No part of the candidate evidence in this exemplar material may be presented in an external assessment for the purpose of gaining credits towards an NCEA qualification.

91164





Level 2 Chemistry, 2015

KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

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

9.30 a.m. Monday 23 November 2015 Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of bonding, structure, properties and energy	Demonstrate in-depth understanding of bonding, structure, properties and	Demonstrate comprehensive understanding of bonding, structure,
changes.	energy changes.	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 is provided on the Resource Sheet L2–CHEMR.

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 2–12 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.

Not Achieved TOTAL 5

ASSESSOR'

QUESTION ONE

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

Molecule	O_2	OCl ₂	CH ₂ O
Lewis structure	OEO	;c\ - \(\dot{O} - \dot{C}\):	H-C-H

(b) Carbon atoms can bond with different atoms to form many different compounds.

The following table shows the Lewis structure for two molecules containing carbon as the central atom, CCl₄ and COCl₂. These molecules have different bond angles and shapes.

Molecule	CCl ₄	COCl ₂
Lewis structure	:Cl: :Cl: :Cl:	: Öl – Ö – Öl : , Ö.,

Evaluate the Lewis structure of each molecule to determine why they have different bond angles and shapes.

In your answer, you should include:

- the approximate bond angle in each molecule
- the shape of each molecule
- factors that determine the shape and bond angle for each molecule.

(OCI2 - Trigonal planar Bond angle: 1200

CC14 - Tetrahedral Planar Bond angle: 1090 (c) BeCl₂ and BF₃ are unusual molecules because there are not enough electrons for the central atoms, Be and B, to have a full valence shell. Their Lewis structures are shown below.

Both molecules have the same polarity.

ASSESSOR'S USE ONLY

Circle the word that describes the polarity of these molecules.

	polar	nor	n-polar
Justify your choice.	[120	_	1
both of these	molecures	are	symmetri
11 1 11		r	N/ A

not the alpoles cancel out noteciles are symmetrical, there along these maleriles non-polar (d) Ethene gas, $C_2H_4(g)$, reacts with bromine gas, $Br_2(g)$, as shown in the equation below.

Calculate the enthalpy change, $\Delta_t H^{\circ}$, for the reaction between ethene and bromine gases, given the average bond enthalpies in the table below.

Show your working and include appropriate units in your answer.

Bond	Average bond enthalpy/kJ mol ⁻¹	
Br–Br	193	
С-С	346	
C=C	614	
C–Br	285	
С–Н	414	

QUESTION TWO

ASSESSOR'S USE ONLY

Hand warmers contain a supersaturated solution of sodium ethanoate which, when activated, crystallises and releases heat.

Circle the term that best describes this reaction.

exothermic

endothermic

Give a reason for your choice.

Glucose is made in plants during photosynthesis when carbon dioxide gas, $CO_2(g)$, and water, $H_2O(\ell)$, react to produce glucose, $C_6H_{12}O_6(aq)$, and oxygen gas, $O_2(g)$. The photosynthesis reaction can be represented by the following equation:

$$6\text{CO}_2(g) + 6\text{H}_2\text{O}(\ell) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(aq) + 6\text{O}_2(g) \quad \Delta_r H^\circ = 2803 \text{ kJ mol}^{-1}$$

Circle the term that best describes this reaction.

exothermic

endothermic

Give a reason for your choice.

+Ve = Exothermiz

Energy released > stored energy = observable

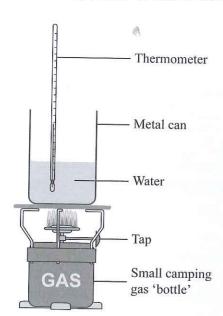
(ii) Calculate how much energy is absorbed or released in the photosynthesis reaction if 19.8 g of carbon dioxide gas, $CO_2(g)$, reacts completely with excess water, $H_2O(\ell)$, to form glucose, $C_6H_{12}O_6(aq)$, and oxygen gas, $O_2(g)$.

Show your working and include appropriate units in your answer.

$$M(CO_2) = 44.0 \text{ g mol}^{-1}$$

ASSESSOR'S USE ONLY

(c) A small camp stove containing butane gas, C₄H₁₀(g), is used to heat some water, as shown in the diagram below. A student measures the temperature change in the water and calculates that when 3.65 g of butane is combusted, 106 kJ of heat is released.



The reaction for the combustion of butane is shown in the equation below.

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(\ell)$$

(i) Calculate the enthalpy change $(\Delta_r H)$ for this reaction, based on the above measurements.

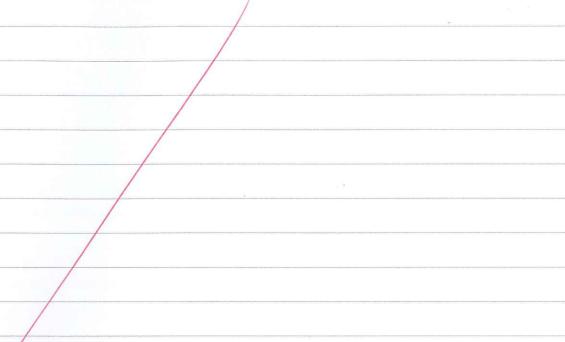
$$M(C_4H_{10}) = 58.0 \text{ g mol}^{-1}$$

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 $\Delta_{\rm r}H$ = -5754 kJ mol⁻¹. Explain why the result you calculated in part (c)(i) is different to the accepted value.

(ii) The accepted enthalpy change for the combustion reaction of butane gas, $C_4H_{10}(g)$, is

Explain why the result you calculated in part (c)(i) is different to the accepted value. In your answer, you should include at least TWO reasons.



(iii) Complete, including labels, the energy diagram for the combustion of butane gas showing reactants, products, and the change in enthalpy.

Reaction proceeds

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No calculations are required.

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QUESTION THREE

(a) Complete the table below by stating the type of solid, the type of particle, and the attractive forces between the particles in each solid.

Solid	Type of solid	Type of particle	Attractive forces between particles
Cu(s) (copper)			/
PCl ₃ (s) (phosphorus trichloride)			
SiO ₂ (s) (silicon dioxide)	8		
KCl(s) (potassium chloride)			

(b)	Phosphorus trichloride, PCl ₃ , is a liquid at room temperature, and does not conduct electricity
	Explain these two observations in terms of the particles, structure, and bonding of PCl ₃ .

M

Complete the table below by identifying which of these solids have the listed physical properties:

Physical properties	Solid	
The solid is insoluble in water and is malleable.	Cu	
The solid is soluble in water and is not malleable.	KCI	
The solid is insoluble in water and is not malleable.	5102	

may use diagrams in your justifica	cion.	these
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Extra paper if required. Write the question number(s) if applicable. QUESTION NUMBER

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Extra paper if required.

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