

# NEWINGTON COLLEGE



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Please write your 4/5  
digit STUDENT NUMBER  
neatly in the boxes.

## CHEMISTRY

2001  
TRIAL HSC EXAMINATION

### General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Periodic Table and Formulae Sheets are provided at the back of this paper.

### Section I

Total marks (75)

This section has two parts, Part A and Part B

#### Part A

Total marks (15)

- Attempt Questions 1-15
- Allow about 25 minutes for this part

#### Part B

Total marks (60)

- Attempt Questions 16-28
- Allow about 1 hour and 50 minutes for this part

**Section I is presented in TWO sections:**

- ◆ **Part A and Part B1, Questions 1-22**
- ◆ **Part B2, Questions 23-28**

### ◆ Section II

Total marks (25)

- Attempt ONE question from Questions 29-30
- Allow about 45 minutes for this section

## Section I

**Total marks (75)**

## Part A

**Total marks (15)**

### Attempt Questions 1-15

**Allow about 25 minutes for this part**

Use the multiple-choice answer sheet.

Select the alternative A, B, C or D that best answers the question. Fill in the response circle completely.

**Sample:**

 $2 + 4 =$ 

(A) 2

(B) 6

(C) 8

(D) 9

A O

B ●

CO

DO

If you think you made a mistake, put a cross through the incorrect answer and fill in the new answer..

A B  $\text{CO}$ 

DO

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows:

A B 

CO

DO

~~correct~~

9

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Marks

- 1 Which of the following correctly describes the Bronsted-Lowry and Lewis definitions of an acid.

	Bronsted-Lowry	Lewis
(A)	proton donor	electron pair donor
(B)	proton acceptor	electron pair donor
(C)	proton donor	electron pair acceptor
(D)	proton acceptor	electron pair acceptor

- 2 Which of the following is NOT an acid-base conjugate pair?

- (A)  $\text{H}_3\text{PO}_4$  and  $\text{H}_2\text{PO}_4^-$   
(B)  $\text{H}_2\text{PO}_4^-$  and  $\text{HPO}_4^{2-}$   
(C)  $\text{PO}_4^{3-}$  and  $\text{HPO}_4^{2-}$   
(D)  $\text{H}_2\text{PO}_4^-$  and  $\text{PO}_4^{3-}$

- 3 Which of the following is a transuranic element?

- (A) thallium  
(B) thulium  
(C) thorium  
(D) bohrium

- 4 Which of the following contains a pair of isomers

- (A) chloroethane and chloroethene  
(B) 2-chloropropane and 2-chlorobutane  
(C) 2-chloropropane and 2-fluoropropane  
(D) 1,1-difluoroethane and 1,2-difluoroethane

- 5 Mercury and silver button cells are widely used in watches and small electronic appliances.

What is the main reason that button cells are preferred to standard dry cells for this purpose?

- (A) Button cells are rechargeable
- (B) Button cells produce constant voltage
- (C) Button cells are much cheaper than dry cells
- (D) Button cells are capable of producing high current

- 6 Ethanol can be dehydrated according to the following equation shown below. Which of the following would be the best catalyst for this reaction?

- (A) dilute sulfuric acid
- (B) concentrated sulfuric acid
- (C) dilute sodium hydroxide solution
- (D) concentrated sodium hydroxide solution

- 7 What volume of  $0.1 \text{ mol L}^{-1}$  hydrochloric acid needs to be diluted to 500 mL to achieve a final concentration of  $0.01 \text{ mol L}^{-1}$ ?

- (A) 1.0 ml
- (B) 5.0 mL
- (C) 10.0 mL
- (D) 50.0 mL

- 8 When butanoic acid and ethanol react, a fruity smelling substance forms. What is the systematic name of this product.

- (A) 1-butanol
- (B) ethanoic acid
- (C) ethyl butanoate
- (D) butyl ethanoate

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Marks

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- 9 When a piece of copper wire is placed in silver nitrate solution the wire becomes coated with crystals of silver metal. What is the oxidant in this reaction?
- (A) Cu  
(B)  $\text{Ag}^+$   
(C)  $\text{NO}_3^-$   
(D)  $\text{H}_2\text{O}$
- 10 Which of the following is amphoteric?
- (A) HCl  
(B)  $\text{HCO}_3^-$   
(C)  $\text{H}_2\text{SO}_4$   
(D)  $\text{CH}_3\text{COOH}$
- 11 Water hardness may be due to which one of the following ions?
- (A) chloride ions  
(B) magnesium ions  
(C) nitrate ions  
(D) sodium ions
- 12 A sample of powder is known to be either sodium carbonate or sodium phosphate. The most appropriate test to identify the substance is
- (A) add water  
(B) add hydrochloric acid  
(C) add sodium hydroxide solution  
(D) heat the sample over a Bunsen burner

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**Marks**

**13** The three most abundant gases in the atmosphere are

- (A) argon, oxygen and nitrogen
- (B) carbon dioxide, oxygen and nitrogen
- (C) hydrogen, oxygen and nitrogen
- (D) methane, oxygen and nitrogen

**14** Which of the following is NOT a polymer?

- (A) acrylonitrile
- (B) cellulose
- (C) nylon
- (D) polyester

**15** To react two compounds it is often useful to conduct the reaction at higher temperature, however volatile reactants and products may be lost before the reaction is complete. What experimental procedure is used to avoid this problem?

- (A) distillation
- (B) oxidation
- (C) reflux
- (D) titration

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Marks

## Section I

### Part B

**Total marks (60)****Attempt Questions 16-28****Allow about 110 minutes for this part**

Answer Questions 16-23 in the Part B1 Answer Booklet.

Answer Questions 24-28 in the Part B2 Answer Booklet.

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Show all relevant working in questions involving calculations.

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Marks**Question 16** (3 marks)

The annual worldwide production of ethene is approximately 100 million tonnes.

Most ethene is produced by 'cracking' larger hydrocarbon molecules.

- (a) Identify the original source of the larger hydrocarbon molecules? 1

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- (b) Explain why catalysts are used in the cracking process. 1

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- (c) Ethene is produced in vast quantities because it is very useful for making other things.  
Account for the usefulness of ethene in terms of the type of reaction it undergoes. 1

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**Question 17** (2 marks)

When a zinc bar is placed in a copper sulfate solution the zinc becomes coated by copper.

- (a) Explain this reaction in terms of electron transfer. 1

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Marks

- (b) Explain why it is not possible to coat a silver bar with copper, by this method.

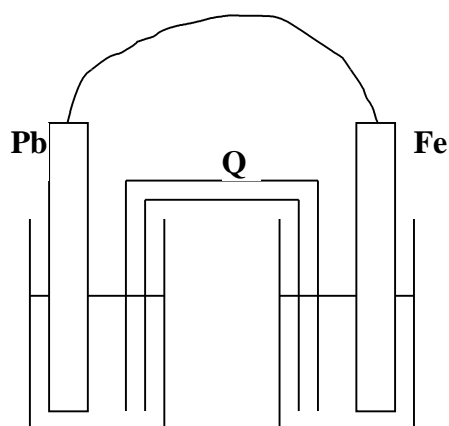
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**Question 18** (5 marks)

A simple galvanic cell can be made using a lead electrode standing in a lead nitrate solution and an iron electrode standing in an iron nitrate solution.



- (a) Identify the anode and the cathode.

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- (b) Describe the movement of electrons in the circuit.

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- (c) Suggest materials that could be used to make Q. Justify your choice.

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- (d) Compare the electrical energy (voltage and current) that is produced in a galvanic cell with that produced by a lead-acid (car) battery.

2

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Marks**Question 19** (6 marks)

In the Haber process, ammonia is produced from nitrogen and hydrogen.

- (a) Write an equation for the formation of ammonia from its elements. 1

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- (b) The reaction is conducted at 500°C. Explain why an elevation in temperature causes an increase in the rate of reaction. 1

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- (c) The formation of ammonia is exothermic. Outline the conditions of temperature and pressure that are used to maximise the production of ammonia. Explain why these conditions produce optimum production. 3

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- (d) Explain why a catalyst is used in the reaction. 1

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Marks

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**Question 20** (7 marks)

Hexane, glucose and ethanol are all useful sources of energy.

- (a) Write the molecular formula of hexane and glucose. 1

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- (b) The table below shows the solubility of three substances in water. Would glucose be more soluble in hexane or ethanol? Explain your prediction. 1

	hexane	glucose	ethanol
Solubility in Water	low	high	high

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- (c) Plants produce glucose during photosynthesis. Some of the glucose is turned into cellulose. Explain why cellulose is called a condensation biopolymer. 2

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Throughout the world ethanol is produced in large quantities in one of two ways.

1. hydration of ethene
2. fermentation of glucose

- (d) Write an equation for the fermentation of glucose. 1

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- (e) Is ethanol a renewable resource? Explain your answer. 2

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Marks

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**Question 21** (2 marks)

When pellets containing molybdenum-98 are placed (in steel rods) in the nuclear reactor, neutrons are absorbed and molybdenum-99 is formed as shown in the nuclear equation below.



- (a) Molybdenum-99 is an unstable isotope and undergoes beta decay to form technetium-99. Write a nuclear equation for the beta decay of molybdenum-99.

1

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- (b) Technetium-99 can be used to detect bone cancer. Once it is injected, the technetium-99 attaches itself to the parts of the bone that have cancer and emit radiation which can be detected by a 'camera' outside the body.

Name a device which could be used as the camera.

1

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**Question 22** (3 marks)

Carbon dioxide is poorly soluble. Small amounts of carbon dioxide can be dissolved in water and like nearly all gases it is more soluble in cold water.

- (a) Write an equation showing carbon dioxide in water. Explain in terms of Le Chatelier's Principle why high pressure carbon dioxide is used to increase the amount which dissolves.

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- (b) Suggest a reason why more gas dissolves at lower temperature.

1

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## Part B2

### (Questions 23-28)

#### Question 23 (4 marks)

The table below shows the pH of four different acidic solutions.

Name	Formula	Concentration ( $\text{molL}^{-1}$ )	pH
hydrobromic	HBr	0.15	2.0
hydrobromic	HBr	0.015	?
hydrochloric	HCl	0.15	1.3
hydrochloric	HCl	0.015	2.3

- (a) With reference to hydrobromic and hydrochloric acids, explain why acids can vary in strength.

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- (b) Predict the pH of  $0.015 \text{ molL}^{-1}$  hydrobromic acid. Justify your prediction.

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- (c) Identify two examples of manufactured acids.

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Marks

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**Question 24** (3 marks)

It is possible to find the concentration of acid in a solution by volumetric analysis (titration).

- (a) Describe the correct technique for rinsing the glassware when preparing for a titration. **2**

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- (b) Explain why it is difficult to accurately titrate a weak base with a weak acid. **1**

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**Question 25** (5 marks)

Nitrogen ( $\text{N}_2$ ) is very stable and forms 78% of the Earth's atmosphere. When lightning strikes, some nitrogen is oxidised and a number of products may form. Some of these are shown in the table.

Name	Formula
nitrous oxide	$\text{N}_2\text{O}$
nitric oxide	$\text{NO}$
nitrogen dioxide	$\text{NO}_2$

- (a) Using an equation, describe the formation of nitrogen dioxide from the reaction of nitrogen and oxygen. **1**

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Marks

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- (b) Calculate the mass of nitrogen which is required to form 1000 litres of nitrogen dioxide (at 298K and 101.3 kPa).

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- (c) Nitrogen dioxide dissolves in water to form a colourless solution.

Name an acid-base indicator and predict the colour that it would be in this solution.

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- (d) Sulfur dioxide is another atmospheric gas. Identify one natural and one industrial source of sulfur dioxide.

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**Question 26** (5 marks)

A sample of river water is thought to contain chloride and sulfate ions.

- (a) Describe tests that you could do to confirm the presence of these two anions.

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Marks

- (b) Describe how Atomic Absorption Spectroscopy (AAS) is used to determine of metal ion concentrations in solutions.

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**Question 27** (7 marks)

Oxygen and ozone are both present in the atmosphere. The concentration of ozone is highest (7.5 ppm) at an altitude of 25 km.

- (a) Draw Lewis electron dot formulas for oxygen and ozone. Indicate any coordinate covalent bonds

2

- (b) Ozone has a higher boiling point than oxygen. Account for this in terms of molecular structure.

1

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- (c) Chemicals such as chlorofluorocarbons (CFCs) have been released into the atmosphere. Identify the origins of these CFCs.

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Marks

- (d) CFC-114 has the molecular formula  $C_2F_4Cl_2$ .  
Systematically name one isomer which has this formula.

1

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- (e) Discuss the problems associated with the use of CFCs and the measures taken to solve them.

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**Question 28** (8 marks)

Monitoring of water quality in waterways is becoming increasingly necessary. Many different tests may be conducted for different reasons.

- (a) Describe how the quantity of total dissolved solids (TDS) may be determined.

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- (b) Explain why it is necessary to test for turbidity.

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Marks

- (c) Sewage and discharge from abbatoirs have high biochemical oxygen demand (BOD).  
Explain why the BOD must be monitored.

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- (d) The purification and treatment of Sydney tap water can be considered as five steps.  
**aeration , chlorination , filtration , fluoridation , sedimentation**  
List these steps in the correct order.

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## Section II

### Options

**Total marks (25)**

**Attempt EITHER Question 29 or 30**

**Allow about 45 minutes for this part**

**Q29 – Forensic Chemistry**

**Q30 – Shipwrecks and Salvage**

Answer this Question in the Option Answer Booklet.

Show all relevant working in questions involving calculations.

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**Marks**

#### **Question 29 Forensic Chemistry (25 marks)**

- (a) It is important for forensic chemists to accurately determine the type of materials present in a sample. The origin of a sample may implicate a particular person in a crime.

- (i) Identify which of the following substances are organic

**2**

**ethanol ( $\text{C}_2\text{H}_6\text{O}$ )**

**calcium carbonate ( $\text{CaCO}_3$ )**

**methane ( $\text{CH}_4$ )**

**glycine ( $\text{C}_3\text{H}_5\text{O}_2\text{N}$ )**

**water ( $\text{H}_2\text{O}$ )**

**potassium cyanide ( $\text{KCN}$ )**

**carbon monoxide ( $\text{CO}$ )**

**glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ )**

- (ii) A bottle containing a flammable liquid was found, but the label had been removed. The liquid in the bottle might be **hexane**, **ethanol** or **methanoic acid**.

Describe the tests that would be necessary to distinguish between these three liquids.

**4**

- (iii) Explain why the inorganic chemical properties of soils may be useful evidence.

**2**

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**Marks**

- (b) Organic material may be found at the scene of a crime. It may be necessary to determine whether the material was originally from a plant or an animal.
- (i) Describe a test that can distinguish between plant and animal material by detecting glycogen and starch. 2
- (ii) Glucose is a monosaccharide. Identify a disaccharide and two polysaccharides. 2
- (iii) Describe a test that a forensic chemist could perform to distinguish between a reducing sugar and a non-reducing sugar. Account for the difference between these two types of sugars in terms of their chemical structure. 3
- (c) Oils that come from plants and animals are called triglycerides and are different from oils that are used as lubricants in motor vehicles.
- (i) Describe the structural differences between these two types of oils. 2
- (ii) Triglycerides can be hydrolysed to produce three fatty acid molecules and one other organic product. Identify this substance 1
- (iii) 1-propanol, 1,2-propandiol and glycerol all react with dilute permanganate solution. Describe what results would be observed in the test. 2
- (d) Proteins are polypeptides which are found in large quantities in animals.
- (i) Proteins often provide structure such as in muscle tissue. Identify another purpose of proteins in animals. 1
- (ii) Draw the peptide bond and explain why the formation of a polypeptide is called a condensation reaction. 2
- (iii) Describe how chromatography can be used to separate different substances such as different proteins. 2

**END OF OPTION**

**Question 30 Shipwrecks and Salvage (25 marks)**

- (a) The ocean has many minerals dissolved in it. Some of these minerals are involved in the chemical process of corrosion.
- (i) Identify TWO different sources of the minerals dissolved in sea water. 2
- (ii) Briefly describe the work of Alessandro Volta and explain how it advanced our understanding of the generation of electricity. 2
- (b) Most large ships built in the last 100 year have been made of metal. Different metals are subject to different rates and different types of corrosion.
- (i) Account for the differences in corrosion of active and passivating metals. 2
- (ii) Describe the conditions under which rusting of iron occurs and explain the process of rusting. 4
- (c) Electrochemical cells involve oxidation and reduction reactions. Electrochemical cells can be divided into two types – galvanic and electrolytic.
- (i) Describe the difference between a galvanic and an electrolytic cell. 1
- (ii) Draw and label an electrolytic cell that could be used for the electrolysis of a **DILUTE** sodium chloride solution using graphite electrodes. 3
- (iii) Write half-equations to represent the oxidation and reduction reactions in the electrolysis of a **DILUTE** sodium chloride solution, by referring to the list of Standard Potentials. 2
- (iv) Describe how increasing the concentration of the sodium chloride affects the products that form. 1
- (v) Define Faraday's first law of electrolysis. 1

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**Marks**

- (d) The corrosion of the metal hull of a ship can occur quickly in a marine environment. It is necessary to protect ships against rapid corrosion.
- (i) Explain why the corrosion of steel is accelerated when it is placed in sea water. **1**
- (ii) Outline the process of impressed current cathodic protection and give an example of its use in a marine environment. Include a diagram in your answer. **3**
- (iii) Briefly describe ONE other method by which a metal hull may be protected. **1**
- (iv) When a piece of nickel and a piece of iron are placed in contact with each other, one of these metals is protected from corrosion, by the other. Use the list of Standard Potentials to explain which metal will corrode and which will be protected. **2**

**END OF OPTION**

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