



Pymble Ladies' College

Chemistry

2003

Trial Examination

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Board-approved calculators may be used
- Write using black or blue pen

Section I

Total marks (75)

This section has two parts, Part A and Part B

Part A Multiple choice Total marks (15)

- Attempt Questions 1–15

Part B Extended Answers Total marks (60)

- Attempt Questions 16–28

Section II

Total marks (25)

- Attempt ONE question - Question 29

A Periodic Table and Data Sheet are provided as a pull-off sheet at the back of this paper.

Section I – Part A

1. While studying for an examination, a student came across the following notes on the internet concerning anodes and cathodes

Which of the following is the correct quote for her to learn?

- A. The anode in a galvanic cell is where oxidation occurs while an electrolytic cell has oxidation at the cathode
- B. The anode in a galvanic cell is where reduction occurs while an electrolytic cell has reduction at the cathode
- C. The anode in a galvanic cell is where oxidation occurs while an electrolytic cell has oxidation at the anode
- D. The anode in a galvanic cell is where reduction occurs while an electrolytic cell has oxidation at the anode

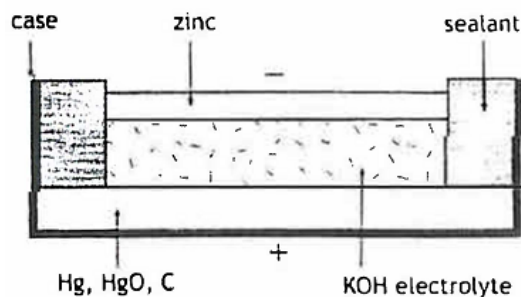
2. In comparing ethane and ethene which of the following statements is correct?

- A. Ethane has a higher melting point due to the weaker dispersion forces between ethane molecules
- B. Ethane is less reactive than ethene and ethane undergoes substitution reactions.
- C. Ethane and ethene are both polar molecules.
- D. Ethane is less reactive than ethene and undergoes addition reactions.

3. The stability of isotopes is related to the ratio of neutrons to protons in the nucleus. Unstable nuclei elements with:

- A. A low atomic number mainly produce β -particles.
- B. An atomic number greater than 83 produce α -particles only.
- C. An atomic number less than 83 produce α -particles and γ -radiation only
- D. A neutron to proton ratio between 1 and 1.1 produce γ -radiation only

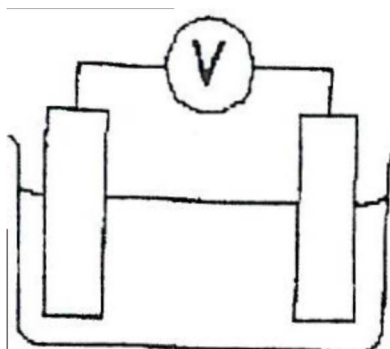
4. The diagram below is of a Mercury cell (a primary cell)



Choose the correct statement

- A. The oxidation process is $\text{HgO} + 2\text{OH}^- + 2\text{e}^- \rightarrow \text{Hg} + 2\text{OH}^-$
- B. The cell reaction is $\text{Zn}_{(s)} + \text{HgO}_{(s)} \rightarrow \text{ZnO}_{(s)} + \text{Hg}_{(s)}$
- C. The HgO is the anode
- D. The electrolyte is liquid mercury.

5. The diagram represents a simple galvanic cell in which two metals are placed in a liquid. The metals are connected by a voltmeter. Which of the following combination would give the highest voltmeter reading?



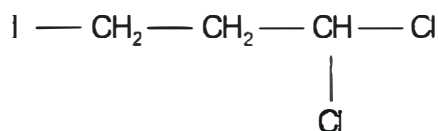
	METAL 1	METAL 2	LIQUID
A.	silver	copper	water
B.	magnesium	lead	ethanol
C.	zinc	tin	hydrochloric acid
D.	copper	copper	copper sulfate solution

6. Esters are often used as food additives. They are formed from the reaction of a carboxylic acid and an alcohol. What is the IUPAC name of the following ester?
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OOCCH}_3$
- A. ethyl butanoate
 B. propyl butanoate
 C. butyl ethanoate
 D. methyl pentanoate
7. Sulfuric acid dissociates completely in water. The pH of $0.0005 \text{ mol L}^{-1}$ solution of sulfuric acid in water
- A. 3.0
 B. 3.3
 C. 11
 D. 10.7
8. Antacid tablets are used to counteract excess stomach acidity. The substance that would be most unsuitable for this purpose would be
- A. sodium hydroxide
 B. aluminium hydroxide
 C. magnesium hydroxide
 D. sodium hydrogen carbonate

9. Excess hydrochloric acid was added to a mixture of sodium carbonate and sodium hydrogen carbonate. 1.0 mol of carbon dioxide was formed. The mixture could have contained:

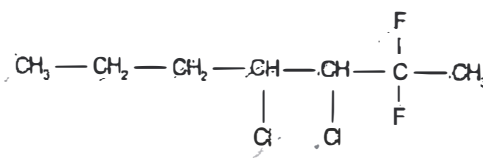
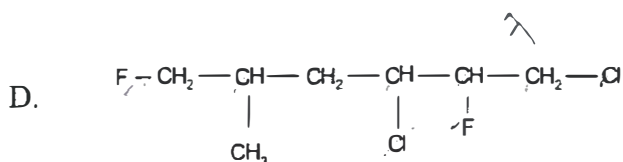
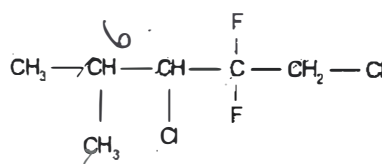
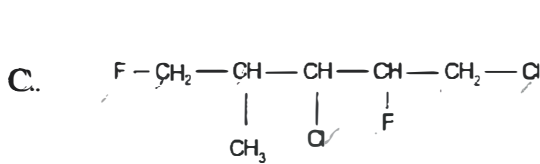
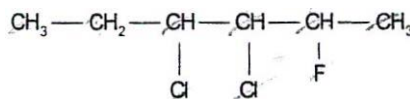
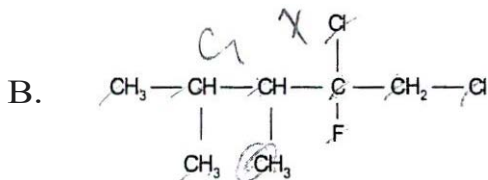
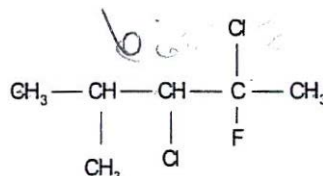
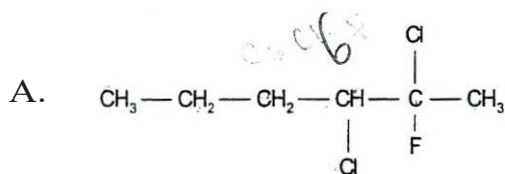
- A. 0.25 mol NaHCO₃ and 0.25 mol Na₂CO₃
- B. 0.50 mol NaHCO₃ and 1.0 mol Na₂CO₃
- C. 0.50 mol NaHCO₃ and 0.50 mol Na₂CO₃
- D. 0.50 mol NaHCO₃ and 0.25 mol Na₂CO₃

10. What is the IUPAC name for this molecule?



- A. 3-iodo-1,1-dichloropropane
- B. 1-iodo-dichloropropane
- C. 1-iodo-3,3-dichloropropane
- D. 1,1-dichloro-3-iodopropane

11. Which of the following is NOT a pair of isomers?



12. Which equation represents the formation of ammonia?

- A. $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \leftrightarrow 2\text{NH}_3 (\text{g})$
- B. $2\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \leftrightarrow 2\text{NH}_3 (\text{g})$
- C. $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \leftrightarrow 2\text{NH}_3 (\text{l})$
- D. $\text{N}_2 (\text{g}) + 4\text{H}_2 (\text{g}) \leftrightarrow 2\text{NH}_4 (\text{g})$

13. What technique is most likely to be used to determine the concentration of metal ions in a solution?

- A. gravimetric analysis
- B. titration
- C. Atomic Absorption spectroscopy
- D. chromatography

14. What test would provide information about whether a sample contained lead ions?

- A. flame test
- B. addition of silver nitrate
- C. addition of sodium hydroxide
- D. litmus test

15. Which layer of the atmosphere contains ozone in the highest concentration?

- A. Troposphere
- B. Stratosphere
- C. Thermosphere
- D. Mesosphere

Section I – Part B
Total Marks (60)
Attempt questions 16-28

Answer the questions in the spaces provided

Question 16 (5 marks)

Polystyrene is a widely used polymer.

- a) Identify the systematic name of the monomer used to manufacture this polymer **1**
- b) Identify ONE use of this polymer and describe its use in terms of its properties. **2**
- c) Explain why the recycling of plastics is an important means of conserving fossil fuel reserves **2**

Question 17 (4 marks)

- a) The radioisotope $^{244}_{94}\text{Pu}$ can be used as a nuclear fuel. What is meant by the term radioisotope? **1**
- b) High concentration of caesium-137 was found over much of Europe after the Chernobyl nuclear power plant explosion. Write a balanced nuclear equation for the Beta decay of Caesium-137 **1**
- c) Name and describe the use of one radioisotope, other than plutonium, that is used in industry. **2**

Question 18 (5 marks)

Cellulose is an example of a condensation polymer that is found in plant materials

- d) Explain what is meant by a condensation polymer. **1**
- e) Discuss the potential of cellulose as a raw material to reduce our dependence on fossil fuels **4**

Question 19 (4 marks)

A student prepared 0.1 M solutions of two different acids, citric (2-hydroxypropane-1,2,3- tricarboxylic acid) and hydrochloric acid.

- a) Compare the relative strength of these acids **1**
- b) Explain, using the relevant equations, why the pH of these acids would differ, despite the fact that they are the same concentration. **3**

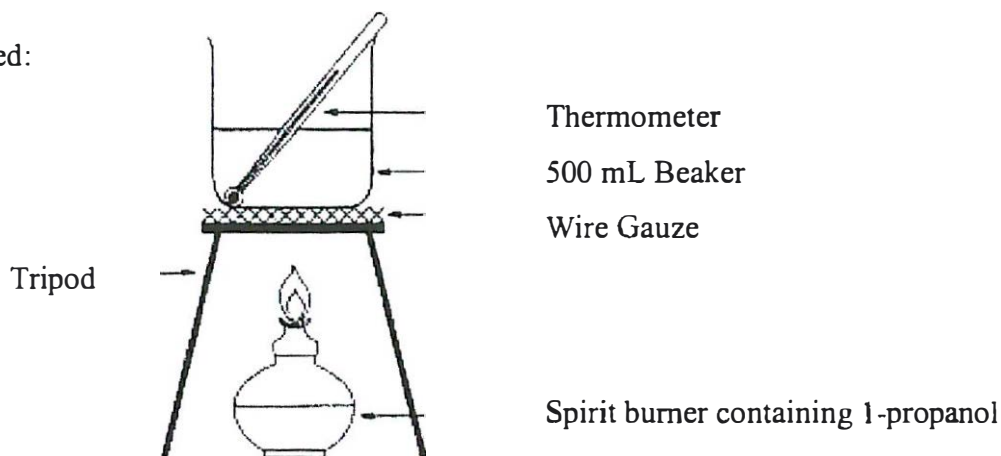
Question 20 (8 marks)

Ethanol is readily available from renewable resources such as plants.

Students were asked to perform a first hand investigation to determine the molar heat of combustion of 1-propanol and compare it to that of ethanol.

The following extract is from the practical report of their experiment.

Apparatus used:



Lab Data

Mass of water =	250.0 g
Initial mass of burner =	221.4 g
Final mass of burner =	219.1 g
Initial temperature of water =	19.0°C
Final temperature of water =	59.0°C

a) The students forgot to prepare a risk assessment for this task. Outline an appropriate risk assessment for this practical.

b) Propose TWO adjustments that could be made to the apparatus or experimental method to improve the accuracy of the experiment.

c) Calculate the molar heat of combustion of 1-propanol. ↘

3

The value for the molar heat of combustion for ethanol in the data books is 1364 kJ mol^{-1} and
d) that for 1-propanol is 2016 kJ mol^{-1} . Suggest one reason that your results might differ from
that of the data books. 1

Question 21 (3 marks)

A solution of potassium hydrogen carbonate is basic while a solution of ammonium nitrate is acidic.

a) Write an equation to show how the potassium hydrogen carbonate reacts with water to produce a basic solution.

b) Identify the acid base conjugate pairs when ammonium nitrate dissolves in water.

2

Question 22 (6 marks)

A student performed a first-hand investigation to decarbonate soft drink. She did this by firstly weighing the unopened bottle of drink. She then released the lid of the drink, allowing as much gas to escape as possible. She then gently warmed the drink for 20 minutes on a hot plate.

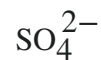
Cooled the bottle and then reweighed it. She repeated this several times. The total loss of weight from the 500mL bottle of drink was 3.5g.

a) What volume would this amount of carbon dioxide occupy at 100 kPa and 25°C? **2**

b) The solubility of carbon dioxide in water varies with temperature and pressure. Explain how this variation occurs using Le Chateliers principle. **4**

Question 23 (3 marks)

There are many species which we say are amphiprotic. From the list below identify ONE amphiprotic species and construct equations to demonstrate the behaviour of this amphiprotic species in acidic and in basic solutions.



Question 24 (3 marks)

Some reactions need to be monitored because they form different products under different conditions.

- a) Write TWO equations to show that the products of combustion vary depending on how much oxygen is available. **2**
- b) Why is it important to monitor this reaction? **1**

Question 25 (8 marks)

The concentration of acid in many common household substances is calculated using the technique of titration. A standard solution is prepared, and the concentration of the unknown substances is determined using this standard solution. Sodium carbonate is often used as a primary standard:

a) Identify the properties required for a substance to be considered a Primary Standard **1**

b) Describe the correct technique for preparing a sodium carbonate solution **3**

c) 2.65 g of sodium carbonate is used to make a standard solution by dissolving it in 250ml of water. This was then used to titrate 25 mL of a solution of vinegar so that its concentration of acetic (ethanoic) acid can be calculated. The titration was repeated until all values agreed within 0.05 mL. The results are shown below. Use these to calculate the concentration of the acetic acid in the vinegar solution.

RUN	ACID TITRE (mL)
Rough	25.80
1	25.60
2	25.55
3	25.65

Question 26 (2 marks)

a) Some of the properties of Ozone and Oxygen are tabulated below

Property	Ozone	Oxygen
Boiling point	-193°C	-111°C
Density	slightly denser than air	1.5 times denser than air
Reactivity	highly reactive	reactive
Colour	blue	colourless

Choose ONE of these properties and account for it in terms of the molecular structure and the molecular bonding of the molecule.

Question 27 (4 marks)

a) Lawn food contains sulfate ions. Explain the chemistry involved in the experiment you did to measure the sulfate content of lawn fertiliser. **2**

b) When a student performed the above experiment, they found the barium sulfate precipitate weighed 2.2 grams. Calculate the mass of the sulfate in the lawn food. **2**

Question 28 (5 marks)

In your studies you have investigated the endothermic esterification reaction and the exothermic reaction which produces ammonia using the Haber process. Compare these processes in terms of reaction rate and equilibrium.