



Chemistry

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Centre Number

Section I (continued)

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Student Number

Part B – 55 marks

Attempt Questions 21-33

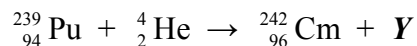
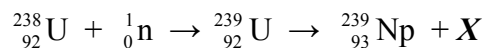
Allow about 1 hour and 35 minutes for this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Question 21 (3 marks)

The production of artificial elements neptunium and curium can be summarised by the following equations:



(a) Identify particle X and particle Y .

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(b) Compare these methods of production of neptunium and curium.

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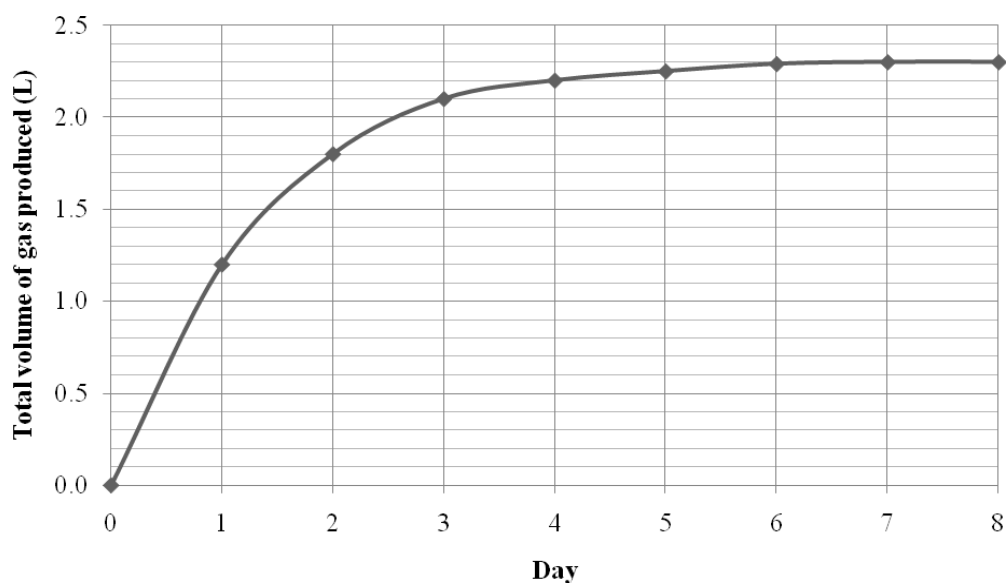
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Question 22 (5 marks)

Ethanol is readily available from renewable sources such as glucose or it may be produced using industrial methods from non-renewable sources.

A student conducted an investigation to produce ethanol from glucose. The graph shows the total volume of gas produced from the reaction vessel over 8 days. The reaction was conducted at 25°C and 100 kPa.



- (a) Identify the process used to produce ethanol from glucose.

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- (b) Calculate the mass of glucose that reacted over the 8 days.

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- (c) Write an equation for the production of ethanol from a non-renewable source and include a catalyst in your equation.

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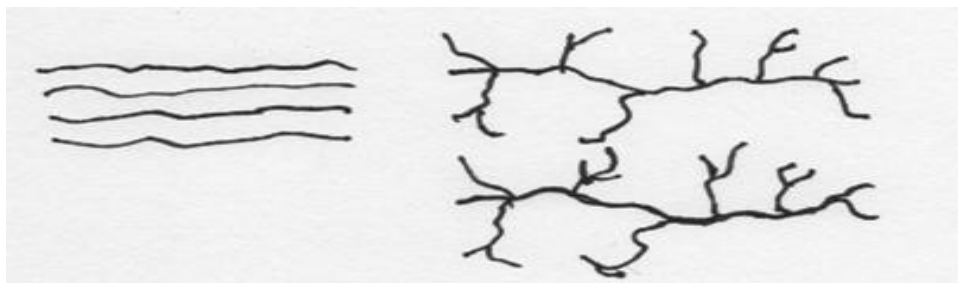
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Question 23 (4 marks)

Models are used in the study of Chemistry to aid our understanding. The diagram shows two different models of the polymer, polyethylene, constructed by a student.

Model A

Model B



Some properties of two forms of polyethylene, known as HDPE and LDPE, are shown in the table.

4

<i>Property</i>	<i>HDPE</i>	<i>LDPE</i>
Melting Point ($^{\circ}\text{C}$)	~ 135	~ 115
Solubility in water	insoluble	insoluble
Flexibility	low	high

Evaluate the effectiveness of the TWO models to explain the properties of HDPE and LDPE shown in the table.

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Question 24 (6 marks)

A student constructed a galvanic cell using two half-cells. One half-cell consisted of a zinc electrode in a zinc sulfate solution. The other half-cell consisted of an aluminium electrode and a solution of aluminium sulfate. A voltmeter and a salt bridge were also used in the cell.

- (a) Write a balanced net ionic equation for the overall cell reaction. **1**

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- (b) Calculate the standard cell potential (E°). **1**

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- (c) The student was told to decrease the cell potential by replacing the reduction half-cell with a different metal cathode and an appropriate solution. **1**

Identify a suitable replacement cathode and solution.

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Question 24 continues on page 17

Question 24 (continued)

- (d) “Oxidation-reduction reactions are increasingly important as a source of energy”.

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Discuss this statement.

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End of Question 24

Question 25 (3 marks)

Nitrogen (N_2) is very stable and forms 78% of the Earth's atmosphere. When lightning occurs, some of the nitrogen is oxidised and a number of products may form. Some of these are shown in the table below.

<i>Name</i>	<i>Formula</i>
dinitrogen monoxide	N_2O
nitrogen monoxide	NO
nitrogen dioxide	NO_2

- (a) Write appropriate equations to show the formation of nitrogen dioxide from nitrogen and oxygen. **2**

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- (b) Identify a problem associated with the presence of oxides of nitrogen in the atmosphere. **1**

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Question 26 (2 marks)

As part of your course an investigation was performed to identify the pH of a range of salt solutions.

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Identify whether ammonium chloride (NH_4Cl) is an acidic, basic or neutral salt and explain your answer, using an appropriate equation.

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Question 27 (3 marks)

A small sample of calcium was reacted with 100.0 mL of water in a beaker. The resulting solution was found to contain hydroxide ions at a concentration of $3.16 \times 10^{-2} \text{ mol L}^{-1}$.

(a) Write a balanced equation for the reaction of calcium with water.

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(b) Determine the volume of the gas formed during this reaction (assume at 25°C and 100 kPa).

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Question 28 (3 marks)

Buffer solutions are important in natural systems.

- (a) Explain why a mixture of sodium chloride and hydrochloric acid cannot form a buffer solution. **2**

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- (b) Account for the importance of buffer solutions in natural systems. **1**

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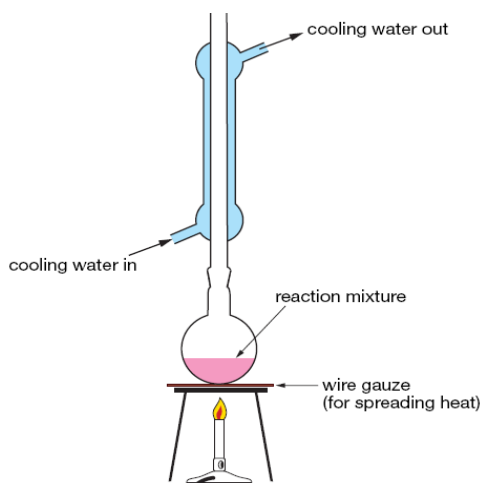
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Question 29 (5 marks)

The diagram shows the apparatus used in a school laboratory to produce the ester, methyl propanoate.



- (a) Name the chemicals used to produce methyl propanoate. **1**

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- (b) Identify the contents of the flask after refluxing for 30 minutes. **2**

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- (c) Justify your answer to part (b) above. **2**

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Question 30 (4 marks)

Our understanding of scientific concepts has developed, over time, as the result of the work of scientists, both individually and in collaboration.

- (a) With reference to the ideas put forward by individual chemists over two centuries, analyse the changes in scientific understanding of the properties of acids. **3**

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- (b) Use an example to identify a benefit of collaboration between chemists in the 21st century. **1**

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Question 31 (6 marks)

Some elements, referred to as trace elements, exist in the environment in very low concentrations which can only be measured in parts per million.

- (a) Describe an appropriate technique for measuring these low concentrations. **2**

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- (b) Assess the impact of the process described in part (a) on the understanding of the effects of a named trace element. **4**

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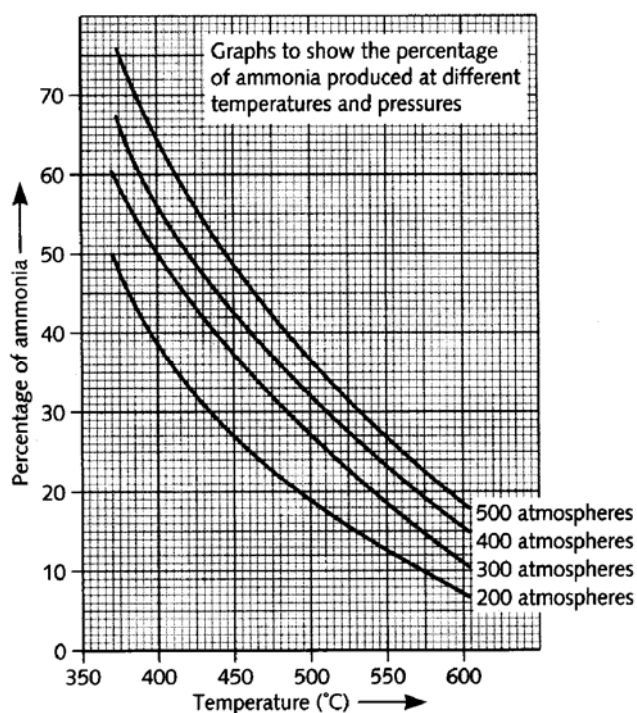
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Question 32 (6 marks)

A student located the following graphs whilst investigating the Haber process.



- (a) Write a balanced chemical equation for the synthesis of ammonia.

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- (b) According to the graphs, which conditions will produce the greatest percentage of ammonia?

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Question 32 continues on page 25

Question 32 (continued)

- (c) Upon further investigation the student discovered the industrial synthesis of ammonia was usually carried out at approximately 450°C and $2 \times 10^4 \text{ kPa}$. 4

With reference to the graphs on page 24 and using your knowledge of the Haber process, explain why these conditions are chosen.

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End of Question 32

Question 33 (5 marks)

According to the Australian Government’s Bureau of Meteorology, “*overwhelming scientific evidence accumulated over more than two decades of study ... has shown that human-made chemicals are responsible for the observed depletion in the ozone layer over Antarctica.*”

Assess the validity of this statement in terms of the scientific evidence gathered and the role of human-made chemicals.

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