91164

911640

2

SUPERVISOR'S USE ONLY

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 2 Chemistry, 2018

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

9.30 a.m. Monday 26 November 2018
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 in the Resource Booklet 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.

TOTAL

ASSESSOR'S USE ONLY

QUESTION ONE

ASSESSOR'S USE ONLY

(a) The equation for the dissolving of ammonium chloride, NH_4Cl, in water is shown below.

$$NH_4Cl(s) \rightarrow NH_4^+(aq) + Cl^-(aq) \quad \Delta_r H^o = +17.8 \text{ kJ mol}^{-1}$$

Circle the term that best describes this reaction:

endothermic **exothermic**

Give a reason for your choice.

(b) (i) Respiration is the process by which energy is released from glucose.

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(\ell)$$

Circle the term that best describes this reaction:

endothermic **exothermic**

Give a reason for your choice.

(ii) Water formed in the respiration reaction evaporates.

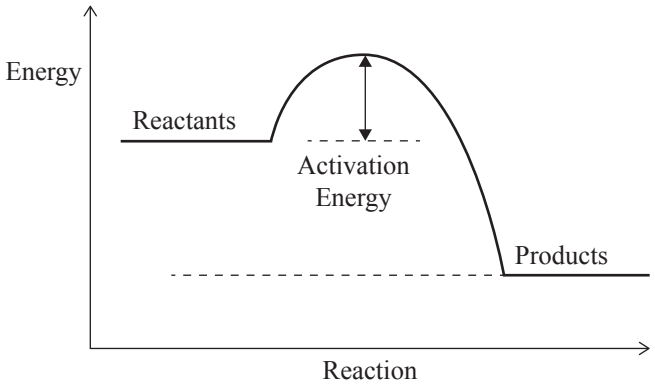
$$H_2O(\ell) \rightarrow H_2O(g)$$

Explain whether this process is endothermic or exothermic

ASSESSOR'S USE ONLY

(c) (i) Butane is used to fuel a camping stove. Butane burns readily in oxygen.

The following is an energy profile diagram for the combustion of butane.



Explain how the diagram shows that the enthalpy change for this reaction is negative.

(ii) The following is the equation for the combustion of butane gas in oxygen.

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g) \qquad \Delta_r H^o = -5760 \text{ kJ mol}^{-1}$$

The fuel cylinder for the stove contains 450 g of butane gas.

Calculate the energy released when this mass of butane gas is burned completely in oxygen.

Show your working and include appropriate units in your answer.

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

ASSESSOR'S USE ONLY

(d) Nitrogen gas, $N_2(g)$, reacts with hydrogen gas, $H_2(g)$, to produce ammonia gas, $NH_3(g)$, as shown by the following equation:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) \quad \Delta_r H^o = -92.0 \text{ kJ mol}^{-1}$$

Calculate the average bond enthalpy of the **N–H** bond in NH_3, using the average bond enthalpies in the table below.

Bond	**Average bond enthalpy kJ mol^{-1}**
N≡N	945
H–H	436

QUESTION TWO

ASSESSOR'S USE ONLY

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

Molecule	H_2S	NH_3	BF_3
Lewis Structure			
Name of Shape			
Approximate bond angle around central atom	109.5°	109.5°	120°

(b) Compare and contrast the shapes and bond angles of NH_3 and BF_3.

ASSESSOR'S USE ONLY

(c) The Lewis structures for two molecules are shown below.

Molecule	H − C ≡ N	O = C = O
Polarity of molecule	Polar	Nonpolar

Hydrogen cyanide, HCN, is polar, and carbon dioxide, CO_2, is nonpolar.

Both molecules are linear.

Explain why the polarities of the molecules are different, even though their shapes are the same.

ASSESSOR'S USE ONLY

(d) Methanol, $CH_3OH(\ell)$, is made industrially by reacting carbon monoxide, $CO(g)$, and hydrogen, $H_2(g)$.

$$CO(g) + 2H_2(g) \rightarrow CH_3OH(\ell) \qquad \Delta_r H^o = -91.0 \text{ kJ mol}^{-1}$$

Calculate the volume of methanol made when 4428 kJ of energy is released.

The mass of 1.00 L of methanol is 0.790 kg.

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

QUESTION THREE

ASSESSOR'S USE ONLY

(a) Complete the table below by choosing the appropriate type of solid that matches the properties shown in the table.

Types of solid: **Ionic**, **Metallic**, **Covalent Network**, **Molecular**.

Solid	Melting point (°C)	Boiling point (°C)	Conducts electricity?	Soluble in water?	Type of solid
A	290	732	solid – no molten – yes	Yes, solution conducts electricity	
B	44	280	No	No	
C	1710	2230	No	No	
D	660	2470	Solid and molten – yes	No	

(b) Explain why Solid **A** does not conduct electricity in the solid state, but will conduct when molten or when dissolved in water.

Refer to the particles, structure, and bonding of this substance.

(c) Elaborate on the differences in the melting points of solids **B** and **D** with reference to their particles, structure, and bonding.

ASSESSOR'S USE ONLY

Question Three continues on the following page.

ASSESSOR'S USE ONLY

(d) (i) Use an annotated diagram to show how solid **A** is able to dissolve in water.
Show the solid before dissolving, and the dissolving process of the solid.

(ii) Explain the attractions that allow solid **A** to be soluble in water.

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91164