See back cover for an English translation of this cover

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91390M

913905

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Tohua tēnei pouaka mēnā KĀORE koe i tuhituhi i roto i tēnei pukapuka

Te Mātauranga Matū, Kaupae 3, 2021

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

Ngā 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 me ētahi atu rauemi tautoko kei te Pukapuka Rauemi L3–CHEMMR.

Ki te hiahia koe ki ētahi atu wāhi hei tuhituhi whakautu, whakamahia te wāhi wātea kei muri i te pukapuka nei.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2 – 17 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki roto i tētahi wāhi kauruku whakahāngai (). Ka tapahia pea tēnei wāhi ina mākahia te pukapuka.

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

TŪMAHI TUATAHI

(a) Whakaotihia te tūtohi e whai ake nei.

Tohu	Whakanaha irahiko (whakamahia te tuhinga *s, p, d*)
Sc	
Ga	
Fe^{3+}	

(b) (i) Whakaotihia te tūtohi e whai ake nei.

	SeF_4	ClF_4^-
Hanganga a Lewis		
Ingoa o te hanga		

(ii) He tōrunga te $\Delta_{vap}H°(SeF_4)$ me te $\Delta_{fus}H°(SeF_4)$.

Whakamāramahia mai he aha e tōrunga ake ai te $\Delta_{vap}H°(SeF_4)$.

QUESTION ONE

(a) Complete the following table.

Symbol	**Electron configuration (use *s*, *p*, *d* notation)**
Sc	
Ga	
Fe^{3+}	

(b) (i) Complete the table below.

	SeF_4	**ClF_4^-**
Lewis structure		
Name of shape		

(ii) Both $\Delta_{vap}H°(SeF_4)$ and $\Delta_{fus}H°(SeF_4)$ are positive.

Explain why $\Delta_{vap}H°(SeF_4)$ is more positive.

(c) Ka memeha noa i te wai te konurehu pākawa ota, KNO_3, e ai ki te whārite i raro:

$KNO_3(s) \rightarrow K^+(aq) + NO_3^-(aq)$ $\Delta_r H° = +34.9$ kJ mol^{-1}

(i) Parahautia, e ai ki ngā panoni o te pūngao ngoikore (entropy) o te pūnaha me te takiwā, he aha i tūpono noa mai ai te tauhohenga.

(ii) Ina memeha te KNO_3 totoka i roto i te wai, ka heke te pāmahana mai i te 21.3 °C ki te 14.2 °C.

Tātaihia te papatipu o te KNO_3 totoka me mātua memeha kia heke pēnā ai te pāmahana.

Me kī, ko te kītanga pōkākā motuhake o te mehanga konurehu pākawa ota he 4.18 J g^{-1} °C^{-1}.

Me kī, ko te papatipu o te mehanga konurehu pākawa ota he 135 g.

$M(KNO_3) = 101$ g mol^{-1}

(c) Potassium nitrate, KNO_3, readily dissolves in water according to the equation below:

$KNO_3(s) \rightarrow K^+(aq) + NO_3^-(aq)$ $\Delta_r H° = +34.9\ \text{kJ mol}^{-1}$

(i) Justify, in terms of the entropy changes of the system and the surroundings, why the reaction is spontaneous.

(ii) When solid KNO_3 dissolves in water, the temperature decreases from 21.3 °C to 14.2 °C.

Calculate the mass of solid KNO_3 that must dissolve to cause this temperature decrease.

Assume the specific heat capacity of potassium nitrate solution is 4.18 J g^{-1} °C^{-1}.

Assume the mass of the potassium nitrate solution is 135 g.

$M(KNO_3) = 101\ \text{g mol}^{-1}$

TŪMAHI TUARUA

(a) Whakamāramatia te rerekētanga i waenga i ngā pūtoro ngota o te konupūmā me te selenium.

	Pūtoro ngota / pm
Konupūmā, Ca	197
Selenium, Se	116

(b) Parahautia, e ai ki ngā āhuatanga ka pā ki ngā ia o te taka pūmotu, he aha te take ko te haukōwhai te pūmotu tino tōraro ā-hiko i te Pou 17.

QUESTION TWO

(a) Explain the difference in the atomic radii of calcium and selenium.

	Atomic radius / pm
Calcium, Ca	197
Selenium, Se	116

(b) Justify, with reference to the factors affecting periodic trends, why fluorine is the most electronegative element in Group 17.

(c) (i) Kei raro nei ko te whārite mō te tauhohenga o te haukini, NH_3, me te hāora, O_2:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

Tātaihia te huringa hāwera māori, $\Delta_r H°$, mō tēnei tauhohenga, mā te whakamahi i ngā raraunga e whai ake ana:

$$2NH_3(g) \rightarrow N_2(g) + 3H_2(g) \qquad \Delta_r H° = +92 \text{ kJ mol}^{-1}$$

$$2H_2O(g) \rightarrow 2H_2(g) + O_2(g) \qquad \Delta_r H° = +572 \text{ kJ mol}^{-1}$$

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \qquad \Delta_r H° = +180 \text{ kJ mol}^{-1}$$

(ii) Whakamāramahia mai he aha te take he tautohe putawera ake te panoni hāwera māori ka tātaihia i te wāhanga (i) mēnā i whakaputaina te wai hei wē.

(c) (i) The equation for the reaction of ammonia, NH_3, with oxygen, O_2, is given below:

$$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$$

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

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ $\quad \Delta_r H° = +92 \text{ kJ mol}^{-1}$

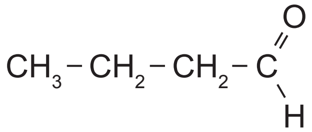
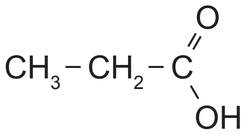
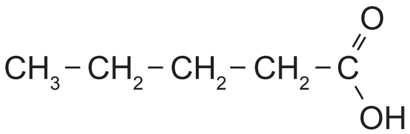
$2H_2O(g) \rightarrow 2H_2(g) + O_2(g)$ $\quad \Delta_r H° = +572 \text{ kJ mol}^{-1}$

$N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\quad \Delta_r H° = +180 \text{ kJ mol}^{-1}$

(ii) Explain why the standard enthalpy change calculated in part (i) would be more exothermic if the water was produced as a liquid.

TŪMAHI TUATORU

(a) (i) Tautohua ngā momo tōpana kume katoa i waenga i ngā korakora o ngā matū e whai ake kei te āhua wē.

Te matū	$\Delta_{vap}H°$ / kJ mol^{-1}	Ngā tōpana kume
Hāparo-tahi pūwaro (ℓ) 	34	
Waikawa pōwaro (ℓ) 	57	
Waikawa pēwaro (ℓ) 	68	

(ii) E ai ki te kaha hāngai o ngā tōpana kume katoa i waenga i ngā korakora o ia matū, parahautia te rerekētanga o te hāwera whakaeto māori, $\Delta_{vap}H°$, mō te hāparo-tahi pūwaro, te waikawa pōwaro me te waikawa pēwaro.

(b) (i) Tuhia te whārite mō te tauhohenga he panoni hāwera e ōrite ana ki te hāwera māori o te hanganga, $\Delta_f H°$, o te kūhuka totoka, $C_6H_{12}O_6(s)$.

(ii) Ka whakaōkaitia te kūhuka i roto i te tukupūngao ā-hāora e ai ki te whārite e whai ake:

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell) \quad \Delta_r H° = –2803 \text{ kJ mol}^{–1}$$

Tātaihia te hāwera māori o te hanganga o te kūhuka, $\Delta_f H°(C_6H_{12}O_6(s))$, mā te whakamahi i ngā raraunga e whai ake nei:

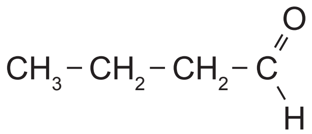
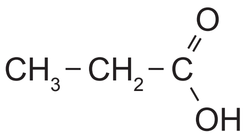
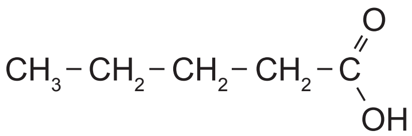
$\Delta_f H°(CO_2(g)) = –394 \text{ kJ mol}^{–1}$

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

Ka haere tonu te Tūmahi Tuatoru i te whārangi 14.

QUESTION THREE

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

Substance	$\Delta_{vap}H°$ / kJ mol^{-1}	Attractive forces
Butanal (ℓ) 	34	
Propanoic acid (ℓ) 	57	
Pentanoic acid (ℓ) 	68	

(ii) With reference to the relative strength of all the attractive forces between the particles in each substance, justify the difference in standard enthalpy of vaporisation, $\Delta_{vap}H°$, for butanal, propanoic acid, and pentanoic acid.

(b) (i) Write the equation for the reaction that has an enthalpy change equal to the standard enthalpy of formation, $\Delta_f H°$, of solid glucose, $C_6H_{12}O_6(s)$.

(ii) Glucose is oxidised during aerobic respiration according to the following equation:

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell) \quad \Delta_r H° = –2803 \text{ kJ mol}^{–1}$$

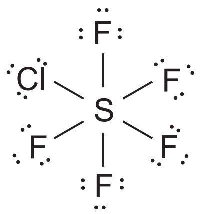
Calculate the standard enthalpy of formation of glucose, $\Delta_f H°(C_6H_{12}O_6(s))$, using the following data:

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

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

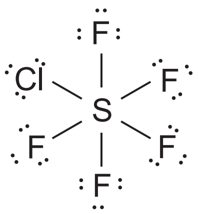
Question Three continues on page 15.

(c) E whakaaturia ana te hanganga Lewis mō te pēwaro pūkōwhai pungatara pūhaumāota (chloropentafluorosulfane), $SClF_5$, i raro:



Tautohua me te whakamārama i te hanga me te tōranga o te $SClF_5$.

(c) The Lewis structure for chloropentafluorosulfane, $SClF_5$, is given below:



Identify and explain the shape and polarity of $SClF_5$.

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

TAU TŪMAHI

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

QUESTION NUMBER

English translation of the wording on the front cover

Level 3 Chemistry 2021

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

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 and other reference material are provided in the Resource Booklet L3–CHEMMR.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–17 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.