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Tirohia te uhi o muri e kitea ai te whakapākehātanga o tēnei uhi

2

91164M

911645

Tuhia he (☒) ki te pouaka mēnā kāore koe i tuhi kōrero ki tēnei puka

+

NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Te Mātai Matū, Kaupae 2, 2025

91164M Te whakaatu māramatanga ki te honohono, ki te hanga, ki ngā āhuatanga me ngā panonitanga o te ngao

Ngā whiwhinga: E rima

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki te honohono, ki te hanga, ki ngā āhuatanga me ngā panonitanga o te ngao.	Te whakaatu māramatanga ki te honohono, ki te hanga, ki ngā āhuatanga me ngā panonitanga o te ngao, kia hōhonu.	Te whakaatu māramatanga ki te honohono, ki te hanga, ki ngā āhuatanga me ngā panonitanga o te ngao, 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, he rauemi anō hoki hei toro māu kua whakaurua ki te Pukapuka Rauemi L2–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 2–27 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

Kaua e tuhi ki ngā paenga (✂✂✂). Ka poroa taua wāhi ka mākahia ana te pukapuka.

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

TE TŪMAHI TUATAHI

Whakamahia ai te konutai pūhaumāota, NaCl, hei patuero, hei patumoroiti hoki. I ngā mahi tātaringa matū, he rite tonu tana tauhohe ki te hiriwa pākawa ota, $AgNO_3$, e whakaaturia nei i raro iho nei.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

(a) Ka āpitihia ana te hiriwa pākawa ota, $AgNO_3$, ki te 73.0 g o te konutai pūhaumāota, NaCl, ka 81.8 kJ te nui o te ngao ka puta.

Tātaia te $\Delta_r H$ mō te tauhohenga o runga ake.

$M(NaCl) = 58.4 \text{ g mol}^{-1}$

(b) (i) Tautohua te matū o raro iho nei e hāngai ana ki ōna kōrero kua tuhia ki te tūtohi, mā te tuhi atu ki te rārangi e tika ana.

Te konutea (Zn) Te haukini (NH_3) Te taimana (C) Te konutai pūhaumāota (NaCl)

Te momo totoka	Te pae rewa (°C)	Te matū i kōwhiria
He Whatunga Matū Ngota e ahu-toru ana	3550	
He katote	801	
He whairino	420	
He rāpoi ngota	–78	

(ii) Whakahāngaitia ngā hononga me ngā hanga i ngā katote me ngā rāpoi ngota e totoka ana, ki ngā pae rewa e hāngai ana.

I tō tuhinga:

- whakaahuatia ngā hononga me ngā hanga i ngā katote me ngā rāpoi ngota e totoka ana
- whakamāramahia te tohu ka puta i te pae rewa o tētahi totoka e pā ana ki te kaha o te kukume i waenganui i ngā korakora
- tūhonoa te kaha o te kukume i waenganui i ngā korakora me ngā pae rewa e hāngai ana.

(c) He rite tonu te whakamahia o te taimana, C, me te kōura, Au, hei waihanga taonga whakapaipai, engari, he tino rerekē ngā matū o tēnā me tēnā.

He tino mārō te taimana, ka mutu, ka rāpia anake e tētahi matū e rite nei tōna mārō. Heoi, e māngohe ana, e kōngohe ana hoki te kōura, ā, ka whakamahia hei waihanga i ngā āhua me ngā tauira manganga.

Whakamāramahia mai te āhua e hua mai ai ēnei āhuatanga i te hanga me te hononga o ia matū.

Te mārō o te taimana, C:

Te māngohe me te kōngohe o te kōura, Au:

QUESTION ONE

Sodium chloride, NaCl, is used as an antiseptic and antimicrobial agent. In analytical chemistry, it is often reacted with silver nitrate, $AgNO_3$, shown below.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

(a) When silver nitrate, $AgNO_3$, is added to 73.0 g of sodium chloride, NaCl, 81.8 kJ of energy is released.

Calculate the $\Delta_r H$ for the above reaction.

M(NaCl) = 58.4 g mol^{-1}

(b) (i) Identify which substance below matches the information provided in the table by placing it into the correct row.

Zinc (Zn) **Ammonia (NH_3)** **Diamond (C)** **Sodium chloride (NaCl)**

Solid type	Melting point (°C)	Substance selected
3D Covalent Network	3550	
Ionic	801	
Metallic	420	
Molecular	–78	

(ii) Relate the bonding and structure in ionic and molecular solids to their relative melting points.

In your answer:

- describe the bonding and structure in ionic and molecular solids
- explain what the melting point of a solid indicates about the strength of forces between its particles
- link the strength of forces between the particles to their relative melting points.

(c) Diamond, C, and gold, Au, are both used frequently in jewellery making, but their properties are very different.

Diamond is very hard and can only be scratched by a substance equally as hard as itself. Gold, however, is malleable and ductile, and is used to craft intricate shapes and patterns.

Explain how the structure and bonding of each substance results in these properties.

Diamond, C, hardness:

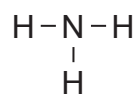
Gold, Au, malleable and ductile:

(d) He whakahirahira te hītori o te whakawhanaketanga o te tukanga Haber-Bosch, e whakaaturia ana i te tauhohenga i raro iho nei.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta_r H = -93.0$ kJ mol^{-1}

Tātaia te toharite o te ngao honohono o te hononga N≡N i te N_2, mā te whakamahi i ngā toharite ngao honohono kua whakarārangihia ki te tūtohi o raro iho nei mō tēnei tauhohenga i waenganui i te hauota, N_2, i te hauwai, H_2, e puta ai te haukini, NH_3.

Te honohono	**Te ngao honohono (kJ mol^{-1})**
H–H	436
N–H	391

N≡N	H−H	

(d) The development of the Haber-Bosch process, shown in the reaction below, is historically significant.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta_r H = -93.0$ kJ mol^{-1}

Calculate the average bond energy of the N≡N bond in N_2, using the average bond energies listed in the table below for this reaction between nitrogen, N_2, and hydrogen, H_2, that produces ammonia, NH_3.

Bond	Bond energy (kJ mol^{-1})
H–H	436
N–H	391

N≡N	H−H	H−N−H | H

TE TŪMAHI TUARUA

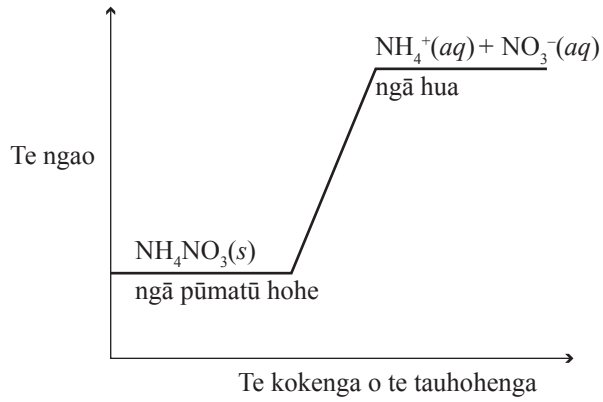
(a) (i) Tautohua mēnā e hāngai ana ia tauākī ki ngā tauhohe pauwera (Endo) rānei, ki ngā tauhohe putawera (Exo) rānei, mā te porohita anake i te kupu e tika ana.

- He nui ake te ngao o te hua, tēnā i ngā matū hohe. **Pauwera / Putawera**
- Ka whakaputaina te ngao ki te taiao. **Pauwera / Putawera**
- E tōrunga ana te panonitanga o te ngao pūhana neke *(enthalpy)* (ΔH) mō te tauhohenga. **Pauwera / Putawera**

(ii) Kōrerohia mēnā e pauwera ana rānei, e putawera ana rānei te tukanga e whai ake nei, ka mutu, homai tētahi take mō tō kōwhiringa.

$H_2O(g) \rightarrow H_2O(\ell)$

Whakamahia ai te haukini pākawa ota hei rongoā i ngā whara. E whakaaturia ana te panonitanga ngao i te tauhohe, i te hoahoa o raro iho nei.



(iii) E mitia ana rānei, e whakaputaina ana rānei te ngao ki te taiao i te tauhohe kei te kauwhata o runga ake nei?

(iv) Porohitatia te kōwhiringa tika hei tautohu i te panonitanga o te ngao pūhana neke (*enthalpy*) o tēnei tauhohe ($\Delta_r H$):

$\Delta_r H < 0$, tōraro **$\Delta_r H > 0$, tōrunga**

QUESTION TWO

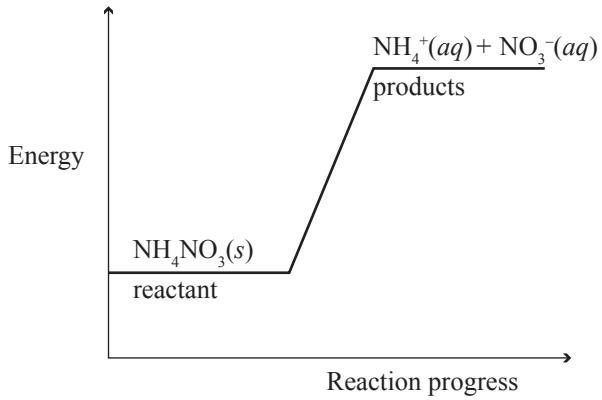
(a) (i) Identify whether each of the statements apply to endothermic (Endo) or exothermic (Exo) reactions by circling the correct term only.

- The products have more energy than the reactants. **Endo / Exo**
- Energy is released to the surroundings. **Endo / Exo**
- The change in enthalpy (ΔH) for the reaction is positive. **Endo / Exo**

(ii) State whether the following process is endothermic or exothermic, and give a reason for your choice.

$H_2O(g) \rightarrow H_2O(\ell)$

Ammonium nitrate, NH_4NO_3, is used in first aid to treat injuries. The energy change in the reaction is shown in the diagram below.

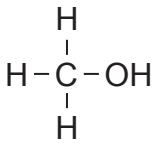
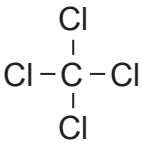
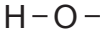


(iii) Is the reaction in the graph above absorbing energy from the surroundings or releasing energy to the surroundings?

(iv) Circle the correct option for identification of the enthalpy change of this reaction ($\Delta_r H$):

$\Delta_r H < 0$, negative **$\Delta_r H > 0$, positive**

(b) He hononga tōranga *(polar bonds)* ō ngā pūhui e toru e kitea ana i te tūtohi o raro iho nei, engari, e rua anake ka kīia he rāpoi ngota tōranga *(polar molecules)*.

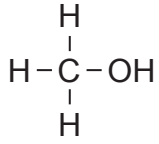
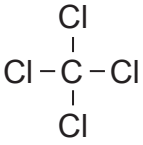
Te mewaro	**Te waro haumāota-whā (Tetrachloromethane)**	**Te wai māori**
		

(i) Tautuhia ngā āhuatanga e tōranga ai tētahi hononga matū, ka mutu, homai tētahi tauira i tētahi o ngā pūhui o runga ake.

(ii) Porohitatia te pūhui i te tūtohi o runga ka kīia he rāpoi ngota **tōranga-kore**.

(iii) Whakamahia ō mōhiotanga ki te hanga me te honohono hei parahau i tō kōwhiringa rāpoi ngota i porohitatia ai e koe i runga ake.

(b) All three of the compounds given in the table below contain polar bonds, but only two of them are polar molecules.

Methanol	Tetrachloromethane	Water
		

(i) Define what makes a chemical bond polar, and give an example from one of the above compounds.

(ii) Circle the compound in the table above that is the **non-polar** molecule.

(iii) Use your understanding of structure and bonding to justify your choice of the molecule you circled above.

(c) Matapaetia te mehamehanga o ngā hanumitanga o ngā matūmeha me ngā tāmeha e whai ake nei, mā te āpiti i tētahi tohu tika (✓) ki te pou e tika ana, mō ia hanumitanga.

Ngā hanumitanga o te matūmeha me te tāmeha	**He matūmeha?**	**He tāmeha?**
Te waro haumāota-whā, CCl_4, i te wai māori, H_2O		
Te konupora pūkane, $MgBr_2$ i te owaro, C_6H_{14}		
Te pūkane, Br_2, i te owaro, C_6H_{14}		

(d) He aha i memeha ai te konutai pūhaumāota, NaCl, i te wai māori, engari kāore e memeha te hautawa, I_2, i te wai?

I tō tuhinga:

- me kōrero te hanga me te honohono o ia matū
- me whakamārama te āhua o te pāhekoheko o ngā matū ki ngā rāpoi ngota wai māori
- me whakauru tētahi hoahoa e whakaatu ana i te memeha o te NaCl i te wai māori.

Tētahi hoahoa hei whakaatu i te NaCl e memeha ana i te wai:

(c) Predict the solubility of the following combinations of solutes and solvents by adding a tick (✓) to the correct column for each combination.

Solute and solvent combination	**Soluble?**	**Insoluble?**
Tetrachloromethane, CCl_4, in water, H_2O		
Magnesium bromide, $MgBr_2$ in hexane, C_6H_{14}		
Bromine, Br_2, in hexane, C_6H_{14}		

(d) What makes sodium chloride, NaCl, soluble in water, but iodine, I_2, insoluble in water?

In your answer:

- refer to the structure and bonding of each substance
- explain how the substance interacts with water molecules
- include a diagram showing the dissolving of NaCl in water.

Diagram to show NaCl dissolving in water:

TE TUMAHI TUATORU

(a) He rerekē te kawenga hiko o ngā hanga rerekē (āhuatini) o te waro. Kāore te taimana e kawe i te hiko, engari, he kawenga hiko tino pai te matāpango.

Whakatairitea, whakatauarotia hoki te hanga me te honohono o ēnei pūhui waro e rua.

I tō tuhinga:

- me whakamārama te hanga me te honohono o te taimana me te matāpango
- tautohua te kawenga hiko i ngā totoka
- parahautia te rerekē o te kawenga hiko i waenganui i te taimana me te matāpango.

Ka āhei tō āpiti i tētahi hoahoa hei tautoko i tō tuhinga.

(b) He tauhohenga matū te ngingiha e whenumi ai tētahi matū ki te hāora, e hua mai ai te wera.

Ka whakangingihatia ana te waihā ewaro, C_2H_5OH, ki te hāora, O_2, ka hua mai te hauhā, CO_2, me te wai māori, H_2O.

$$C_2H_5OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O\ (\ell) \qquad \Delta_r H = -1370 \text{ kJ mol}^{-1}$$

(i) Tātaia te papatipu o te waihā ewaro, C_2H_5OH, me mātua tauhohe e puta ai te 17 500 kJ o te ngao.

$$M(C_2H_5OH) = 46.7 \text{ g mol}^{-1}$$

(ii) Tātaia te panonitanga ngao ka puta ana te 187 g o te konutea ōkai, ZnO, i te tauhohenga i waenganui i te konutea, Zn, me te hāora, O_2, kei raro iho nei.

$$2Zn(s) + O_2(g) \rightarrow 2ZnO(s) \qquad \Delta_r H = -696 \text{ kJ mol}^{-1}$$

$$M(ZnO) = 81.4 \text{ g mol}^{-1}$$

QUESTION THREE

(a) Different forms (allotropes) of carbon have different electrical conductivities. Diamond does not conduct electricity, but graphite is a very good electrical conductor.

Compare and contrast the structure and bonding of these two carbon compounds.

In your answer:

- explain the structure and bonding of diamond and graphite
- define electrical conductivity in solids
- justify the difference in electrical conductivity between diamond and graphite.

You may include a diagram to support your answer.

(b) Combustion is a chemical reaction in which a substance combines with oxygen and produces heat.

When ethanol, C_2H_5OH, is combusted with oxygen, O_2, carbon dioxide, CO_2, and water, H_2O, are produced.

$C_2H_5OH(\ell) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O\ (\ell)$ $\Delta_r H = -1370$ kJ mol^{-1}

(i) Calculate the mass of ethanol, C_2H_5OH, that must react to release 17 500 kJ of energy.

$M(C_2H_5OH) = 46.7$ g mol^{-1}

(ii) Calculate the energy change when 187 g of zinc oxide, ZnO, is produced in the reaction below between zinc, Zn, and oxygen, O_2.

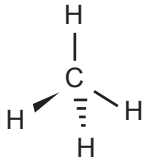
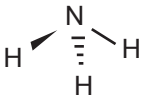
$2Zn(s) + O_2(g) \rightarrow 2ZnO(s)$ $\Delta_r H = -696$ kJ mol^{-1}

$M(ZnO) = 81.4$ g mol^{-1}

(c) Tāngia te hoahoa irahiko *(Lewis structure)* mō ia rāpoi ngota e whai ake nei, ka homai ai i te āhua o tēnā, o tēnā.

Te rāpoi ngota	**CO_2**	**Cl_2O**	**BF_3**
Te hoahoa irahiko			
Te ingoa o te āhua			

(d) E takoto ana i te tūtohi nei ngā kōrero e pā ana ki te āhua o te matū o ia rāpoi ngota.

Te ingoa totoka	**Te mewaro**	**Te haukini**
Te hoahoa o te āhua		
Ngā koki honohono	109.5°	109.5°
Te āhua o te rāpoi ngota	He matawhā rite	He koeko-tapatoru rite

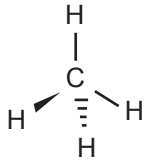
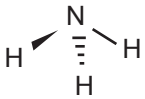
Whakatairitea ngā āhua e rua, ka whakamārama ai i ngā āhuatanga e whai pānga ana ki ēnei e whai ake nei:

- te takoto o ngā āhuatanga e karapoti ana i te ngota matua
- te āhua o te rāpoi ngota.

(c) Draw the Lewis structure (electron dot diagram) for each of the following molecules, and give their shapes.

Molecule	**CO_2**	**Cl_2O**	**BF_3**
Lewis structure			
Name of shape			

(d) The table gives information relating to the shape of each molecular substance.

Solid name	**Methane**	**Ammonia**
Shape diagram		
Bond angle	109.5°	109.5°
Molecular shape	Tetrahedral	Trigonal pyramid

Compare the two shapes and explain the factors that contribute to:

- arrangement around the central atom
- molecular shape.

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

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 2 Chemistry 2025

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

Credits: Five

91164M

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.

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 L2–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 2–27 in the correct order and that none of these pages is blank.

Do not write in any margins (⁘). This area will be cut off when the booklet is marked.

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