



For Supervisor's use only

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90310



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA



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

Level 2 Chemistry, 2003

90310 Describe principles of chemical reactivity

Credits: Four

2.00 pm Monday 24 November 2003

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 printed on page 2 of this booklet.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the pages 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.

Achievement Criteria			For Assessor's use only	
Achievement		Achievement with Merit		Achievement with Excellence
Describe and use thermochemical and equilibrium information.	<input type="checkbox"/>	Interpret information about thermochemical and equilibrium systems.	<input type="checkbox"/>	Evaluate and explain information about thermochemical and equilibrium systems.
Overall Level of Performance			<input type="checkbox"/>	

PERIODIC TABLE OF THE ELEMENTS

18

		Atomic Number																Atomic Mass	
1	2																		
3 Li 6.9	4 Be 9.0																	2 He 4.0	
11 Na 23.0	12 Mg 24.3																	10 Ne 20.2	
19 K 39.1	20 Ca 40.1	3 Sc 45.0	4 Ti 47.9	5 V 50.9	6 Cr 52.0	7 Mn 54.9	8 Fe 55.9	9 Co 58.9	10 Ni 58.7	11 Cu 63.5	12 Zn 65.4	13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 40.0		
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131		
55 Cs 133	56 Ba 137	71 Lu 175	72 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po 210	85 At 210	86 Rn 222		
87 Fr 223	88 Ra 226	103 Lr 262	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt											

Lanthanide Series														57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 147	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173
Actinide Series														89 Ac 227	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu 239	95 Am 241	96 Cm 247	97 Bk 249	98 Cf 251	99 Es 254	100 Fm 257	101 Md 258	102 No 255

You are advised to spend 45 minutes answering the questions in this booklet.

Assessor's
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QUESTION ONE

A 1 g lump of calcium carbonate was added to a 250 mL beaker containing 100 mL of 1.0 mol L^{-1} hydrochloric acid solution, at room temperature (25°C). Bubbles of carbon dioxide were produced.

The experiment was repeated under different conditions, as given below.

- (a) For EACH change, describe how the **reaction rate** would be affected. Use the words 'increase', 'decrease' or 'remain the same' in each answer.

Change 1

The temperature of the reaction mixture was increased to 40°C .

Effect: _____

Change 2

100 mL of water was added to the acid. 100 mL of this diluted acid solution was added to a 1 g lump of calcium carbonate.

Effect: _____

Change 3

The 1 g lump of calcium carbonate was ground to form a powder, and then 100 mL of the 1.0 mol L^{-1} hydrochloric acid was added.

Effect: _____

Change 4

A 500 mL beaker was used instead of the 250 mL beaker, but the same amounts of reactants were used.

Effect: _____

- (b) Explain the effect on the reaction rate for **Change 1** and **Change 2** above by referring to the collisions of particles.

Change 1: _____

Change 2: _____

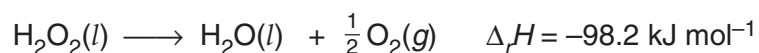
QUESTION TWO

Classify EACH of the following processes as **either** endothermic **or** exothermic.

	Process	endothermic or exothermic
(a)	$\text{H}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{H}_2\text{O}(\text{g}) \quad \Delta_r H = -286 \text{ kJ mol}^{-1}$	
(b)	Photosynthesis – food-making process in plants	
(c)	Freezing of water	
(d)	Dissolving sodium hydroxide in water (the temperature increases)	
(e)	Sublimation of solid carbon dioxide to carbon dioxide gas	

QUESTION THREE

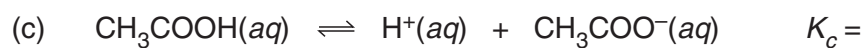
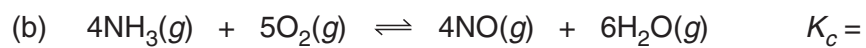
Hydrogen peroxide, a common bleaching agent, decomposes as follows:



- (a) Calculate how much energy is released when 5 moles of hydrogen peroxide decompose.
- (b) Calculate how much energy is released when 1.0 g of oxygen is formed by the decomposition of hydrogen peroxide.
- (c) Calculate the mass of hydrogen peroxide that must decompose to produce 600 kJ of energy.

QUESTION FOURAssessor's
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Write the equilibrium constant expression for EACH of the following reactions:



QUESTION FIVEAssessor's
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Two oxides of nitrogen exist in the following equilibrium system:



- (a) Which oxide would you expect to be present in the greater concentration at equilibrium?

(Circle your answer.) **NO₂** or **N₂O₄**

- (b) Justify your answer to (a) above.

- (c) NO₂ is a brown gas and N₂O₄ is a colourless gas.

What would you expect to observe when the following changes are applied to the equilibrium system? In EACH case, justify your observation.

- (i) The temperature is increased to 500°C (without changing the pressure).

Observation: _____

Explanation: _____

- (ii) More NO₂ gas is added to the system.

Observation: _____

Explanation: _____

QUESTION SIXAssessor's
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The pH of a 0.10 mol L^{-1} solution of acid **HX** and the pH of a 0.10 mol L^{-1} solution of acid **HY** are measured. The pH of acid **HX** is 3 and the pH of acid **HY** is 1.

- (a) Which of the two acids, **HX** or **HY**, is the stronger acid?

(Circle your answer.) **HX** or **HY**

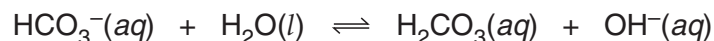
- (b) Justify your answer to (a) in terms of the measured pH.

- (c) Describe **another** test that could be carried out to confirm that the acid you selected in (a) above is the stronger of the two.

Describe what you would do and what you would expect to observe.

QUESTION SEVENAssessor's
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$\text{HCO}_3^-(aq)$ is a species that may act as an acid or a base. Consider the equilibrium system:



(a) Is $\text{HCO}_3^-(aq)$ acting as an acid or a base?

(Circle your answer.)

ACID

or

BASE

(b) Justify your answer to (a) above.

QUESTION EIGHT

A sample of solid ammonium chloride, NH_4Cl , is dissolved in water. The solution formed is tested and is found to be acidic.

Explain why the solution is acidic. Include appropriate equation(s) in your answer.

QUESTION NINEAssessor's
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Complete the following table by showing the:

- hydronium ion concentration for both solution **A** and solution **B**
- hydroxide ion concentration for solution **B**
- pH of solution **A**.

$$K_w = [\text{H}_3\text{O}^+] [\text{OH}^-] = 1.00 \times 10^{-14}$$

Solution	$[\text{H}_3\text{O}^+] / \text{mol L}^{-1}$	$[\text{OH}^-] / \text{mol L}^{-1}$	pH
A		0.0288	
B			5.24

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

*Assessor's
use only*

Question
Number

[illegible]

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

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