

## THEME

# 2

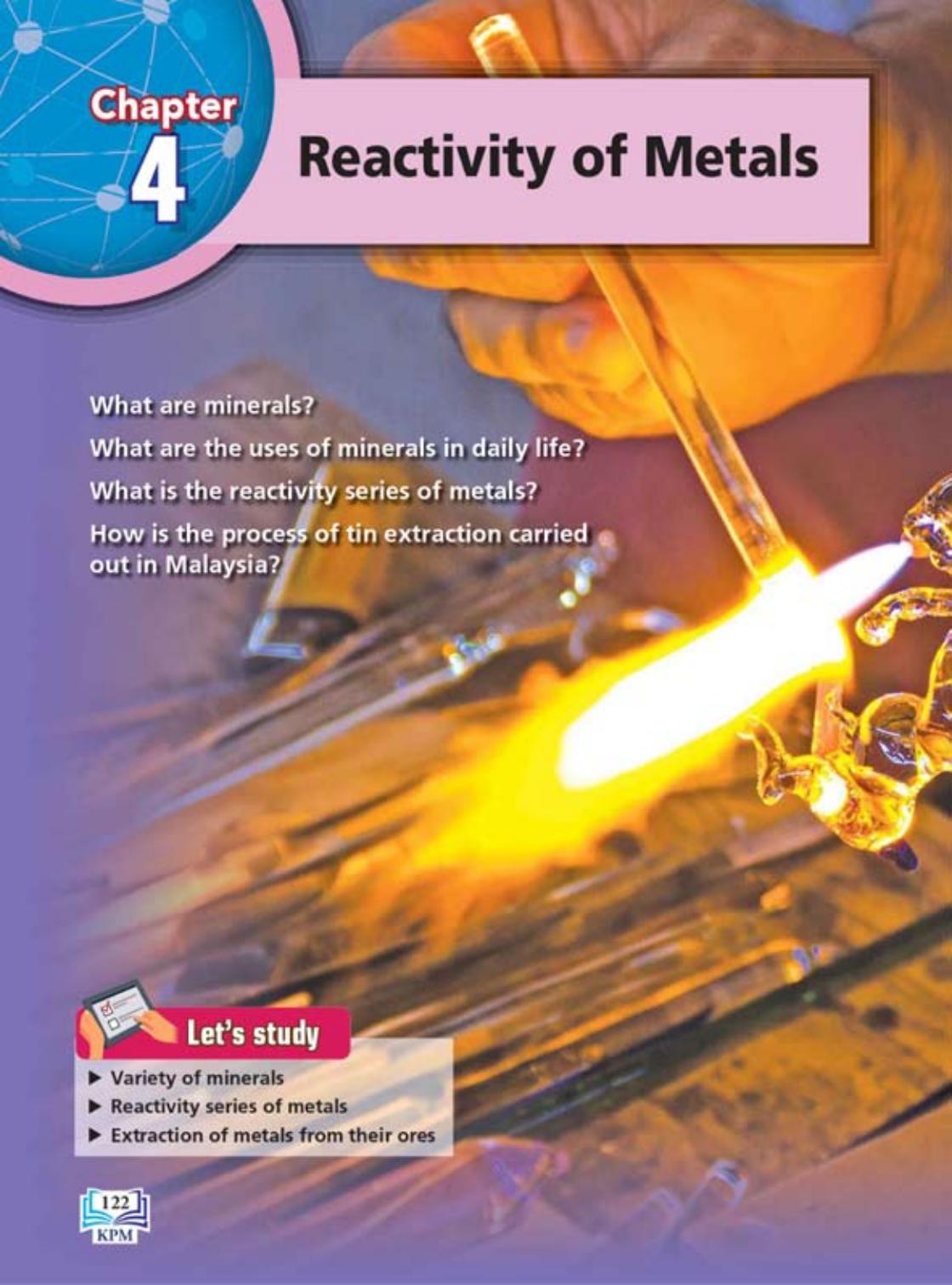
## Exploration of Elements in Nature

H																	He																																	
Li	Be											B	C	N	O	F	Ne																																	
Na	Mg											Al	Si	P	S	Cl	Ar																																	
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																																	
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																																	
Cs	Ba	57-71*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																																	
Fr	Ra	89-103**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Uuu	Uub	Uut																																						
<table border="1"> <tr> <td>* La</td><td>Ce</td><td>Pr</td><td>Nd</td><td>Pm</td><td>Sm</td><td>Eu</td><td>Gd</td><td>Tb</td><td>Dy</td><td>Ho</td><td>Er</td><td>Tm</td><td>Yb</td><td>Lu</td> </tr> <tr> <td>** Ac</td><td>Th</td><td>Pa</td><td>U</td><td>Np</td><td>Pu</td><td>Am</td><td>Cm</td><td>Bk</td><td>Cf</td><td>Es</td><td colspan="7"></td> </tr> </table>																		* La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	** Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es							
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At the end of the 17<sup>th</sup> century, the number of metals listed in the reactivity series of metals was only twelve! Why? What changes do you expect in the reactivity series of metals in future?

Colourful fireworks display is one of the applications of thermochemistry. Does the chemical reaction of the fireworks display release or absorb heat? What is the use of heat in the fireworks display?





## Chapter 4

# Reactivity of Metals

What are minerals?

What are the uses of minerals in daily life?

What is the reactivity series of metals?

How is the process of tin extraction carried out in Malaysia?



### Let's study

- ▶ Variety of minerals
- ▶ Reactivity series of metals
- ▶ Extraction of metals from their ores

## Science Gallery

According to existing records, the first metal used by humans is gold. Gold was discovered in its mineral element form in a cave in Spain in 40 000 BC. Due to the importance of various metals used in daily life, scientists have constructed a reactivity series of metals to understand the order of metals according to their reactivity towards oxygen as shown in the figure below.



Reactivity of metals towards oxygen increases

K	Potassium
Na	Sodium
Ca	Calcium
Mg	Magnesium
Al	Aluminium
C	Carbon
Zn	Zinc
H	Hydrogen
Fe	Iron
Sn	Tin
Pb	Lead
Cu	Copper
Hg	Mercury
Ag	Silver
Au	Gold

Based on this reactivity series of metals, we can determine the properties of metals such as the reactions of metals with oxygen, acid or water. We can also understand how the extraction of a metal from its ore is carried out. The mining issues of metals can also be highlighted to increase awareness on the importance of sustainable management and development of the environment.

### Keywords

- ◆ Mineral
- ◆ Natural compound
- ◆ Element
- ◆ Earth's crust
- ◆ Reactivity series of metals
- ◆ Extraction of metal
- ◆ Mining issues
- ◆ Physical characteristic
- ◆ Chemical characteristic
- ◆ Blast furnace
- ◆ Slag

# 4.1

## Variety of Minerals

Look at Photograph 4.1. This photograph shows various types of ores found in Earth's crust. Each type of ore is different in terms of colour, structure, shape and texture because the ores contain different minerals.



*Photograph 4.1 Various types of ores found in Earth's crust*

Try to guess, how many minerals exist on this Earth! Then, compare your guess with the number of minerals listed in the following website:

<http://bt.sasbadi.com/sc3124>



Is your guess close to the number of minerals listed by the International Mineralogical Association, IMA?

What are the names of these ores?



### **i** SCIENCE INFO

**Mineralogy** or the study of minerals is an active field of science because the number and properties of minerals keep increasing.

### **My World of Science**

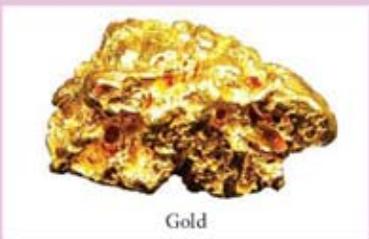
Soon, all cars using petrol or diesel will be replaced with electric cars. This can be realised with the discovery of two minerals which can produce long lasting batteries. These two minerals are **lithium** and **cobalt**.

## Various Forms of Minerals in Earth's Crust

**Minerals** are solid elements or compounds present naturally with definite crystalline structures and chemical compositions. Various minerals are contained in rocks found in Earth's crust.

**Minerals** that can be found in Earth's crust are made up of the following:

### A Elements



Gold



Silver

Photograph 4.2 Gold and silver

### B Compounds



Bauxite



Hematite



Galena



Cassiterite

Photograph 4.3 Bauxite, hematite, galena and cassiterite

The common and systematic names of natural compounds and the combination of their elements are shown in Table 4.1.

Table 4.1 Natural compounds and their elements

Common name	Systematic name	Combination of elements
Hematite	Iron(III) oxide	Iron, oxygen
Cassiterite	Tin(IV) oxide	Tin, oxygen
Quartz	Silicon dioxide	Silicon, oxygen
Bauxite (aluminium ore)	Aluminium oxide	Aluminium, oxygen
Galena (lead ore)	Lead(II) sulphide	Lead, sulphur
Pyrite	Iron(II) sulphide	Iron, sulphur
Calcite	Calcium carbonate	Calcium, carbon, oxygen

## Natural Compounds are the Combination of Several Elements



Photograph 4.4 Limestone quarry

### BRAIN TEASER

The compound shown in this photograph has a common name, that is bauxite or aluminium ore. Its systematic name is aluminium oxide. Who normally uses the common and systematic names for this compound?



### My World of Science

**Calcium silicate** is a natural compound that can be used as an additive in human food.

**Limestone** is a mineral that has many uses in daily life such as in the construction of roads and buildings, and for table tops. Is limestone a natural compound made up of a combination of several elements? Let us investigate this by carrying out Activity 4.1. Then, carry out Activity 4.2 to create a multimedia presentation on examples of properties of natural minerals and their uses in daily life.

### Activity 4.1

#### Inquiry-based activity

To show that a natural compound is a combination of several elements

#### Materials

Calcium carbonate powder, clear limewater and dilute hydrochloric acid

#### Apparatus

Boiling tube labelled P, boiling tube labelled Q, spatula, test tube, Bunsen burner, rubber stopper with delivery tube, filter funnel and retort stand with clamp

#### Instructions

1. Put a spatula of calcium carbonate into boiling tubes P and Q.
2. Pour 10 ml of dilute hydrochloric acid into boiling tube P.
3. Set up the apparatus to test the property of the gas released by passing it through limewater as shown in Figure 4.1.

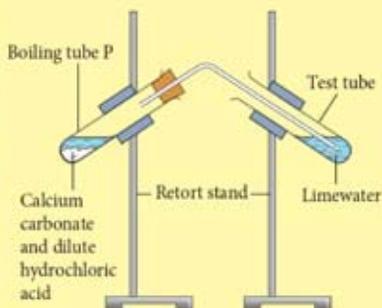


Figure 4.1 Apparatus set-up to test gas released

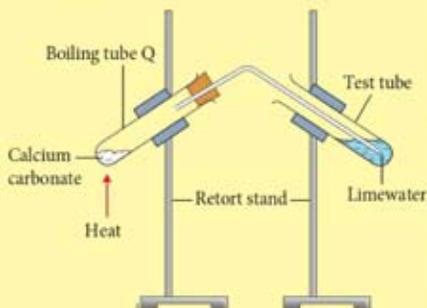


Figure 4.2 Apparatus set-up to heat calcium carbonate

- Observe and record the changes in the limewater, if any, in a table.
- Set up the apparatus as shown in Figure 4.2. Heat the calcium carbonate in boiling tube Q strongly until gas is released.
- Observe and record the changes in the limewater, if any, in the table.



### Safety Precaution

Do not point the mouth of the boiling tube that is being heated at yourself or others.

### Observation

Action on calcium carbonate	Condition of limewater	
	before gas passes through	after gas passes through
Calcium carbonate mixed with dilute hydrochloric acid		
Calcium carbonate heated strongly		

### Questions

- Name the gas that is tested using limewater.
- How is the test for the gas carried out? Explain.
- Name the gas released when calcium carbonate:
  - reacts with dilute hydrochloric acid
  - is heated strongly
- Complete the word equation for each reaction in question 3.
  - Calcium carbonate + hydrochloric acid  $\rightarrow$   +  +
  - Calcium carbonate  $\xrightarrow{\text{heated}}$   +
- Name **three** elements that are combined in calcium carbonate.

## **i** SCIENCE INFO

Calcium carbonate is a natural compound that exists in various forms, colours and textures such as calcite, limestone, marble, chalk, coral reefs and shells of marine animals.



Limestone



Marble



Chalk



Calcite

### Activity 4.2

To create a multimedia presentation on examples of properties of natural minerals and their uses in daily life

**21<sup>st</sup> Century Skills**

- Technology-based activity

#### Instructions

1. Work in groups.
2. Gather and discuss information on examples of properties of natural minerals and their uses in daily life. Then, fill in the information in the table as follows:

Natural mineral	Physical characteristics	Chemical characteristics	Uses in daily life

3. Present the findings of your group discussion in class.

### Formative Practice 4.1

1. What are minerals?
2. Name **one** example of a mineral in the form of:
  - (a) element
  - (b) natural compound
3. State **two** examples of minerals, their chemical or physical characteristics and their uses in daily life.

## 4.2 Reactivity Series of Metals

Compare and contrast the reactions of metals with oxygen in the air as shown in Photograph 4.5.



(a) Magnesium burning in air



(b) Iron exposed to air

*Photograph 4.5 Reactions between metals and oxygen*

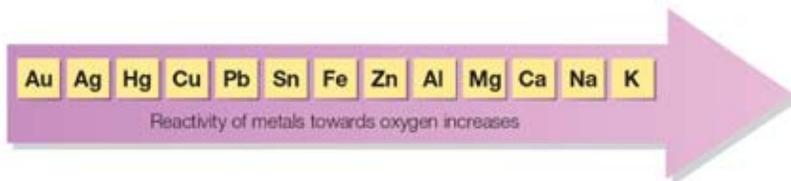
Is the vigour of the reactions of different metals such as magnesium and iron with oxygen the same or different?

In a **vigorous reaction** between a more reactive metal such as magnesium and oxygen, a bright flame is observed as shown in Photograph 4.5(a).

In a **less vigorous reaction** between a less reactive metal such as iron and oxygen, only a glow or slow change in colour is observed as shown in Photograph 4.5(b).

### Constructing Reactivity Series of Metals

Different metals have different reactivities towards oxygen. Metals that are **more reactive** towards oxygen react **more vigorously** with oxygen. **Reactivity series of metals** is a list of metals arranged in order of their reactivity towards oxygen as shown in Figure 4.3.



*Figure 4.3 Reactivity series of metals towards oxygen*

Let us carry out Activity 4.3 to compare and contrast the reactivity of several different metals towards oxygen.

## Activity 4.3

### Inquiry-based activity

Investigating the reactivity of several metals towards oxygen

**Aim:** To study the reaction of heating metals such as magnesium, aluminium, zinc, iron and lead with oxygen

#### Materials

Potassium manganate(VII) crystals, magnesium powder, aluminium powder, zinc powder, iron powder, lead powder and glass wool

#### Apparatus

Boiling tube, retort stand with clamp, porcelain plate, spatula and Bunsen burner

#### Instructions

#### Safety Precautions

- Glass wool fibres are very dangerous. Use forceps to handle them. Make sure you wear safety glasses and cover your mouth and nose when handling glass wool. Do not allow glass wool to enter your body. Wash your hands after handling glass wool.
- Potassium manganate(VII) crystals and metal powder can explode if mixed during heating. Make sure both of these materials are always kept apart.
- Make sure you wear safety glasses and do not look directly at the flame caused by heating metal powder with oxygen.
- Use only a small amount of metal powder.

1. Put a spatula of potassium manganate(VII) crystals into a dry boiling tube. Use some glass wool to prevent it from coming out as shown in Figure 4.4.

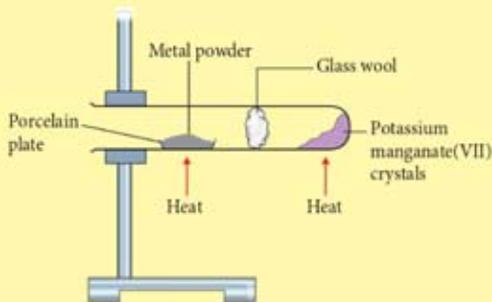


Figure 4.4

2. Clamp the boiling tube horizontally onto the retort stand as shown in Figure 4.4.
3. Put a spatula of magnesium powder on a small porcelain plate. Put the porcelain plate into the boiling tube as shown in Figure 4.4.



#### VIDEO

Reaction between metal and oxygen



- Heat the magnesium powder strongly. Then, heat the potassium manganate(VII) crystals.
- Observe the vigour of the reaction.
- Record your observations in a table. Take a video recording and/or photographs of the reaction.
- Repeat steps 1 to 6 using the powdered form of the metals listed in the following table:

### Observations

Metal	Observation				
	Metal burns very quickly and brightly	Metal burns quickly and brightly	Metal burns slowly	Metal glows brightly	Metal glows dimly
Magnesium					
Aluminium					
Zinc					
Iron					
Lead					

### Questions

- Complete the word equation for the reaction of each metal with oxygen.
  - Magnesium + oxygen  $\rightarrow$
  - Aluminium + oxygen  $\rightarrow$
  - Zinc + oxygen  $\rightarrow$
  - Iron + oxygen  $\rightarrow$
  - Lead + oxygen  $\rightarrow$
- State the relationship between the vigour of the reactions and the reactivity of the metals towards oxygen.
- Based on the results from this activity, complete the following sequence of metals according to their decreasing reactivity towards oxygen.

$\rightarrow$    $\rightarrow$    $\rightarrow$    $\rightarrow$

## Position of Carbon in the Reactivity Series of Metals

The position of a metal in the reactivity series of metals depends on the reactivity of the metal when reacting with oxygen. Can the position of a non-metal such as **carbon** and **hydrogen** in the reactivity series of metals be determined according to the reactivity of carbon and hydrogen with oxygen?

Let us carry out Activity 4.4 to determine the position of carbon in the reactivity series of metals.



Write the word equation for the reaction between:

- carbon and oxygen
- hydrogen and oxygen

### Activity 4.4

### Inquiry-based activity

Determining the position of carbon in the reactivity series of metals

**Aim:** To determine the position of carbon in the reactivity series of metals by heating the following substances:

- (a) Zinc oxide with carbon
- (b) Aluminium oxide with carbon
- (c) Lead(II) oxide with carbon

#### Materials

Carbon powder, zinc oxide, aluminium oxide and lead(II) oxide

#### Apparatus

Crucible, spatula, Bunsen burner, pipeclay triangle and tripod stand

#### Instructions

##### A Teacher's demonstration

Observe carefully when the teacher conducts a demonstration of steps 1 to 4 as follows:

1. Put a spatula of carbon powder and a spatula of zinc oxide powder into a dry crucible. Mix the powders evenly in the crucible.
2. Place the crucible on a pipeclay triangle on a tripod stand as shown in Figure 4.5.

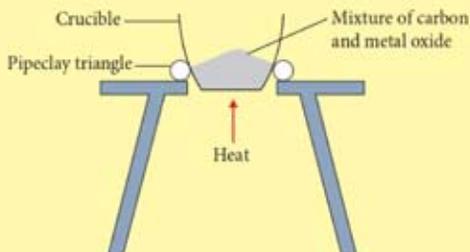


Figure 4.5



### VIDEO

Position of carbon in the reactivity series of metals



- Heat the mixture in the crucible strongly.
- Observe the changes that happen to the mixture. Record your observation in a table.

### B Student's activity

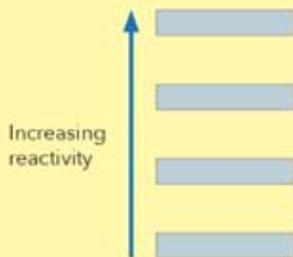
Repeat steps 1 to 4 replacing zinc oxide with aluminium oxide and lead(II) oxide.

#### Observations

Mixture	Observation	Reactivity of carbon
Zinc oxide and carbon		
Aluminium oxide and carbon		
Lead(II) oxide and carbon		

#### Questions

- Complete the word equation for each reaction of metal oxide with carbon, if any.
  - Zinc oxide + carbon →
  - Aluminium oxide + carbon →
  - Lead(II) oxide + carbon →
- Name the metal that is less reactive than carbon. Explain your answer.
- Based on the results of this activity, complete the following sequence to show the arrangement of elements according to their increasing reactivity towards oxygen:

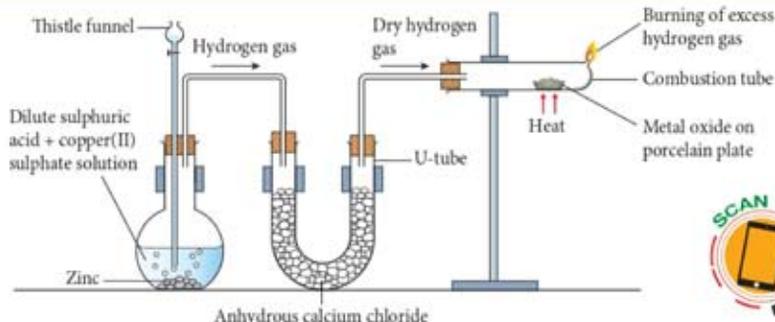


- Give **one** application of the position of carbon in the reactivity series of metals for industrial use. Explain your answer.
- Underline the correct answer for the following statements:
  - If carbon can remove oxygen from a metal oxide, it means carbon is (more/less) reactive than the metal.
  - If carbon cannot remove oxygen from a metal oxide, it means carbon is (more/less) reactive than the metal.

## Position of Hydrogen in the Reactivity Series of Metals

The position of **hydrogen** in the reactivity series of metals can be determined through interpretation of the data based on Figure 4.6 and Table 4.2.

Figure 4.6 shows the apparatus set-up used to determine the position of hydrogen in the reactivity series of metals.



**Figure 4.6** Apparatus set-up to determine the position of hydrogen in the reactivity series of metals

Table 4.2 shows the results from activities carried out by chemists to determine the position of hydrogen in the reactivity series of metals.

**Table 4.2** The results from activities to determine the position of hydrogen in the reactivity series of metals

Mixture	Observation	Inference
Hydrogen and aluminium oxide	Aluminium oxide does not glow. Aluminium oxide is white in colour.	Hydrogen does not reduce aluminium oxide.
Hydrogen and zinc oxide	Zinc oxide does not glow. Zinc oxide turns yellow when hot and white on cooling.	Hydrogen does not reduce zinc oxide.
Hydrogen and iron(III) oxide	Iron(III) oxide burns brightly. Reddish brown powder turns shiny grey.	Iron is produced. Hydrogen reduces iron(III) oxide to iron.
Hydrogen and lead(II) oxide	Lead(II) oxide burns brightly. Yellow powder turns shiny grey.	Lead is produced. Hydrogen reduces lead(II) oxide to lead.
Hydrogen and copper(II) oxide	Copper(II) oxide burns very brightly. Black powder turns brown.	Copper is produced. Hydrogen reduces copper(II) oxide to copper.

Based on the results given in Table 4.2,

- (a) Underline the correct answers about the reactivity of hydrogen.
- Hydrogen is (less/more) reactive than aluminium.
  - Hydrogen is (less/more) reactive than zinc.

- (iii) Hydrogen is (less/more) reactive than iron.  
 (iv) Hydrogen is (less/more) reactive than copper.  
 (v) Hydrogen is (less/more) reactive than lead.  
 (b) State the metals which are more reactive than hydrogen.  
 (c) State the metals which are less reactive than hydrogen.

## Conclusion on the Position of Carbon and Hydrogen in the Reactivity Series of Metals

In Activity 4.3, you have arranged metals according to their reactivity towards oxygen. The arrangement you made is part of the reactivity series of metals. In Activity 4.4 and data interpretation in Table 4.2, you determined the position of **carbon** and **hydrogen** in the reactivity series of metals. Even though the **reactivity series of metals** is an arrangement of metals according to their reactivity towards oxygen, the position of non-metals such as carbon and hydrogen is also shown in the reactivity series of metals (Figure 4.7).

**Reactivity Series of Metals**



K	Potassium
Na	Sodium
Ca	Calcium
Mg	Magnesium
Al	Aluminium
C	Carbon
Zn	Zinc
H	Hydrogen
Fe	Iron
Sn	Tin
Pb	Lead
Cu	Copper
Hg	Mercury
Ag	Silver
Au	Gold

Reactivity of metal towards oxygen increases

Figure 4.7 Reactivity series of metals

### My World of Science

Lithium batteries will explode when heated. Due to this, passengers are not allowed to keep lithium batteries in their luggage placed in aircrafts.



### SCIENCE INFO

Coal is one of the minerals found in Malaysia. About 80% of the coal is found in Sarawak, 19% in Sabah dan 1% in Peninsular Malaysia. The largest coal reserve is located in Merit Pila, Sarawak.



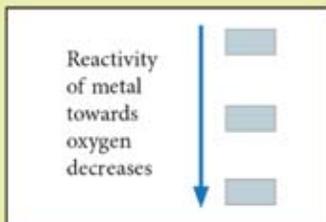


1. What is reactivity series of metals?
2. Figure 1 shows the reaction between metal X and oxygen in the air.



Figure 1

- (a) Is metal X reactive towards oxygen? Explain your answer.
- (b) Metal Y glows brightly when it reacts with oxygen. Is metal Y more or less reactive than metal X? 
- (c) If metal Z does not react with oxygen, arrange metals X, Y and Z in the reactivity series of metals based on their reactions.



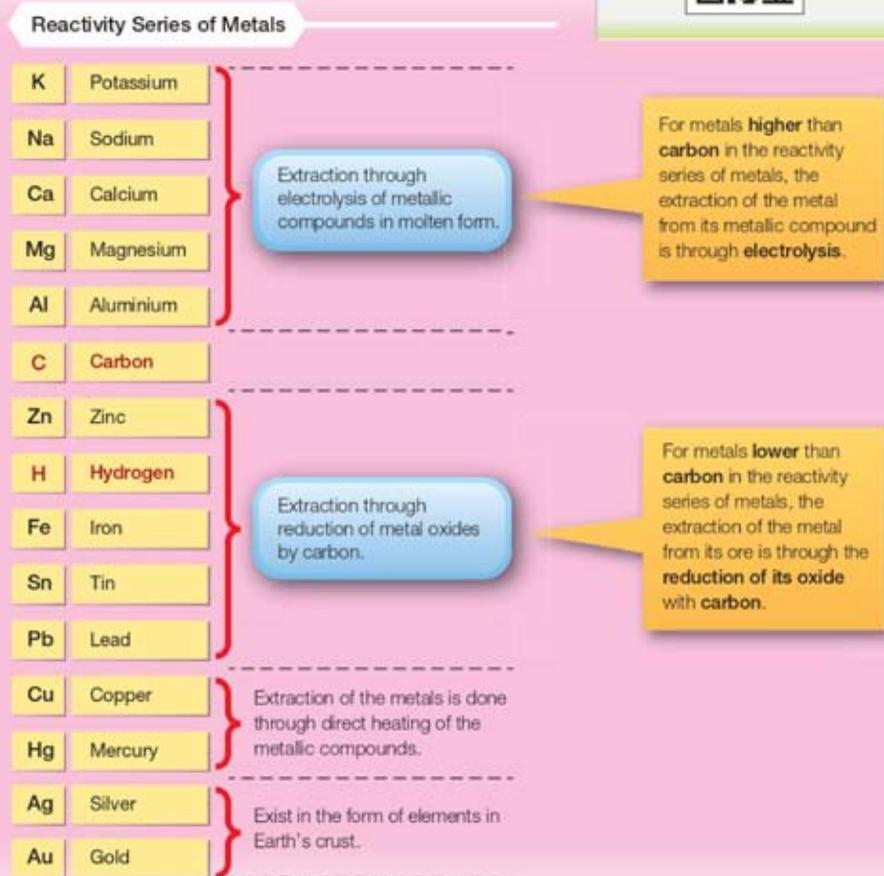
3. Underline the correct answers.
  - (a) Metals are arranged in the reactivity series of metals based on the reaction of the metal towards (carbon/oxygen).
  - (b) The most reactive metal in the reactivity series of metals is (calcium/potassium).
  - (c) The reactivity series of metals is applied in the (melting/extraction) of metals from their ores.
4.
  - (a) State the most reactive metal in the reactivity series of metals.
  - (b) State the least reactive metal in the reactivity series of metals.
5.
  - (a) State **two** non-metal elements that are included in the reactivity series of metals.
  - (b) Why are these two non-metal elements included in the reactivity series of metals?

## 4.3

## Extraction of Metals from their Ores

## Extraction of Metals

**Extraction of metals** is the process to obtain metals from their ores. Observe the relationship between the position of carbon and hydrogen in the reactivity series of metals and the method used to extract metals from their ores as shown in Figure 4.8.



The extraction of iron from its ore by a local company in Malaysia.  
<http://bt.sasbadi.com/sc3137>



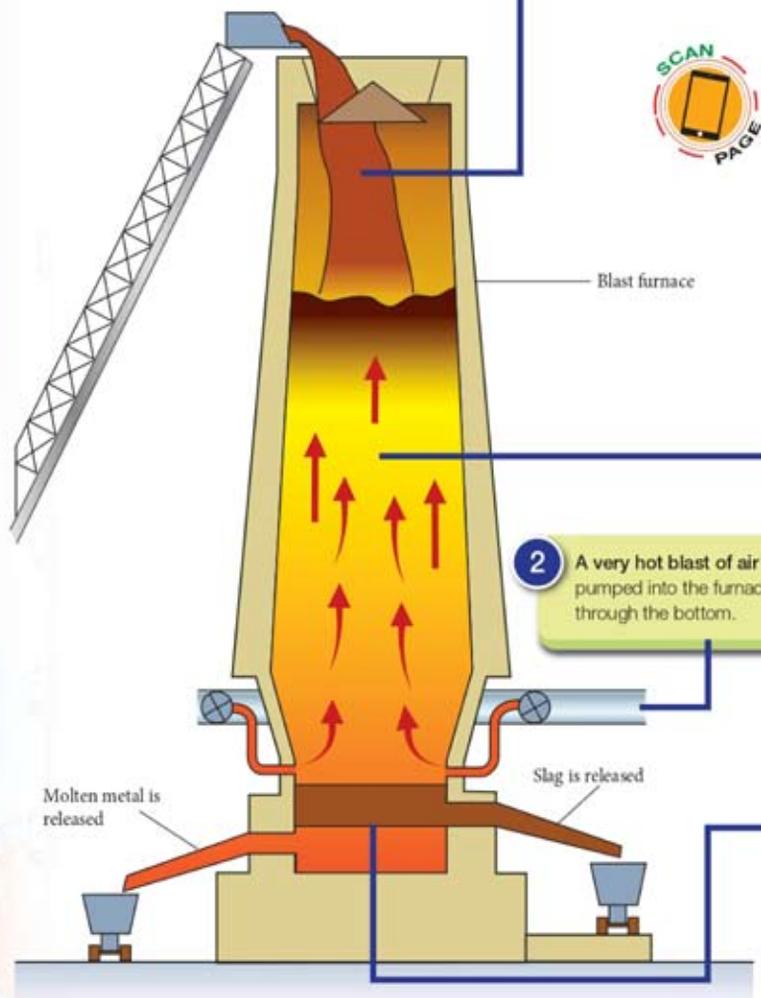
Figure 4.8 Reactivity series of metals and methods of extracting metals from their ores

## Process of Iron Extraction

The extraction of iron from its ore is carried out in a **blast furnace** as shown in Figure 4.9.

1

A mixture of concentrated **iron ore** or iron oxide, **coke** and **limestone** is added into a **blast furnace** through the top.



2

A very hot blast of air is pumped into the furnace through the bottom.

Figure 4.9 Extraction of iron in a blast furnace

3 Reactions that occur in the furnace at high temperature.

#### Production of iron

- Coke or carbon reacts with oxygen in the hot air to produce carbon dioxide and heat



- Carbon dioxide that is produced reacts with the rest of the hot coke to form carbon monoxide which is a strong reducing agent.



- Carbon monoxide and carbon reduces iron oxide into iron.

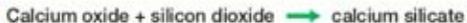


#### Production of slag

- Limestone or calcium carbonate decomposes to form calcium oxide and carbon dioxide.



- Calcium oxide reacts with impurities such as sand or silicon dioxide in iron ore to form slag or calcium silicate.



4 At high temperature in the furnace,

- **iron** that is produced will melt. This molten iron flows to the bottom part of the furnace. From time to time, the molten iron is tapped off and channelled into moulds and allowed to cool and freeze. The molten iron that has solidified is known as **cast iron**.
- **slag** that is produced will melt. This molten slag also flows to the bottom part of the furnace. Since molten slag is less dense than molten iron, the slag will float on top of the molten iron. From time to time, the molten slag is tapped off and used to make the base of buildings and roads.

## Activity 4.5

To create a multimedia presentation explaining how metal extraction is carried out based on the processes of iron and tin extractions in Malaysia

21<sup>st</sup> Century Skills

- ICS
- Technology-based activity

### Instructions

1. Work in groups.
2. Gather materials from various media on how metals are extracted in the mining sector in Malaysia.
3. Examples of websites are as follows:

- Source of minerals in Malaysia  
<http://bt.sasbadi.com/sc3140-1>



- Process of tin extraction in Malaysia  
<http://bt.sasbadi.com/sc3140-2>



4. Discuss the processes of iron and tin extractions from their ores.
5. Present the findings of your group discussion using multimedia presentation such as MS PowerPoint.

## Mining Issues in Malaysia

Mining issues in Malaysia and their impact on life in the local or global context are shown in Figure 4.10.



Figure 4.10 Mining issues in Malaysia and their impact

Let us carry out Activity 4.6 to study problems of mining issues in Malaysia shown in Figure 4.10.

## Activity 4.6

To solve problems of mining issues in Malaysia

## Instructions

1. Work in groups.
2. Gather information on issues of poorly planned mining activities in Malaysia and their impact on life in the local or global context.
3. Examples of websites are as follows:

- The Ministry of Human Resources  
<http://bt.sasbadi.com/sc3141-1>



- Impact of bauxite mining in Kuantan, Pahang  
<http://bt.sasbadi.com/sc3140-2>



4. Debate on the information gathered.
5. Generate ideas to solve problems of the adverse effects from mining activities that have been poorly planned to life on Earth.
6. Prepare posters for Gallery Walk on efforts to conserve mining areas towards sustainable development.
7. Display three of the best posters on the science bulletin board.

21<sup>st</sup> Century Skills

- ICS
- Discussion/  
project-based  
activity

## Formative Practice 4.3

1. State the extraction method of the following metals from their ore or metal oxides:
  - (a) Aluminium oxide
  - (b) Iron ore
2. Figure 1 shows a blast furnace used to extract iron.
  - (a) Name **one** example of a metal other than iron that is extracted using the blast furnace.
  - (b) Name the substance that is added into the blast furnace through the parts labelled:
    - (i) P
    - (ii) Q
  - (c) Name the substance that is tapped off from the blast furnace through the parts labelled:
    - (i) R
    - (ii) S
3. State **one** adverse effect from unplanned mining activities and ways to solve it in the following contexts:
  - (a) Local context
  - (b) Global context

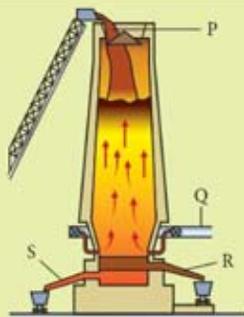


Figure 1

# Summary

## Variety of minerals in Earth's crust

extracted in the sector

### Mining

that is poorly planned will cause

### Mineral elements

made up of

### Mineral compounds

such as

#### Non-metals

example

Graphite

classified in

#### Metals

examples

Gold, silver

#### Reactivity series of metals

based on

Vigour of reaction of metal towards oxygen

#### Metal oxides

examples

- Bauxite (aluminium ore)
- Galena (lead ore)
- Hematite (iron ore)
- Cassiterite(tin ore)

Extracted from metal ore using electrolysis or carbon as the reducing agent in a blast furnace

#### Adverse effects and impact

on

#### Life

that needs

To be solved using application of creative and innovative ideas and ways


**Self-reflection**

After studying this chapter, you are able to:

**4.1 Variety of Minerals**

- Explain with examples minerals that are found in Earth's crust.
- Identify elements found in natural compounds.
- Explain with examples the characteristics of natural minerals and its uses in daily life.

**4.2 Reactivity Series of Metals**

- Construct a reactivity series of metals based on its reactivity with oxygen and write the word equation for the reactions.
- Determine the position of carbon and hydrogen in the reactivity series of metals.

**4.3 Extraction of Metals from their Ores**

- Communicate the extraction of metals from its ore using illustrations.
- Generate ideas on how to solve problems from unplanned mining activities to life on Earth.


**Summative Practice 4**

Answer the following questions:

1. The following are some of the minerals found in Earth's crust.

Iron

Quartz

Silver

Bauxite

Potassium

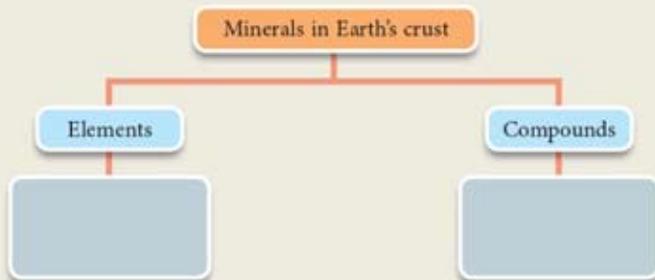
Galena

Tin

Hematite

Limestone

- (a) Classify the above minerals into two groups, namely elements and compounds. 



(b) Give **one** example of metal ore and name the elements combined in the metal ore.

2. Figure 1 shows tin ore.



Figure 1

- (a) What is the systematic name of tin ore?
- (b) State the substance used to extract tin from tin ore.
- (c) Write the word equation for the reaction between tin and oxygen.

3. Mark '✓' for the correct statements.

- (a) The number of minerals in Earth's crust is the same as the number of elements. ( )
- (b) Aluminium ore is a mineral compound in Earth's crust. ( )
- (c) Calcium oxide that is used to reduce the acidity of soil is basic. ( )
- (d) Carbon is used to form metal ores. ( )

4. (a) Name the substance that reacts with metals and is used to determine the position of the metals in the reactivity series of metals.

(b) Potassium and sodium are kept in dark reagent bottles filled with paraffin oil. Explain why. 

5. Figure 2 shows the apparatus set-up of an activity to test the reaction of a metal towards gas X.

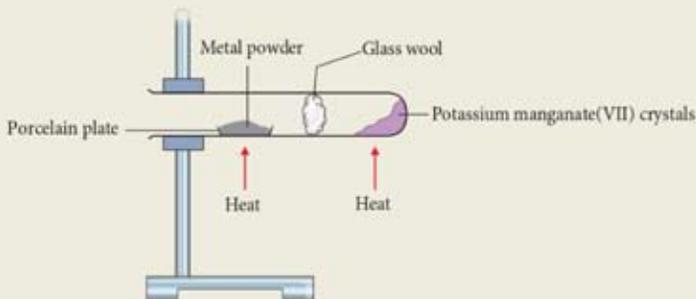


Figure 2

- (a) Name gas X.
  - (b) What is the function of potassium manganate(VII) crystals in this activity?
  - (c) Explain the steps of the correct heating procedure in this activity.
  - (d) State the aim of this activity.
6. How can the position of carbon in the reactivity series of metals determine the method of extraction of metals from their ores or metallic compounds?

### Focus on HOTS

7. The construction of 3D (three dimensional) models are normally used in various fields. You are required to make a 3D model of a blast furnace using the following materials:

- Drinking straw
- Empty mineral water bottle
- Water
- Cooking oil
- Iron powder
- Coke
- Limestone powder
- Transparent plastic bag
- Motor
- Blade of fan
- Paper clips

Sketch your 3D model and explain. 🍷