GRAYS TUITION CENTRE – Online Tutoring

WEEK: 16

Week Beginning: (6/07/20)

Subject: SCIENCE

Year: 7

Lesson Objective:

- Reactivity series.
- Reaction of metals with acids.

Keywords/ Concepts

- Extraction
- Ores
- Acid

Class Questions

Homework

- Any worksheets that are not completed in lesson.

Additional Notes

- Answers to homework week 15 can be found below.

Answers

Pages 113-114 — Acids and Alkalis

Q1 Apple — acid
Orange — acid
Lemonade — acid
Bleach — alkali
Water — neutral
Washing powder — alkali

Q2

pH Scale

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	i)			ii)			iii)			v)				iv)

Q3

Useful Substance	pH value	Colour with Universal Indicator	Acid, Alkaline or Neutral
a) Hydrochloric acid in stomach	pH1	red	strong acid
b) Rain water	pH6	yellow	weak acid
c) Sodium hydroxide	pH13	purple	strong alkali
d) Tap water	pH7	green	neutral
e) Washing up liquid	pH8	blue	weak alkali

Q4 **a) i)** E.g. litmus
ii) E.g. red (answer will depend on answer to **a)i)**)
iii) E.g. blue (answer will depend on answer to **a)i)**)
b) Universal indicator gives you the strength/pH of the acid or alkali.

Q5 **a)** Take a small sample of the acid and alkali and test them separately with a few drops of the indicator.
b) i) acidic
ii) green

Pages 115-117 — Neutralisation Reactions

Q1 **a)** neutralisation
b) pH 7
c) i) Sodium hydroxide + **sulfuric acid** → sodium sulfate + water
ii) Sodium hydroxide + **nitric acid** → sodium nitrate + water
iii) Calcium hydroxide + **hydrochloric acid** → calcium chloride + water
iv) Calcium hydroxide + **sulfuric acid** → calcium sulfate + water

Q2 Salts are prepared by the **neutralisation** of an **acid/alkali** and an **acid/alkali**. This also gives **water**. To make sure the acid and alkali are added in the right amounts an **indicator** is used to test the solution. **Universal indicator** is a good indicator to use. It goes **green** in a neutral solution. The type of acid used will give a particular salt. For example **sulfuric acid** will give a sulfate, hydrochloric acid will give a **chloride** and nitric acid will give a **nitrate**. All these are types of salts.

Q3 **a)** If a pure sample of salt is to be produced, then the right amounts of acid and alkali must be used. The right amounts will have been mixed when the alkali becomes neutralised by the added acid.
b) E.g. universal indicator
c) You do not want the salt crystals to be coloured by the indicator.
d) E.g. wear eye protection.
e) sodium chloride

Q4 **a)** potassium chloride
b) i) Water from the solution is evaporated, leaving behind a more concentrated salt solution.
ii) A solution in which no more salt can be dissolved.
c) i) smaller, bigger
ii) E.g. heat the salt solution using the Bunsen burner until all the water from the solution has evaporated. / Leave the salt solution in a warmer room.

Pages 118-119 — Reactivity Series and Metal Extraction

Q1 potassium, magnesium, aluminium, zinc, iron, copper

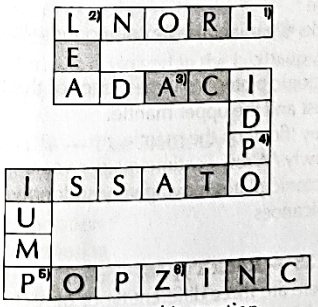
Q2 **a)** lead — reduced by carbon
potassium — electrolysis
gold — very unreactive, found on its own
magnesium — electrolysis
b) E.g. lead can be extracted using carbon because it is less reactive than carbon. Gold is much less reactive than carbon — it is an unreactive metal and doesn't need to be extracted. Magnesium and potassium are more reactive than carbon, so they can't be extracted by reduction with carbon — electrolysis is used instead.

Q3 C

Q4 **a)** Rocks containing different metals and metal compounds (usually metal oxides).
b) carbon + iron oxide → iron + carbon dioxide
c) Aluminium is higher than carbon in the reactivity series / is more reactive than carbon.
d) electrolysis

Pages 120-123 — Reactions of Metals with Acids

Q1



The mystery word is reaction.

Q2 **a)**

Metal	Observations of reaction	Sound made by a lit splint above reaction
Zinc	Bubbled slightly	Squeaky pop
Magnesium	Bubbled vigorously	Big squeaky pop
Iron	Bubbled slightly	Squeaky pop
Copper	No reaction	No sound

Classwork

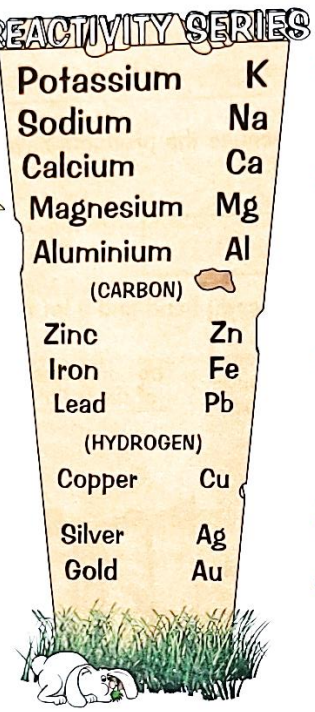
Reactivity Series and Metal Extraction

You need to know which metals are most reactive — and which are least reactive.

The Reactivity Series — How Well a Metal Reacts

The Reactivity Series lists metals in order of their reactivity towards other substances.

Make sure you learn this list:



Very Reactive

Fairly Reactive

Not Very Reactive

Not At All Reactive

Carbon and hydrogen are non-metals, but it's useful to know where they are in the reactivity series (see below and p.55).

Some Metals Can Be Extracted With Carbon

1) Metals are usually mined as ores — rocks containing different metals and metal compounds (usually metal oxides — see page 56).
2) A metal can be extracted from its ore by reduction using carbon. When an ore is reduced, oxygen is removed from it.
E.g. the oxygen is removed from iron oxide to extract the iron:

iron oxide + carbon → iron + carbon dioxide

3) Only metals that are less reactive than carbon (i.e. metals below carbon in the reactivity series) can be extracted from their ore using carbon.
4) Metals that are more reactive than carbon need to be extracted using electrolysis (where electrical energy splits up the ore into the elements that make it up).
5) Some metals, like silver and gold, are pretty unreactive, so they're often found in their pure form.

Potassium
Sodium
Calcium
Magnesium
Aluminium
—CARBON—
Zinc
Iron
Lead
Copper
Silver
Gold

Reaction of Metals with Acids

One more page on metals to test your mettle — it's not so bad though, I promise. You don't need to know about each individual reaction, just how the reactivity of each metal affects it. Simple, no?

Reacting Metals With Dilute Acid

metal + acid → salt + hydrogen

All acids contain hydrogen — so the hydrogen here comes from the acid.

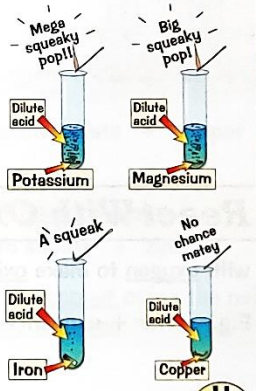
1) Metals above hydrogen in the reactivity series (see page 54) will react with acids to make a salt and hydrogen.
2) The metals below hydrogen in the reactivity series don't react with acids.
3) The reaction becomes less and less exciting as you go down the series.

More Reactive Metals React More Violently

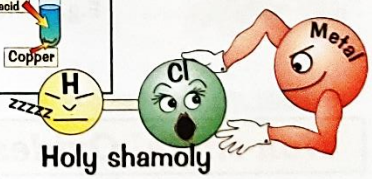
Reaction with Dilute Acids — Results

If you hold a lit splint to the test tube and hear a squeaky pop, it shows you've got yourself some hydrogen.

Potassium, Sodium, Calcium	React violently with dilute acids.
Magnesium, Aluminium, Zinc, Iron, Lead	React fairly well with dilute acids.
Copper, Silver, Gold	Don't react with dilute acids.



The lower the reactivity, the less likely it is for the reaction to happen.



EXAMPLES:

a) zinc + sulfuric acid → zinc sulfate + hydrogen

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

The zinc takes the place of the hydrogen in the acid because it's more reactive than the hydrogen.

b) sodium + hydrochloric acid → sodium chloride + hydrogen

$2Na + 2HCl \rightarrow 2NaCl + H_2$

The sodium takes the place of the hydrogen in the acid — again because it's more reactive than the hydrogen.

Reactivity Series and Metal Extraction

Before you can tackle questions on the reactions of metals, you need to know about the **reactivity series**. The important fact you must learn is:

"A more reactive metal will displace a less reactive metal from its compound."

Metals that are **higher** in the reactivity series will **displace** or replace metals that are **lower** in the reactivity series. The reactivity series is simply a list of metals in **order of reactivity**. So if you don't know the reactivity series you don't stand a chance...

Q1 Put the following metals in the order of the reactivity series, starting with the **most reactive**.

Magnesium, Iron, Potassium, Copper, Aluminium, Zinc

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Q2 How easy or how hard it is to **extract** a metal from its ore depends on how reactive it is.

a) Draw lines to match up the following metals to their **method of extraction**.

lead	very unreactive, found on its own
gold	electrolysis
potassium	reduced by carbon
magnesium	electrolysis

b) Explain your choices. Refer to the reactivity of each metal compared to **carbon**.

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Reactivity Series and Metal Extraction

Q3 Explain why **silver** is found in the ground on its own but **calcium** is combined with other substances by selecting the correct answer A → D.

A Silver is very reactive and so is calcium.

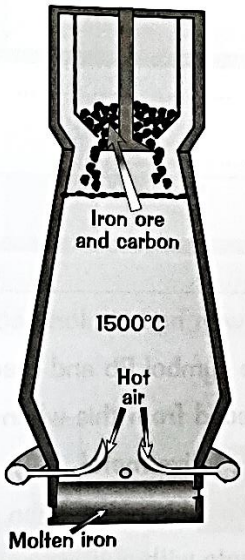
B Silver is very unreactive and so is calcium.

C Silver is very unreactive and calcium is quite reactive.

D Silver is very reactive and calcium is quite unreactive.

Answer = ☐

Q4 Iron is found in the ground as **iron ore**. Iron is **extracted** from its ore in a large piece of industrial apparatus called a **blast furnace**.



a) What are **ores**?

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b) Iron ore is mostly made up of **iron oxide**. Complete the equation below showing how carbon and iron ore react. (Words to use: carbon, iron, dioxide, carbon.)

..... + iron oxide → ..... + ...

c) Why can't aluminium be extracted from its ore using a blast furnace?

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d) What method would you use to extract aluminium from its ore?

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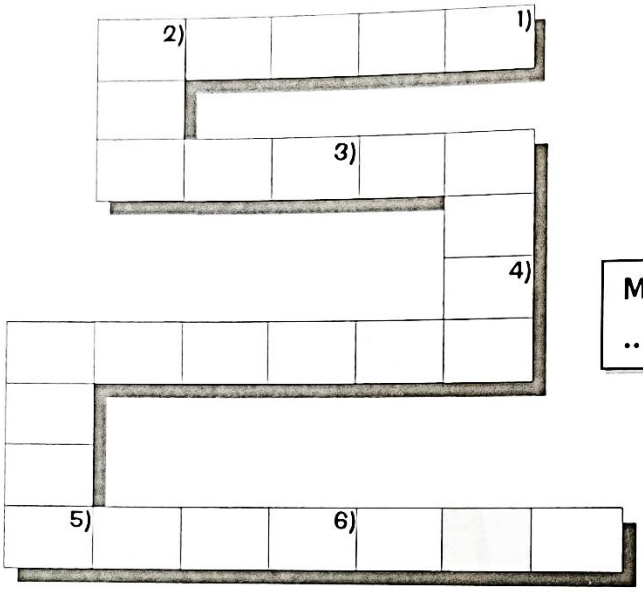
Reactions of Metals with Acids

Q1 Fill in the spaces with the clues and find the mystery word.
The letters that make up this word are in the coloured boxes.



Mystery Word:
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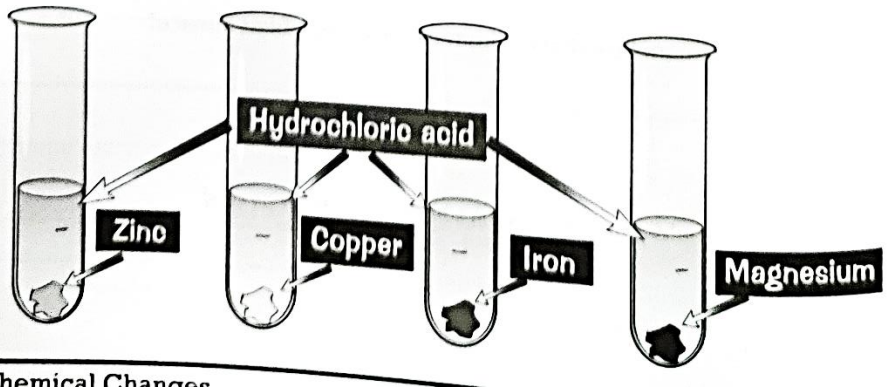
1. Reacts fairly well with hydrochloric acid to make iron chloride. (4)
2. This metal has the symbol Pb and reacts fairly well with acids. (4)
3. Hydrogen is displaced from this when you add a reactive metal. (4)
4. A very very very reactive metal. (9)
5. Hydrogen gas makes this noise when ignited. (3)
6. The metal that reacts with sulfuric acid to give zinc sulfate. (4)

Q2 A student set up four test tubes as shown below and observed the reactions that happened. She also held a lit splint over each test tube, and recorded some of the things she saw and heard in the table on the next page.



Section 6 — Chemical Changes

Reactions of Metals with Acids

a) Complete the table by filling in what she should have observed.

Metal	Observations of reaction	Sound made by a lit splint above reaction
Zinc		Squeaky pop
Magnesium	Bubbled vigorously	
Iron	Bubbled slightly	
Copper		No sound

b) Which gas causes the squeaky pop? Where does this gas come from?

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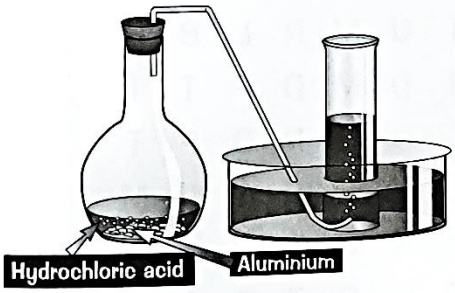
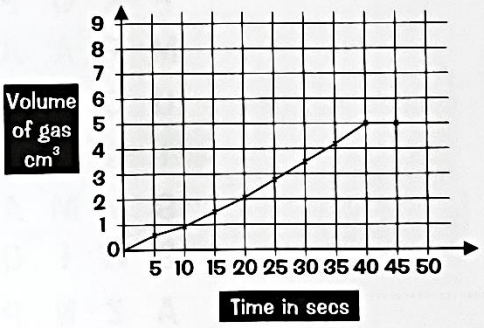
Q3 Joshua put some **aluminium** in a flask with some **hydrochloric acid**. He collected the gas given off as shown in the diagram.





a) He recorded the total volume of gas given off at regular intervals and plotted the results on a graph. What **volume** of gas had been given off after:

i) 15 seconds? .....

ii) 30 seconds? .....

b) Would the reaction be more or less violent if **calcium** metal was used instead of aluminium? Explain your answer.

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Reactions of Metals with Acids

Q4 Damian's teacher reacted **potassium** with **hydrochloric acid**. Damian knew that if they reacted they would make **potassium chloride** and hydrogen gas, but he didn't know how violently they would react.

a) Would potassium and hydrochloric acid react violently, fairly well or not at all?

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b) What would Damian hear if the hydrogen gas was ignited?

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c) Complete this equation to show the reaction. Don't forget to balance the equation.

$2K + 2HCl \rightarrow$ ..... + ...

Q5 In this word search you will find **seven** metals that react with an acid to give a salt and hydrogen. Find the words and then put them in order of how **violently** they react with acid. Start with the **most reactive**.

F	R	Q	P	F	M	U	I	D	O	S
M	F	A	A	I	U	M	R	L	B	B
U	Q	L	A	J	D	M	O	F	T	I
I	S	U	J	O	S	N	N	D	F	T
S	V	M	A	G	N	E	S	I	U	M
S	W	I	Q	F	R	F	I	U	M	L
A	Z	N	P	T	O	S	T	P	A	N
T	Z	I	N	C	F	R	V	T	B	C
O	A	U	O	M	U	I	C	L	A	C
P	M	M	T	S	S	A	T	T	O	B

Reactions of Metals with Acids

Q6 Complete the chemical equations below by drawing lines between the correct **products** and **reactants**.

a) Potassium + sulfuric acid →

b) Sodium + hydrochloric acid →

c) Iron + sulfuric acid →

d) Copper + hydrochloric acid →

e) Magnesium + sulfuric acid →

Iron sulfate + hydrogen

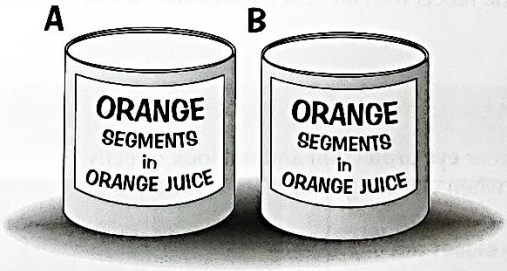
Sodium chloride + hydrogen

No reaction — metal too unreactive

Magnesium sulfate + hydrogen

Potassium sulfate + hydrogen

Q7 A food company is trying to decide which metal to make food cans from.
They made two cans and filled them with orange segments in orange juice
Can A was made of **copper** and Can B was made of **zinc**. Orange juice is about **pH 4.**



Which can should they use, **A** or **B**? Explain your answer.

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