91164

911640

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

2

SUPERVISOR'S USE ONLY

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.

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 2–12 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.

TOTAL

ASSESSOR'S USE ONLY

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

ASSESSOR'S USE ONLY

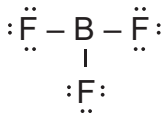
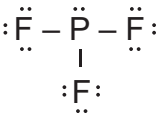
QUESTION ONE

(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.

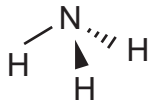
In your answer include:

- 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

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.

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.

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.

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

QUESTION THREE

ASSESSOR'S USE ONLY

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

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

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.

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

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

exothermic **endothermic**

Give a reason for your choice.

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}.

ASSESSOR'S USE ONLY

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

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

$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(s)$ $\quad \Delta_r H° = -851$ 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(Fe) = 55.9 g mol^{-1}.

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91164