See back cover for an English translation of this cover

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91166M

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SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Te Mātauranga Matū, Kaupae 2, 2014

91166M Te whakaatu māramatanga ki te tauhohehohe matū

2.00 i te ahiahi Rātū 11 Whiringa-ā-rangi 2014
Whiwhinga: Whā

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te tauhohehohe matū.	Te whakaatu māramatanga hōhonu ki te tauhohehohe matū.	Te whakaatu māramatanga matawhānui ki te tauhohehohe matū.

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

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

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

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia te (ngā) whārangi kei muri i te pukapuka nei, ka āta tohu ai i ngā 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

PĀTAI TUATAHI

MĀ TE KAIMĀKA ANAKE

(a) Ka memeha te haukini, NH_3, ki te wai ka puta tētahi mehanga whai pH o te 11.3.

(i) Whakaotihia te whārite mā te tuhi i ngā ture tātai o ngā hua e rua.

$$NH_3(waiwai) + H_2O(\ell) \rightleftharpoons \_\_\_\_\_ + \_\_\_\_\_$$

(ii) Whakamāramahia mai kei te aha i te wā o tēnei tauhohenga.

I tō whakautu, me:

- tautohu i te waikawa me tana pāpāhua haumi
- tautohu i te pāpāhua me tana waikawa haumi
- whakaahua i te whakawhiti iraoho ka pā.

(b) (i) I roto i tētahi mehanga o te konurehu waihā, KOH, ka kitea ko te pH he 12.8.

Tātaitia te kukūtanga katote hauwai honowai, $[H_3O^+]$, me te kukūtanga katote waihā, $[OH^-]$, i roto i te mehanga.

$[H_3O^+]$ =

$[OH^-]$ =

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Ammonia, NH_3, is dissolved in water and the resulting solution has a pH of 11.3.

(i) Complete the equation by writing the formulae of the two products.

$$NH_3(aq) + H_2O(\ell) \rightleftharpoons \_\_\_\_\_ + \_\_\_\_\_$$

(ii) Explain what is occurring during this reaction.

In your answer you should:

- identify the acid and its conjugate base
- identify the base and its conjugate acid
- describe the proton transfer that occurs.

(b) (i) In a solution of potassium hydroxide, KOH, the pH is found to be 12.8.

Calculate the hydronium ion concentration, $[H_3O^+]$, and the hydroxide ion concentration, $[OH^-]$, in the solution.

$[H_3O^+]$ =

$[OH^-]$ =

MĀ TE KAIMĀKA ANAKE

(ii) Tātaitia te pH o tētahi mehanga konutai waihā, NaOH, 2.25×10^{-4} mol L^{-1}.

pH = _____

(c) E whakaatu ana te tūtohi i te kawenga hiko o ngā mehanga rerekē e rima o te **kukūtanga ōrite**, me te tae o ngā pepa tohu waikawa i tautauhia ki ia mehanga.

Mehanga	**A**	**B**	**C**	**D**	**E**
Kawenga hiko	koretake	pai	pai	koretake	pai
Pepa tohu waikawa whero	huri kikorangi	noho whero	noho whero	noho whero	huri kikorangi
Pepa tohu waikawa kikorangi	noho kikorangi	huri whero	noho kikorangi	huri whero	noho kikorangi

Tautohua tētahi pāpāhua[1] kaha me tētahi pāhare ngū, mā te whakamahi i ngā kōrero kei roto i te tūtohi i runga ake.

I roto i tō whakautu, me parahau ō kōwhiringa mā te kōrero mō ngā āhuatanga o ngā mehanga i tautohua.

[1] kawakore

ASSESSOR'S USE ONLY

(ii) Calculate the pH of a 2.25×10^{-4} mol L^{-1} sodium hydroxide, NaOH, solution.

pH = _____

(c) The table below shows the relative electrical conductivity of five solutions of the **same concentration**, and the colour of pieces of litmus paper which have been dipped into each solution.

Solution	**A**	**B**	**C**	**D**	**E**
Electrical conductivity	poor	good	good	poor	good
Red litmus paper	turns blue	stays red	stays red	stays red	turns blue
Blue litmus paper	stays blue	turns red	stays blue	turns red	stays blue

Identify a strong base and a neutral salt, using the information in the table above.

In your answer you should justify your choices by referring to the properties of the identified solutions.

PĀTAI TUARUA

MĀ TE KAIMĀKA ANAKE

Ka taea te waihanga hauwai ahumahitia mā te whakahohe i te mewaro ki te wai. Ka taea te whakaatu i tētahi whārite mō tēnei tauhohenga mā te:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

$K_c = 4.7$ i te 1127°C

(a) (i) Whakaotihia te kīanga aumou taurite mō tēnei tauhohe:

$K_c =$

(ii) Ko ngā kukūtanga o ngā haurehu e whā i roto i tētahi ranunga tauhohe i te 1127°C ka kitea ko:

Haurehu	CH_4	H_2O	CO	H_2
Kukūtanga / mol L^{-1}	0.0300	0.0500	0.200	0.300

Whakamahia ēnei uara ki te whakahaere i tētahi tātaitanga hei whakatau mēnā kei te taurite te tauhohenga.

Kei te taurite te ranunga? **Āe** **Kāo** (porohitatia te mea tika)

Tātaitanga:

QUESTION TWO

ASSESSOR'S USE ONLY

Hydrogen can be produced industrially by reacting methane with water. An equation for this reaction can be represented by:

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$$

$K_c = 4.7$ at 1127°C

(a) (i) Complete the equilibrium constant expression for this reaction:

$K_c =$

(ii) The concentrations of the four gases in a reaction mixture at 1127°C are found to be:

Gas	CH_4	H_2O	CO	H_2
Concentration / mol L^{-1}	0.0300	0.0500	0.200	0.300

Use these values to carry out a calculation to determine if the reaction is at equilibrium.

Mixture at equilibrium? **Yes** **No** (circle correct option)

Calculation:

(b) Kei te taurite te tauhohenga e whakaaturia ana i te whārite i raro.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Whakaahuahia te pānga o ia huringa e whai ake ki te kukūtanga taurite o te waihā mewaro (piki, heke, noho ōrite).

Parahautia ō whakautu mā te whakamahi i ngā mātāpono taurite.

Ka tāpirihia he whākōkī konukura ōkai, CuO.

Ko te rahi o te $CH_3OH(g)$:

ka piki TĒRĀ RĀNEI **ka heke** TĒRĀ RĀNEI **ka noho ōrite**

(porohitatia te whakautu tika)

Pūtake:

Ka tangohia te H_2(g).

Ko te rahi o te $CH_3OH(g)$:

ka piki TĒRĀ RĀNEI **ka heke** TĒRĀ RĀNEI **ka noho ōrite**

(porohitatia te whakautu tika)

Pūtake:

ASSESSOR'S USE ONLY

(b) The reaction shown in the equation below is at equilibrium.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

Describe the effect of each of the following changes on the equilibrium concentration of methanol (increase, decrease, stay the same).

Justify your answers using equilibrium principles.

A copper oxide, CuO, catalyst is added.

Amount of $CH_3OH(g)$ would: **increase** OR **decrease** OR **stay the same** (circle correct answer)

Reason:

H_2(g) is removed.

Amount of $CH_3OH(g)$ would: **increase** OR **decrease** OR **stay the same** (circle correct answer)

Reason:

(c) I tētahi tauhohenga, ka noho taurite te haurehu parauri hauota hāora-rua, $NO_2(g)$, me te haurehu kanokore hauota-rua ōkai-whā, $N_2O_4(g)$.

MĀ TE KAIMĀKA ANAKE

E whakaaturia ana te whārite mō tēnei tauhohenga i raro nei:

$$\underset{\text{haurehu parauri}}{2NO_2(g)} \rightleftharpoons \underset{\text{haurehu kanokore}}{N_2O_4(g)}$$

E whakaatu ana te tūtohi i raro i ngā kitenga ina pā ngā huringa ki te pūnaha.

Huringa		**Ngā kitenga**
Pēhanga	piki (mā te whakaheke i te rōrahi o te ipu)	Mōnehu te tae
	heke (mā te whakapiki i te rōrahi o te ipu)	Kaha ake te tae
Pāmahana	ka raua te ipu me te ranunga tauhohe ki te wai wera	Kaha ake te tae
	ka raua te ipu me te ranunga tauhohe ki te wai tio	Mōnehu te tae

Tātarihia ēnei kitenga whakamātau.

I tō whakautu, me:

- tūhono ngā kitenga katoa ki ngā mātāpono taurite
- parahau mēnā ko te putanga o te hauota-rua ōkai-whā mai i te hauota hāora-rua he pauwera, putawera rānei.

ASSESSOR'S USE ONLY

(c) In a reaction, the brown gas nitrogen dioxide, $NO_2(g)$, exists in equilibrium with the colourless gas dinitrogen tetroxide, $N_2O_4(g)$.

The equation for this reaction is represented by:

$$\underset{\text{brown gas}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless gas}}{N_2O_4(g)}$$

The table below shows the observations when changes were made to the system.

Change		**Observations**
Pressure	increased (by decreasing the volume of the container)	Colour faded
	decreased (by increasing the volume of the container)	Colour darkened
Temperature	container with reaction mixture put into hot water	Colour darkened
	container with reaction mixture put into ice water	Colour faded

Analyse these experimental observations.

In your answer you should:

- link all of the observations to equilibrium principles
- justify whether the formation of dinitrogen tetroxide from nitrogen dioxide is endothermic or exothermic.

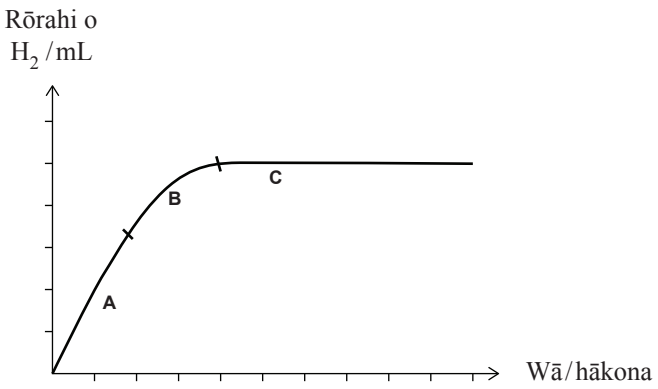
PĀTAI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) E whakaaturia ana te whārite mō tēnei tauhohenga i waenga i ngā pata konutea (ngā pōkurukuru), Zn(*s*), me te waikawa pungatara, H_2SO_4(*waiwai*), e te:

$$Zn(s) + H_2SO_4(waiwai) \rightarrow ZnSO_4(waiwai) + H_2(g)$$

E whakaatu ana te kauwhata i raro i te huringa o te rōrahi haurehu hauwai ka puta i roto i te wā, ina whakahohea te konutea ki te waikawa pungatara inati i te 20°C.



Whakamāramahia ngā huringa i te pāpātanga tauhohenga i roto i ngā wā **A**, **B** me **C**.

I tō whakautu me kōrero koe mō te ariā tukinga.

A: _____

B: _____

C: _____

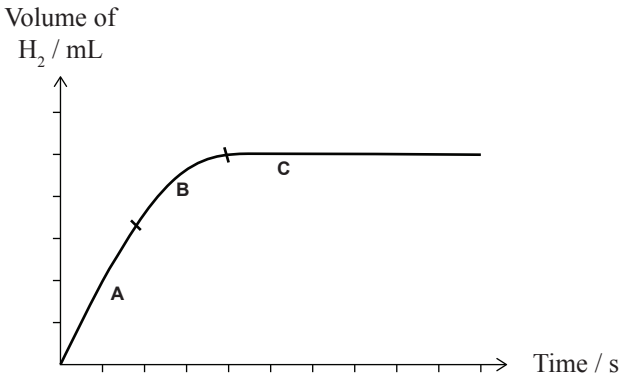
QUESTION THREE

ASSESSOR'S USE ONLY

(a) The equation for the reaction between zinc granules (lumps), Zn(*s*), and sulfuric acid, $H_2SO_4(aq)$, is represented by:

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

The graph below shows how the volume of hydrogen gas produced changes with time, when zinc is reacted with excess sulfuric acid at 20°C.



Explain the changes in the reaction rate during the periods **A**, **B** and **C**.

In your answer you should refer to collision theory.

A: _____

B: _____

C: _____

(b) Ka taea te huri te pāpātanga o te tauhohenga i waenga i te konutea me te waikawa pungatara mā te tāpiri maramara konukura, Cu(*s*), hei whākōkī.

Whakamāramahia te mahi a te whākōkī konukura i roto i te tauhohenga i waenga i te konutea me te waikawa pungatara.

I tō whakautu me kōrero koe mō te ariā tukinga.

(c) E whakaaturia ana ki te tūtohi i raro ko ngā uara pH o ngā mehanga 0.100 mol L^{-1} o ngā waikawa e rua, HA me HB.

Mehanga	**pH**
0.100 mol L^{-1} HA(*waiwai*)	1.0
0.100 mol L^{-1} HB(*waiwai*)	2.2

(i) Whakatauritea ngā kaha rerekē o ngā waikawa e rua, HA(*waiwai*) me HB(*waiwai*), mā te whakamahi i ngā mōhiohio i runga ake.

Whakaurua mai ki tō whakautu ngā whārite me ngā tātaitanga.

ASSESSOR'S USE ONLY

(b) The rate of the reaction between zinc and sulfuric acid can be changed by the addition of small pieces of copper, Cu(*s*), as a catalyst.

Explain the role of the copper catalyst in the reaction between zinc and sulfuric acid.

In your answer you should refer to collision theory.

(c) The pH values of 0.100 mol L^{-1} solutions of two acids, HA and HB, are given in the table below.

Solution	**pH**
0.100 mol L^{-1} HA(*aq*)	1.0
0.100 mol L^{-1} HB(*aq*)	2.2

(i) Compare the relative strengths of the two acids, HA(*aq*) and HB(*aq*), using the information given above.

Your answer should include equations and calculations.

(ii) Me matapae ka whakataurite, me ngā pūtake, he aha ka kitea ina whakahohea takitahitia ngā tīpako 5 g e rua o ngā kongakonga konupūmā pākawa waro, $CaCO_3(s)$, ki te HA me te HB inati.

MĀ TE KAIMĀKA ANAKE

(ii) Predict and compare, with reasons, what would be observed when two 5 g samples of calcium carbonate chips, $CaCO_3(s)$, are reacted, separately, with excess HA and HB.

ASSESSOR'S USE ONLY

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

TAU PĀTAI

MĀ TE KAIMĀKA ANAKE

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

QUESTION NUMBER

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English translation of the wording on the front cover

Level 2 Chemistry, 2014

91166 Demonstrate understanding of chemical reactivity

2.00 pm Tuesday 11 November 2014
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–CHEMMR.

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.