91390M

913905

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

3

SUPERVISOR'S USE ONLY

Te Mātauranga Matū, Kaupae 3, 2016

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

2.00 i te ahiahi Rāhina 21 Whiringa-ā-rangi 2016
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 mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

He taka pūmotu kua whakaritea ki te Puka Rauemi L3-CHEMMR.

Mēnā ka hiahia whārangi atu anō koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i te tau tūmahi.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

ME HOATU RAWA KOE I TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

(a) Whakaotihia te tūtohi e whai ake nei.

Tohu	Whakanaha irahiko
Cl	
Zn	
Cr^{3+}	

(b) (i) Whakamāramahia mai te take he aha i rerekē ai te pūtoro o te ngota CI me te pūtoro o te katote Cl^-.

	Pūtoro (pm)
Ngota Cl	99
Katote Cl^-	181

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Complete the following table.

Symbol	Electron configuration
Cl	
Zn	
Cr^{3+}	

(b) (i) Explain why the radius of the Cl atom and the radius of the Cl^- ion are different.

	Radius (pm)
Cl atom	99
Cl^- ion	181

(ii) Whakamāramahia mai ngā āhuatanga e whakaawe ana i ngā ia i roto i te tōrarotanga hiko me te pūngao katotetanga tuatahi ki raro i tētahi rōpū o te taka pūmotu.

MĀ TE KAIMĀKA ANAKE

I tō tuhinga me:

- tautuhi i ngā kupu "tōrarotanga hiko" me te "pūngao katotetanga tuatahi"
- whakamārama i te ia i roto i te tōrarotanga hiko me te pūngao katotetanga tuatahi ki raro i tētahi rōpū
- whakataurite i te ia i roto i te tōrarotanga hiko me te pūngao katotetanga tuatahi ki raro i tētahi rōpū.

(ii) Explain the factors influencing the trends in electronegativity and first ionisation energy down a group of the periodic table.

ASSESSOR'S USE ONLY

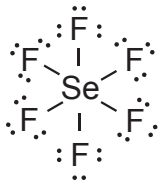
In your answer you should:

- define both electronegativity and first ionisation energy
- explain the trend in both electronegativity and first ionisation energy down a group
- compare the trend in electronegativity and first ionisation energy down a group.

(c) (i) Whakaotihia te tūtohi e whai ake nei:

	ICl_4^-	**ClF_3**
Hoahoa Lewis		
Te ingoa o te āhua		

(ii) E whakaaturia ana i raro ko te hoahoa Lewis mō SeF_6.



Ko te tūmanako ka rewa te SeF_6 i rō wai?

Āe **Kāo**

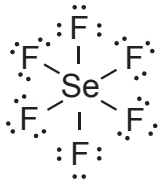
Whakamāramahia tō whakautu e ai ki te āhua me te pitoruatanga o SeF_6.

ASSESSOR'S USE ONLY

(c) (i) Complete the following table:

	ICl_4^-	ClF_3
Lewis diagram		
Name of shape		

(ii) The Lewis diagram for SeF_6 is shown below.



Would you expect SeF_6 to be soluble in water?

Yes **No**

Explain your answer in terms of the shape and polarity of SeF_6.

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

Ko te hāwera noa o te rehuwaitanga, $\Delta_{vap}H°$, o te konutai pūhaumāota, NaCl, te hauwai pūhaumāota, HCl, me te pūhaumāota mewaro, CH_3Cl, ka tukuna i te tūtohi i raro.

(a) Tautuhia ngā tōpana kume katoa i waenga i ngā korakora o ngā pūhui e whai ake i te āhua wē.

Pūhui	$\Delta_{vap}H°$ / kJ mol^{-1}	**Ngā tōpana kume**
NaCl	194	
HCl	16.0	
CH_3Cl	22.0	

(b) (i) Whakamāramahia mai he aha i tino teitei ake ai te $\Delta_{vap}H°$(NaCl) i te $\Delta_{vap}H°$(HCl) me te $\Delta_{vap}H°(CH_3Cl)$.

(ii) Whakamāramahia mai he aha i nui ake ai te $\Delta_{vap}H°(CH_3Cl)$ i te $\Delta_{vap}H°$(HCl).

QUESTION TWO

ASSESSOR'S USE ONLY

The standard enthalpy of vaporisation, $\Delta_{vap}H°$, of sodium chloride, NaCl, hydrogen chloride, HCl, and chloromethane, CH_3Cl, are given in the table below.

(a) Identify all the attractive forces between particles of the following compounds in their liquid state.

Compound	$\Delta_{vap}H°$ / kJ mol^{-1}	Attractive forces
NaCl	194	
HCl	16.0	
CH_3Cl	22.0	

(b) (i) Explain why $\Delta_{vap}H°(NaCl)$ is significantly higher than both $\Delta_{vap}H°(HCl)$ and $\Delta_{vap}H°(CH_3Cl)$.

(ii) Explain why $\Delta_{vap}H°(CH_3Cl)$ is greater than $\Delta_{vap}H°(HCl)$.

(c) (i) Tautuhi $\Delta_{fus}H°$(NaCl).

MĀ TE KAIMĀKA ANAKE

(ii) He aha i nui ake ai te $\Delta_{vap}H°$(NaCl) i te $\Delta_{fus}H°$(NaCl)?

(iii) He aha e tere rewa ai te NaCl i te wai, ahakoa he āhua pauwera te tukanga?

$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq) \qquad \Delta_r H° = +3.90 \text{ kJ mol}^{-1}$$

ASSESSOR'S USE ONLY

(c) (i) Define $\Delta_{fus}H°(NaCl)$.

(ii) Why is $\Delta_{vap}H°(NaCl)$ greater than $\Delta_{fus}H°(NaCl)$?

(iii) Why does NaCl readily dissolve in water, even though the process is slightly endothermic?

$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq) \qquad \Delta_rH° = +3.90 \text{ kJ mol}^{-1}$$

TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) Ko te whārite mō te tahu o te wē waihā mewaro ko:

$$CH_3OH(\ell) + \tfrac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$$

Tātaihia te hāwera noa o te ngingiha o te wē waihā mewaro, $\Delta_c H°(CH_3OH(\ell))$, mā te whakamahi i ngā kōrero e tukuna ana i raro.

Pūhui	kJ mol^{-1}
$\Delta_c H°(C(s))$	–394
$\Delta_c H°(H_2(g))$	–286
$\Delta_f H°(CH_3OH(\ell))$	–240

QUESTION THREE

ASSESSOR'S USE ONLY

(a) The equation for the combustion of liquid methanol is:

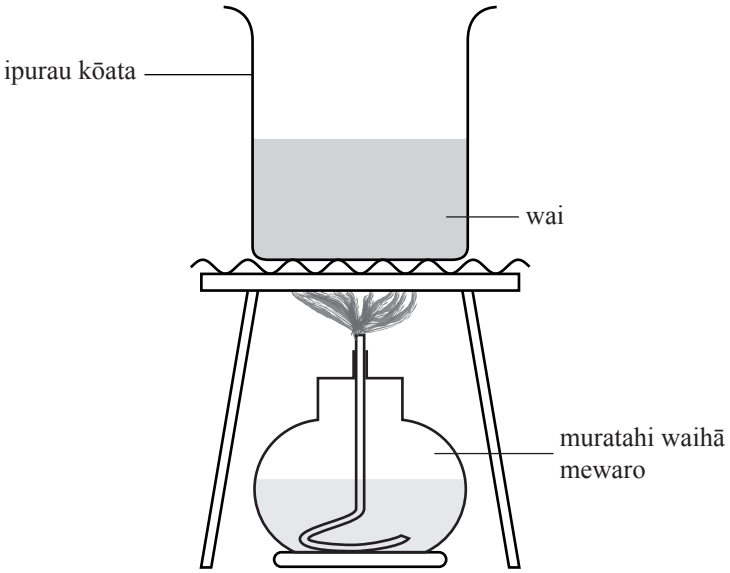
$$CH_3OH(\ell) + \tfrac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$$

Calculate the standard enthalpy of combustion of liquid methanol, $\Delta_c H°(CH_3OH(\ell))$, using the information in the table below.

Compound	kJ mol^{-1}
$\Delta_c H°(C(s))$	–394
$\Delta_c H°(H_2(g))$	–286
$\Delta_f H°(CH_3OH(\ell))$	–240

MĀ TE KAIMĀKA ANAKE

(b) Ka tāea anō te hāwera o te ngingiha o te wē waihā mewaro, $\Delta_c H°(CH_3OH(\ell))$, te whakarite mā te tahu i tētahi papatipu e mōhiotia ana o te waihā mewaro me te ine i te huringa paemahana i roto i tētahi papatipu e mōhiotia ana o te wai i runga ake o te waihā mewaro e tahuna ana.



(i) Mēnā e tahuna ana te 2.56 g o te waihā mewaro, ka piki te paemahana o te wai 500 g mai i te 21.2°C ki te 34.5°C.

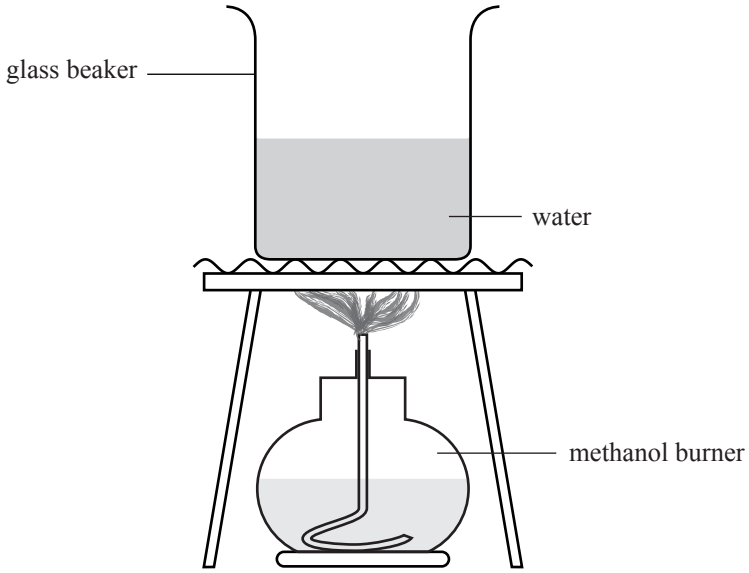
Mā te whakamahi i ēnei otinga, tātaihia te uara whakamātautau o te $\Delta_c H°(CH_3OH(\ell))$.

Ko te whakaweratanga motuhake o te wai he 4.18 J $°C^{-1}$ g^{-1}.

$M(CH_3OH)$ = 32.0 g mol^{-1}

ASSESSOR'S USE ONLY

(b) The enthalpy of combustion of liquid methanol, $\Delta_c H°(CH_3OH(\ell))$, can also be determined by burning a known mass of methanol and measuring the temperature change in a known mass of water above the burning methanol.



(i) If 2.56 g of methanol is burned, the temperature of 500 g water increases from 21.2°C to 34.5°C.

Using these results, calculate the experimental value of $\Delta_c H°(CH_3OH(\ell))$.

The specific heat capacity of water is 4.18 J $°C^{-1}$ g^{-1}.

$M(CH_3OH)$ = 32.0 g mol^{-1}

(ii) He aha te take he iti ake ai te tōraro o te uara whakamātautau i te wāhanga (b)(i) tēnā i te uara ariā i whakatauhia i te wāhanga (a)?

MĀ TE KAIMĀKA ANAKE

(iii) Ko te whārite mō te whakaetonga o te wē waihā mewaro he:

$$CH_3OH(\ell) \rightarrow CH_3OH(g)$$

Whakamāramahia mai ngā panoni pūngao ngoikore o te pūnaha me waho mō te whakaetonga o te waihā mewaro.

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(ii) Why is the experimental value obtained in part (b)(i) less negative than the theoretical value determined in part (a)?

(iii) The equation for the evaporation of liquid methanol is:

$$CH_3OH(\ell) \rightarrow CH_3OH(g)$$

Explain the entropy changes of the system and surroundings for the evaporation of methanol.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

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, 2016

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

2.00 p.m. Monday 21 November 2016
Credits: Five

91390M

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 in the Resource Sheet L3–CHEMMR.

If you need more room for any answer, use the extra space 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.