91390M

913905

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, 2015

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

2.00 i te ahiahi Rāapa 11 Whiringa-ā-rangi 2015
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
Al	
Cu^{2+}	
Sc	

(b) Tautuhia ngā kupu tōrarotanga hiko me te pūngao katotetanga tuatahi.

Tōrarotanga hiko: _____

Pūngao katotetanga tuatahi: _____

(c) E whakaatu ana te tūtohi i raro i ngā uara pūngao katotenga tuatahi mō ngā pūmotu i te wāhanga tuatoru o te taka pūmotu.

Pūmotu	Pūngao katotetanga tuatahi / kJ mol^{-1}
Na	502
Al	584
Si	793
Ar	1 527

Parahautia te ia taka o ngā pūngao katotetanga tuatahi e whakaaturia ana e ngā raraunga i te tūtohi i runga ake, ā, ka whakahāngai i tēnei ki te ia e tūmanakohia ana i ngā pūtoru ngota puta i te wāhanga tuatoru.

He wāhi anō mō tō tuhinga mō tēnei tūmahi kei te whārangi 4.

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Complete the following table.

Symbol	Electron configuration
Al	
Cu^{2+}	
Sc	

(b) Define the terms electronegativity and first ionisation energy.

Electronegativity: _____

First ionisation energy: _____

(c) The following table shows the first ionisation energy values for elements in the third period of the periodic table.

Element	First ionisation energy / kJ mol^{-1}
Na	502
Al	584
Si	793
Ar	1 527

Justify the periodic trend of first ionisation energies shown by the data in the table above, and relate this to the expected trend in atomic radii across the third period.

There is more space for your answer to this question on page 5.

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

Ko te whārite mō te $\Delta_f H°$ o $H_2O(\ell)$ ko:

$H_2(g) + ½O_2(g) \rightarrow H_2O(\ell)$ $\quad -286$ kJ mol^{-1}

(a) (i) Tuhia te whārite mō $\Delta_c H°$ ($H_2(g)$).

(ii) Mā te whakamahi i ngā whārite i runga ake, whakamāramahia te take he uara ōrite tō $\Delta_c H°$ (H_2) me $\Delta_f H°$ (H_2O) o te -286 kJ mol^{-1}.

(b) Ka huri i te hāwera o te waihanga mēnā ka waihangatia te wai hei haurehu kē, kaua hei wē.

(i) Porohitatia te kīanga tika hei whakatutuki i te rārangi kōrero i raro.

he iti ake te tōraro / he ōrite te tōraro / he nui ake te tōraro

o te $\Delta_f H°$ ($H_2O(g)$) i te $\Delta_f H°$ ($H_2O(\ell)$).

(ii) Parahautia tō kōwhiringa.

He wāhi anō mō tō tuhinga mō tēnei tūmahi kei te whārangi 7.

QUESTION TWO

ASSESSOR'S USE ONLY

The equation for $\Delta_f H°$ of $H_2O(\ell)$ is:

$H_2(g) + ½O_2(g) \rightarrow H_2O(\ell)$ $\quad -286$ kJ mol^{-1}

(a) (i) Write the equation for $\Delta_c H°$ ($H_2(g)$).

(ii) Using the equations above, explain why $\Delta_c H°$ (H_2) and $\Delta_f H°$ (H_2O) have the same value of -286 kJ mol^{-1}.

(b) The enthalpy of formation would change if the water was formed as a gas rather than a liquid.

(i) Circle the correct phrase to complete the sentence below.

$\Delta_f H°$ ($H_2O(g)$) is:

less negative than / the same as / more negative than $\Delta_f H°$ ($H_2O(\ell)$).

(ii) Justify your choice.

There is more space for your answer to this question on page 8.

MĀ TE KAIMĀKA ANAKE

(c) Tātaitia te $\Delta_f H°$ mō te $B_2H_6(g)$, e ai ki ngā raraunga i raro nei:

$\Delta_f H°\ (B_2O_3(s))$ $= -1255$ kJ mol^{-1}

$\Delta_f H°\ (H_2O(\ell))$ $= -286$ kJ mol^{-1}

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(\ell)$ $\Delta_r H° = -2148$ kJ mol^{-1}

Ko te pae rewa o te pūtiwha kei te 2300ºC.

ASSESSOR'S USE ONLY

(c) Calculate the $\Delta_f H°$ for $B_2H_6(g)$, given the following data:

$\Delta_f H°\ (B_2O_3(s))$ $= -1255$ kJ mol^{-1}

$\Delta_f H°\ (H_2O(\ell))$ $= -286$ kJ mol^{-1}

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(\ell)$ $\Delta_r H° = -2148$ kJ mol^{-1}

The melting point of boron is 2300°C.

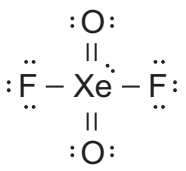
TŪMAHI TUATORU

MĀ TE KAIMĀKA ANAKE

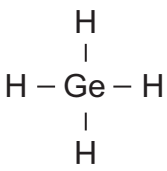
(a) Whakaotihia te tūtohi e whai ake nei.

	AsF_5	SeF_6
Hoahoa Lewis		
Te ingoa o te āhua		

(b) E whakaatuhia ana i raro ngā hoahoa Lewis me ngā hanga mō XeO_2F_2 me GeH_4.



pīoi



matawhā

Whakatauritea ngā pitoruatanga[1] me ngā āhua o ēnei rāpoi ngota e rua.

He wāhi anō mō tō tuhinga mō tēnei tūmahi kei te whārangi 11.

[1] tōranga

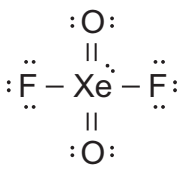
QUESTION THREE

ASSESSOR'S USE ONLY

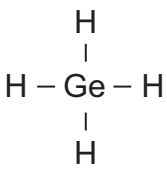
(a) Complete the following table.

	AsF_5	SeF_6
Lewis diagram		
Name of shape		

(b) The Lewis diagrams and shapes for XeO_2F_2 and GeH_4 are shown below.



see-saw



tetrahedral

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

There is more space for your answer to this question on page 12.

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(c) He ōrite te tātai rāpoi ngota o ngā rāpoi ngota i raro ($C_5H_{12}O$) engari he rerekē ngā pae koropupū.

MĀ TE KAIMĀKA ANAKE

Ingoa	Waihā-1-pēwaro	Waihā-1-powaro mewaro-rua
Hanganga	$CH_3-CH_2-CH_2-CH_2-CH_2-OH$	$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}-CH_2-OH$
Pae koropupū	138°C	113°C

(i) Whakarārangihia mai ngā tōpana kume katoa i waenga i ēnei rāpoi ngota i ngā āhua wē katoa.

(ii) Whakamahia ngā kōrero katoa i runga ake hei whakamārama i ngā rerekētanga o ngā pae koropupū o te waihā-1-pēwaro me te waihā-1-powaro mewaro-rua mā te whakataurite i ngā kaha hāngai o ngā tōpana kume i waenga i ngā rāpoi ngota kei roto.

ASSESSOR'S USE ONLY

(c) The two molecules below have the same molecular formula ($C_5H_{12}O$) but have different boiling points.

Name	Pentan-1-ol	Dimethylpropan-1-ol
Structure	$CH_3-CH_2-CH_2-CH_2-CH_2-OH$	$CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}}-CH_2-OH$
Boiling point	138°C	113°C

(i) List all the forces of attraction between these molecules in each of their liquid states.

(ii) Use the information above to explain the difference in the boiling points of pentan-1-ol and dimethylpropan-1-ol by comparing and contrasting the relative strengths of the attractive forces between the molecules involved.

(d) Ko te whārite mō te ngingiha o te waihā-1-pēwaro ko:

$$C_5H_{12}O(\ell) + 7½\,O_2(g) \rightarrow 5CO_2(g) + 6H_2O(\ell)$$

Tātaihia te $\Delta_c H°$ mō te waihā-1-pēwaro, e ai ki te raraunga e whai nei:

$\Delta_f H°\ (C_5H_{12}O(\ell)) \quad = -295$ kJ mol^{-1}

$\Delta_f H°\ (CO_2(g)) \quad = -394$ kJ mol^{-1}

$\Delta_f H°\ (H_2O(\ell)) \quad = -286$ kJ mol^{-1}

MĀ TE KAIMĀKA ANAKE

(d) The equation for the combustion of pentan-1-ol is:

$$C_5H_{12}O(\ell) + 7\frac{1}{2}O_2(g) \rightarrow 5CO_2(g) + 6H_2O(\ell)$$

Calculate $\Delta_c H^\circ$ for pentan-1-ol, given the following data:

$\Delta_f H^\circ (C_5H_{12}O(\ell)) = -295$ kJ mol^{-1}

$\Delta_f H^\circ (CO_2(g)) = -394$ kJ mol^{-1}

$\Delta_f H^\circ (H_2O(\ell)) = -286$ kJ mol^{-1}

ASSESSOR'S USE ONLY

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, 2015

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

2.00 p.m. Wednesday 11 November 2015
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 on 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.