

10%

Metallurgy

Session 4

Migma Tshering

Learning Objectives

4 Steps to extract metals:

- *3rd & 4th Steps*

Step 3

to Extract Metals

Step 3: Extraction of Metals from the Concentrated Ore

a. Conversion of Ores into Metal Oxides

- i. Calcination**
- ii. Roasting**

b. Reduction of Metal Oxide to Metal

- i. Pyrometallurgy: The carbon reduction process**
- ii. Aluminothermy: Reduction with aluminium**
- iii. Auto-reduction**
- iv. Electrolytic Reduction**

Step 3: Extraction of Metals from the Concentrated Ore

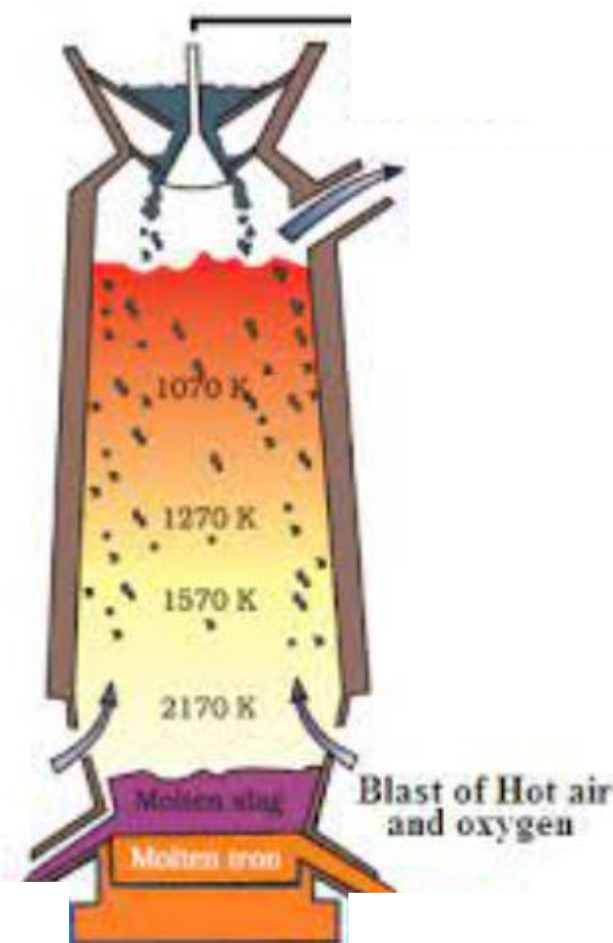
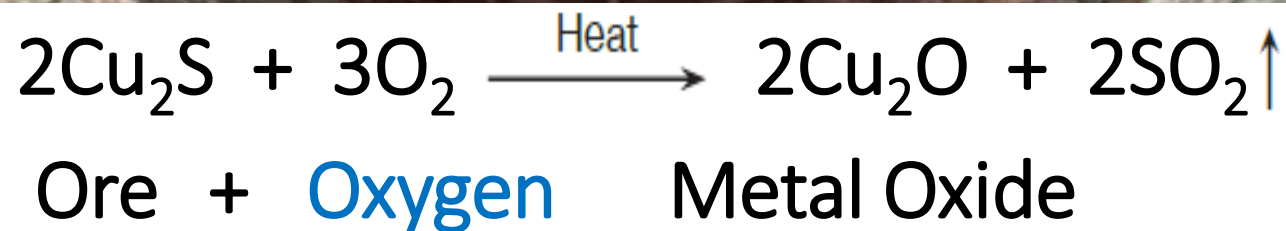
a. Conversion of Ores into Metal Oxides

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Step 3: Extraction of Metals from the Concentrated Ore:

a. Conversion of Ores into Metal Oxides:

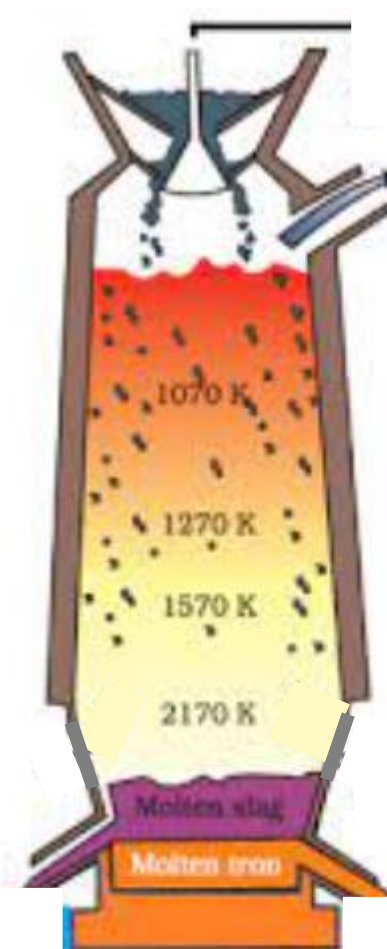
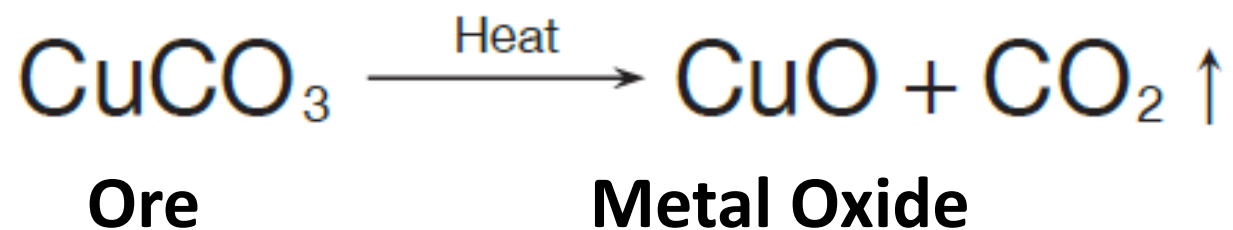
i. Roasting



Step 3: Extraction of Metals from the Concentrated Ore:

a. Conversion of Ores into Metal Oxides:

ii. Calcination



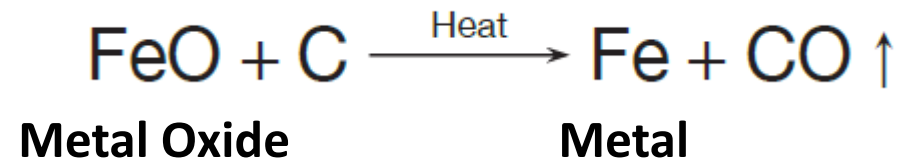
Step 3: Extraction of Metals from the Concentrated Ore

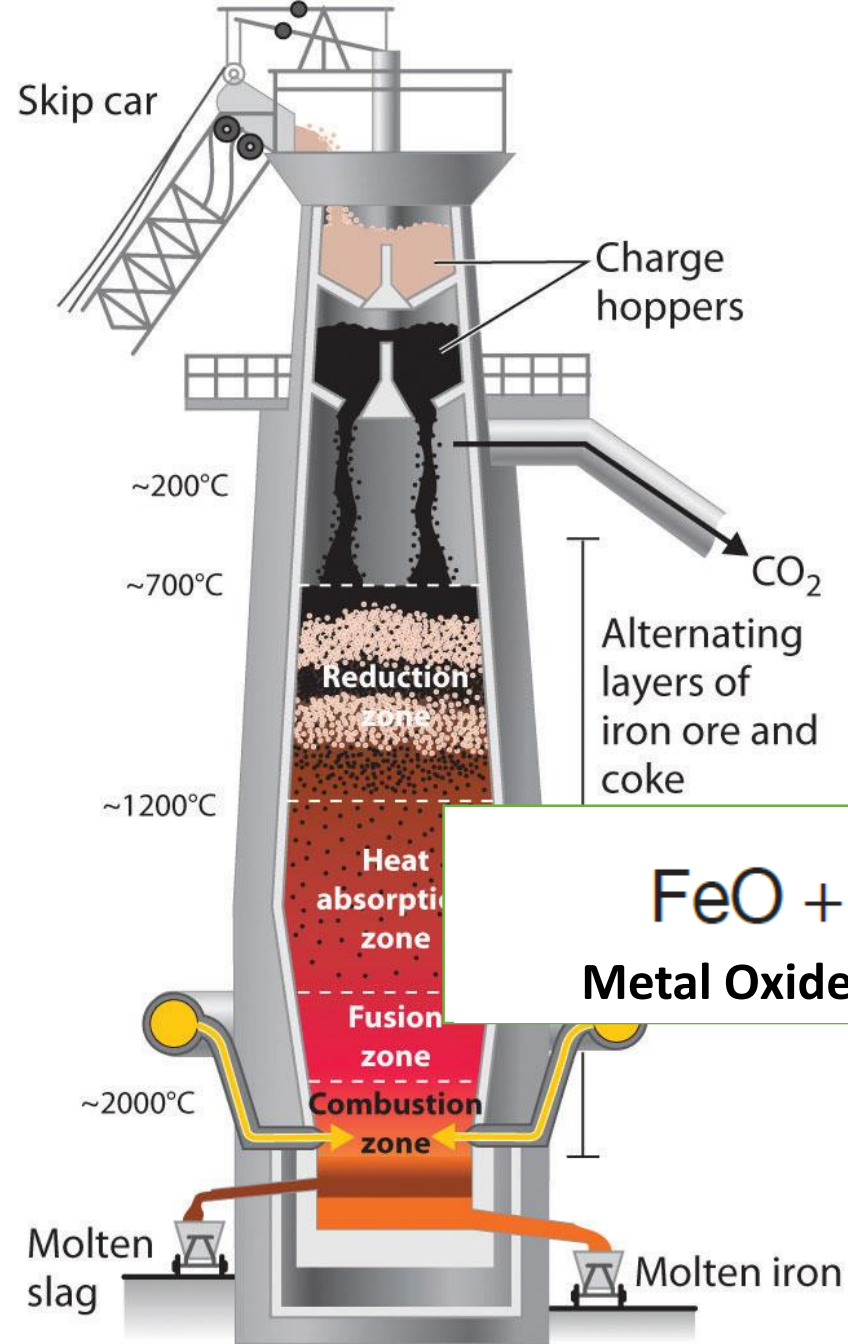
b. Reduction of Metal Oxide to Metal

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Step 3: Extraction of Metals from the Concentrated Ore:**b. Reduction of Metal Oxide to Metal:****i. Pyrometallurgy: *The carbon reduction process***

- Heating of **Metal Oxide** with **Carbon**

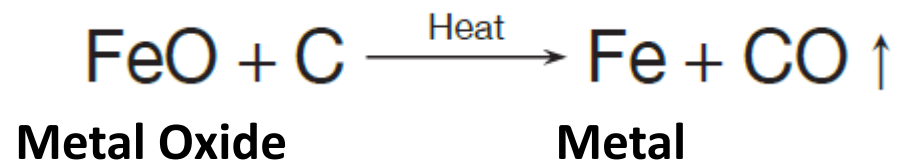




(a) Blast furnace



(b) World's largest blast furnace in 1931



Step 3: Extraction of Metals from the Concentrated Ore:**b. Reduction of Metal Oxide to Metal :****ii. Aluminothermy: Reduction with aluminium****• Heating of Metal Oxide with Aluminum**

- Iron(III) oxide
- Aluminum



Aluminum **Metal Oxide** **Iron**

Step 3: Extraction of Metals from the Concentrated Ore:
b. Reduction of Metal Oxide to Metal :
iii. Auto-reduction



Cu_2S
(Unreacted Ore)

+

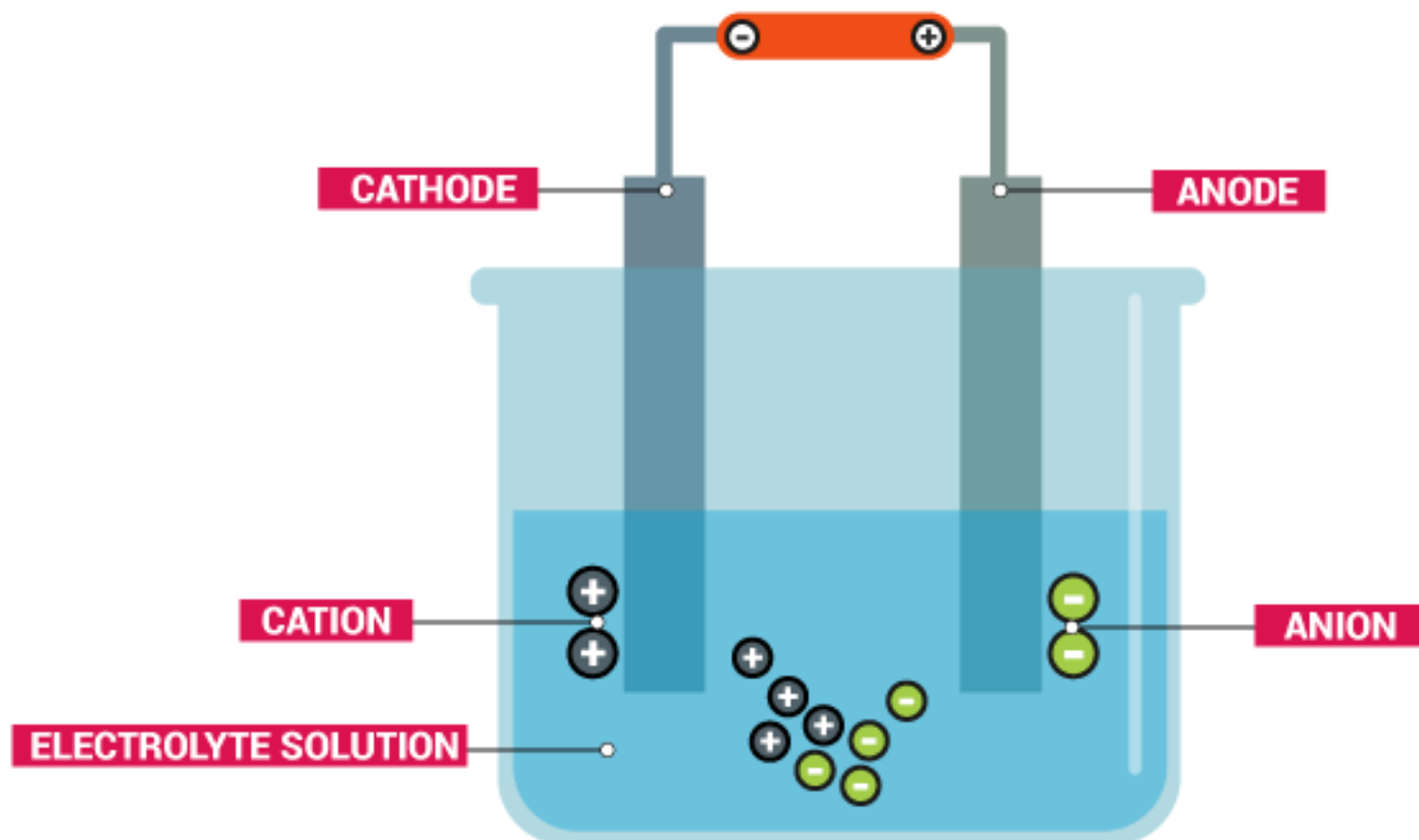


Cu_2O
(Roasted Ore)




Cu
(Copper)

Basic Concept of Electrolysis



Step 3: Extraction of Metals from the Concentrated Ore:
b. Reduction of Metal Oxide to Metal :
iv. Electrolytic Reduction

<p style="color: red; font-weight: bold;">Highly reactive</p>  <p style="color: red; font-weight: bold;">Least reactive</p>	Li	Lithium	↑
	K	Potassium	↑
	Ba	Barium	↑
	Na	Sodium	↑
	Ca	Calcium	↑
	Mg	Magnesium	↑
	Al	Aluminum	↑
	C	Carbon	↓
	Zn	Zinc	↑
	Fe	Iron	↑
	Ni	Nickel	↑
	Sn	Tin	↑
	Pb	Lead	↑
	H	Hydrogen	↓
	Cu	Copper	↓
	Hg	Mercury	↓
	Ag	Silver	↓
	Au	Gold	↓
	Pt	Platinum	↓

↑

Extraction by electrolysis

Expensive

↓

↑

Extraction by reduction of metal oxide with C or CO

Inexpensive

↓

Step 3: Extraction of Metals from the Concentrated Ore:
b. Reduction of Metal Oxide to Metal :
iv. Electrolytic Reduction

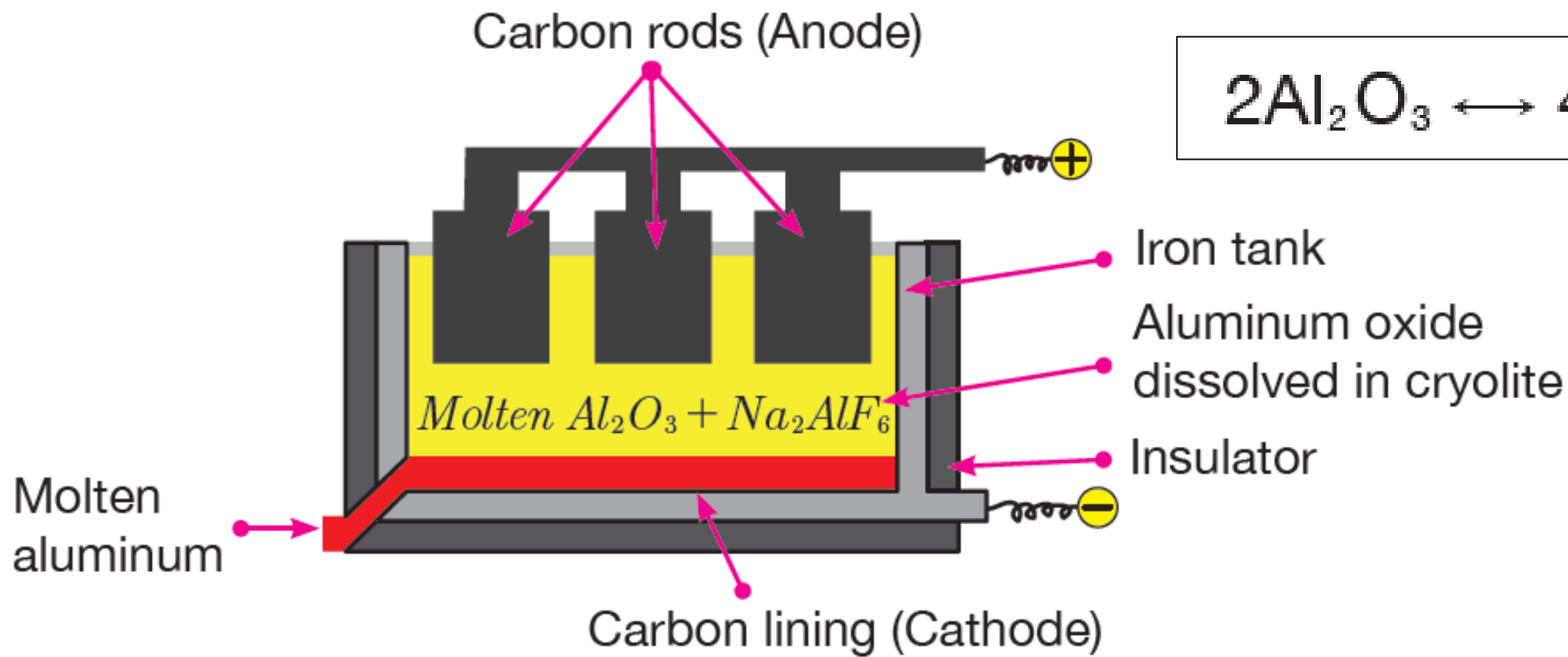


Figure 3.16 Electrolysis of fused alumina.

Step 4

to Extract Metals

Step 4: Purification or Refining of Metal

- a. Liquation**
- b. Distillation Method**
- c. Electrolytic Refining**
- d. Oxidative Refining**

Step 4: Purification or Refining of Metal: i. Liquefaction

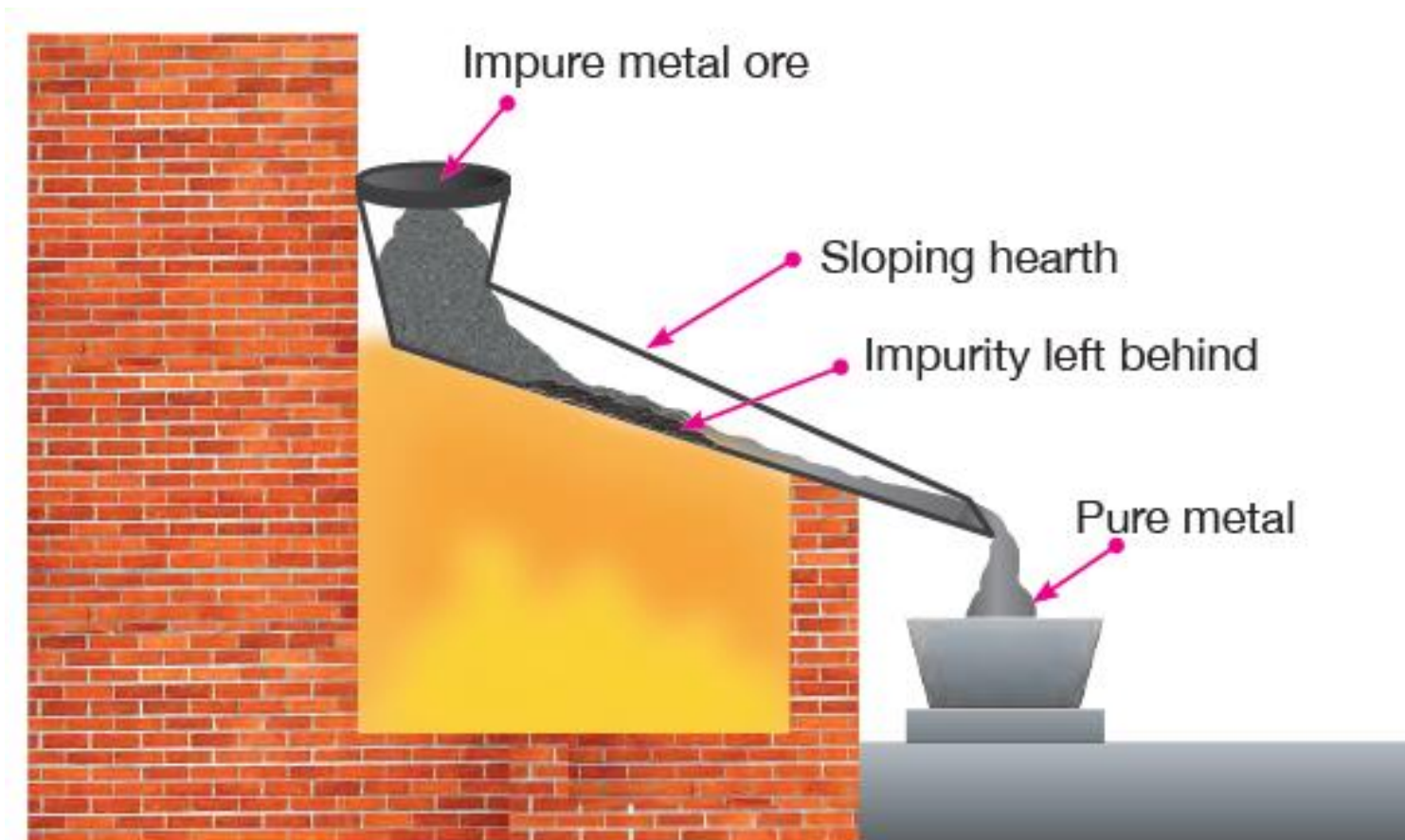
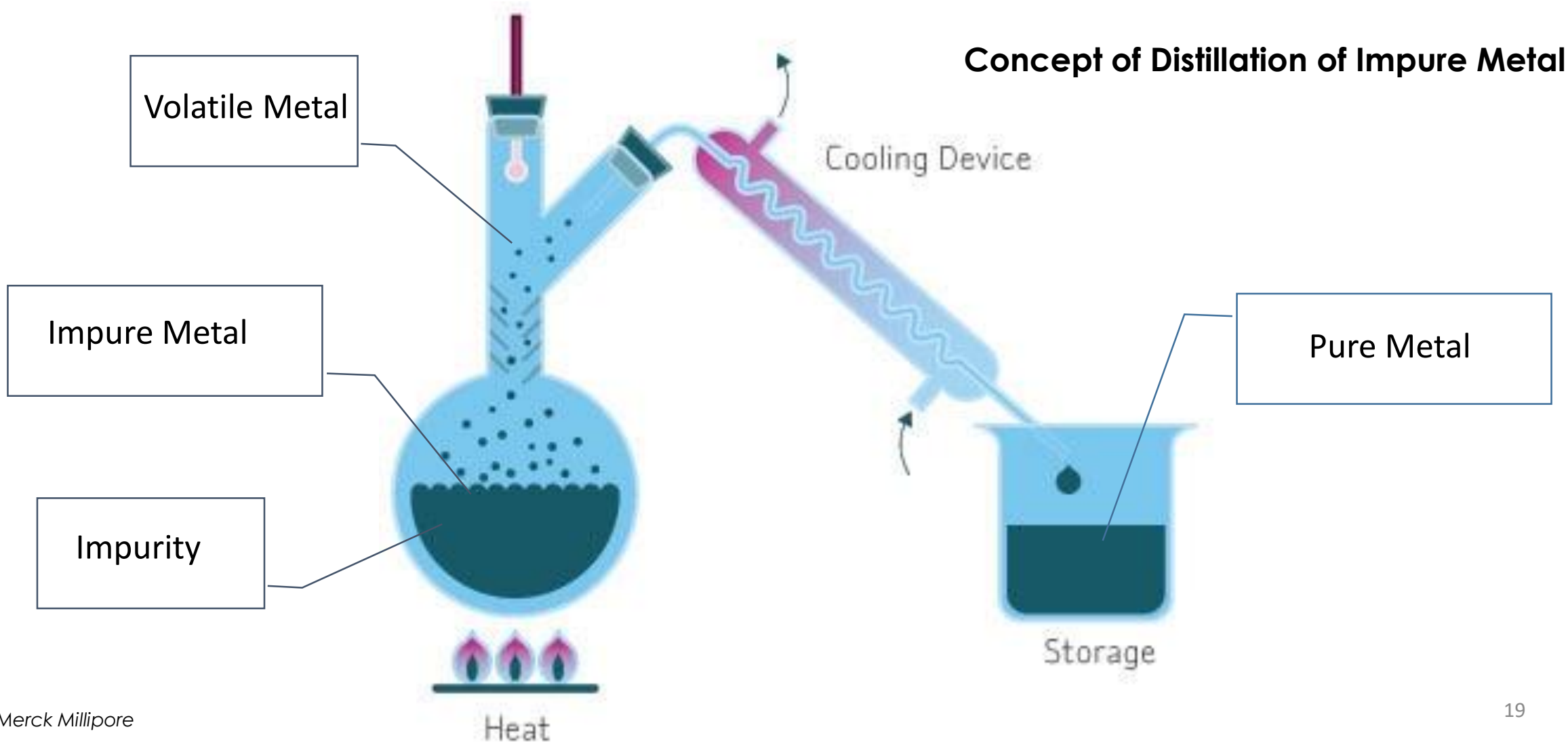


Figure 3.10 Purification of metal by liquation.

Step 4: Purification or Refining of Metal: ii. Distillation Method



Step 4: Purification or Refining of Metal: iii. Electrolytic Refining

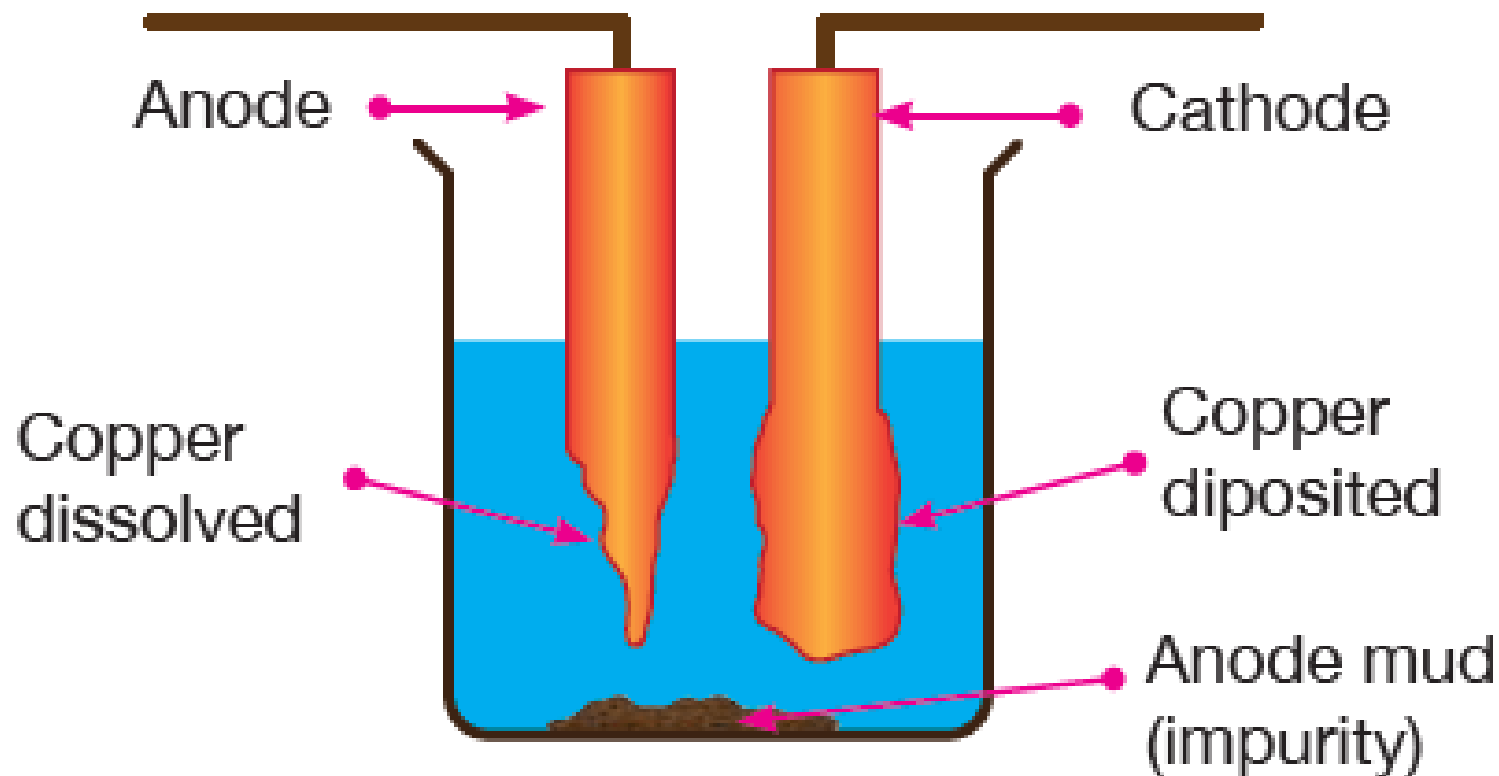
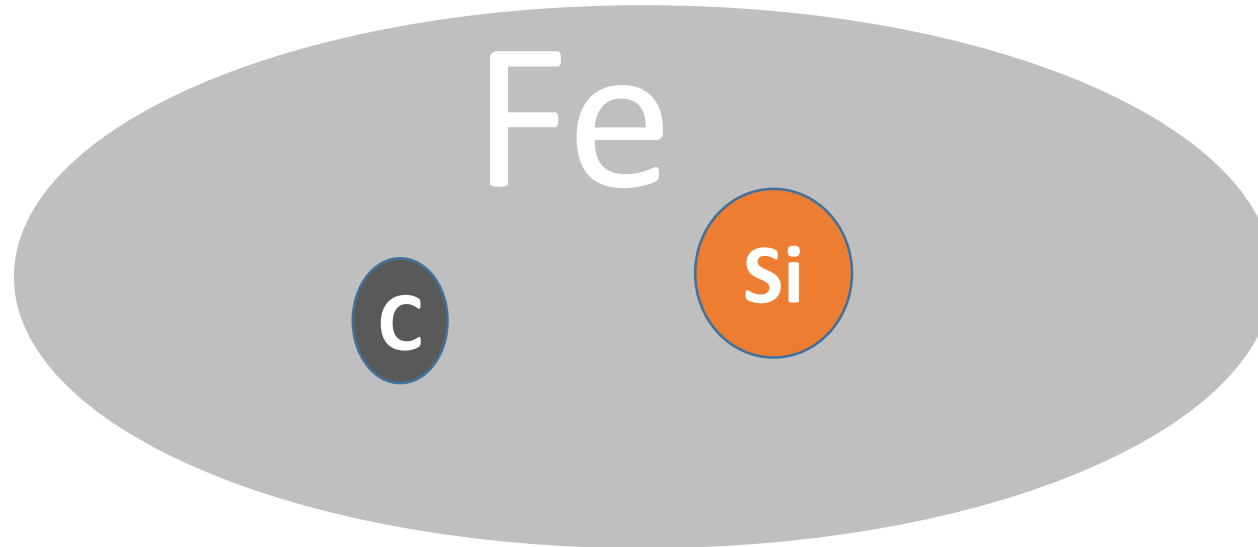


Figure 3.11 Electrolytic refining.

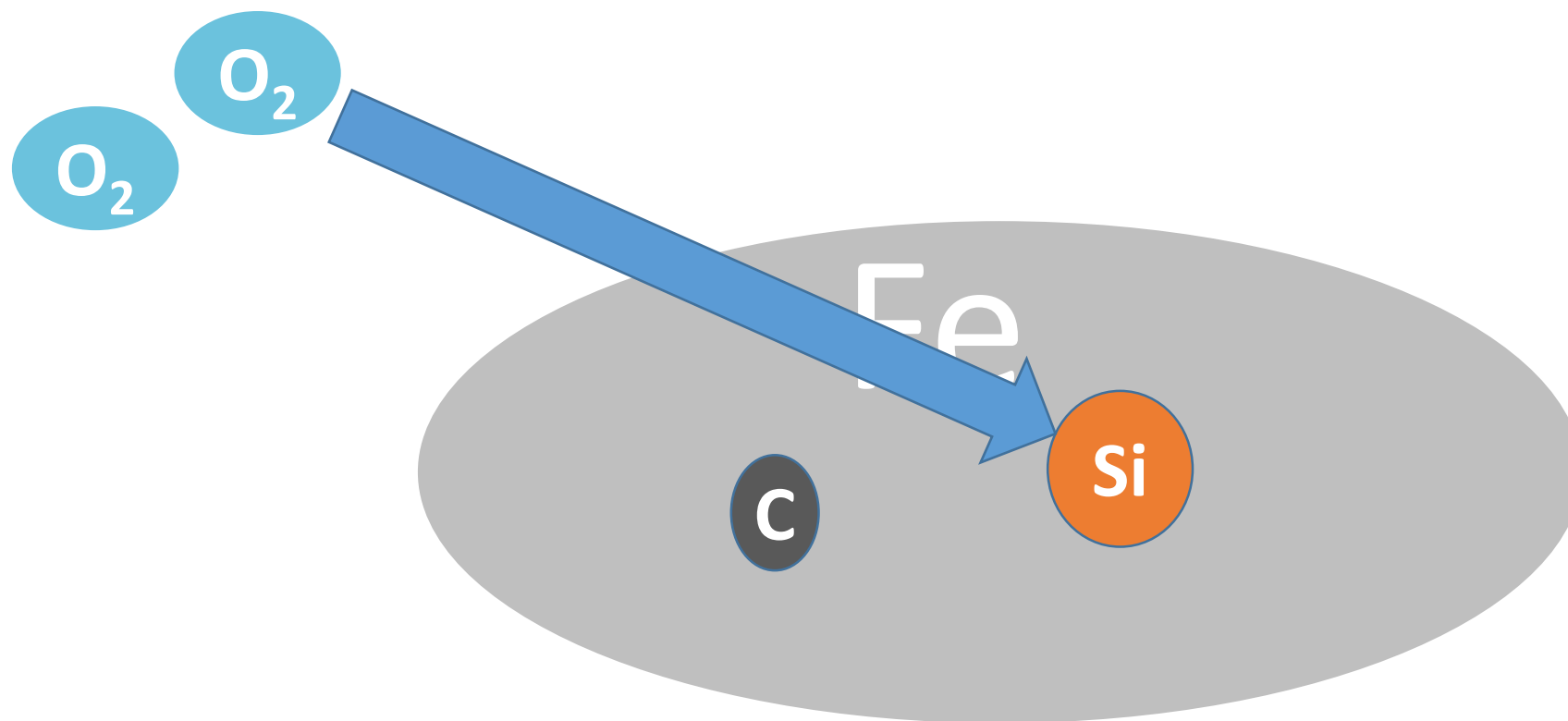
Step 4: Purification or Refining of Metal: iv. Oxidative Refining

Q. What is Oxidation?

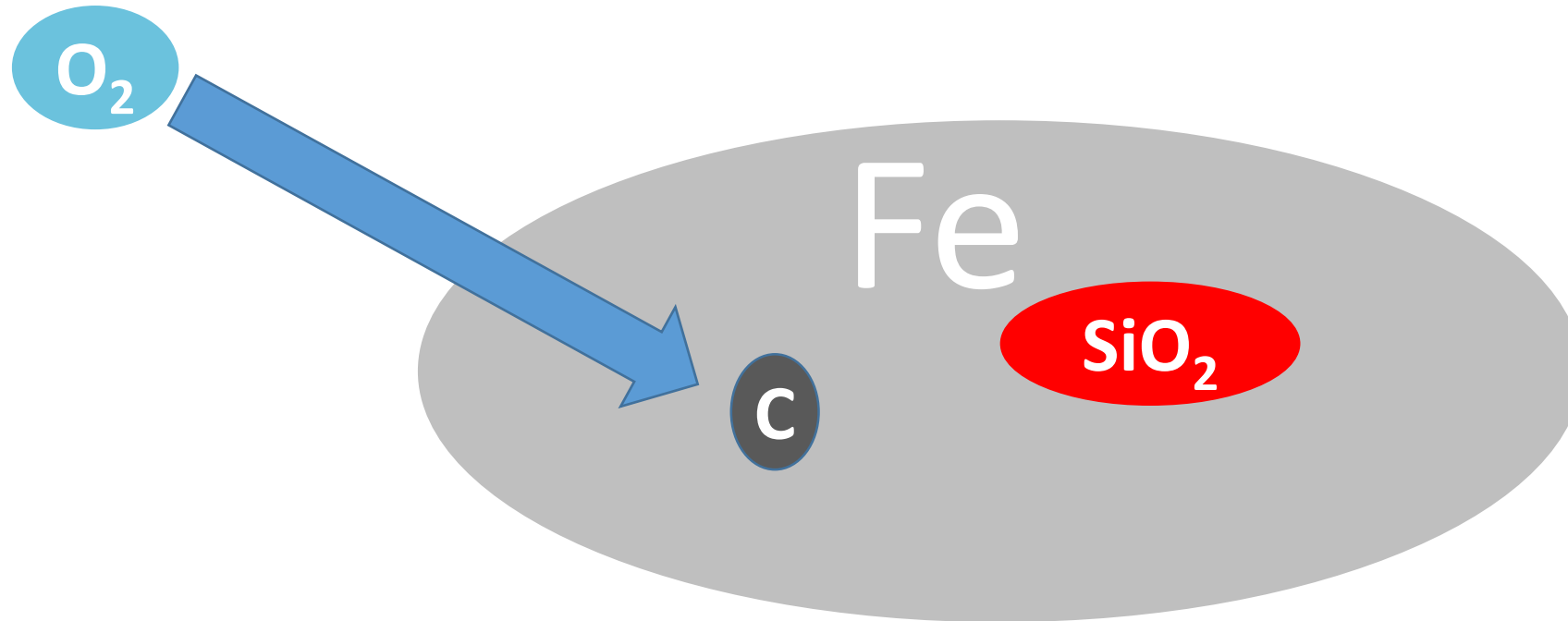
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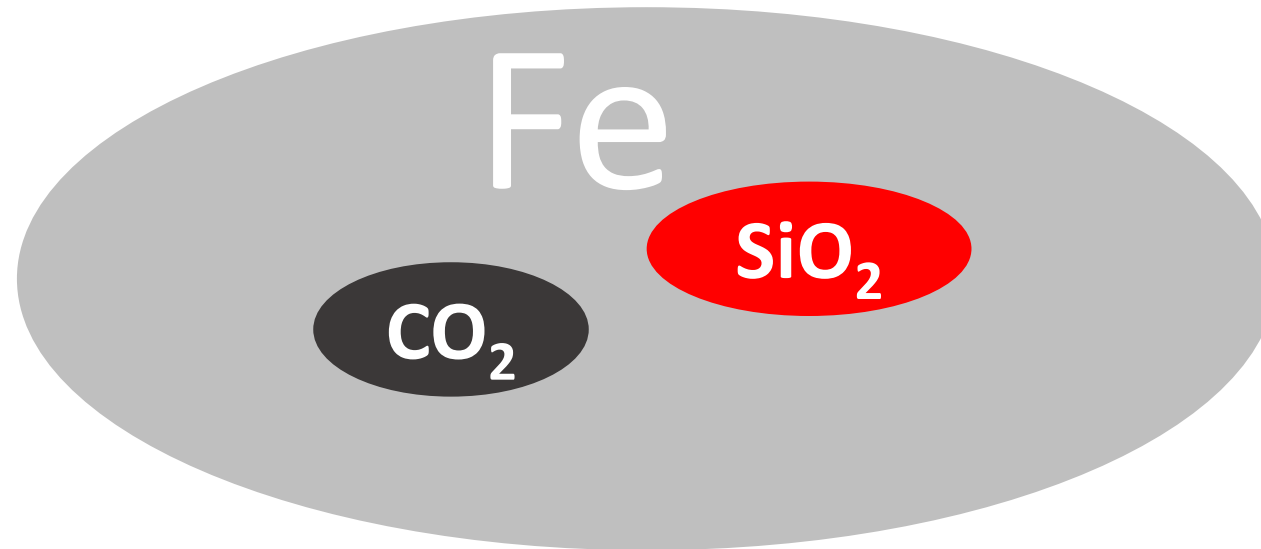
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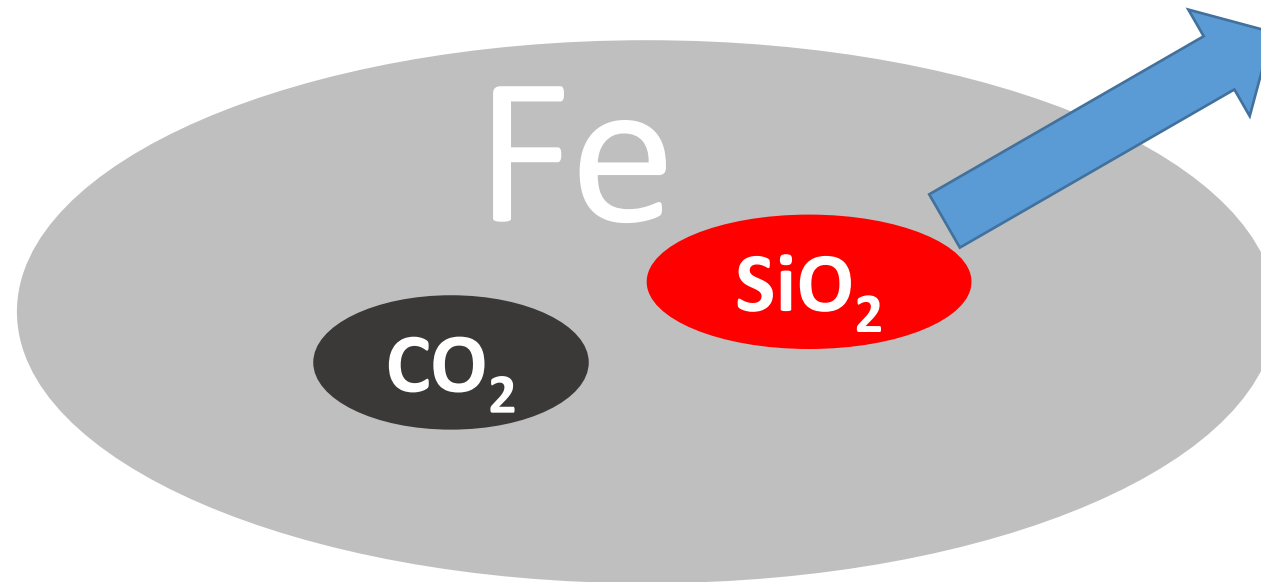
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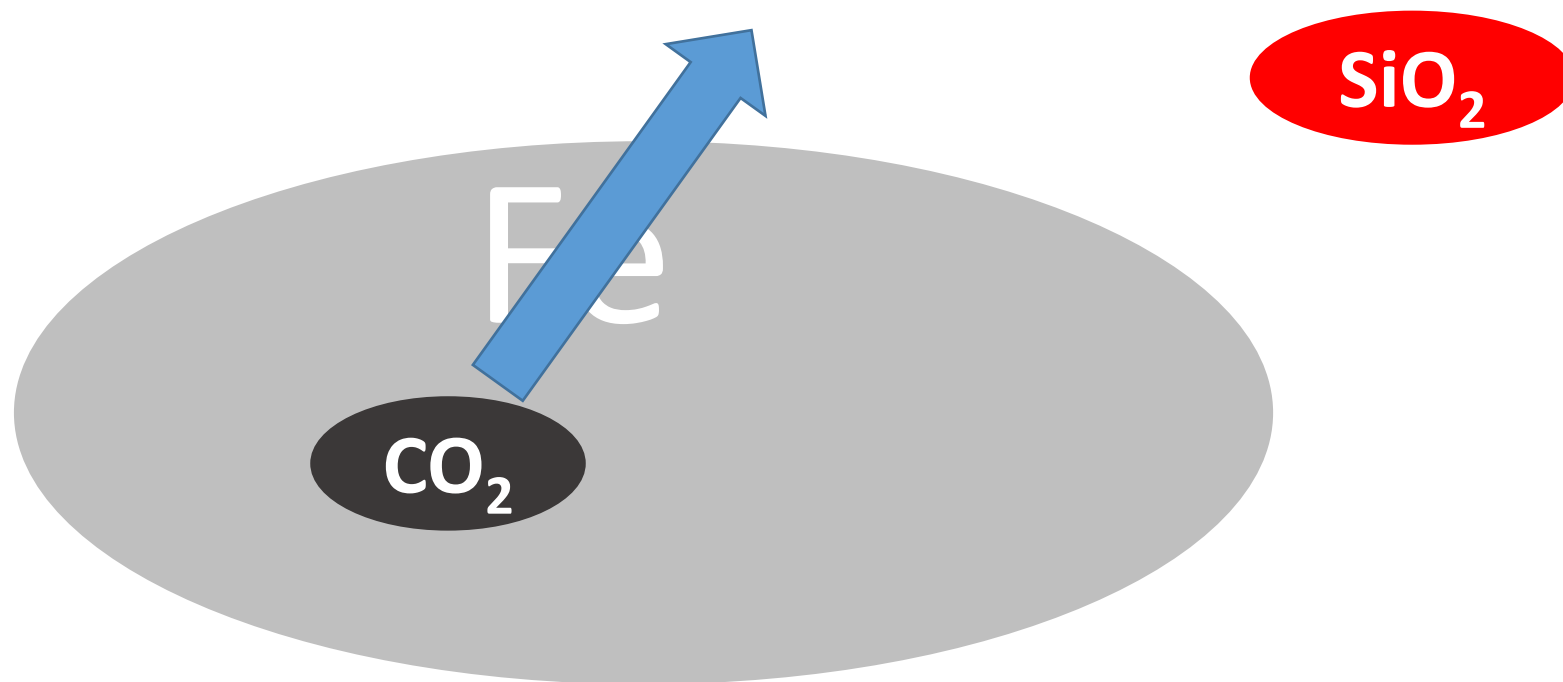
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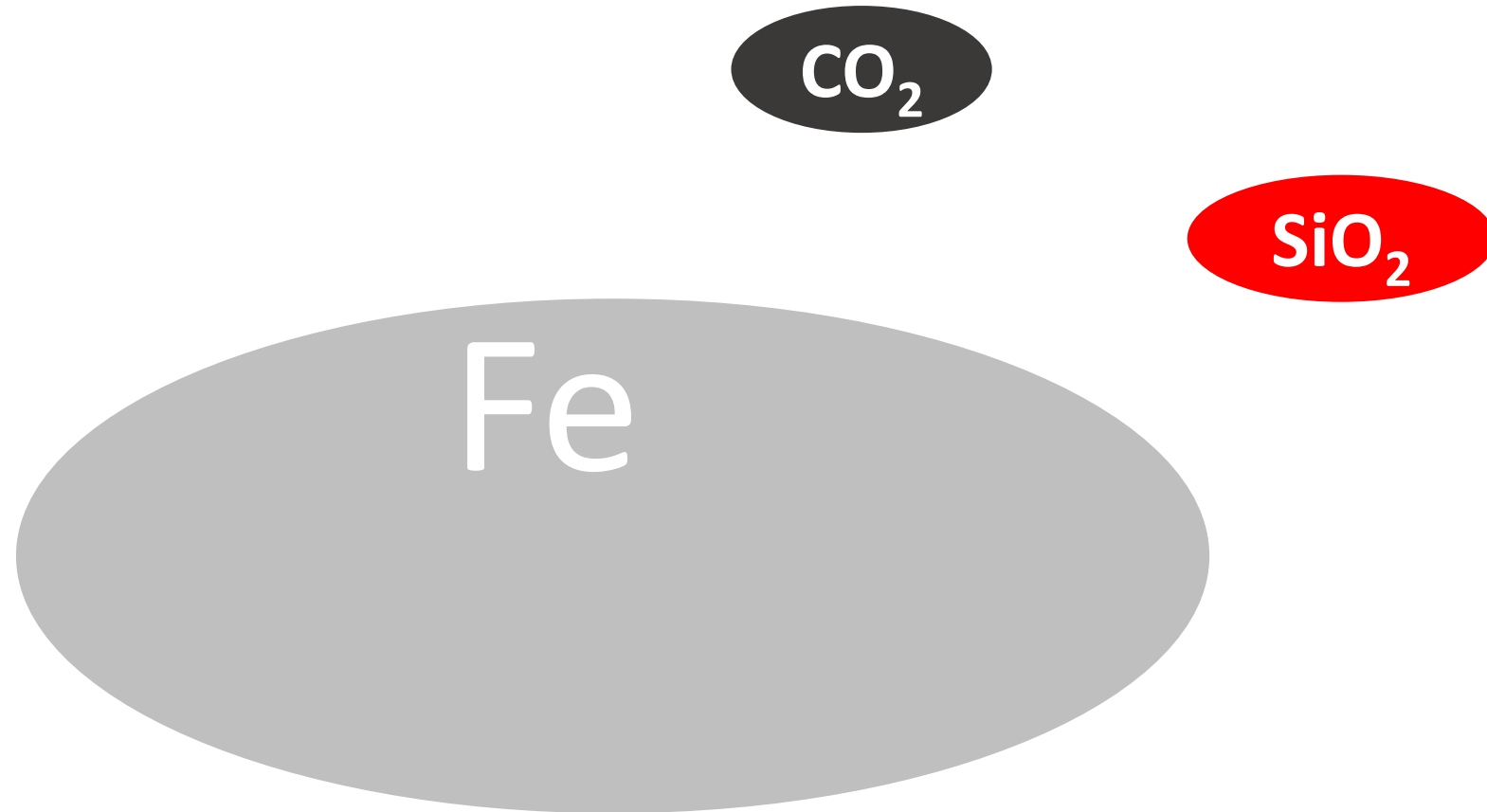
Step 4: Purification or Refining of Metal: iv. Oxidative Refining



Step 4: Purification or Refining of Metal: iv. Oxidative Refining



Step 4: Purification or Refining of Metal: iv. Oxidative Refining



Step 1: Dressing of Ores

a. Hand Picking

b. Crushing and Grinding of Ore

Step 2: Concentration of Ores

- a. Froth Floatation Process
- b. Gravity Separation or Levitation
- c. Magnetic Separation
- d. Leaching

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- b. Distillation Method**
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4 Steps to extract metals:

- *3rd & 4th Steps*