3

91390

913900

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

SUPERVISOR'S USE ONLY

Level 3 Chemistry, 2016

91390 Demonstrate understanding of thermochemical principles and the properties of particles and substances

2.00 p.m. Monday 21 November 2016
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of thermochemical principles and the properties of particles and substances.	Demonstrate in-depth understanding of thermochemical principles and the properties of particles and substances.	Demonstrate comprehensive understanding of thermochemical principles and the properties of particles and substances.

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 Sheet L3–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 2–11 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

ASSESSOR'S USE ONLY

QUESTION ONE

(a) Complete the following table.

Symbol	Electron configuration
Cl	
Zn	
Cr^{3+}	

(b) (i) Explain why the radius of the Cl atom and the radius of the Cl^- ion are different.

	Radius (pm)
Cl atom	99
Cl^- ion	181

(ii) Explain the factors influencing the trends in electronegativity and first ionisation energy down a group of the periodic table.

In your answer you should:

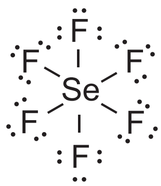
- define both electronegativity and first ionisation energy
- explain the trend in both electronegativity and first ionisation energy down a group
- compare the trend in electronegativity and first ionisation energy down a group.

ASSESSOR'S USE ONLY

(c) (i) Complete the following table:

	ICl_4^-	ClF_3
Lewis diagram		
Name of shape		

(ii) The Lewis diagram for SeF_6 is shown below.



Would you expect SeF_6 to be soluble in water?

Yes **No**

Explain your answer in terms of the shape and polarity of SeF_6.

ASSESSOR'S USE ONLY

ASSESSOR'S USE ONLY

QUESTION TWO

The standard enthalpy of vaporisation, $\Delta_{vap}H°$, of sodium chloride, NaCl, hydrogen chloride, HCl, and chloromethane, CH_3Cl, are given in the table below.

(a) Identify all the attractive forces between particles of the following compounds in their liquid state.

Compound	$\Delta_{vap}H°$ / kJ mol^{-1}	Attractive forces
NaCl	194	
HCl	16.0	
CH_3Cl	22.0	

(b) (i) Explain why $\Delta_{vap}H°$(NaCl) is significantly higher than both $\Delta_{vap}H°$(HCl) and $\Delta_{vap}H°$(CH_3Cl).

(ii) Explain why $\Delta_{vap}H°$(CH_3Cl) is greater than $\Delta_{vap}H°$(HCl).

ASSESSOR'S USE ONLY

(c) (i) Define $\Delta_{fus}H°(NaCl)$.

(ii) Why is $\Delta_{vap}H°(NaCl)$ greater than $\Delta_{fus}H°(NaCl)$?

(iii) Why does NaCl readily dissolve in water, even though the process is slightly endothermic?

$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq) \qquad \Delta_rH° = +3.90 \text{ kJ mol}^{-1}$$

QUESTION THREE

ASSESSOR'S USE ONLY

(a) The equation for the combustion of liquid methanol is:

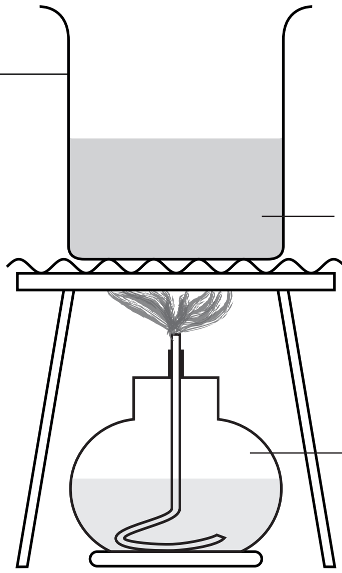
$$CH_3OH(\ell) + \tfrac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$$

Calculate the standard enthalpy of combustion of liquid methanol, $\Delta_c H°(CH_3OH(\ell))$, using the information in the table below.

Compound	**kJ mol^{-1}**
$\Delta_c H°(C(s))$	–394
$\Delta_c H°(H_2(g))$	–286
$\Delta_f H°(CH_3OH(\ell))$	–240

ASSESSOR'S USE ONLY

(b) The enthalpy of combustion of liquid methanol, $\Delta_c H°(CH_3OH(\ell))$, can also be determined by burning a known mass of methanol and measuring the temperature change in a known mass of water above the burning methanol.



(i) If 2.56 g of methanol is burned, the temperature of 500 g water increases from 21.2°C to 34.5°C.

Using these results, calculate the experimental value of $\Delta_c H°(CH_3OH(\ell))$.

The specific heat capacity of water is 4.18 J $°C^{-1}$ g^{-1}.

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

(ii) Why is the experimental value obtained in part (b)(i) less negative than the theoretical value determined in part (a)?

(iii) The equation for the evaporation of liquid methanol is:

$$CH_3OH(\ell) \rightarrow CH_3OH(g)$$

Explain the entropy changes of the system and surroundings for the evaporation of methanol.

ASSESSOR'S USE ONLY

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

91390