

91166



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 2 Chemistry, 2013

91166 Demonstrate understanding of chemical reactivity

9.30 am Tuesday 19 November 2013

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chemical reactivity.	Demonstrate in-depth understanding of chemical reactivity.	Demonstrate comprehensive understanding of chemical reactivity.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L2-CHEMR.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

ASSESSOR'S USE ONLY

**This page has been deliberately left blank.
The examination begins on the following page.**

You are advised to spend 60 minutes answering the questions in this booklet.

QUESTION ONE

- (a) Hydrochloric acid was reacted with calcium carbonate in the form of marble chips (lumps) and powder (crushed marble chips) in an experiment to investigate factors affecting the rate of a chemical reaction.

Marble chips (lumps)



<https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcTZD8kay1SBm9N6sSYimAnkGYxFM7nPts1o9WEAyR5giwILW38O>

Crushed marble chips (powder)



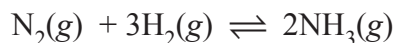
<http://hoangnhat.en.ecplaza.net/ground-calcium-carbonate-powder--333617-2615449.html>

- (i) Identify the factor being investigated.

- (ii) Explain why the hydrochloric acid would react faster with the powder.

QUESTION TWO

- (a) Ammonia gas, $\text{NH}_3(\text{g})$, is formed from hydrogen gas and nitrogen gas, as shown in the following equation.



Complete the equilibrium constant expression for this reaction.

$K_c =$

- (b) The K_c for a different reaction is

$$K_c = \frac{[\text{SO}_3(\text{g})]^2}{[\text{SO}_2(\text{g})]^2 [\text{O}_2(\text{g})]}$$

Write the chemical equation that corresponds to this expression in the box below.

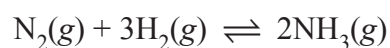
\rightleftharpoons

- (c) The two reactions shown in the following table are both at equilibrium.

Reaction	Equation	Affected by increased pressure
One	$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$	no
Two	$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$	yes

Compare and contrast the effect of increasing the pressure on both reactions, with reference to the equilibrium positions.

- (d) For **Reaction Two** in part (c), the values of K_c at different temperatures are shown below.



Temperature	227°C	327°C	427°C	527°C
K_c	90	3	0.3	0.04

Use this information to determine whether the formation of $\text{NH}_3(\text{g})$ is endothermic or exothermic. Justify your reasoning using equilibrium principles.

QUESTION THREE

- (a) The table below shows two acids with their conjugate base.

Acid	Conjugate base
HCl	Cl ⁻
HSO ₄ ⁻	SO ₄ ²⁻

Explain the relationship between an acid and its conjugate base using one example from the table above.

- (b) In a solution of nitric acid, HNO₃, the concentration of H₃O⁺ ions is 0.0125 mol L⁻¹.

Determine the concentration of hydroxide ions, OH⁻, and the pH of this solution.

[OH⁻] = _____

pH = _____

- (c) A solution of ethanoic acid, CH₃COOH, is found to be acidic.

- (i) Complete the equation for the reaction of ethanoic acid with water.



- (ii) Explain why the solution is acidic.

- (d) The following table shows the concentration and pH of three acids, and the relative rate of reaction with magnesium (Mg) metal.

Acid	Concentration / mol L ⁻¹	pH	Relative rate of reaction with Mg
HA	0.100	3.4	slow
HB	0.0100	2	fast
HC	1.00×10^{-5}	5	very slow

- (i) Write an equation for the reaction of **HA** with magnesium in the box below.

- (ii) Explain the difference between a strong acid and a weak acid.

- (iii) Compare and contrast the reactivity of the three acids with magnesium.

In your answer:

- determine the concentration of hydronium ions, H_3O^+ , in each acid
- compare the concentration of hydronium ions to the concentration of the acid
- explain the relative rate of reaction for each acid with magnesium by referring to the information in the table above.
