For Supervisor's use only

2

90310

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 2 Chemistry, 2005

90310 Describe thermochemical and equilibrium principles

Credits: Five
2.00 pm Wednesday 23 November 2005

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

A Periodic Table is provided on the RESOURCE SHEET in your Level 2 Chemistry package.

You should answer ALL the questions in this booklet.

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 2–9 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.

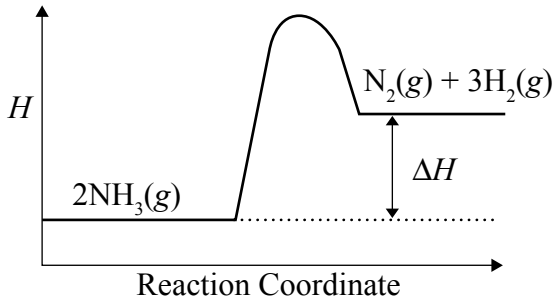
For Assessor's use only	**Achievement Criteria**	
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Describe thermochemical and equilibrium principles. ☐	Interpret information about thermochemical and equilibrium systems. ☐	Discuss information about thermochemical and equilibrium systems. ☐
Overall Level of Performance ☐		

You are advised to spend 55 minutes answering the questions in this booklet.

Assessor's use only

QUESTION ONE

State whether the following processes are endothermic or exothermic.

	Process	Endothermic or exothermic?
(a)	$C(s) + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -393 \text{ kJ mol}^{-1}$	
(b)	Formation of snow from water vapour.	
(c)		
(d)	When magnesium is added to hydrochloric acid a reaction occurs and the temperature of the reaction mixture increases.	

QUESTION TWO

Assessor's use only

(a) Complete the equilibrium constant expression for the following reaction.

(i) $Ag^+(aq) + 2NH_3(aq) \rightleftharpoons Ag(NH_3)_2^+(aq)$

$K_c =$

(ii) At 25°C the value of K_c is 1.70×10^7. **Circle** the species that would be present in the higher concentration in the equilibrium mixture at this temperature.

$Ag^+(aq)$ or **$Ag(NH_3)_2^+(aq)$**

Justify your choice.

(b) Complete the equilibrium constant expression for the following reaction.

(i) $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$

$K_c =$

(ii) At 200°C the value of K_c is 1.10×10^{-5}. **Circle** the species that would be present in the higher concentration in the equilibrium mixture at this temperature.

$NO_2(g)$ or **$NO(g)$**

Justify your choice.

QUESTION THREE

Assessor's use only

29.6 g of sodium hydroxide was dissolved in water and excess hydrochloric acid was added. Using the temperature increase and the heat capacity of water, it was calculated that 43.5 kJ of heat was released.

(a) Determine the enthalpy change, $\Delta_r H$, for the following reaction:

$$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

(b) What mass of sodium hydroxide is required to produce 150 kJ of energy?

QUESTION FOUR

Assessor's use only

The following reaction is exothermic:

$$2N_2O_5(g) \rightleftharpoons 4NO_2(g) + O_2(g)$$

Both N_2O_5 and O_2 are colourless gases and NO_2 is a brown gas.
A mixture of these gases exists at equilibrium and is observed as a brown colour.

(a) Complete the equilibrium constant expression for the reaction.

$K_c =$

(b) For each of the following changes applied to the equilibrium system, describe the expected observation and explain why this occurs.

(i) The mixture of gases is heated (at constant pressure).
Expected observation:

Explanation:

(ii) The pressure is increased, by decreasing the volume of the container.
Expected observation:

Explanation:

QUESTION FIVE

Assessor's use only

Hydrogen peroxide decomposes at room temperature (25°C) according to the following equation.

$$2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

As the decomposition reaction occurs, bubbles of gas are produced.

(a) On addition of a very small amount of solid manganese dioxide, the rate at which the bubbles of gas are produced is increased so that rapid fizzing is observed. Further observation indicates that manganese dioxide remains after reaction has stopped.

With reference to the collisions of particles, explain why the reaction rate has increased.

(b) Hydrogen peroxide is stored at a low temperature. Discuss this statement in terms of reaction rate.

QUESTION SIX

Assessor's use only

The concentration and pH of three acids, HA, HB and HC, are shown in the table below.

acid	concentration (mol L^{-1})	pH
HA	0.100	1.00
HB	0.100	2.50
HC	0.00100	3.00

(a) A small piece of magnesium is added to a 20 mL sample of each of the acids.

Circle the acid that would be expected to react most rapidly with the magnesium.

acid HA **acid HB** **acid HC**

Explain why this acid will react the fastest.

(b) Circle the weakest acid.

acid HA **acid HB** **acid HC**

Explain why this acid is the weakest.

QUESTION SEVEN

Assessor's use only

Complete the following table showing hydronium ion concentration, hydroxide ion concentration and pH for some solutions. $K_w = 1.00 \times 10^{-14}$

Solution	$[H_3O^+]$	$[OH^-]$	pH
1	0.0350		
2			10.8
3		5.66×10^{-6}	

QUESTION EIGHT

A solution of sodium ethanoate ($NaCH_3COO$) is tested and found to have a pH of 8.50.

Discuss why the pH of the solution is greater than 7.
Include appropriate equation(s) in your answer.

Extra paper for continuation of answers if required.
Clearly number the question.

Assessor's use only

Question number	