See back cover for an English translation of this cover

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91166M

911665

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Te Mātauranga Matū, Kaupae 2, 2012

91166M Te whakaatu māramatanga ki te kaha o te tauhohenga matū

9.30 i te ata Rātū 20 Whiringa-ā-rangi 2012
Whiwhinga: Whā

Paetae	Paetae Kaiaka	Paetae Kairangi
Te whakaatu māramatanga ki te kaha o te tauhohenga matū.	Te whakaatu māramatanga hōhonu ki te kaha o te tauhohenga matū.	Te whakaatu māramatanga matawhānui ki te kaha o te tauhohenga matū.

Tirohia mehemea e ōrite ana te Tau Ākonga ā-Motu (NSN) kei tō pepa whakauru ki te tau kei runga ake nei.

Me whakautu e koe ngā pātai KATOA kei roto i te pukapuka nei.

He taka pūmotu kua whakaritea ki te Pukaiti Rauemi L2-CHEMMR.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia te wāhi wātea kei muri i te pukapuka nei, ka āta tohu ai i te tau pātai.

Tirohia mehemea kei roto nei ngā whārangi 2–19 e raupapa tika ana, ā, kāore hoki he whārangi wātea.

HOATU TE PUKAPUKA NEI KI TE KAIWHAKAHAERE HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

Kia 60 meneti hei whakautu i ngā pātai o tēnei pukapuka.

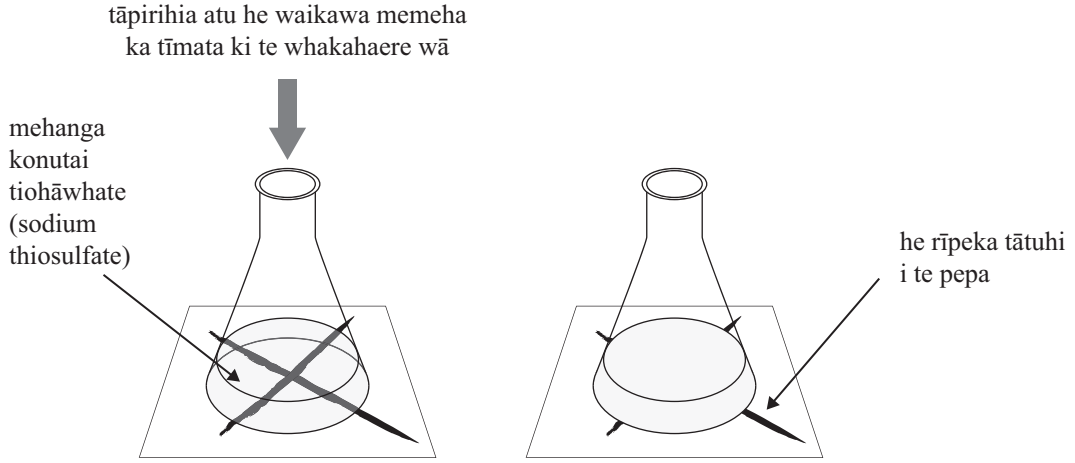
MĀ TE KAIMĀKA ANAKE

PĀTAI TUATAHI

Ina tāpirihia atu te waikawa pūhaumāota memeha, HCl(*aq*), ki te konutai tiohāwhate, $Na_2S_2O_3(aq)$, i roto i tētahi puoto kōrere, ka pā mai te tauhohenga e whai ake:

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(\ell)$$

Ka puta tētahi pungatara totoka kōwhai mā, S(*s*), i te tauhohenga. Nāwai rā, ka ngaro haere te rīpeka i te pepa i raro i te puoto kōrere ina tirohia atu mai i runga.



(a) Whakarārangitia mai ngā tikanga e RUA hei whakaiti i te tere o tēnei tauhohenga.

(b) I whakahaerehia ngā whakamātau e whai ake nei, ā, i tuhia ngā wā mō te ngaromanga haere o te rīpeka. He inati te HCl(*aq*) i ngā whakamātau katoa.

Whakamātau	**Kukūtanga o te 50.0 mL $Na_2S_2O_3$ / mol L^{-1}**	**Kukūtanga o te 10.0 mL HCl / mol L^{-1}**	**Paemahana / °C**	**Te wā ngaromanga o te rīpeka / hēkona**
1	0.0500	1.00	25	127
2	0.0250	1.00	25	206
3	0.0500	1.00	45	34

Tātarihia te tauritenga o ngā hua o te **Whakamātau 2** me te **Whakamātau 3** ki te **Whakamātau 1**.

I roto i tō whakautu me:

- tautohu te take kei te whakarerekēhia, me te pānga ki te tere o te tauhohenga
- whakamārama i pēhea te pānga ki te tere o te tauhohenga, ka kōrero hoki mō te tukinga o ngā korakora, me te pūngao whakaoho ina e hāngai ana.

MĀ TE KAIMĀKA ANAKE

Te tauritenga o te **Whakamātau 2** ki te **Whakamātau 1**:

Te tauritenga o te **Whakamātau 3** ki te **Whakamātau 1**:

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

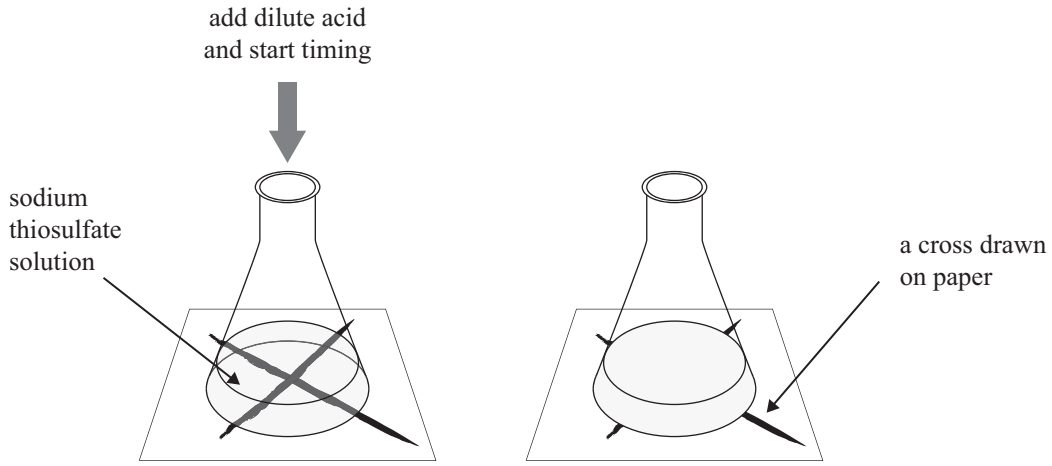
ASSESSOR'S USE ONLY

QUESTION ONE

When dilute hydrochloric acid, HCl(*aq*), is added to sodium thiosulfate, $Na_2S_2O_3(aq)$, in a conical flask, the following reaction occurs:

$$2HCl(aq) + Na_2S_2O_3(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(\ell)$$

A pale yellow solid of sulfur, S(*s*), forms during the reaction. Over time, a cross on a piece of paper under the conical flask gradually disappears when viewed from above.



(a) List TWO ways that the rate of this reaction could be decreased.

(b) The following experiments were carried out, and the times taken for the cross to disappear recorded. The HCl(*aq*) was in excess in all of the experiments.

Experiment	Concentration of 50.0 mL $Na_2S_2O_3$ / mol L^{-1}	Concentration of 10.0 mL HCl / mol L^{-1}	Temperature / °C	Time taken for cross to disappear/s
1	0.0500	1.00	25	127
2	0.0250	1.00	25	206
3	0.0500	1.00	45	34

ASSESSOR'S USE ONLY

Analyse how the results of **Experiment 2** and **Experiment 3** compare to **Experiment 1**.

In your answer you should:

- identify the factor being changed and the effect it has on the reaction rate
- explain how the rate of reaction was affected, with reference to the collision of particles, and activation energy where appropriate.

Experiment 2 compared to **Experiment 1**:

Experiment 3 compared to **Experiment 1**:

PĀTAI TUARUA

MĀ TE KAIMĀKA ANAKE

Ka ngawhere te haurehu pūtūtaewhetū pūhaumāota-rima, $PCl_5(g)$, ki te haurehu pūtūtaewhetū pūhaumāota-toru, $PCl_3(g)$, me te haurehu haumāota, $Cl_2(g)$. Ka taea te whakaatu i te taurite hei:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

(a) Whakaotihia te kīanga aumou taurite mō tēnei tauhohenga.

$K_c =$

(b) E whakaatu ana te tūtohi i raro nei i ngā uara o te aumou taurite, K_c, i ngā paemahana rerekē e rua.

Paemahana / °C	**Uara o K_c**
200	8.00×10^{-3}
350	0.612

(i) Porohitatia te momo kukū rawa atu i te **200°C**.

$PCl_5(g)$ **$PCl_3(g)$**

(ii) Whakamāramahia tō whakautu.

(iii) Tātaitia te kukūtanga o te PCl_5 i te taurite o te 350°C, mēnā ko ngā kukūtanga o te PCl_3 me te Cl_2 he 0.352 mol L^{-1}.

(c) Mō ia rerekētanga e whai ake e pā ana ki tēnei pūnaha:

(i) Tuhia mēnā ka piki, ka heke iho rānei te rahi o **te haurehu haumōata, $Cl_2(g)$**.

(ii) Parahautia ō whakautu mā ngā mātāpono taurite.

Kua whakakorehia te $PCl_3(g)$.

Te rahi o te $Cl_2(g)$ _____

Te pūtake:

_____

_____

_____

_____

_____

Ka whakaitihia te pēhanga.

Te rahi o te $Cl_2(g)$ _____

Te pūtake:

_____

_____

_____

_____

_____

MĀ TE KAIMĀKA ANAKE

QUESTION TWO

ASSESSOR'S USE ONLY

Phosphorus pentachloride gas, $PCl_5(g)$, decomposes to form phosphorus trichloride gas, $PCl_3(g)$, and chlorine gas, $Cl_2(g)$. The equilibrium can be represented as:

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

(a) Complete the equilibrium constant expression for this reaction.

$K_c =$

(b) The table below shows the value of the equilibrium constant, K_c at two different temperatures.

Temperature / °C	**Value of K_c**
200	8.00×10^{-3}
350	0.612

(i) Circle the species that will be in the highest concentration at **200°C**.

$PCl_5(g)$ **$PCl_3(g)$**

(ii) Explain your answer.

(iii) Calculate the concentration of PCl_5 at equilibrium at 350°C, if the concentrations of PCl_3 and Cl_2 are both 0.352 mol L^{-1}.

ASSESSOR'S USE ONLY

(c) For each of the following changes applied to this system:

(i) State if the amount of **chlorine gas, $Cl_2(g)$,** would increase or decrease.

(ii) Justify your answers using equilibrium principles.

$PCl_3(g)$ is removed.

Amount of $Cl_2(g)$ _____

Reason:

The pressure is decreased.

Amount of $Cl_2(g)$ _____

Reason:

(d) Ina whakapikihia te paemahana o te pūnaha taurite mai i te 200°C ki te 350°C (i te pēhanga aumou), ka piki te uara o K_c, e ai ki te tūtohi i (b) kei te whārangi 6.

MĀ TE KAIMĀKA ANAKE

Whakamahia ēnei pārongo hei whakatau mēnā he pauwera, he putawera rānei te PCl_5.

Parahautia ō whakaaro mā ngā mātāpono taurite.

ASSESSOR'S USE ONLY

(d) When the temperature of the equilibrium system is increased from 200°C to 350°C (at constant pressure), the value of K_c increases, as shown in the table in (b) on page 8.

Use this information to determine whether the decomposition of PCl_5 is endothermic or exothermic.

Justify your reasoning using equilibrium principles.

PĀTAI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) (i) Whakaotihia te tūtohi i raro nei hei whakaatu i ngā takirua waikawa-kawakore haumi.

Waikawa haumi	Kawakore[1] haumi
HCO_3^-	
H_2O	
	CN^-

(ii) Ko te $HPO_4^{2-}(aq)$ tētahi momo ka mahi hei waikawa, hei kawakore rānei.

Tuhia kia rua ngā whārite mō ngā tauhohenga o te HPO_4^{2-} me te wai: kia kotahi te whārite ina ka mahi hei waikawa, kia kotahi ina mahi hei kawakore.

Ko te HPO_4^{2-} e mahi ana hei	Whārite
waikawa	$HPO_4^{2-} + H_2O \rightarrow \rightleftharpoons$
kawakore	$HPO_4^{2-} + H_2O \rightarrow \rightleftharpoons$

(b) Kei tētahi mehanga he 9.56×10^{-5} mol L^{-1} o ngā katote waihā.

(i) Tātaihia te kukūtanga o ngā katote hauwai honowai (hydronium), H_3O^+.

(ii) He waikawa, he kawakore, he ngū rānei tēnei mehanga i te 25°C?

Porohitatia kia kotahi mō te whakautu.

waikawa **kawakore** **ngū**

Parahautia tō whakautu.

[1] pāpāhua

QUESTION THREE

ASSESSOR'S USE ONLY

(a) (i) Complete the table below to show the conjugate acid-base pairs.

Conjugate acid	Conjugate base
HCO_3^-	
H_2O	
	CN^-

(ii) $HPO_4^{2-}(aq)$ is a species that can act as an acid or a base.

Write equations for the reactions of HPO_4^{2-} with water: one where it acts as an acid, and one where it acts as a base.

HPO_4^{2-} acting as	**Equation**
an acid	$HPO_4^{2-} + H_2O \rightleftharpoons$
a base	$HPO_4^{2-} + H_2O \rightleftharpoons$

(b) A solution contains 9.56×10^{-5} mol L^{-1} of hydroxide ions.

(i) Calculate the concentration of hydronium ions, H_3O^+.

(ii) Is this solution acidic, basic or neutral at 25°C?

Circle one answer.

acidic **basic** **neutral**

Explain your answer.

(c) (i) Tātaitia te pH o tētahi mehanga waikawa pūhaumāota 0.133 mol L^{-1}.

(ii) Tātaitia te kukūtanga katote waihā, $[OH^-]$, o tētahi mehanga konutai waihā me tētahi pH o te 12.8.

(d) E whakaaturia ana i te tūtohi i raro nei ētahi āhuatanga o ngā mehanga waiwai A, B, me C, o ngā kukūtanga ōrite.

Mehanga	**A**	**B**	**C**
pH	5.15	11.6	1.05
Te kawenga hiko	pai	koretake	pai

Kua tangohia ngā tapanga o ngā mehanga e toru.

E mōhiotia ana ko ngā mehanga he $NH_3(aq)$, $HCl(aq)$ me te $NH_4Cl(aq)$.

Whakamahia ngā raraunga o te tūtohi i runga nei hei tautohu i tēnā, i tēnā o ngā mehanga e toru hei whakaoti i te tūtohi i raro nei.

Mehanga	**A**	**B**	**C**
Te tautohunga o te mehanga ($NH_3(aq)$, $HCl(aq)$, $NH_4Cl(aq)$ rānei)			

Parahautia te tautohunga o ngā mehanga e toru.

I roto i tō whakautu me:

- kōrero mō te pH me te kawenga hiko o ngā mehanga
- hono ō whakautu ki ngā whārite matū tōtika.

ASSESSOR'S USE ONLY

(c) (i) Calculate the pH of a 0.133 mol L^{-1} solution of hydrochloric acid.

(ii) Calculate the hydroxide ion concentration, $[OH^-]$, of a solution of sodium hydroxide with a pH of 12.8.

(d) Some properties of three aqueous solutions A, B and C, of equal concentration are shown in the table below.

Solution	**A**	**B**	**C**
pH	5.15	11.6	1.05
Electrical conductivity	good	poor	good

The labels of the three solutions have been removed.

It is known that the solutions are $NH_3(aq)$, $HCl(aq)$ and $NH_4Cl(aq)$.

Use the information in the table above to identify each of the three solutions and complete the table below.

Solution	**A**	**B**	**C**
Identity of solution ($NH_3(aq)$, $HCl(aq)$, or $NH_4Cl(aq)$)			

Justify the identification of all three solutions.

In your answer you should:

- refer to both pH and electrical conductivity of the solutions
- link your answers to appropriate chemical equations.

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

He puka anō mēnā ka hiahiatia.
Tuhia te (ngā) tau pātai mēnā e hāngai ana.

TAU PĀTAI

MĀ TE KAIMĀKA ANAKE

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 2 Chemistry, 2012

91166 Demonstrate understanding of chemical reactivity

9.30 am Tuesday 20 November 2012
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.

91166M

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 2–19 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.