



CATHOLIC SECONDARY SCHOOLS  
ASSOCIATION OF NEW SOUTH WALES

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Centre Number

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Student Number

**2008**  
**TRIAL HIGHER SCHOOL CERTIFICATE**  
**EXAMINATION**

# Chemistry

Morning Session  
Thursday, 7 August 2008

## General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Use the Data Sheet and Periodic Table provided
- Use the Multiple Choice Answer Sheet provided
- Write your Centre Number and Student Number at the top of this page and page 9

**Total marks – 100**

### Section I

Pages 2–24

**75 marks**

This section has two parts, Part A and Part B

Part A – 15 marks

- Attempt Questions 1–15
- Allow about 30 minutes for this part

Part B – 60 marks

- Attempt Questions 16–30
- Allow about 1 hour and 45 minutes for this part

### Section II

Pages 25–35

**25 marks**

- Attempt ONE question from Questions 31–35
- Allow about 45 minutes for this section

## Disclaimer

Every effort has been made to prepare these 'Trial' Higher School Certificate Examinations in accordance with the Board of Studies documents, *Principles for Setting HSC Examinations in a Standards-Referenced Framework* (BOS Bulletin, Vol 8, No 9, Nov/Dec 1999), and *Principles for Developing Marking Guidelines for Examinations in a Standards Referenced Framework* (BOS Bulletin, Vol 9, No 3, May 2000). No guarantee or warranty is made or implied that the 'Trial' Examination papers mirror in every respect the actual HSC Examination question paper in any or all courses to be examined. These papers do not constitute 'advice' nor can they be construed as authoritative interpretations of Board of Studies intentions. The CSSA accepts no liability for any reliance, use or purpose related to these 'Trial' question papers. Advice on HSC examination issues is only to be obtained from the NSW Board of Studies.

**3501-1**

## Section I

75 marks

### Part A – 15 marks

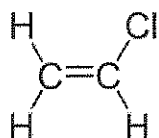
Attempt Questions 1-15

Allow about 30 minutes for this part

Use the Multiple Choice Answer Sheet provided.

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- 1 Which of the following correctly identifies this monomer?



	<i>Systematic name</i>	<i>Common name</i>
(A)	chloroethene	vinyl chloride
(B)	styrene	chloroethene
(C)	chloroethene	styrene
(D)	vinyl chloride	chloroethene

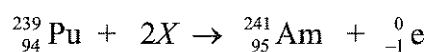
- 2 The following table gives the heats of combustion of three liquid alkanols in kJ/g.

<i>Alkanol</i>	<i>Heat of combustion (kJ/g)</i>
methanol	22.7
ethanol	29.7
1-butanol	36.1

Which of the following is the best approximation for the molar heat of combustion of 1-propanol?

	<i>Molar heat of combustion (kJ/mol)</i>
(A)	34
(B)	43
(C)	2000
(D)	3200

- 3 Most of the world's ethylene is currently produced from the
- (A) dehydration of ethanol.
  - (B) fermentation of sugars.
  - (C) treatment of biomass.
  - (D) cracking of crude oil.
- 4 Which part of a galvanic cell is responsible for maintaining electrical neutrality?
- (A) The anode
  - (B) The cathode
  - (C) The electrolyte solution surrounding the electrodes
  - (D) The electrolyte solution in the salt bridge
- 5 Americium-241 is produced according to the reaction



What is the identity of  $X$ ?

- (A) A neutron
- (B) A proton
- (C) A beta particle
- (D) An alpha particle

- 6 An unknown chemical was removed from the surface of a food storage cupboard being checked for contamination. One of the first tests performed by the chemist was to determine the pH of the chemical by using indicators.

The results are shown in the table below.

<i>Indicator</i>	<i>Colour</i>
Phenolphthalein	Colourless
Methyl orange	Yellow
Bromothymol blue	Yellow

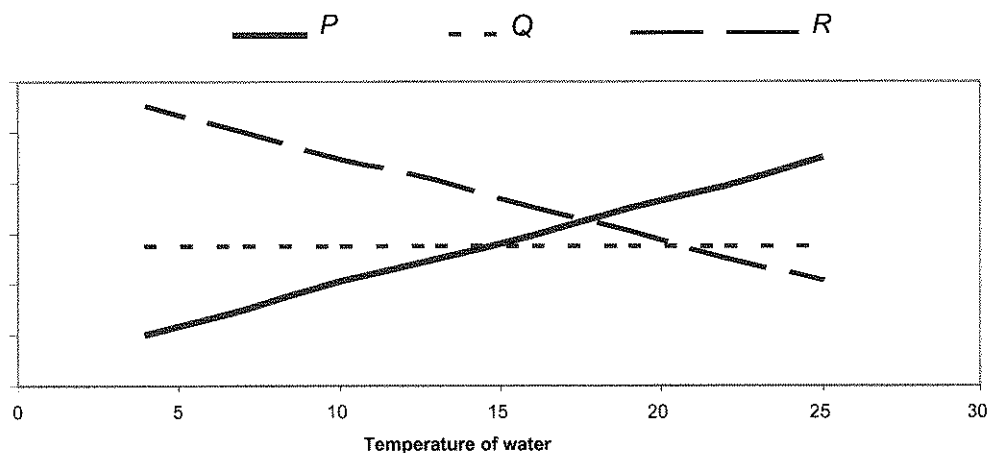
How should the chemist classify the chemical?

- (A) Strongly acidic  
(B) Slightly acidic  
(C) Neutral  
(D) Slightly alkaline
- 7 The conjugate base of  $\text{HNO}_2$  is
- (A)  $\text{OH}^-$   
(B)  $\text{NO}_2^-$   
(C)  $\text{NO}_3^-$   
(D)  $\text{H}_3\text{O}^+$
- 8 Which action would result in an increase of TWO pH units of the solution?
- (A) Diluting 10 mL of  $0.01 \text{ mol L}^{-1} \text{ HCl (aq)}$  to 40 mL  
(B) Diluting 10 mL of  $0.01 \text{ mol L}^{-1} \text{ NaOH (aq)}$  to 40 mL  
(C) Diluting 10 mL of  $0.01 \text{ mol L}^{-1} \text{ HCl (aq)}$  to 1000 mL  
(D) Diluting 10 mL of  $0.01 \text{ mol L}^{-1} \text{ NaOH (aq)}$  to 1000 mL

- 9 A naturally occurring, moderately weak, triprotic acid is represented by the formula
- (A)  $\text{C}_6\text{H}_8\text{O}_7$
  - (B)  $\text{CH}_3(\text{CH}_2)_6\text{COOH}$
  - (C)  $\text{CH}_3\text{COOH}$
  - (D)  $\text{H}_3\text{O}^+$
- 10 During the esterification process, a reflux system is often set up. The refluxing
- (A) allows the reaction to proceed at a lower temperature.
  - (B) prevents the very volatile concentrated sulfuric acid from evaporating.
  - (C) allows the reactants to react efficiently at a higher temperature.
  - (D) prevents the alcohol from boiling in the flask.

- 11 A river that begins at the foot of a glacier was tested for water quality at several places along its course as the water moves downstream through uninhabited forest reserve. The temperature of the water increases as the water moves downstream. THREE different tests (labelled *P*, *Q* and *R* in the graph's legend) were conducted at EACH location.

The data plotted to represent the results of the three tests (*P*, *Q* and *R*) is shown below.



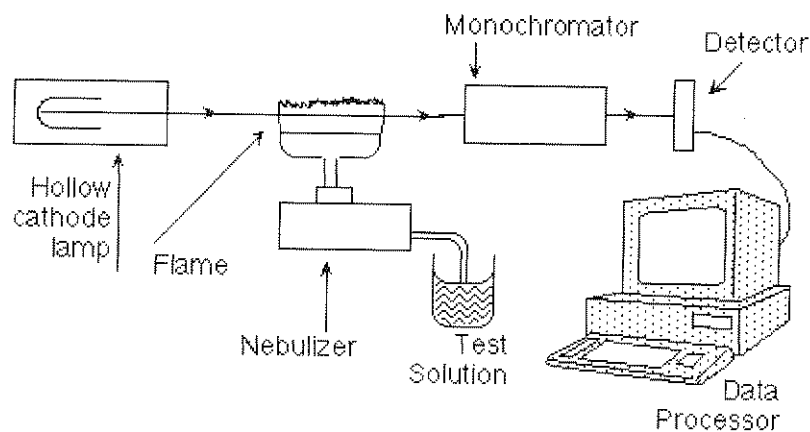
Identify the THREE tests carried out.

	<i>Test P</i>	<i>Test Q</i>	<i>Test R</i>
(A)	Total dissolved solids	Acidity	Dissolved oxygen
(B)	Turbidity	Total dissolved solids	Hardness
(C)	Acidity	Hardness	Turbidity
(D)	Dissolved oxygen	Turbidity	Total dissolved solids

- 12 Which of the following species does not contain a co-ordinate covalent bond?

- (A)  $\text{O}_3$
- (B)  $\text{CO}$
- (C)  $\text{NH}_4^+$
- (D)  $\text{CH}_4$

- 13 The diagram below shows an Atomic Absorption Spectrometer being used to test for the presence of lead.



<http://www.chemistry.nmsu.edu/Instrumentation/AAS1.html>

- If the test solution contains lead, then the light picked up by the detector will be at a
- (A) higher intensity than the light produced by the hollow cathode lamp.
  - (B) lower intensity than the light produced by the hollow cathode lamp.
  - (C) higher frequency than the light produced by the hollow cathode lamp.
  - (D) lower frequency than the light produced by the hollow cathode lamp.
- 14 In the Haber process, which of the following conditions would result in the most industrially efficient method of increasing the yield of ammonia?
- (A) Increasing the temperature of the reaction vessel
  - (B) Increasing the amount of  $\text{N}_2(g)$
  - (C) Increasing the amount of  $\text{H}_2(g)$
  - (D) Removing the  $\text{NH}_3(g)$  as it forms

- 15 A student was given a pure sample of an unknown salt and asked to determine the cation and anion present. She carried out the following reactions.

	<i>Method</i>	<i>Result</i>
Test 1	Dilute nitric acid was added to a portion of the sample.	Bubbles of gas were observed. The solid sample dissolved, forming a solution. No precipitate formed.
Test 2	Dilute hydrochloric acid was added to another portion of the sample.	Bubbles of gas were observed. The solid sample dissolved, forming a solution. No precipitate formed.
Test 3	Dilute sulfuric acid was added to another portion of the sample.	Bubbles of gas were observed. The solid sample dissolved, forming a solution. No precipitate formed.
Test 4	Excess sodium hydroxide solution was added to the solution resulting from Test 1.	A white precipitate formed which turned brown on standing.
Test 5	A flame test was carried out on a fresh portion of the sample.	No distinctive flame colour was observed.

The student's results are consistent with the unknown salt being

- (A) calcium carbonate.
- (B) calcium nitrate.
- (C) iron (II) carbonate.
- (D) iron (II) nitrate.





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Centre Number

## Chemistry

### Section I (continued)

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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.

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**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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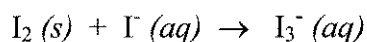
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**Question 17 (5 marks)**

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.



- (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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The following image was found during an investigation about biopolymers.



School of Biological Sciences  
Universiti Sains Malaysia



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

[illegible]

**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  $E^\circ$  value. Suggest a possible reason for this difference. **1**

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**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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**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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**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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**Question 23 (6 marks)**

A titration was carried out to determine the concentration of an acetic acid solution, using previously standardised  $0.105 \text{ mol L}^{-1}$  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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**Question 24** (4 marks)

When sodium burns in oxygen it forms sodium oxide,  $\text{Na}_2\text{O}$ .

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  $3.16 \times 10^{-2} \text{ mol L}^{-1}$ .

- (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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**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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**Question 26 (3 marks)**

**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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**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:

	<i>Method</i>	<i>Observations</i>
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.

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**Question 27 continues on page 21**

Question 27 (continued)

**Marks**

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

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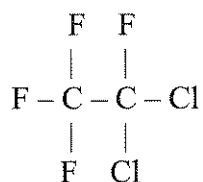
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**End of Question 27**

**Question 28** (4 marks)

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

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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.

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**Question 29** (3 marks)

**Marks**

The catalyst used in the Haber process is iron on the surface of magnetite.  
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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This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.