2

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91166



Level 2 Chemistry, 2013

91166 Demonstrate understanding of chemical reactivity

9.30 am Tuesday 19 November 2013 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 2–12 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

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The examination begins on the following page.

You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE

(i)

(a) Hydrochloric acid was reacted with calcium carbonate in the form of marble chips (lumps) and powder (crushed marble chips) in an experiment to investigate factors affecting the rate of a chemical reaction.

Marble chips (lumps)

Crushed marble chips (powder)

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https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcT ZD8kay1SBm9N6sSYimAnkGYxFM7nPts1o9WEAyR5gi wILW38O

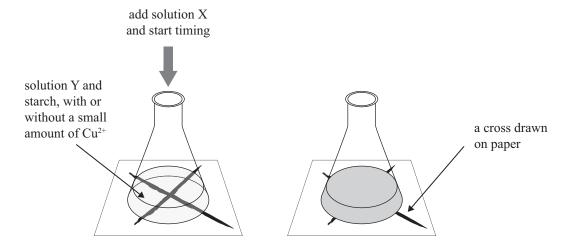
Identify the factor being investigated

http://hoangnhat.en.ecplaza.net/ground-calcium-carbonate-powder--333617-2615449.html

2 1 1 1 1 1	. 1 11 .	.1 11		41 1	
Explain why the l	hydrochloric a	cid would rea	ct faster with	the powder.	

(b) A *clock reaction* involves mixing solution X and solution Y with starch present. When the reaction is complete the solution turns blue-black in colour.

A student carried out this reaction between solution X and solution Y in a conical flask. Over time, the cross on the piece of paper under the flask disappeared when viewed from above.



The following experiments were carried out, and the times taken for the cross to disappear recorded.

Experiment		Temperature/°C	Time for cross to disappear/s
1	No Cu ²⁺ present	25	42
2	No Cu ²⁺ present	50	23
3	Cu ²⁺ present	25	5

Elaborate on why the reactions in **Experiment 2** and **Experiment 3** occur faster than the reaction in **Experiment 1**.

In your answer, include the following words or terms.

collisions	activation energy	temperature	effective	catalyst	

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QUESTION TWO

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(a) Ammonia gas, $NH_3(g)$, is formed from hydrogen gas and nitrogen gas, as shown in the following equation.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Complete the equilibrium constant expression for this reaction.

$$K_{\rm c} =$$

(b) The K_c for a different reaction is

$$K_{c} = \frac{[SO_{3}(g)]^{2}}{[SO_{2}(g)]^{2}[O_{2}(g)]}$$

Write the chemical equation that corresponds to this expression in the box below.

\rightleftharpoons	

(c) The two reactions shown in the following table are both at equilibrium.

Reaction	Equation	Affected by increased pressure
One	$H_2(g) + I_2(g) \implies 2HI(g)$	no
Two	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	yes

Compare and contrast the effect of increasing the pressure on both reactions, with reference to the equilibrium positions.

(d)

r Reaction Two $N_2(g) + 3H_2$			es of $K_{\rm c}$ at	different t	emperature	s are show	n below.
Temperature	227°C	327°C	427°C	527°C			
$K_{\rm c}$	90	3	0.3	0.04			
					$H_3(g)$ is end	Notife the Control of	or exothermic.
					H ₃ (g) is end	Notife the Control of	or exothermic.
					H ₃ (g) is end		or exothermic.
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					H ₃ (g) is end		or exothermic.
					H ₃ (g) is end		or exothermic.
stify your reason					H ₃ (g) is end		or exothermic.

Calculate the concent	tration of HI(g), at equi	librium, at 491°C, if t	he concentration of $H_2(g)$	is	
Calculate the concentration of $HI(g)$, at equilibrium, at 491°C, if the concentration of $H_2(g)$ is 0.0190 mol L^{-1} and the concentration of $I_2(g)$ is 0.210 mol L^{-1} .					

(a) The table below shows two acids with their conjugate base.

Acid	Conjugate base
HC1	Cl ⁻
HSO ₄	SO ₄ ²⁻

Explain the relationship between an acid and its conjugate base using one example from the table above.

(b)	In a solution of nitric acid	HNO ₂ , the concentration	of H_3O^+ ions is 0.0125 mol L^{-1} .
(-)		,	

Determine the concentration of hydroxide ions, OH⁻, and the pH of this solution.

$$[OH^{-}] =$$

$$pH =$$

- (c) A solution of ethanoic acid, CH₃COOH, is found to be acidic.
 - (i) Complete the equation for the reaction of ethanoic acid with water.

$$CH_3COOH + H_2O \rightleftharpoons$$

(ii) Explain why the solution is acidic.

(d) The following table shows the concentration and pH of three acids, and the relative rate of reaction with magnesium (Mg) metal.

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Acid	Concentration/mol L-1	рН	Relative rate of reaction with Mg
НА	0.100	3.4	slow
НВ	0.0100	2	fast
НС	1.00×10^{-5}	5	very slow

Explain the difference between a strong acid and a weak acid.			
Compare and contrast the reactivity of the three acids with magnesium. In your answer:			
•	determine the concentration of hydronium ions, H ₃ O ⁺ , in each acid		
•	compare the concentration of hydronium ions to the concentration of the acid		
•	explain the relative rate of reaction for each acid with magnesium by referring the information in the table above.		

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