

Section Three : Metals

Unit Nine: Occurrence and Extraction of Metals

II. Relating Uses of Metals to Their Properties and Prices

Metal	Uses	Reasons for use
Aluminium	window frames	<ul style="list-style-type: none"> ◇ resists corrosion ◇ strong ◇ attractive
	overhead power cables	<ul style="list-style-type: none"> ◆ good electrical conductor ◆ ductile ◆ low density ◆ cheaper than copper
	aircraft body	<ul style="list-style-type: none"> ✓ low density ✓ light but strong ✓ resists corrosion
	soft drink cans	<ul style="list-style-type: none"> ■ non-poisonous ■ low density ■ resists corrosion ■ malleable
	saucepans cooking foil	<ul style="list-style-type: none"> □ good thermal conductor □ non-poisonous □ resists corrosion □ malleable
car headlamps	<ul style="list-style-type: none"> ● reflects light 	
Copper	electrical wires	<ul style="list-style-type: none"> ◇ ductile ◇ good electrical conductor ◇ resists corrosion
	water pipes tanks	<ul style="list-style-type: none"> ◆ resists corrosion ◆ non-poisonous ◆ malleable ◆ ductile ◆ easy to weld by soldering
	cooking utensils	<ul style="list-style-type: none"> ✓ good thermal conductor ✓ non-poisonous ✓ resists corrosion ✓ malleable
Iron	construction, transport	<ul style="list-style-type: none"> ■ strong ■ hard ■ malleable ■ cheap
	magnet	<ul style="list-style-type: none"> □ magnetic
Titanium	supersonic aircraft	<ul style="list-style-type: none"> ● resists corrosion ● light but strong ● withstands intense cold and heat without loss of strength

Gold	jewellery	<ul style="list-style-type: none"> ✧ shiny golden yellow colour ✧ resists corrosion ✧ malleable ✧ ductile ✧ never tarnishes
	protective coating	✓ reflects heat and light
Mercury	thermometers	<ul style="list-style-type: none"> ● liquid at room temperature ● expands on heating
Silver	jewellery , coins	<ul style="list-style-type: none"> ✧ shiny silvery colour ✧ resists corrosion
	electronic components	✧ malleable, ductile and moderately soft

Exercise

1. Resists corrosion – window frame
 Good conductor of heat – cooking pot
 Good conductor of electricity – overhead cable
 Low density – soft drink can
2. (a) Good conductor of electricity
 (b) Aluminium – light, good conductor of electricity, resists corrosion
3. (a) good appearance
 (b) too expensive, soft
 (c) electroplating
4. Cheap and strong

III. Problems of Using Metals

B. Mining Metals

1. Benefits of mining ores:
 - (a) creating jobs
 - (b) creating wealth
2. Drawbacks (effects on the environment):
 - (a) destroy habitats
 - (b) Produce waste and noise

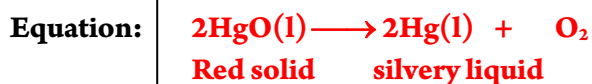
VI. Reactivity of Metals

- ✧ In general, metals react by **losing** their outermost shell electrons and become **positive metal ions**.
- ✧ The **readiness** of elements to lose electrons
 - (a) **decreases** across a period,
 i.e. reactivity of metals **decreases** across a period.
 - (b) **increases** down a group,
 i.e. reactivity of metals **increases** down a group.

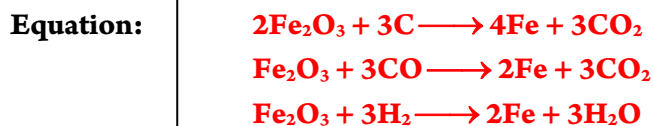
		← increasing reactivity of metals		
		Group		
↑ increasing reactivity of metals	Period	<i>I</i>	<i>II</i>	<i>III</i>
	2	Li	Be	B
	3	Na	Mg	Al
	4	K	Ca	

Experiment 8.1:

3. a) **It relights.**
b) **Oxygen**
4. **A black powder**
5. $2\text{Ag}_2\text{O}(\text{s}) \longrightarrow 4\text{Ag}(\text{s}) + \text{O}_2(\text{g})$
6. a) **No**
b) **No**
7. **Yes. Since both zinc and copper are above silver in the Reactivity Series and their oxides do not decompose.**
Mercury is below silver, so its oxide should decompose.

VII. Extraction of Metals by Heating the Metal Oxides*e.g. Heating mercury(II) oxide***Experiment 8.2 :**

4. **Yes**
5. $2\text{PbO}(\text{s}) + \text{C}(\text{s}) \longrightarrow 2\text{Pb}(\text{s}) + \text{CO}_2(\text{g})$
6. **Carbon**
Lead(II) oxide
Carbon
Lead(II) oxide
8. **No. (Colour change: hot - yellow; cold - white)**
No. (Colour change: brown to silvery or grey)
Yes. (Colour change: hot - orange; cold - yellow; to silvery)
Yes. (Colour change: black to brown)

VIII. Extraction of Metals by Heating the Metal Oxides with Reducing Agent 還原劑a) *Reduction with metals:* e.g. *Magnesium powder + copper(II) oxide*b) *Reduction with carbon (coke)* e.g. *Lead(II) oxide + carbon* e.g. *Copper(II) oxide + carbon***IX. Summary of the Extraction of Metal 金屬的開採****A. Metals low in the reactivity series**e.g. *Mercury(II) oxide*e.g. *Extraction of iron***Exercise**(i) *Reactivity of B < A, C, D*(ii) *Reactivity of A > B, C, D*(iii) *Reactive of B, C < A, D**Conclusion: Reactivity A > D > C > B***Supplementary Exercise**

- Too soft / weak. Does not resist corrosion.*
 - cheap, strong*
 - Poor resistance to corrosion. (It rusts.)*
 - Resists corrosion better than iron. Less dense than iron but still strong.*
 - Does not corrode, so retains its shiny appearance.*
 - Too expensive.*
- D (high m.p.; metals conduct electricity in solid state)*
 - C (ionic structures have high m.p.; conduct when molten but not solid)*
 - A (high m.p.; does not conduct electricity under any conditions)*
 - B (low m.p.; does not conduct electricity under any conditions)*
- Tin*
 - Tin and lead are among the least abundant metals. Thus prices increase as supply decreases.*
 - More ore may be discovered in the Earth. Less metal may be used in the future.*
 - More zinc is used than silver.*