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3

91390M

913915

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

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Tohua tēnei pouaka mēnā KĀORE koe i tuhi kōrero ki tēnei pukapuka

Mātai Matū, Kaupae 3, 2022

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

Ngā whiwhinga: E rima

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū.	Te whakaatu māramatanga ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū, kia hōnonu.	Te whakaatu māramatanga ki ngā tikanga matūrewarau me ngā āhuatanga o ngā korakora me ngā matū, kia tōtōpū.

Tirohia kia kitea ai 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 wāhi atu anō koe mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka.

Tirohia kia kitea ai 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.

Kaua e tuhi ki tētahi wāhi e kitea ai te kauruku whakahāngai (✂). Ka poroa pea taua wāhanga ka mākahia ana te pukapuka.

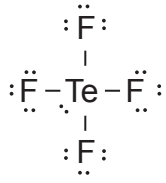
HOATU TĒNEI PUKAPUKA KI TE KAIWHAKAHAERE Ā TE MUTUNGA O TE WHAKAMĀTAUTAU.

TE TŪMAHI TUATAHI

(a) Whakaotia te tūtohi i raro nei.

	$BrCl_5$	**BrF_3**
Te hanganga a Lewis		
Te ingoa o te āhua		

(b) E whai ake nei, ko te hanganga a Lewis me te āhua o te Tellurium tetrafluoride, TeF_4:



pīoi

Tautohua, whakamāramahia hoki te tōranga o te TeF_4.

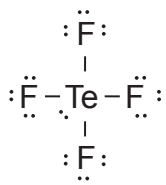
Me whakauru tētahi whakamāramatanga o te hanga ki tō whakautu.

QUESTION ONE

(a) Complete the table below.

	$BrCl_5$	**BrF_3**
Lewis structure		
Name of shape		

(b) Tellurium tetrafluoride, TeF_4, has the following Lewis structure and shape:

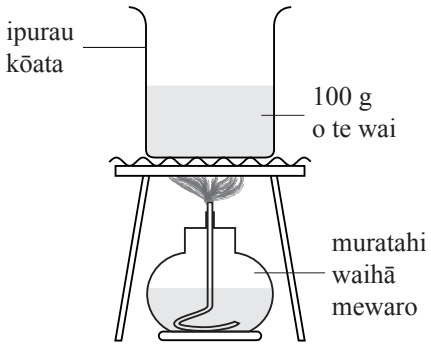


seesaw

Identify and explain the polarity of TeF_4.

Your answer should include an explanation of the shape.

(c) (i) I tahu tētahi ākonga i te 2.28 g o te wē waihā mewaro, $CH_3OH(\ell)$, hei whakamahana i te 100 g o te wai. I te tuatahi, he 20.6 °C te pāmahana o te wai. Nō te ngingihatanga katoa o te waihā mewaro, i tika te whakatau a te ākonga i te huringa hāwera whakamātau mō te ngingihatanga o te wē waihā mewaro, $\Delta_c H(CH_3OH(\ell))$, ko te –68.6 kJ mol^{-1}.



He 4.18 J g^{-1} $°C^{-1}$ te kītanga wera motuhake o te wai

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

Tātaihia te pāmahana whakamutunga i ekea rawatia e te 100 g o te wai i tēnei whakamātau.

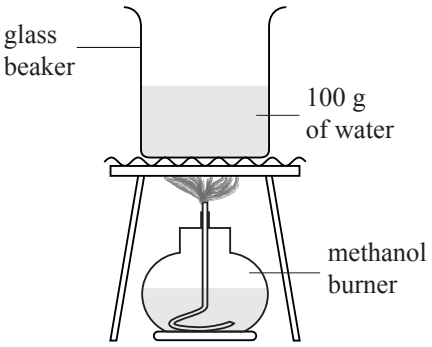
(ii) He tino nui ake te putawera o te hāwera māori (*standard enthalpy*) i te ngingihatanga o te waihā mewaro wē, tēnā i te uara whakamātau i te wāhanga (i).

Whakamāramahia mai ngā pūtake e RUA mō tēnei rerekētanga.

(c) (i) A student burnt 2.28 g of liquid methanol, $CH_3OH(\ell)$, to heat 100 g of water. The initial temperature of the water was 20.6 °C. Once all of the methanol had combusted, the student correctly determined the experimental enthalpy change for the combustion of liquid methanol, $\Delta_c H(CH_3OH(\ell))$, to be –68.6 kJ mol^{-1}.

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

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



Calculate the final temperature that the 100 g of water must have reached in this experiment.

(ii) The standard enthalpy of combustion of liquid methanol is significantly more exothermic than the experimental value provided in part (i).

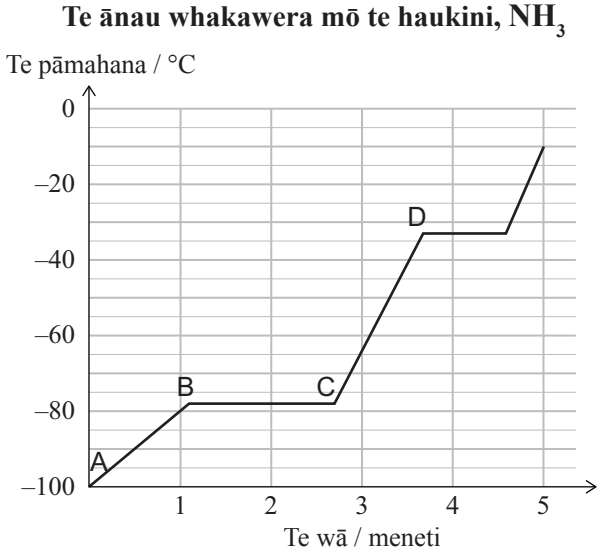
Explain TWO reasons for this difference.

TE TŪMAHI TUARUA

(a) Whakaotia te tūtohi e whai ake nei.

Te tohu	Te whakatakoto irahiko (whakamahia te reo tohu ***s*, *p*, *d*)**
Br	
V	
Ni^{2+}	

(b) E whakaatu ana te ānau whakawera i raro nei i te panonitanga o te pāmahana ina tukuna ki tētahi tīpako o te haukini, NH_3, tētahi pōkākā pūmau mō te rima meneti.



(i) Tuhia te whārite mō te tauhohenga e ōrite ana te huringa hāwera ki te hāwera māori o te honokarihi, $\Delta_{fus}H°$, o te NH_3.

(ii) Kōrerotia te ānau whakawera mō te haukini i runga nei hei whakamārama mai i ngā panonitanga i waenga i te A me te D.

I tō tuhinga, me kōrero mō:

- te pūngao me te nekeneke a ngā korakora
- ngā tōpana kume i waenga i ngā rāpoi ngota.

(c) Ka tauhohe ana te *diborane*, B_2H_6, ki te hāora, O_2, ka kā mai. E whakaaturia ana te tauhohenga i raro iho nei:

$$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(\ell)$$

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

$\Delta_f H°(B_2H_6(g)) = +41.0$ kJ mol^{-1}

$\Delta_f H°(B_2O_3(s)) = -1274$ kJ mol^{-1}

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

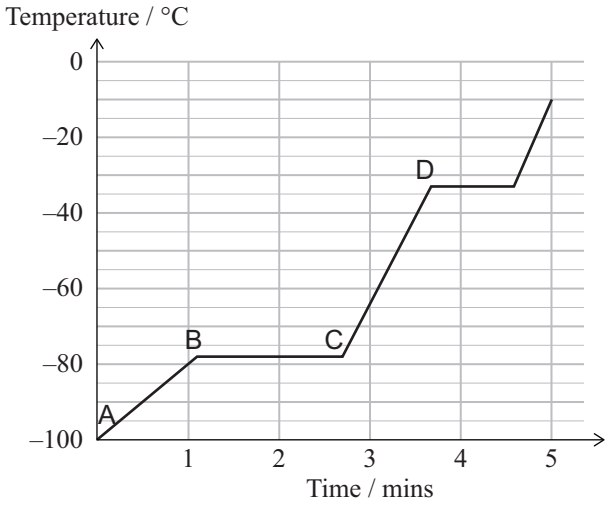
QUESTION TWO

(a) Complete the following table.

Symbol	Electron configuration (use *s*, *p*, *d* notation)
Br	
V	
Ni^{2+}	

(b) The heating curve below shows the change in temperature as a sample of ammonia, NH_3, is supplied with a constant amount of heat over a time period of five minutes.

Heating curve for ammonia, NH_3



(i) Write the equation for the reaction that has an enthalpy change equal to the standard enthalpy of fusion, $\Delta_{fus}H°$, of NH_3.

(ii) With reference to the heating curve for ammonia above, explain the changes between points A and D.

Your answer should refer to:

- energy and movement of particles
- intermolecular forces of attraction.

(c) When diborane, B_2H_6, reacts with oxygen, O_2, it catches fire. The reaction is given below:

$B_2H_6(g) + 3O_2(g) \rightarrow B_2O_3(s) + 3H_2O(\ell)$

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

$\Delta_f H°(B_2H_6(g)) = +41.0$ kJ mol^{-1}

$\Delta_f H°(B_2O_3(s)) = -1274$ kJ mol^{-1}

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

(ii) Parahautia, i runga i ngā panonitanga kaumingomingo o te pūnaha me te takiwā, te take i tūpono noa ake ai te tauhohenga i te wāhanga (i).

(ii) Justify, in terms of the entropy changes of the system and the surroundings, why the reaction in part (i) occurs spontaneously.

TE TŪMAHI TUATORU

(a) Whakamāramahia mai te take i rerekē ai te pūtoro o te ngota Cl i tō te katote Cl^-.

Te pūtoro o te ngota Cl = 99 pm Te pūtoro o te katote Cl^- = 181 pm

(b) Parahautia te take i piki ake ai te pūngao katotetanga tuatahi me te tōraro ā-hiko rere noa i tētahi kapa (o te Taka Pūmotu), engari i heke iho te pūtoro ngota rere noa i taua kapa.

QUESTION THREE

(a) Explain why the radii of the Cl atom and the Cl^- ion are different.

Radius of Cl atom = 99 pm Radius of Cl^- ion = 181 pm

(b) Justify why both first ionisation energy and electronegativity increase across a period, but atomic radius decreases across a period.

(c) (i) Tautohua ngā momo tōpana kume KATOA i waenga i ngā korakora o ngā matū e whai ake nei ka wē ana te āhua.

Te matū	**Te papatipu rāpoi ngota / g mol^{-1}**	**Te pae koropupū /°C**	**Ngā tōpana kume**
N_2H_4	32.0	114	
BF_3	67.8	–102	
NOCl	65.5	–6	

(ii) Whakamāramahia mai te take ko te pae koropupū o te N_2H_4 te pae koropupū wera katoa o ngā rāpoi ngota e toru.

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

Substance	Molar mass / g mol^{-1}	Boiling point / °C	Attractive forces
N_2H_4	32.0	114	
BF_3	67.8	–102	
NOCl	65.5	–6	

(ii) Explain why N_2H_4 has the highest boiling point of the three molecules.

(iii) Parahautia te take i mātao noa atu ai te pae koropupū o te BF_3, tēnā i tō te NOCl.

(iii) Justify why BF_3 has a much lower boiling point than NOCl.

He whārangi anō ki te hiahiatia.
Tuhia te tau tūmahi mēnā e hāngai ana.

TE 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 2022

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 – 19 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.