See back cover for an English translation of this cover

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91390M

913905

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Te Mātauranga Matū, Kaupae 3, 2014

91390M Te whakaatu māramatanga ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū

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

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū.	Te whakaatu māramatanga hōhonu ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū.	Te whakaatu māramatanga matawhānui ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā 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 L3-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) Whakaotihia te tūtohi e whai ake nei.

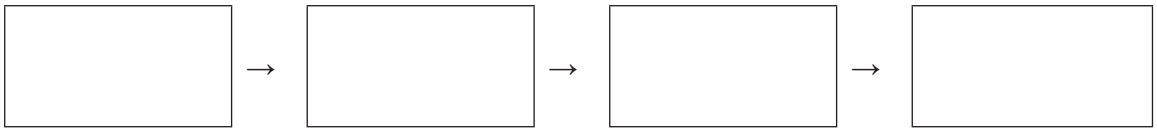
Tohu	Whakanaha irahiko
K	
Cr	
As	

(b) Whakamāramahia te rerekētanga i waenga i ngā pūtoro o te ngota K me te katote K^+.

(c) E whakaatu ana te tūtohi e whai ake i ngā whakanaha irahiko o ngā ngota e whā, He, B, N, me Ne.

Whakaraupapahia ēnei ngota ki te pikitanga o te pūngao katotetanga tuatahi mā te tuhi i te tohu o te ngota e tika ana ki ngā pouaka i raro.

Ngota	He	B	N	Ne
Whakanaha irahiko	$1s^2$	$1s^2 2s^2 2p^1$	$1s^2 2s^2 2p^3$	$1s^2 2s^2 2p^6$



pūngao katotetanga iti rawa

pūngao katotetanga teitei rawa

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Complete the following table.

Symbol	Electron configuration
K	
Cr	
As	

(b) Explain the difference between the radii of the K atom and the K^+ ion.

(c) The following table shows the electron configurations of four atoms, He, B, N, and Ne.

Arrange these atoms in order of increasing first ionisation energy by writing the symbol of the appropriate atom in the boxes below.

Atom	He	B	N	Ne
Electron configuration	$1s^2$	$1s^2 2s^2 2p^1$	$1s^2 2s^2 2p^3$	$1s^2 2s^2 2p^6$

	→	→	→
lowest ionisation energy			highest ionisation energy

(d) Ko te Rōpū 17 o te taka pūmotu he whāpāhare katoa.

MĀ TE KAIMĀKA ANAKE

(i) E whakaaturia ana te pitoruatanga o te rāpoi ngota HBr i raro nei.

$$\overset{\delta+}{H}—\overset{\delta-}{Br}$$

Mā te whakamahi i tēnei hei tauira, tohua te pitoruatanga o ngā hononga e whai ake mā te tohu i ngā wehewhana (dipoles) kei reira.

1. F—Cl

2. At—Cl

(ii) Mā te whakamahi i ō mōhiotanga ki ngā ia i roto i te taka pūmotu, porohitatia te ngota kei raro e nui ake ana tana uara tāhikotōraro.

Br I

Parahautia tō whakautu.

ASSESSOR'S USE ONLY

(d) The halogens make up Group 17 of the periodic table.

(i) The polarity of the HBr molecule is shown below.

$$\overset{\delta+}{H}—\overset{\delta-}{Br}$$

Using this as an example, indicate the polarity of the following bonds by indicating any dipoles present.

1. F—Cl

2. At—Cl

(ii) Using your knowledge of trends in the periodic table, circle the atom below that has the greater electronegativity value.

Br I

Justify your answer.

PĀTAI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) Kei roto i te tūtohi i raro ko ngā pae koropupū o te haukini, NH_3, te haukōwhai, F_2, me te hauwai pūhaumāota, HCl.

Whakaotihia te tūtohi hei tautohu i ngā tōpana kume i waenga i ngā rāpoi ngota i te āhua wē.

Te rāpoi ngota	Pae koropupū/°C	Ngā tōpana kume
Haukini, NH_3	−33	
Haukōwhai, F_2	−188	
Hauwai pūhaumāota, HCl	−85	

(b) Matapakihia ngā rerekētanga i waenga i ngā pae koropupū o te NH_3 me te HCl, e ai ki te kaha o ngā tōpana kume i waenga i ngā korakora.

Kātahi ka whakaahua i te take kei te F_2 te pae koropupū iti rawa.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) The boiling points of ammonia, NH_3, fluorine, F_2, and hydrogen chloride, HCl, are given in the table below.

Complete the table to identify the attractive forces between the molecules in their liquid state.

Molecule	Boiling point / °C	Attractive forces
Ammonia, NH_3	−33	
Fluorine, F_2	−188	
Hydrogen chloride, HCl	−85	

(b) Discuss the differences between the boiling points of NH_3 and HCl, in terms of the strength of the attractive forces between the particles involved.

Then describe why F_2 has the lowest boiling point.

(c) Ko te whārite mō te tauhohenga i waenga i te haurehu haukini me te haurehu hauwai pūhaumāota he:

$$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$$

Tātaihia te panoni hāwera noa, $\Delta_r H°$, mō tēnei tauhohenga, mā te whakamahi i ngā raraunga e whai ake ana.

$\Delta_f H°\ (NH_3(g))$	=	–46 kJ mol^{-1}
$\Delta_f H°\ (HCl(g))$	=	–92 kJ mol^{-1}
$\Delta_f H°\ (NH_4Cl(s))$	=	–314 kJ mol^{-1}

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(c) An equation for the reaction of ammonia gas with hydrogen chloride gas is:

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

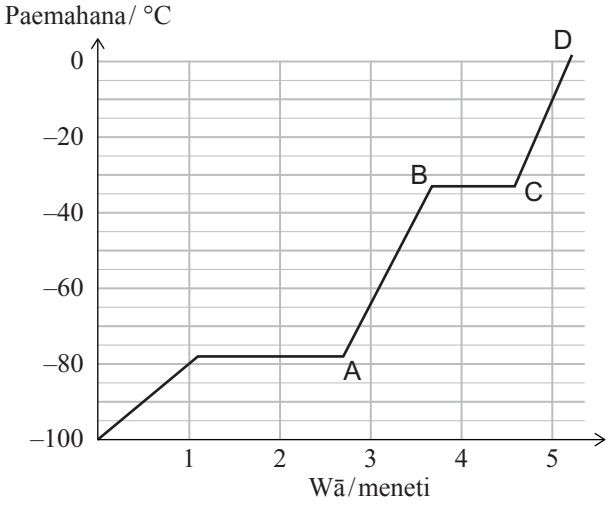
Calculate the standard enthalpy change, $\Delta_r H°$, for this reaction, using the following data.

$\Delta_f H°\ (NH_3(g)) = -46$ kJ mol^{-1}
$\Delta_f H°\ (HCl(g)) = -92$ kJ mol^{-1}
$\Delta_f H°\ (NH_4Cl(s)) = -314$ kJ mol^{-1}

(d) E whakaatu ana te kauwhata e whai ake i te huringa o te paemahana mō tētahi tīpakotanga haukini i roto i te wā e rima meneti te roa, e whakawerahia ai ki tētahi weranga aumou i te meneti.

MĀ TE KAIMĀKA ANAKE

Ānau whakawera mō te haukini

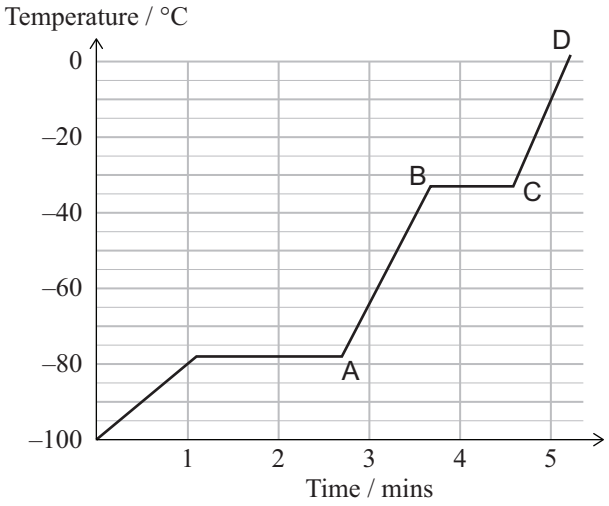


Mā te whakamahi i te kauwhata i runga ake, parahautia ngā panoni ōkiko e pā ana ki te haukini i waenga i ngā pūwāhi A me D, e ai ki te pūngao o ngā korakora me ngā tōpana kume i waenga rāpoi ngota.

ASSESSOR'S USE ONLY

(d) The following graph shows the change in temperature over a five-minute period for a sample of ammonia, where a constant amount of heat was applied per minute.

Heating curve for ammonia



Using the graph above, justify the physical changes occurring to ammonia between points A and D, in terms of the energy of the particles and the intermolecular forces of attraction.

PĀTAI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) I Aotearoa, ko te pūkōwhai mō te whakapai i te wai he konutai pākawa takawai haukōwhai, Na_2SiF_6.

Ko tētahi o ngā katote ka puta i roto i te mehanga mai i te konutai pākawa takawai haukōwhai he SiF_6^{2-}.

Whakaotihia te tūtohi i raro nei.

	SiF_6^{2-}
Hoahoa Lewis	
Te ingoa o te āhua	

(b) Whakamahia ai te haukini pākawa ota i roto i ngā 'pōkai mātao' hei whakaora wharanga nā ngā hākinakina. He aunoa te memeha o ngā tioata utoka o te haukini pākawa ota (e tohua mai i te whārite i raro), ahakoa he pauwera.

$$NH_4NO_3(s) \rightarrow NH_4^+(waiwai) + NO_3^-(waiwai)$$

Whakamāramahia mai he aha i pēnei ai, e ai ki te panoni pūngao ngoikore (entropy change) mō te pūnaha tauhohenga.

QUESTION THREE

ASSESSOR'S USE ONLY

(a) In New Zealand, fluoride for water treatment is supplied as sodium fluorosilicate, Na_2SiF_6. One of the ions formed in the solution from sodium fluorosilicate is SiF_6^{2-}.

Complete the table below.

	SiF_6^{2-}
Lewis diagram	
Name of shape	

(b) Ammonium nitrate is used in 'cold packs' to relieve symptoms of a sports injury. The dissolving of the solid crystals of ammonium nitrate (shown in the equation below) is spontaneous, despite being endothermic.

$$NH_4NO_3(s) \rightarrow NH_4^+(aq) + NO_3^-(aq)$$

Explain why this is so, in terms of the entropy change for the reaction system.

(c) Ka wehe mai te haukini pākawa ota i roto i tētahi tauhohenga pauwera, e ai ki te whārite i raro nei.

$$NH_4NO_3(s) \rightarrow NH_3(g) + HNO_3(g)$$

Kei raro he tūtohi e whakarārangi ana i ngā tauākī e whā mō ngā panoni i te pūngao ngoikore ka puta pea i te wā o tētahi tauhohenga.

Tohua (✓) i te taha mauī o tētahi tauākī kei te tika mō te tauhohenga o runga ake.

Tohu (✓)	**Tauākī pūngao ngoikore**
	Ka piki te pūngao ngoikore o te pūnaha.
	Ka piki te pūngao ngoikore o waho.
	Ka heke te pūngao ngoikore o te pūnaha.
	Ka heke te pūngao ngoikore o waho.

Parahautia (t)ō kōwhiringa.

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(c) Ammonium nitrate dissociates in an endothermic reaction, as shown in the equation below.

$$NH_4NO_3(s) \rightarrow NH_3(g) + HNO_3(g)$$

Below is a table outlining four statements about changes in entropy that may occur during any reaction.

Tick (✓) to the left of any statement that is correct for the above reaction.

Tick (✓)	Entropy statement
	The entropy of the system increases.
	The entropy of the surroundings increases.
	The entropy of the system decreases.
	The entropy of the surroundings decreases.

Justify your choice(s).

(d) (i)

Pūhui	kJ mol^{-1}
$\Delta_c H°$ (C(s))	–394
$\Delta_f H°$ ($H_2O(\ell)$)	–286
$\Delta_c H°$ ($C_2H_5OH(\ell)$)	–1367

Tātaihia te hāwera noa o te waihanga o te wē waihā ewaro mā te whakamahi i ngā kōrero e tukuna ana i runga.

MĀ TE KAIMĀKA ANAKE

(ii) Matapakihia ka pēhea te rerekētanga o te uara o te panoni hāwera (enthalpy change) mēnā ko te hua waihā ewaro ka puta he haurehu kē, kaua te wē.

Kāore te tātai e whai wāhi ana.

(d) (i)

Compound	kJ mol^{-1}
$\Delta_c H°$ (C(s))	–394
$\Delta_f H°$ ($H_2O(\ell)$)	–286
$\Delta_c H°$ ($C_2H_5OH(\ell)$)	–1367

Calculate the standard enthalpy of formation of liquid ethanol using the information given above.

ASSESSOR'S USE ONLY

(ii) Discuss how the value of the enthalpy change would differ if the ethanol product formed was a gas rather than a liquid.

No calculation is necessary.

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

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 3 Chemistry, 2014

91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

2.00 pm Tuesday 11 November 2014
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of thermochemical principles and the properties of particles and substances.	Demonstrate in-depth understanding of thermochemical principles and the properties of particles and substances.	Demonstrate comprehensive understanding of thermochemical principles and the properties of particles and substances.

91390M

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 L3–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.