Centre Number

Chemistry
Section I (continued)

Student Number

Part B – 60 marks
Attempt Questions 16-30
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 (4 marks)

In your course you conducted a first-hand investigation to compare the reactivities, in bromine water, of an appropriate alkene and its corresponding alkane.

(a) Identify the dependent variable in your investigation. **1**

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(b) Name and draw the structural formula for the alkene used in your investigation. **1**

(c) Justify the selection of this alkene. **2**

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Marks

Question 17 (5 marks)

Tincture of iodine is an antiseptic often found in medical kits. It is a solution of iodine (I_2) in ethanol. Ethanol is used as the solvent as iodine is relatively insoluble in water. When an aqueous solution of iodine is required, iodide ions are added to iodine to form the triiodide ion (I_3^-) which is more soluble in water.

$$I_2\ (s) + I^-\ (aq) \rightarrow I_3^-\ (aq)$$

(a) Draw an electron dot structure for the iodide ion. **1**

(b) Draw a labelled diagram to explain the solubility of iodine (I_2) in ethanol. **2**

(c) Explain why the triiodide ion (I_3^-) is more soluble in water than is iodine (I_2). **2**

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Marks

Question 18 (5 marks)

The following image was found during an investigation about biopolymers. **5**

http://www.ecobiomaterial.com/research-002.php

Assess the validity of the claims made in this source, by referring BOTH to a recently developed biopolymer and to a petroleum-based polymer.

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Marks

Question 19 (3 marks)

A student was asked to construct a galvanic cell using lead and magnesium electrodes and lead (II) nitrate and magnesium nitrate as electrolyte solutions.

(a) Calculate the maximum cell voltage that could be produced from this galvanic cell at standard conditions, showing the reduction and oxidation half-equations and all relevant working. **2**

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(b) The cell voltage measured by the student was less than the calculated E° value. Suggest a possible reason for this difference. **1**

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Marks

Question 20 (3 marks)

Radioisotopes are used both in medicine and industry. **3**

Identify a radioisotope used EITHER in industry OR medicine.
Describe its use and explain how the properties of the identified radioisotope make it appropriate for the use you have described.

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Marks

Question 21 (2 marks)

As part of your course work, you prepared an indicator from a natural material.

(a) Outline the procedure that you followed. **1**

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(b) Outline how you determined whether the indicator you produced was appropriate to test the acidity of a substance. **1**

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Marks

Question 22 (4 marks)

One equilibrium reaction occurring in soft drinks involves carbon dioxide dissolving in water. The dissolution reaction is exothermic.

(a) Use Le Chatelier's Principle to predict the effect on the solubility of carbon dioxide in water as the temperature is increased. **2**

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(b) Using an equilibrium equation, explain why a solution of carbon dioxide in water is acidic. **2**

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Marks

Question 23 (6 marks)

A titration was carried out to determine the concentration of an acetic acid solution, using previously standardised 0.105 mol L^{-1} sodium hydroxide solution.

(a) Outline the method used to standardise the sodium hydroxide solution. **2**

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(b) Calculate the concentration of the acetic acid solution, if 25.0 mL of this solution reacted completely with 17.6 mL of the sodium hydroxide solution. **2**

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(c) Methyl orange is NOT a suitable indicator for use in this titration. Justify this statement. **2**

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Marks

Question 24 (4 marks)

When sodium burns in oxygen it forms sodium oxide, Na_2O.
Sodium also reacts with water to form sodium hydroxide and hydrogen gas.
A small sample of sodium was reacted with 100.0 mL water in a beaker and the resulting sodium hydroxide solution was found to have a concentration of 3.16×10^{-2} mol L^{-1}.

(a) Explain why sodium oxide is classified as a basic oxide. **1**

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(b) Write a balanced equation for the reaction of sodium with water. **1**

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(c) Determine the mass of sodium which must have reacted with the water in the beaker. **2**

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Marks

Question 25 (4 marks)

A student mixed 1-butanol and ethanoic acid together and heated them under reflux with concentrated sulfuric acid.

(a) Name the ester which was produced in this reaction. **1**

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(b) Draw the structural formula for this ester. **1**

(c) Outline TWO purposes for the addition of concentrated sulfuric acid. **2**

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Marks

Question 26 (3 marks)

In the combustion chamber of a petrol-burning car, the majority of the fuel burnt is octane.

(a) Write the balanced equation for the complete combustion of octane. **1**

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(b) Calculate the volume of carbon dioxide which would be produced by the complete combustion of 1.000 kg of octane (measured at 25°C and 100 kPa pressure). **2**

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Marks

Question 27 (6 marks)

A student was given a water sample and asked to determine whether the water should be classified as hard or soft and whether calcium ions were present in the sample.

The steps he took were as follows:

	Method	*Observations*
Step 1	The student added soap solution to a portion of the sample in a test tube and shook the test tube.	Bubbles formed.
Step 2	The student added sodium carbonate solution to a portion of the sample in a test tube and shook the test tube. The student filtered off the precipitate, discarded the precipitate and retained the filtrate for Step 3.	A white precipitate formed.
Step 3	The student heated the filtrate from Step 2 in an evaporating basin until the water had evaporated and a dry solid remained. He then carried out a flame test on the dry solid.	A yellow flame was produced.

The student concluded that:

- the water sample he tested should be classified as soft, as bubbles had formed in Step 1.
- calcium ions were present in the sample, as a white solid had been precipitated in Step 2 and a yellow flame had been observed in Step 3.

The teacher told the student that his conclusions were not valid.

(a) Explain the difference between an invalid experiment and an unreliable experiment. **2**

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Question 27 continues on page 21

Marks

Question 27 (continued)

(b) Evaluate the validity of the conclusions that the student reached. **4**

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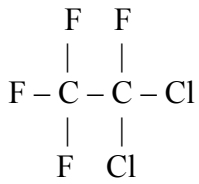
End of Question 27

Marks

Question 28 (4 marks)

(a) Use systematic naming to identify this isomer of $C_2Cl_2F_4$. **1**



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(b) Use appropriate chemical equations to show how the release of ONE $C_2Cl_2F_4$ molecule into the atmosphere can result in the destruction of many ozone molecules. **3**

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Marks

Question 29 (3 marks)

The catalyst used in the Haber process is iron on the surface of magnetite. **3**
By referring to the role of the catalyst, explain why it is essential for industrial chemists to monitor the condition of the catalyst used in this process.

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Marks

Question 30 (4 marks)

The water supply of large cities needs to be purified and sanitised before it is acceptable for human consumption. **4**
Outline the methods used to purify the supply PRIOR to its chlorination, and discuss the need for purification of the water supply.

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