See back cover for an English translation of this cover

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91164M

911645

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Te Mātauranga Matū, Kaupae 2, 2013

91164M Te whakaatu māramatanga ki te honohono, te hanganga, ngā āhuatanga me ngā huringa ngao

9.30 i te ata Rātū 19 Whiringa-ā-rangi 2013
Whiwhinga: Rima

Paetae	Paetae Kaiaka	Paetae Kairangi
Te whakaatu māramatanga ki te honohono, te hanganga, ngā āhuatanga me ngā huringa ngao.	Te whakaatu māramatanga hōhonu ki te honohono, te hanganga, ngā āhuatanga me ngā huringa ngao.	Te whakaatu māramatanga matawhānui ki te honohono, te hanganga, ngā āhuatanga me ngā huringa ngao.

Tirohia mehemea e ōrite ana te Tau Ākonga ā-Motu 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 L2-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 2–23 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.

MĀ TE KAIMĀKA ANAKE

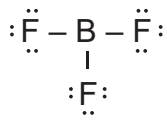
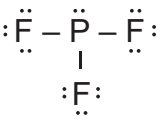
PĀTAI TUATAHI

(a) Tāngia te hanganga a Lewis mō ia rāpoi ngota e whai ake nei.

Te Rāpoi Ngota	CH_4	H_2O	N_2
Hanganga a Lewis			

(b) Ka hono te pūtiwha me te pūtūtaewhetū ki ngā ngota haukōwhai e toru hei hanga i te BF_3 me te PF_3. Engari, he rerekē te āhua me ngā koki honohono o ngā rāpoi ngota.

E whakaatu ana te tūtohi i raro i ngā hanganga Lewis mō te rāpoi ngota BF_3 me te PF_3.

Te Rāpoi Ngota	BF_3	PF_3
Hanganga a Lewis		

Whakamāramahia he aha i rerekē ai ngā āhua me ngā koki honohono o ēnei rāpoi ngota.

Me whakauru ki tō whakautu:

- ngā āhua o te BF_3 me te PF_3
- ngā āhuatanga e whakarite ai i te āhua o ia rāpoi ngota
- te koki honohono āwhiwhi i te BF_3 me te PF_3
- he parahautanga o ngā koki honohono i kōwhiria e koe mō ia rāpoi ngota.

MĀ TE KAIMĀKA ANAKE

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

ASSESSOR'S USE ONLY

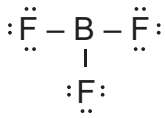
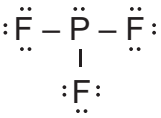
QUESTION ONE

(a) Draw the Lewis structure for each of the following molecules.

Molecule	CH_4	H_2O	N_2
Lewis structure			

(b) Boron and phosphorus both bond with three fluorine atoms to form BF_3 and PF_3. However, the molecules have different shapes and bond angles.

The following table shows the Lewis structures for the molecules BF_3 and PF_3.

Molecule	BF_3	PF_3
Lewis structure		

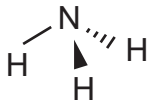
Explain why these molecules have different shapes and bond angles.

In your answer include:

- the shapes of BF_3 and PF_3
- factors that determine the shape of each molecule
- the approximate bond angle in BF_3 and PF_3
- justification of your chosen bond angles for each molecule.

ASSESSOR'S USE ONLY

(c) (i) E whakaaturia ana te hoahoa ahu-3 o te NH_3 i raro.



Porohitatia te kupu e whakaahua ana i te **pitoruatanga** o te rāpoi ngota NH_3.

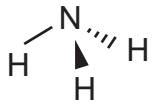
pitorua **pitokore**

Parahautia tō kōwhiringa.

MĀ TE KAIMĀKA ANAKE

ASSESSOR'S USE ONLY

(c) (i) The 3-dimensional diagram of NH_3 is shown below.



Circle the word that describes the **polarity** of the molecule NH_3.

polar **non-polar**

Justify your choice.

(ii) Ka hanga ngā pūmotu M me X i te pūhui MX_2. He teitei ake te uara tōrarotangahiko o ngā ngota o te pūmotu X i ngā ngota o te pūmotu M, nō reira he pitorua ngā hononga M–X.

MĀ TE KAIMĀKA ANAKE

Kei te āhua o ngā pūmotu M me X, ko ngā rāpoi ngota o te pūhui ka waihangatia he **pitorua**, he **pitokore** rānei.

Tuhia te (ngā) āhua o te rāpoi ngota ka tino taea rawa mēnā he:

Pitorua: _____

Pitokore: _____

Parahautia tō whakautu me te tuhi hoahoa o ngā rāpoi ngota ka taea me te tapa i ngā takirua pito (dipoles).

Kāore e hiahiatia kia tautuhia e koe ngā pūmotu o te M me te X.

ASSESSOR'S USE ONLY

(ii) Elements M and X form a compound MX_2. Atoms of element X have a higher electronegativity value than atoms of element M, therefore the M–X bonds are polar.

Depending on what elements M and X are, molecules of the compound formed will be **polar** or **non-polar**.

State the most likely shape(s) of the molecule if it is:

Polar:

Non-polar:

Justify your answer and draw diagrams of the possible molecules with dipoles labelled.

You do not need to identify what elements M and X are.

PĀTAI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) Whakaotihia te tūtohi i raro mā te tuhi i te tūmomo matū, te tūmomo korakora, me te honohono (tōpana kume) i waenga i ngā korakora mō ia matū.

Matū	Tūmomo matū	Tūmomo korakora	Tōpana kume i waenga i ngā korakora
C(*s*) (matāpango)			
$Cl_2(s)$ (haumāota)			
$CuCl_2(s)$ (konukura pūhaumāota)			
Cu(*s*) (konukura)			

(b) (i) Whakamāramahia te take he haurehu te haumāota i te pāmahana[1] rūma, engari he totoka te konukura pūhaumāota i te pāmahana rūma.

I tō whakautu, me kōrero koe mō ngā korakora me ngā tōpana kei waenga i ngā korakora i roto i ngā matū e **rua**.

[1] paemahana

MĀ TE KAIMĀKA ANAKE

(ii) Mā te whakamahi i ō mōhiotanga ki te hanganga me te honohono, whakamāramahia te take he pai te konukura mō ngā waea hiko engari kaua te matāpango, ahakoa te pai o te pūkawe hiko o te matāpango me te konukura.

QUESTION TWO

ASSESSOR'S USE ONLY

(a) Complete the table below by stating the type of substance, the type of particle, and the bonding (attractive forces) between the particles for each of the substances.

Substance	Type of substance	Type of particle	Attractive forces between particles
C(*s*) (graphite)			
$Cl_2(s)$ (chlorine)			
$CuCl_2(s)$ (copper chloride)			
Cu(*s*) (copper)			

(b) (i) Explain why chlorine is a gas at room temperature, but copper chloride is a solid at room temperature.

In your answer, you should refer to the particles and the forces between the particles in **both** substances.

ASSESSOR'S USE ONLY

(ii) Using your knowledge of structure and bonding, explain why, although both graphite and copper are good conductors of electricity, copper is suitable for electrical wires, but graphite is not.

(c) Ka hohe te haumāota ki te mewaro hei hanga mewaro haumāota me te hauwai pūhaumāota, e ai ki te whārite i raro.

MĀ TE KAIMĀKA ANAKE

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$$

Whakamahia ngā hāwera o te honohono e whai ake nei hei tātai i te $\Delta_r H°$ mō tēnei tauhohenga.

Honohono	**Hāwera o te honohono /kJ mol^{-1}**
H – Cl	431
C–H	414
C – Cl	324
Cl – Cl	242

ASSESSOR'S USE ONLY

(c) Chlorine reacts with methane to form chloromethane and hydrogen chloride, as shown in the equation below.

$$CH_4(g) + Cl_2(g) \rightarrow CH_3Cl(g) + HCl(g)$$

Use the following bond enthalpies to calculate $\Delta_r H°$ for this reaction.

Bond	Bond enthalpy /kJ mol^{-1}
H – Cl	431
C – H	414
C – Cl	324
Cl – Cl	242

PĀTAI TUATORU

MĀ TE KAIMĀKA ANAKE

(a) Ka taea te whakaatu i te whakarewatanga o te haukini pākawa ota i roto i tētahi ipurau me te wai mā te whārite e whai ake:

$$NH_4NO_3(s) \rightarrow NH_4^+(aq) + NO_3^-(aq) \qquad \Delta_r H^\circ = 25.1 \text{ kJ mol}^{-1}$$

Porohitahia te kupu i raro e whakaahua tika ana i tēnei tukanga.

putawera **pauwera**

Porohitatia te whakaahuatanga i raro e whakaahua tika ana i ngā mea ka kite koe i roto i te ipurau i te wā o tēnei tukanga.

mātao haere ake **noho rite tonu** **mahana haere ake**

Whakamāramahia ō kōwhiringa.

(b) He puna hira te kūhuka o te pūngao i roto i ā tātou kai. E whakaatu ana te whārite i raro i te ngingiha o te kūkuha hei hanga waro hāora rua[2] me te wai.

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell) \qquad \Delta_r H^\circ = -2\,820 \text{ kJ mol}^{-1}$$

(i) Porohitatia te kupu i raro e whakaahua tika ana i tēnei tukanga.

putawera **pauwera**

Homai tētahi pūtake mō tō kōwhiringa.

[2] hauhā

QUESTION THREE

ASSESSOR'S USE ONLY

(a) Dissolving ammonium nitrate in a beaker containing water can be represented by the following equation:

$$NH_4NO_3(s) \rightarrow NH_4^+(aq) + NO_3^-(aq) \qquad \Delta_r H° = 25.1 \text{ kJ mol}^{-1}$$

Circle the term below that best describes this process.

exothermic **endothermic**

Circle the description below that best describes what you would observe happening to the beaker during this process.

gets colder **stays the same** **gets warmer**

Explain your choices.

(b) Glucose is an important source of energy in our diet. The equation below shows the combustion of glucose to form carbon dioxide and water.

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell) \qquad \Delta_r H° = -2\,820 \text{ kJ mol}^{-1}$$

(i) Circle the term below that best describes this process.

exothermic **endothermic**

Give a reason for your choice.

MĀ TE KAIMĀKA ANAKE

(ii) Ko ngā wāhine e āhua korikori ana me whai 9 800 kJ o te pūngao ia rā.

Tātaihia te maha o ngā mol kūhuka hei whakarato i tēnei whakaritenga pūngao o ia ra.

(c) (i) He maha ngā hūhunu[3] kawe me ngā kēne haurehu puni he pūwaro kei roto, C_4H_{10}. He haurehu te pūwaro i te pāmahana rūma, ā, ko tana ira koropupū he -0.5°C. Kei roto i ngā kēne haurehu te pūwaro haurehu me te pūwaro wē. I te whakamahinga o te pūwaro haurehu, ka whakaeto haere ētahi wē.

Porohitahia te kupu i raro e whakaahua tika ana i tēnei tukanga.

putawera **pauwera**

Homai he pūtake mō tō kōwhiringa, ka whakamahi i ō mōhiotanga ki te hanganga me te honohono, me ngā panonitanga pūngao, hei whakamārama i ngā panonitanga i te wā whakaeto haere ana te wē.

(ii) E whakaatu ana te whārite i raro i te ngingiha o te pūwaro.

$$C_4H_{10}(g) + 13/2\ O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$$

Ina ngingiha te rahinga pūwaro 100 g, he 4 960 kJ o te pūngao ka whakaputahia.

Tātaihia te panoni hāwera ina ngingiha te 1 mol o te pūwaro.

$M(C_4H_{10}) = 58.1\ \text{g mol}^{-1}$.

[3] rorerore

ASSESSOR'S USE ONLY

(ii) Females who are moderately active need 9 800 kJ of energy per day.

Calculate the number of moles of glucose that would provide this daily energy requirement.

(c) (i) Many portable BBQ and camping gas canisters contain butane, C_4H_{10}. Butane is a gas at room temperature, and has a boiling point of -0.5°C. The gas canisters contain both gas and liquid butane. As the gaseous butane is used, some of the liquid evaporates.

Circle the term below that best describes this process.

exothermic **endothermic**

Give a reason for your choice, and use your knowledge of structure and bonding, and energy changes, to explain the changes occurring as the liquid evaporates.

(ii) The equation below shows the combustion of butane.

$$C_4H_{10}(g) + 13/2\ O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$$

When 100 g of butane undergoes combustion, 4 960 kJ of energy is released.

Calculate the enthalpy change when 1 mole of butane undergoes combustion.

$M(C_4H_{10}) = 58.1$ g mol^{-1}.

(d) Ka hohe te rino ōkai Fe_3O_4 me te Fe_2O_3 ki te konumohe, e ai ki te whakaaturanga i raro.

MĀ TE KAIMĀKA ANAKE

$3Fe_3O_4(s) + 8Al(s) \rightarrow 4Al_2O_3(s) + 9Fe(s)$ $\quad \Delta_r H^\ominus = -3\,348$ kJ mol^{-1}

$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$ $\quad \Delta_r H^\ominus = -851$ kJ mol^{-1}

Parahautia ko tēhea te rino ōkai, Fe_3O_4, Fe_2O_3 rānei he nui ake te whakaputa pūngao wera ina hangaia he rino 2.00 kg i te wā e hohe ana ki te konumohe.

Me whakauru ki tō whakautu ngā tātaitanga o te pūngao wera ka whakaputahia mō te papatipu o te rino ka hangaia.

M(Fe) = 55.9 g mol^{-1}.

ASSESSOR'S USE ONLY

(d) The iron oxides Fe_3O_4 and Fe_2O_3 react with aluminium as shown below.

$$3Fe_3O_4(s) + 8Al(s) \rightarrow 4Al_2O_3(s) + 9Fe(s) \qquad \Delta_r H^\circ = -3\,348 \text{ kJ mol}^{-1}$$

$$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s) \qquad \Delta_r H^\circ = -851 \text{ kJ mol}^{-1}$$

Justify which iron oxide, Fe_3O_4 or Fe_2O_3, will produce more heat energy when 2.00 kg of iron is formed during the reaction with aluminium.

Your answer should include calculations of the heat energy produced for the given mass of iron formed.

$M(\text{Fe}) = 55.9 \text{ g mol}^{-1}$.

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

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 2 Chemistry, 2013

91164 Demonstrate understanding of bonding, structure, properties and energy changes

9.30 am Tuesday 19 November 2013
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of bonding, structure, properties and energy changes.	Demonstrate in-depth understanding of bonding, structure, properties and energy changes.	Demonstrate comprehensive understanding of bonding, structure, properties and energy changes.

91164M

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 L2–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 2–23 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.