

2006
Higher School Certificate
Preliminary Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- A data sheet and periodic table are provided
- Write your student number and/or name at the top of every page

Total marks – 75

Attempt ALL questions

Section I – Pages 2 – 5

Total marks (15)

Attempt Questions 1 – 15

Allow about 30 minutes for this section

Section II – Pages 6 – 17

Total marks (60)

Attempt Questions 16 – 27

Allow about 1 hour 30 minutes for this section

This paper MUST NOT be removed from the examination room

STUDENT NUMBER/NAME:

Section I**Total marks (15)****Attempt Questions 1 – 15****Allow about 30 minutes for this part**

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
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1. Pyrite is a mineral with the formula FeS_2 .

Which of the following is the systematic (IUPAC) name for this substance?

- (A) Iron disulfide
- (B) Iron (II) sulfide
- (C) Iron (IV) sulfide
- (D) Iron disulfate

2. Which combination of properties for an element suggests a semi-metal?

- (A) Low melting point, soft, poor conductor
- (B) Low melting point, brittle, good conductor
- (C) Low melting point, malleable, non-conductor
- (D) High melting point, hard, poor conductor

3. In Queensland, a recently discovered body of copper ore contains a high proportion of native (uncombined) copper.

Which property of copper relates most closely to its occurrence as an element?

- (A) Copper has low reactivity
- (B) Copper is a transition metal
- (C) Copper has no reaction with water
- (D) Copper forms insoluble compounds

4. An atom present in a compound has 13 protons, 14 neutrons and 10 electrons.

Which of the following identifies the atomic number and mass number for this compound?

	Atomic No.	Mass No.
(A)	10	13
(B)	13	14
(C)	10	24
(D)	13	27

5. What is the IUPAC name for a compound with the structural formula $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCH}_2$?

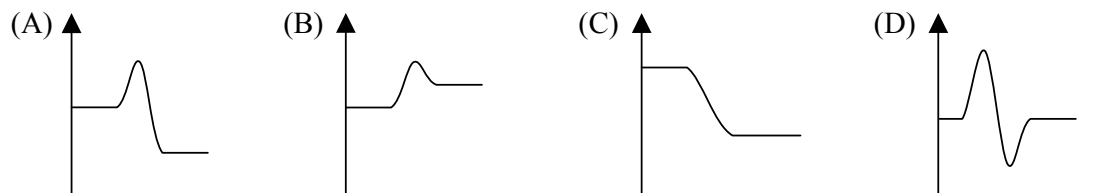
- (A) Butane
- (B) 1-pentene
- (C) 4-pentane
- (D) 4-pentene

6. Which of the following is a reaction where the total volume is the same for reactants and products, at the same temperature and pressure?
- (A) $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$
(B) $2\text{H}_2\text{S}(\text{g}) + \text{SO}_2(\text{g}) \rightarrow 3\text{S}(\text{s}) + 2\text{H}_2\text{O}(\text{l})$
(C) $\text{C}_2\text{H}_4(\text{g}) + 3\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
(D) $\text{C}(\text{s}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}(\text{g}) + \text{H}_2(\text{g})$
7. Which statement describes the transfer of electrons when zinc reacts with dilute sulfuric acid?
- (A) From sulfate ion to zinc
(B) From zinc to hydrogen ion
(C) From zinc to hydrogen gas
(D) From hydrogen gas to zinc
8. Which reaction is exothermic?
- (A) Production of sugar by plants
(B) Electrolysis of water
(C) Reaction of sodium with water
(D) Darkening of silver chloride in light
9. A beaker contains 100mL of silver sulfate (Ag_2SO_4) solution at a concentration of $1.0 \times 10^{-5} \text{ mol L}^{-1}$.
- What is the mass of silver ions in the beaker?
- (A) $1.0 \times 10^{-5} \text{ g}$
(B) $2.16 \times 10^{-4} \text{ g}$
(C) $1.08 \times 10^{-3} \text{ g}$
(D) $1.5 \times 10^{-2} \text{ g}$
10. Which of the following is a direct result of the thermal pollution of a freshwater lake?
- (A) Reduced plant growth
(B) Reduced oxygen levels
(C) Increased salinity
(D) Fewer water birds

Refer to the following information when answering Questions 11 – 12.

Equal volumes of hydrogen and chlorine are mixed in a strong glass tube. When exposed to ultraviolet light the mixture explodes, forming hydrogen chloride gas.

- 11 Which diagram best represents the energy profile for this reaction?



- 12 Which of the following statements correctly describes the reaction of hydrogen with chlorine?

- (A) More energy is required to break H-H and Cl-Cl bonds than two H-Cl bonds.
- (B) H-Cl bonds are stronger than H-H bonds.
- (C) Ultraviolet light is a catalyst for the reaction.
- (D) More energy is released when H-Cl bonds are formed than is required to break H-H and Cl-Cl bonds.

- 13 Which of the following substances demonstrates hydrogen bonding?

- (A) Water
- (B) Hydrogen gas
- (C) Methane
- (D) Lithium hydride

- 14 Dust explosions are a major danger in grain storage containers such as wheat silos and the holds of ships.

What is the main factor which creates the dust explosion hazard.

- (A) Small surface area
- (B) Large surface area
- (C) Presence of a catalyst
- (D) Lack of air in confined spaces

- 15 A small quantity of a liquid hydrocarbon is burned in an excess of oxygen. The gas mixture formed consists of equal volumes of carbon dioxide and gaseous water.

What is the empirical formula for this hydrocarbon?

- (A) C_2H_4
- (B) CH_4
- (C) CH_2
- (D) C_2H

Section II**Total marks (60)****Attempt Questions 16 – 27****Allow about 1 hour 30 minutes for this section**Answer the questions in the spaces provided.

Question 16 (5 marks)**Marks**

Sodium and chlorine both form compounds with sulfur.

- (a) Describe the electronic energy levels (shell configuration) of the sulfur atom.

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- (b) Apply Lewis electron dot structures to compare the bonding of sulfur with sodium and sulfur with chlorine.

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- (c) Identify ONE physical property which differs in the compounds above and relate this difference to their atomic bonding.

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Question 17 (5 marks)

Marks

For an industrial separation process you have studied:

- (a) Identify the properties of the mixture which allow it to be separated. **1**

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- (b) Identify the products of separation and their uses. **2**

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- (c) Discuss issues associated with wastes produced in the separation process. **2**

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Question 18 (3 marks)**Marks**

With reference to molecular forces, explain why more energy is required to produce hydrogen from water than to produce steam from water.

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Question 19 (4 marks)

(a) Define the term *first ionisation energy* using sodium as an example.

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(b) Explain the importance of first ionisation energy in determining the reactivity of a metal such as sodium.

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Question 20 (5 marks)**Marks**

The 20th century sometimes is termed the *Age of Aluminium* as this metal replaced traditional materials in many uses.

- (a) Describe ONE significant use of aluminium and identify the material it has replaced. **1**

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- (b) Explain why aluminium's reactivity prevented its widespread use in earlier times. **2**

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- (c) Evaluate the importance of recycling aluminium. **2**

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Question 21 (6 marks)**Marks**

- (a) Describe the observable changes when magnesium reacts with air, water and diluted acid.

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- (b) Construct chemical equations, showing the state of each substance, for each of the reactions in (a).

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Question 22 (5 marks)

Marks

- (a) Compare the structure of an ionic substance with that of a macromolecular substance.
In your answer give ONE specific example of each substance.

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- (b) Explain why many ionic substances dissolve in water but most macromolecular substances do not.

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Question 23 (5 marks)**Marks**

Lake Vostok is a vast (13000km^2) fresh water lake in Antarctica, which has been isolated under 3.6km of ice for hundreds of thousands of years. In a controversial project, Russian scientists are drilling into this lake, which might support unique life forms.

- (a) Describe THREE properties of water which enable it to provide a stable environment for living things.

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- (b) Propose TWO reasons why this project is controversial.

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Question 24 (5 marks)**Marks**

Iodine is extremely soluble in hexane but has very low solubility in water.

- (a) Explain this difference in solubility in terms of molecular properties. **2**

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- (b) Identify ONE molecular substance which dissolves in water, but not in hexane. **1**

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- (c) Identify a practical procedure for separating:

- (i) A mixture of water and iodine. **1**

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- (ii) A mixture of hexane and iodine. **1**

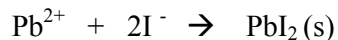
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Question 25 (2 marks)**Marks**

Equal volumes of lead nitrate solution and sodium iodide solution, each with a concentration of 0.10mol L^{-1} , are mixed. A yellow precipitate of lead iodide results.



Calculate the concentration of each ion remaining in solution.

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Question 26 (5 marks)

Disposable propane cylinders are classified as hazardous waste when discarded. Their safe disposal can cost almost as much as their purchase price.

(a) Explain why these containers are hazardous.

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(b) Evaluate the usefulness of propane as a fuel.

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Question 26 continues on the next page

Question 26 (continued)

Marks

- (c) Discuss the necessary conditions for the safe storage of propane.

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Question 27 (10 marks)

In an experiment to investigate the energy and reaction rate for magnesium and hydrochloric acid, 10 small squares of magnesium were dropped into 100mL of the acid, in a foam cup.

Measurements were made for different acid concentrations, prepared by diluting a measured volume of 2.0mol L^{-1} HCl to 100mL. Refer to the table of measurements below.

Volume of 2.0 mol L^{-1} HCl/mL	Initial Temp ($^{\circ}\text{C}$)	Final Temp ($^{\circ}\text{C}$)	Time for complete Reaction
10	21.2	24.5	55
20	20.8	24.8	33
40	20.5	23.2	19
60	20.3	24.2	17
80	20.0	24.8	8
100	19.8	25.0	6

100 squares of magnesium were found to have a total mass of 1.24g.

- (a) Demonstrate that there is a large excess of hydrochloric acid in the first measurement of the table.

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Question 27 continues on the next page

Question 27 (continued)

Marks

- (b) Construct a graph showing the relationship between reaction time and acid concentration. Describe this relationship.

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- (c) Use the data to calculate the energy of the reaction per mole of magnesium.

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Question 27 continues on the next page

Question 27 (continued)

Marks

- (d) Describe TWO essential safety precautions for this experiment.

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