

# Reactions of Acids

## Question Paper 1

Level	GCSE (9-1)
Subject	Combined Science: Trilogy - Chemistry
Exam Board	AQA
Topic	5.4 Chemical Changes
Sub-Topic	Reactions of Acids
Difficulty Level	Gold Level
Booklet	Question Paper 1

Time Allowed: 60 minutes

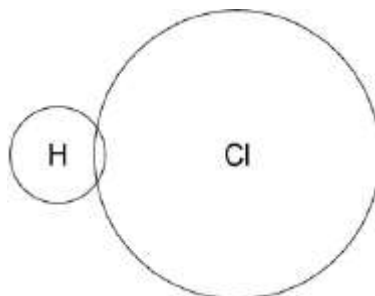
Score: /57

Percentage: /100

Grade Boundaries:

**Q1.**Hydrogen chloride (HCl) is a gas.

- (a) Complete the diagram to show all of the arrangement of the outer shell electrons of the hydrogen and chlorine atoms in hydrogen chloride.



(1)

- (b) Hydrochloric acid is a strong acid.  
Ethanoic acid is a weak acid.

Describe a reaction that could be used to show the difference between a weak acid and a strong acid.

You should explain why the weak acid and the strong acid give different results.

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(6)  
(Total 7 marks)

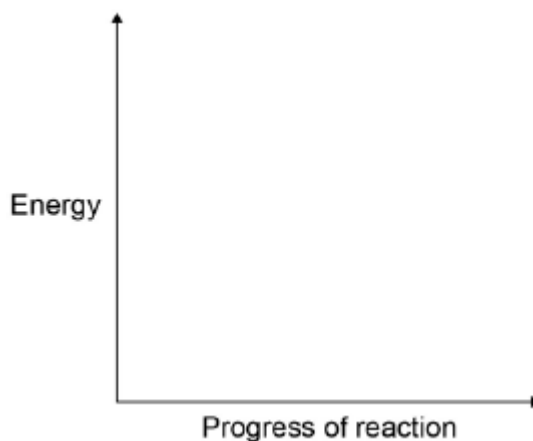
**Q2.**Exothermic reactions transfer energy to the surroundings.

- (a) Draw a reaction profile for an exothermic reaction using the axes in **Figure 1**.

Show the:

- relative energies of the reactants and products
- activation energy and overall energy change.

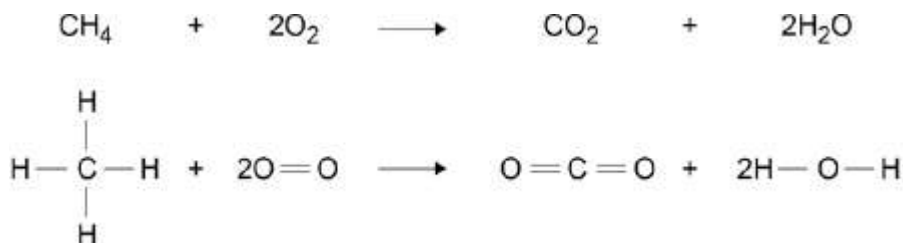
**Figure 1**



(2)

- (b) Combustion is an exothermic reaction.

Calculate the overall energy change for the complete combustion of one mole of methane in oxygen.



Bond	Bond energy in kJ / mol
C — H	413
O = O	498
C = O	805
O — H	464

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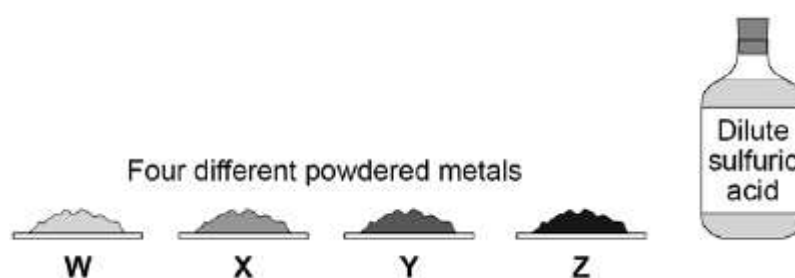
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Overall energy change = ..... kJ / mol

(3)

- (c) **Figure 2** shows the chemicals given to a student.

**Figure 2**



The student wants to investigate the reactivity of the four metals.

Outline a plan the student could use to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The plan should use the fact that all four metals react exothermically with dilute sulfuric acid.

You should name the apparatus used and comment on the safe use of the chemicals.

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(6)

- (d) Another student used displacement reactions to investigate the relative reactivity of the four metals, **W**, **X**, **Y** and **Z**.

The table below shows the student's results.

Solution	Observations			
	Metal W	Metal X	Metal Y	Metal Z
Copper nitrate	Brown layer formed on metal	Brown layer formed on metal	Brown layer formed on metal	No change
Magnesium sulfate	No change	No change	No change	No change
Sulfuric acid	Gas bubbles produced	Few gas bubbles produced	Gas bubbles produced	No change
Zinc chloride	Grey layer formed on metal	No change	No change	No change

Give the order of reactivity of metals, **W**, **X**, **Y** and **Z**.

Use the results in the table above to justify your answer.

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(3)

- (e) The student concluded that these results could also be used to justify the order of reactivity of copper, magnesium, hydrogen and zinc.

The student is **not completely** correct. Use the results in the table above to explain why.

Suggest one further experiment that would provide evidence for the student's conclusion.

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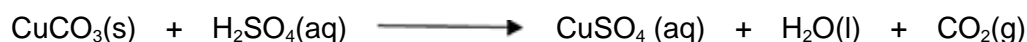
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(4)  
(Total 18 marks)

**Q3.** The salt copper sulfate can be made by reacting copper carbonate with dilute sulfuric acid.



- (a) Write a method that a student could use to prepare a pure, dry sample of copper

You do **not** need to write a risk assessment or include safety points.

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(6)

- (b) Calculate the **number of molecules** in 14 g of carbon dioxide.

Give your answer in standard form.

Relative atomic masses ( $A_r$ ): C = 14; O = 16

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Answer = ..... molecules

(4)  
(Total 10 marks)

**Q4.** This question is about compounds.

- (a) The table gives information about the solubility of some compounds.

Soluble compounds
All potassium and sodium salts
All nitrates
Chlorides, bromides and iodides, except those of silver and lead

Use information from the table to answer these questions.

- (i) Name a soluble compound that contains silver ions.

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(1)

- (ii) Name a soluble compound that contains carbonate ions.

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(1)

- (b) Metal oxides react with acids to make salts.

What type of compound is a metal oxide?

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(1)

(c) Lead nitrate solution is produced by reacting lead oxide with nitric acid.

(i) State how solid lead nitrate can be obtained from lead nitrate solution.

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(1)

(ii) Balance the equation for the reaction.



(1)

(iii) Give the total number of atoms in the formula  $\text{Pb}(\text{NO}_3)_2$

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(1)

(d) An oxide of lead that does **not** have the formula PbO contains 6.21 g of lead and 0.72 g of oxygen.

Calculate the empirical formula of this lead oxide.

Relative atomic masses ( $A_r$ ): O = 16; Pb = 207

You must show your working to gain full marks.

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Empirical formula = .....

(4)

(Total 10 marks)



**Q5.** Sulfur is a non-metal.

Sulfur burns in the air to produce sulfur dioxide,  $\text{SO}_2$

(a) Why is it important that sulfur dioxide is **not** released into the atmosphere?

Tick (✓) **one** box.

Sulfur dioxide causes acid rain.

☐

Sulfur dioxide causes global dimming.

☐

Sulfur dioxide causes global warming.

☐

(1)

(b) Sulfur dioxide dissolves in water.

What colour is universal indicator in a solution of sulfur dioxide?  
Give a reason for your answer.

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(2)

(c) Sulfur dioxide is a gas at room temperature.

The bonding in sulfur dioxide is covalent.

Explain, in terms of its structure and bonding, why sulfur dioxide has a low boiling point.

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(3)

- (d) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

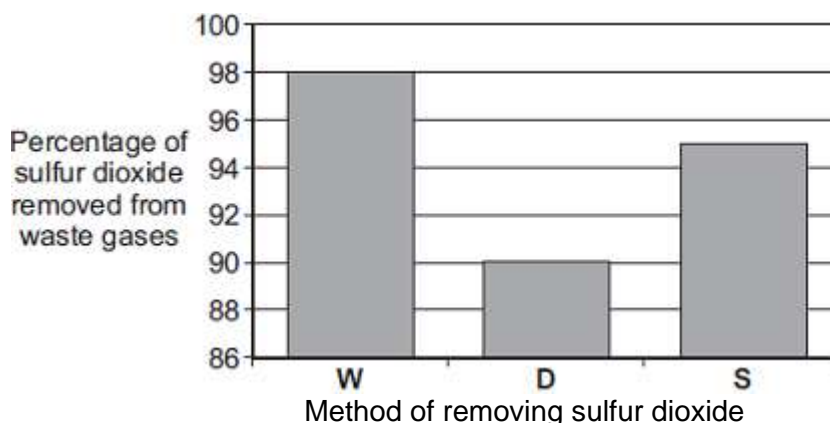
Sulfur dioxide is produced when fossil fuels are burned.

It is important that sulfur dioxide is not released into the atmosphere.

Three of the methods used to remove sulfur dioxide from gases produced when fossil fuels are burned are:

- wet gas desulfurisation (**W**)
- dry gas desulfurisation (**D**)
- seawater gas desulfurisation (**S**).

Information about the three methods is given in the bar chart and in **Table 1** and **Table 2**.



**Table 1**

Method	Material used	How material is obtained
<b>W</b>	Calcium carbonate, $\text{CaCO}_3$	Quarrying
<b>D</b>	Calcium oxide, $\text{CaO}$	Thermal decomposition of calcium carbonate: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
<b>S</b>	Seawater	From the sea

Method	What is done with waste material
<b>W</b>	Solid waste is sold for use in buildings. Carbon dioxide is released into the atmosphere.
<b>D</b>	Solid waste is sent to landfill.
<b>S</b>	Liquid waste is returned to the sea.

Compare the three methods and give a justified conclusion.

[illegible]

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