

91166



911660


 NEW ZEALAND QUALIFICATIONS AUTHORITY  
 MANA TOHU MĀTAURANGA O AOTEAROA

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## Level 2 Chemistry, 2014

### 91166 Demonstrate understanding of chemical reactivity

2.00 pm Tuesday 11 November 2014

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of chemical reactivity.	Demonstrate in-depth understanding of chemical reactivity.	Demonstrate comprehensive understanding of chemical reactivity.

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 2–10 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

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## QUESTION ONE

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(a) Ammonia,  $\text{NH}_3$ , is dissolved in water and the resulting solution has a pH of 11.3.

(i) Complete the equation by writing the formulae of the two products.



(ii) Explain what is occurring during this reaction.

In your answer you should:

- identify the acid and its conjugate base
- identify the base and its conjugate acid
- describe the proton transfer that occurs.

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(b) (i) In a solution of potassium hydroxide, KOH, the pH is found to be 12.8.

Calculate the hydronium ion concentration,  $[\text{H}_3\text{O}^+]$ , and the hydroxide ion concentration,  $[\text{OH}^-]$ , in the solution.

$[\text{H}_3\text{O}^+] =$  \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

$[\text{OH}^-] =$  \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (ii) Calculate the pH of a  $2.25 \times 10^{-4} \text{ mol L}^{-1}$  sodium hydroxide, NaOH, solution.

pH = \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- (c) The table below shows the relative electrical conductivity of five solutions of the **same concentration**, and the colour of pieces of litmus paper which have been dipped into each solution.

Solution	A	B	C	D	E
Electrical conductivity	poor	good	good	poor	good
Red litmus paper	turns blue	stays red	stays red	stays red	turns blue
Blue litmus paper	stays blue	turns red	stays blue	turns red	stays blue

Identify a strong base and a neutral salt, using the information in the table above.

In your answer you should justify your choices by referring to the properties of the identified solutions.

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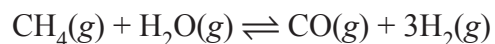
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## QUESTION TWO

Hydrogen can be produced industrially by reacting methane with water. An equation for this reaction can be represented by:



$$K_c = 4.7 \text{ at } 1127^\circ\text{C}$$

- (a) (i) Complete the equilibrium constant expression for this reaction:

$K_c =$

- (ii) The concentrations of the four gases in a reaction mixture at  $1127^\circ\text{C}$  are found to be:

Gas	$\text{CH}_4$	$\text{H}_2\text{O}$	$\text{CO}$	$\text{H}_2$
Concentration/ $\text{mol L}^{-1}$	0.0300	0.0500	0.200	0.300

Use these values to carry out a calculation to determine if the reaction is at equilibrium.

Mixture at equilibrium?      **Yes**                      **No**      (circle correct option)

Calculation:

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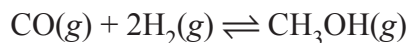
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- (b) The reaction shown in the equation below is at equilibrium.



Describe the effect of each of the following changes on the equilibrium concentration of methanol (increase, decrease, stay the same).

Justify your answers using equilibrium principles.

*A copper oxide, CuO, catalyst is added.*

Amount of  $\text{CH}_3\text{OH(g)}$  would:      **increase**      OR      **decrease**      OR      **stay the same**  
(circle correct answer)

Reason:

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*$\text{H}_2\text{(g)}$  is removed.*

Amount of  $\text{CH}_3\text{OH(g)}$  would:      **increase**      OR      **decrease**      OR      **stay the same**  
(circle correct answer)

Reason:

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- The equation for this reaction is represented by:



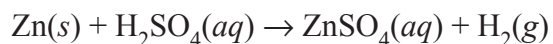
Analyse these experimental observations.

In your answer you should:

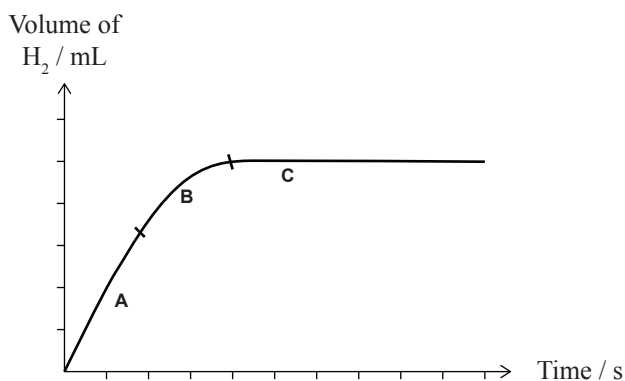
- link all of the observations to equilibrium principles
- justify whether the formation of dinitrogen tetroxide from nitrogen dioxide is endothermic or exothermic.

**QUESTION THREE**ASSESSOR'S  
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- (a) The equation for the reaction between zinc granules (lumps),  $\text{Zn}(s)$ , and sulfuric acid,  $\text{H}_2\text{SO}_4(aq)$ , is represented by:



The graph below shows how the volume of hydrogen gas produced changes with time, when zinc is reacted with excess sulfuric acid at  $20^\circ\text{C}$ .



Explain the changes in the reaction rate during the periods **A**, **B** and **C**.

In your answer you should refer to collision theory.

**A:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**B:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**C:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

- (b) The rate of the reaction between zinc and sulfuric acid can be changed by the addition of small pieces of copper,  $\text{Cu}(s)$ , as a catalyst.

Explain the role of the copper catalyst in the reaction between zinc and sulfuric acid.

In your answer you should refer to collision theory.

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- (c) The pH values of  $0.100 \text{ mol L}^{-1}$  solutions of two acids, HA and HB, are given in the table below.

Solution	pH
$0.100 \text{ mol L}^{-1} \text{ HA}(aq)$	1.0
$0.100 \text{ mol L}^{-1} \text{ HB}(aq)$	2.2

- (i) Compare the relative strengths of the two acids,  $\text{HA}(aq)$  and  $\text{HB}(aq)$ , using the information given above.

Your answer should include equations and calculations.

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- (ii) Predict and compare, with reasons, what would be observed when two 5 g samples of calcium carbonate chips,  $\text{CaCO}_3(s)$ , are reacted, separately, with excess HA and HB.

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

QUESTION  
NUMBER

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