See back cover for an English translation of this cover

3

91390M

913905

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Te Mātauranga Matū, Kaupae 3, 2013

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

2.00 i te ahiahi Rātū 19 Whiringa-ā-rangi 2013
Whiwhinga: Rima

Paetae	Paetae Kaiaka	Paetae 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 mēnā 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.

PĀTAI TUATAHI

(a) Whakaotia te tūtohi e whai ake nei.

Tohu	Whakanaha irahiko
Se	
V	
V^{3+}	

(b) Matapakitia ngā raraunga mō ia takirua korakora e whai ake ana.

(i)

Ngota	Tōrarotangahiko
O	3.44
Se	2.55

(ii)

Ngota, katote rānei	Pūtoro / pm
Cl	99
Cl^{-}	181

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

ASSESSOR'S USE ONLY

QUESTION ONE

(a) Complete the following table.

Symbol	Electron configuration
Se	
V	
V^{3+}	

(b) Discuss the data for each of the following pairs of particles.

(i)

Atom	Electronegativity
O	3.44
Se	2.55

(ii)

Atom or ion	Radius/pm
Cl	99
Cl^-	181

(iii)

Ngota	Pūngao katotetanga tuatahi / kJ mol^{-1}
Li	526
Cl	1 257

(c) (i) Whakaotihia te tūtohi e whai ake.

Te Rāpoi Ngota	BrF_3	PCl_6^-
Hoahoa Lewis		
Ingoa o te āhua		

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(iii)

Atom	First ionisation energy / kJ mol^{-1}
Li	526
Cl	1 257

(c) (i) Complete the following table.

Molecule	BrF_3	PCl_6^-
Lewis diagram		
Name of shape		

(ii) E whakaaturia ana i raro ngā hoahoa Lewis mō SF_4 me XeF_4.

Whakatauritea, whakatairitea hoki ngā pitoruatanga me ngā āhua o ēnei rāpoi ngota e rua.

MĀ TE KAIMĀKA ANAKE

(ii) The Lewis diagrams for SF_4 and XeF_4 are shown below.

Compare and contrast the polarities and shapes of these two molecules.

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MĀ TE KAIMĀKA ANAKE

PĀTAI TUARUA

(a) (i) Whakamāramahia te tikanga o te tūkupu $\Delta_{vap}H°(H_2O(\ell))$.

(ii) Ina whakawerahia ngā haurehu hauwai me te hāora i roto i tētahi ipuipu, ka hua mai he pata waiwai ki ngā taha o te ipuipu.

Tātaihia a $\Delta_f H°(H_2O(\ell))$, e ai ki ngā raraunga e whai ake nei:

$\Delta_f H°(H_2O(g)) = -242 \text{ kJ mol}^{-1}$

$\Delta_{vap}H°(H_2O(\ell)) = +44 \text{ kJ mol}^{-1}$

(iii) Whakamāramahia te take e kore e huri te pāmahana[1] o te wai wē ina whakawerahia ki te 100°C.

[1] paemahana

QUESTION TWO

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(a) (i) Explain what is meant by the term $\Delta_{vap}H°(H_2O(\ell))$.

(ii) When gaseous hydrogen and oxygen are heated in a test tube, droplets of liquid water form on the sides of the test tube.

Calculate $\Delta_f H°(H_2O(\ell))$, given the following data:

$\Delta_f H°(H_2O(g))$ = -242 kJ mol^{-1}

$\Delta_{vap}H°(H_2O(\ell))$ = $+44$ kJ mol^{-1}

(iii) Explain why the temperature of liquid water does not change when it is heated at 100°C.

MĀ TE KAIMĀKA ANAKE

(b) (i) Ina tāpirihia te 25.0 mL o tētahi 1.00 mol L^{-1} mehanga waikawa pūhaumāota, HCl, ki te 25.0 mL o tētahi 1.00 mol L^{-1} mehanga haukini, NH_3, ka tuhia te pikinga pāmahana o te 6.50°C, i te tauhohenga whakangūtanga ki te whakaputa haukini pūhaumāota waiwai me te wai.

Tātaihia a $\Delta_r H°$ mō tēnei tauhohenga whakangūtanga.

Ko te papatipu o te ranunga he 50.0 g.

Me kī ko te kahapuri wera o te haukini pūhaumāota waiwai he = 4.18 J g^{-1} $°C^{-1}$

(ii) I te kitenga o te $\Delta_r H°$ mō taua whakangūtanga mā te whakamātautau i tētahi taiwhanga pūtaiao kura, he iti ake te uara i riro mai i te uara ariā.

Kōrero mō te rerekētanga ā-uara, me te kī ka pēhea tēnei rerekētanga e whakaitia iho ai.

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(b) (i) When 25.0 mL of a 1.00 mol L^{-1} hydrochloric acid solution, HCl, is added to 25.0 mL of a 1.00 mol L^{-1} ammonia solution, NH_3, a temperature rise of 6.50°C is recorded, as a neutralisation reaction occurs to produce aqueous ammonium chloride and water.

Calculate $\Delta_r H°$ for this neutralisation reaction.

The mass of the mixture is 50.0 g.

Assume specific heat capacity of the aqueous ammonium chloride = 4.18 J g^{-1} $°C^{-1}$

(ii) When the $\Delta_r H°$ for the neutralisation above was found experimentally in a school laboratory, the value obtained was lower than the theoretical value.

Account for the difference in values, and suggest how this difference could be minimised.

PĀTAI TUATORU

MĀ TE KAIMĀKA ANAKE

(a)

Te Rāpoi Ngota	Pae koropupū / °C
Haitarahine [hydrazine], N_2H_4	114
Haukōwhai mewaro, CH_3F	–78.4
Ngawaro, $C_{10}H_{22}$	174

Whakamahia ngā mōhiohio kei te tūtohi i runga hei whakataurite, hei whakatairite i ngā pae koropupū o te haitarahine, haukōwhai mewaro, me te ngawaro e pā ana ki ngā kaha katoa o ngā tōpana kume i waenga i ngā korakora kei roto.

QUESTION THREE

ASSESSOR'S USE ONLY

(a)

Molecule	Boiling point / °C
Hydrazine, N_2H_4	114
Fluoromethane, CH_3F	–78.4
Decane, $C_{10}H_{22}$	174

Use the information in the table above to compare and contrast the boiling points of hydrazine, fluoromethane, and decane in terms of the relative strengths of the attractive forces between the particles involved.

MĀ TE KAIMĀKA ANAKE

(b) He wāhanga te ngawaro o te kōhinu. Ka hua mai te waro hāora-rua[2] me te wai ina tahuna katoahia te ngawaro i roto i te hāora.

$$C_{10}H_{22}(\ell) + 15.5O_2(g) \rightarrow 10CO_2(g) + 11H_2O(\ell)$$

Tātaitia a $\Delta_c H°(C_{10}H_{22}(\ell))$, e ai ki ngā raraunga e whai ake nei:

$\Delta_f H°(C_{10}H_{22}(\ell))$ = –250 kJ mol^{-1}
$\Delta_f H°(CO_2(g))$ = –393 kJ mol^{-1}
$\Delta_f H°(H_2O(\ell))$ = –286 kJ mol^{-1}

(c) Whakamahia ai te haitarahine hei kora tākirirangi. Ina ngingihatia te haitarahine wē, ka hua mai te hauota me te wai:

$$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(g) \qquad \Delta_c H°(N_2H_4(\ell)) = -624 \text{ kJ mol}^{-1}$$

Whakamāramahia te take ka tahu ngāwari noa te haitarahine wē i roto i te hāora.

Me whai whakaaro tō whakautu ki ngā panoni hāwera (enthalpy) me ngā panoni pūngao ngoikore (entropy).

[2] hauhā

MĀ TE KAIMĀKA ANAKE

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(b) Decane is a component of petrol. Carbon dioxide and water are formed when decane burns completely in oxygen.

$$C_{10}H_{22}(\ell) + 15.5O_2(g) \rightarrow 10CO_2(g) + 11H_2O(\ell)$$

Calculate $\Delta_c H°(C_{10}H_{22}(\ell))$, given the following data:

$\Delta_f H°(C_{10}H_{22}(\ell)) = -250 \text{ kJ mol}^{-1}$
$\Delta_f H°(CO_2(g)) = -393 \text{ kJ mol}^{-1}$
$\Delta_f H°(H_2O(\ell)) = -286 \text{ kJ mol}^{-1}$

(c) Hydrazine is often used as a rocket fuel. When liquid hydrazine undergoes combustion, it forms nitrogen and water:

$$N_2H_4(\ell) + O_2(g) \rightarrow N_2(g) + 2H_2O(g) \qquad \Delta_c H°(N_2H_4(\ell)) = -624 \text{ kJ mol}^{-1}$$

Explain why liquid hydrazine readily burns in oxygen.

Your answer should consider both enthalpy and entropy changes.

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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

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English translation of the wording on the front cover

91390M

Level 3 Chemistry, 2013

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

2.00 pm Tuesday 19 November 2013
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.

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–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.