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NZQA
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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

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The examination begins on the following page.

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

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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.

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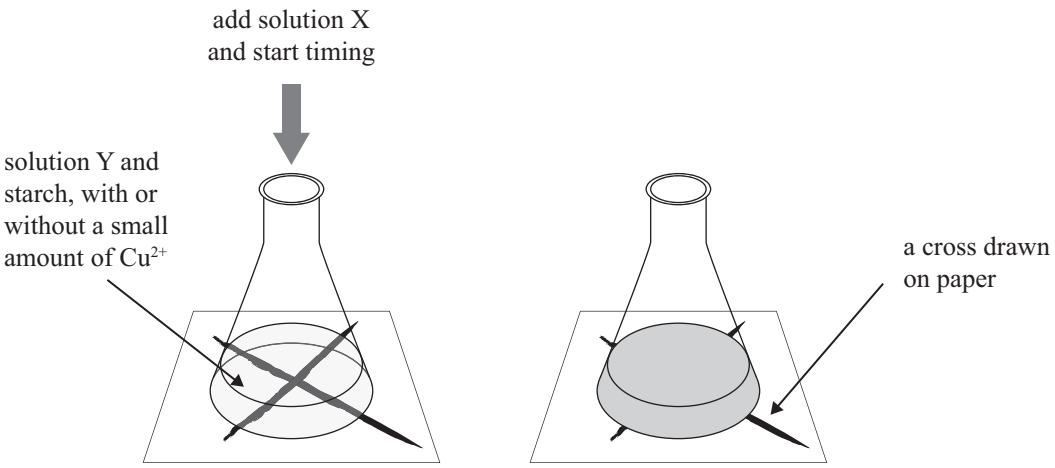
(b) A *clock reaction* involves mixing solution X and solution Y with starch present. When the reaction is complete the solution turns blue-black in colour.

A student carried out this reaction between solution X and solution Y in a conical flask. Over time, the cross on the piece of paper under the flask disappeared when viewed from above.



The following experiments were carried out, and the times taken for the cross to disappear recorded.

Experiment		Temperature / °C	Time for cross to disappear / s
1	No Cu^{2+} present	25	42
2	No Cu^{2+} present	50	23
3	Cu^{2+} present	25	5

Elaborate on why the reactions in **Experiment 2** and **Experiment 3** occur faster than the reaction in **Experiment 1**.

In your answer, include the following words or terms.

collisions **activation energy** **temperature** **effective** **catalyst**

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QUESTION TWO

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(a) Ammonia gas, $NH_3(g)$, is formed from hydrogen gas and nitrogen gas, as shown in the following equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Complete the equilibrium constant expression for this reaction.

$K_c =$

(b) The K_c for a different reaction is

$$K_c = \frac{[SO_3(g)]^2}{[SO_2(g)]^2 [O_2(g)]}$$

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	$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$	no
Two	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	yes

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

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

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Temperature	227°C	327°C	427°C	527°C
$\boldsymbol{K_c}$	90	3	0.3	0.04

Use this information to determine whether the formation of $NH_3(g)$ is endothermic or exothermic. Justify your reasoning using equilibrium principles.

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(e) For **Reaction One** in part (c), the K_c value is 46.8 at 491°C

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

Calculate the concentration of HI(g), at equilibrium, at 491°C, if the concentration of $H_2(g)$ is 0.0190 mol L^{-1} and the concentration of $I_2(g)$ is 0.210 mol L^{-1}.

QUESTION THREE

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(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, HNO_3, the concentration of H_3O^+ 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, CH_3COOH, is found to be acidic.

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

$$CH_3COOH + H_2O \rightleftharpoons$$

(ii) Explain why the solution is acidic.

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(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.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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