks**

(a) Using a labelled diagram, demonstrate how polystyrene can be produced from its monomer. **2**

(b) Explain ONE use of this polymer in terms of ONE of its physical properties. **1**

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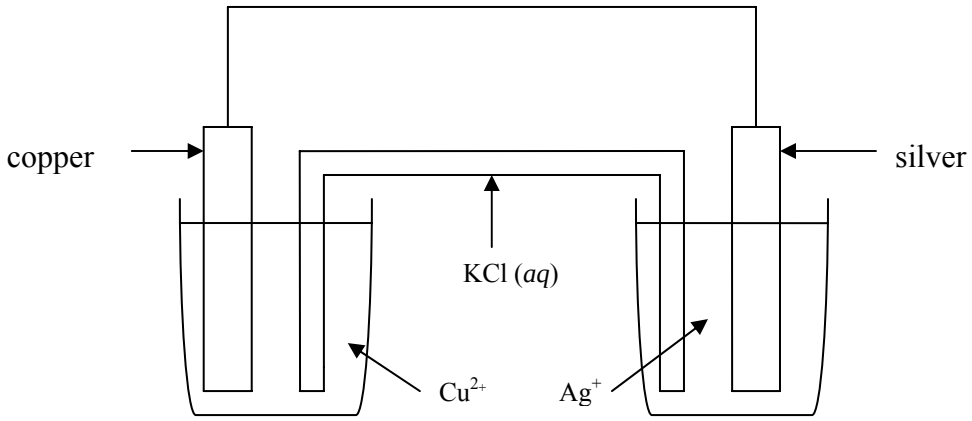
Question 17 (6 marks) **Marks**

In order to produce a cell with a voltage between 1.1 V and 1.2 V, a student constructed the following galvanic cell.



(a) Label the cathode on the above diagram. **1**

(b) Explain why KCl (*aq*) would be an *inappropriate* choice for the salt bridge in this cell. **2**

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(c) Calculate the cell potential, showing relevant half-equations, in order to evaluate the student's selection of electrodes and electrolytes. (Assume standard conditions.) **3**

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Question 18 (2 marks) **Marks**

Name an isotope used in industry. Explain how its use is related to its properties. **2**

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Question 19 (2 marks) **Marks**

Cobalt – 60 forms when cobalt – 59 captures a neutron.

(a) Write a balanced nuclear equation for this reaction. **1**

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(b) Explain why cobalt – 60 is produced in a nuclear reactor rather than a cyclotron (particle accelerator). **1**

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Question 20 (7 marks) **Marks**

Fossil fuels are currently the dominant source of both energy and raw materials needed for the production of polymers. However, the supply of fossil fuels is finite and rapidly diminishing. In the near future, a replacement source of both energy and polymer raw materials will need to be found and one potential source is ethanol. **7**

Using appropriate chemical equations, assess the potential of ethanol as a resource to replace fossil fuels for the supply of both polymers and energy.

Question 21 (4 marks) **Marks**

(a) SO_2, K_2O, N_2O_5, CaO

From the list of oxides above, identify:

(i) a basic oxide …….. **1**

(ii) an acidic oxide ……... **1**

(b) Write a balanced equation for a reaction which illustrates the acidic or basic nature of one of the oxides you identified in part (a). **1**

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(c) Aluminium oxide is classified as amphoteric. Define the term amphoteric. **1**

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Question 22 (3 marks) **Marks**

(a) State an industrial use for a named ester. **1**

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(b) (i) Draw the structural formula for the ester produced in the reaction between 1-butanol and ethanoic acid, in the presence of concentrated sulfuric acid. **1**

(ii) Name this ester. **1**

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Question 23 (8 marks) **Marks**

Hydrogen sulfide gas is extremely toxic if inhaled, has an unpleasant smell (rotten eggs) and is highly flammable. Stringent precautions are required when handling it.

(a) Explain why hydrogen sulfide is classified as a WEAK acid. **1**

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(b) Explain (with the aid of a chemical equation) why H_2S is considered a Bronsted-Lowry acid. **2**

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(c) Identify ONE conjugate acid-base pair involved in the equation you have written in (b) above. **1**

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Question 23 continues on page 15

Question 23 (continued) **Marks**

(d) Hydrogen sulfide *(g)* is formed when hydrochloric acid reacts with zinc sulfide.

$ZnS\ (s)\ +\ 2HCl\ (aq) \rightarrow\ ZnCl_2\ (aq)\ +\ H_2S\ (g)$

In an experiment performed in a fume cupboard 50.0 mL of 0.10M HCl was added to 0.11 g of solid zinc sulfide.

(i) Which reagent is in excess? *Show Your Working.* **2**

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(ii) What volume of hydrogen sulfide *(g)* is produced at 298K and 100 kPa in this experiment **2**

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End of Question 23

Question 24 (5 marks) **Marks**

Caustic soda (sodium hydroxide) can be used to strip paint off furniture.
A 3.0 g container of caustic soda was dissolved in water and the volume of the solution was made up to 3.0 L.
The sodium hydroxide solution was then titrated with 0.026 mol L^{-1} hydrochloric acid solution.

(a) Calculate the concentration of the sodium hydroxide solution in mol L^{-1}. *Show your working.* **1**

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(b) Determine the pH of the hydrochloric acid solution. **1**

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(c) Evaluate the use of sodium hydroxide as a *primary standard.* **3**

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Question 25 (4 marks) **Marks**

The Haber Process has been used for over 90 years for the industrial production of ammonia. This process must be carefully managed and monitored by industrial chemists. **4**

Analyse the impact of changes in pressure and temperature on the yield and rate of production of ammonia during the Haber Process.

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Question 26 (2 marks) **Marks**

Explain why incomplete combustion of carbon-based fuels is considered a problem for the environment and identify how scientists can reduce the possibility of incomplete combustion occurring. **2**

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Question 27 (5 marks) **Marks**

(a) Identify the purpose of using standard solutions in atomic absorption spectroscopy (AAS). **1**

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(b) Assess the impact of atomic absorption spectroscopy (AAS) on scientific understanding of the effects of ONE trace element that you have studied. **4**

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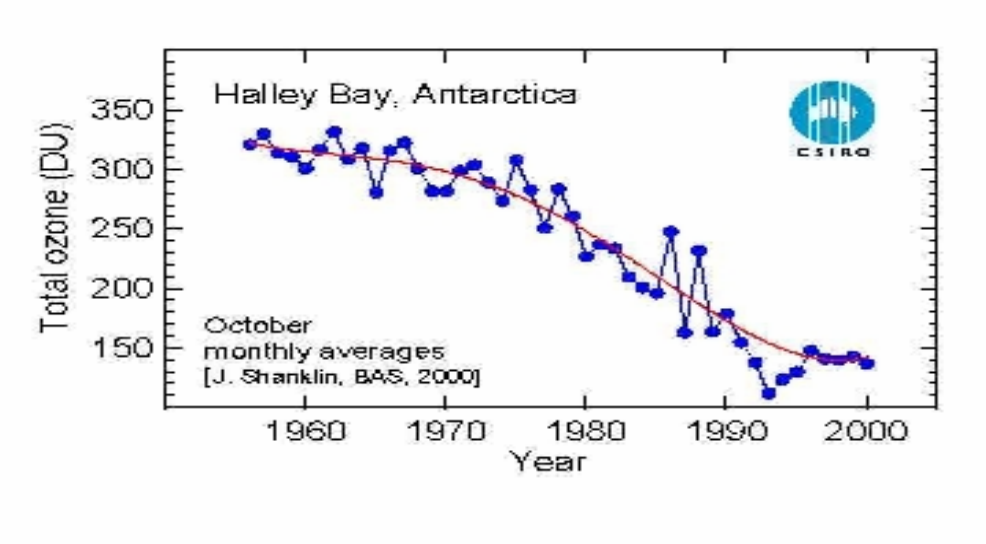
Question 28 (4 marks) **Marks**

This graph summarises the atmospheric ozone concentrations measured at Halley Bay.



(a) Identify the trends or patterns described by the graph. **2**

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(b) Explain ONE method of obtaining the data in the graph. **2**

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Question 29 (5 marks) **Marks**

The hardness of a sample of water was investigated using the following methods.

Method A

25.0 mL samples of water were titrated against ethylenediamine tetra-acetic acid (EDTA) with Eriochrome Black T indicator. 21.7 mL of EDTA was required. The hardness was calculated to be equivalent to 17 mg/L of $CaCO_3$.

Method B

Three drops of detergent were added to separate vials containing 5 mL samples of distilled water, hard water and the sample. After shaking the vials ten times the heights of froth were compared. The procedure was repeated twice. As the amount of froth in the three samples was only slightly less than in the distilled water the sample was determined to be soft.

(a) Identify which of the TWO methods is classified as *qualitative.* **1**

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(b) Using the following table, the results from Method A indicated the sample was soft. **1**

Water Hardness Scale	
Concentration of $CaCO_3$	**Classification**
less than 20 ppm	soft
20-60 ppm	slightly hard
60-120 ppm	moderately hard
more than 120 ppm	hard

Justify this conclusion.

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Question 29 continues on page 21

Question 29 (continued) **Marks**

(c) Compare the appropriateness of Method A and Method B for determining the hardness of the water. **3**

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End of Question 29

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