

# Metallurgy

## Question1

Which of the following are carbonate ores?

I. Siderite

II. Kaolinite

III. Calamine

IV. Sphalerite

AP EAPCET 2025 - 26th May Morning Shift

Options:

A.

I, II only

B.

II, III only

C.

I, III only

D.

II, IV only

**Answer: C**

**Solution:**



I. Siderite ( $\text{FeCO}_3$ ) and (III)

Calamine ( $\text{ZnCO}_3$ ) are carbonate ions.

II. Kaolinite :  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$

[Aluminium ore]

IV. Sphalerite : (Zn, Fe) S [sulphur ore]

Thus I and III are carbonate ore.

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## Question2

**Which of the following methods is useful for producing semiconductor grade metals of high purity?**

**AP EAPCET 2025 - 26th May Evening Shift**

**Options:**

A.

Liquation

B.

Vapour phase refining

C.

Electrolytic refining

D.

Zone refining

**Answer: D**

**Solution:**

Zone refining is useful for producing semiconductor grade metals of high purity. In this method, materials are repeatedly melted and solidifying narrow zone of a substance. As molten zone more along the material, impurities tends to dissolve in molten region leaving pure solid as it solidifies.

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# Question3

Which of the following is not associated with water molecules ?

AP EAPCET 2025 - 24th May Morning Shift

Options:

A.

Cryolite

B.

Bauxite

C.

Kernite

D.

Borax

**Answer: A**

**Solution:**

Let's analyze each option in terms of whether it contains **water of crystallization** or is associated with **water molecules**:

1. **Cryolite ( $\text{Na}_3\text{AlF}_6$ )**

→ This compound does **not** contain water molecules. It is **anhydrous** (no water of crystallization).

*Not associated with water molecules.*

2. **Bauxite ( $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$ )**

→ This is a **hydrated form of alumina**, i.e. it **does contain water molecules**.

– Associated with water.

3. **Kernite ( $\text{Na}_2\text{B}_4\text{O}_7 \cdot 4\text{H}_2\text{O}$ )**

→ This is **hydrated sodium borate**, contains **crystallization water**.

– Associated with water.

#### 4. Borax ( $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ )

→ This also contains **crystal water**.

– Associated with water.

**Correct Answer: Option A — Cryolite**

**Reason:** Cryolite ( $\text{Na}_3\text{AlF}_6$ ) is **not associated with water molecules**.

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## Question4

Match the following

List-I (Process)		List-II (Metal)	
(A)	Hall-Heroult process	(I)	Ti
(B)	Mond process	(II)	In
(C)	van-Arkel process	(III)	Al
(D)	Zone refining process	(IV)	Ni

**The correct answer is**

### AP EAPCET 2025 - 24th May Morning Shift

**Options:**

A.

A-IV, B-III, C-I, D-II

B.

A-III, B-I, C-IV, D-II

C.

A-II, B-III, C-IV, D-I

D.

A-III, B-IV, C-I, D-II



**Answer: D**

## Solution:

Let's match each process with the metal it is primarily associated with:

- Hall-Heroult process:** This is a major industrial process for the primary production of **aluminum (Al)**. It involves the electrolytic reduction of alumina ( $\text{Al}_2\text{O}_3$ ) dissolved in molten cryolite.
  - So, (A) Hall-Heroult process matches with (III) Al.
- Mond process:** This process is used for the purification of **nickel (Ni)**. Impure nickel is reacted with carbon monoxide to form volatile nickel tetracarbonyl  $[\text{Ni}(\text{CO})_4]$ , which is then decomposed at a higher temperature to yield pure nickel.
  - So, (B) Mond process matches with (IV) Ni.
- van-Arkel process:** This process is used for the ultra-purification of metals like **titanium (Ti)**, zirconium (Zr), and hafnium (Hf). The metal is converted into a volatile compound (e.g., iodide) and then decomposed to yield a very pure metal.
  - So, (C) van-Arkel process matches with (I) Ti.
- Zone refining process:** This method is used for obtaining highly pure metals, especially for semiconductors, by exploiting the difference in solubility of impurities in the molten and solid states of the metal. Metals like germanium (Ge), silicon (Si), gallium (Ga), and **indium (In)** are purified by this method.
  - So, (D) Zone refining process matches with (II) In.

Combining these matches:

- A-III
- B-IV
- C-I
- D-II

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## Question5

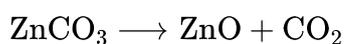
**Which of the following reactions is an example of roasting?**

**AP EAPCET 2025 - 23rd May Evening Shift**

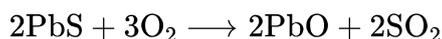
**Options:**

A.





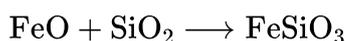
B.



C.



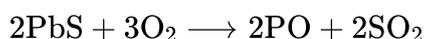
D.



**Answer: B**

### **Solution:**

Reaction given in option (b),



is an example of Roasting.

When an sulphide ore is heated in presence of oxygen/air, it is called as roasting.

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## **Question6**

**Consider the following.**

**Statement-I** In the extraction of Al by Hall-Heroult process, pure  $\text{Al}_2\text{O}_3$  mixed with  $\text{Na}_3\text{AlF}_6$  lowers its melting point and increases conductivity.

**Statement-II** Zirconium metal is purified by zone refining method.

**The correct answer is**

**AP EAPCET 2025 - 23rd May Morning Shift**

**Options:**

A.



Both statement-I and statement-II are correct.

B.

Both statement-I and statement-II are not correct.

C.

Statement-I is correct, but statement-II is not correct.

D.

Statement-I is not correct, but statement-II is correct.

**Answer: C**

## Solution:

### Statement I

In the extraction of Al by the Hall–Héroult process, pure  $\text{Al}_2\text{O}_3$  mixed with  $\text{Na}_3\text{AlF}_6$  lowers its melting point and increases conductivity.

True.

- In the Hall–Héroult process, pure alumina ( $\text{Al}_2\text{O}_3$ ) has a very high melting point ( $\sim 2050^\circ\text{C}$ ).
- It is dissolved in molten cryolite ( $\text{Na}_3\text{AlF}_6$ ) and sometimes small quantities of  $\text{CaF}_2$  are also added.
- The cryolite mixture **lowers the melting point** to around  $950\text{--}1000^\circ\text{C}$  and **increases the electrical conductivity** of the electrolyte.

Hence, **Statement I is correct.**

### Statement II

Zirconium metal is purified by zone refining method.

Incorrect.

- The **zone refining** method is used for metals that need to be extremely pure and are **less reactive**, such as *silicon, germanium, gallium, indium, etc.*
- **Zirconium** (and hafnium) are purified by the **van Arkel (iodide) process**, not by zone refining.
- This process involves conversion of crude Zr into volatile  $\text{ZrI}_4$ , which then decomposes on a hot filament to yield pure zirconium metal.

Hence, **Statement II is not correct.**

Final Answer:

**Option C — Statement I is correct, but Statement II is not correct.**

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## Question7

Which of the following is used as froth stabilizer in froth floatation process?

AP EAPCET 2025 - 22nd May Evening Shift

Options:

A.

Xanthate

B.

Aniline

C.

Pine oil

D.

NaCN

**Answer: B**

**Solution:**

Aniline is used as froth stabiliser in froth floatation process.

Aniline stabilise the froth, allowing desired mineral particle to bubble and be separated from the impurity in the ore slurry.

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## Question8

In the extraction of iron from haematite, the impurity ( $x$ ) of the ore is removed in the form of ' $y$ ', what are  $x$  and  $y$  respectively?



# AP EAPCET 2025 - 22nd May Morning Shift

## Options:

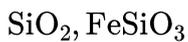
A.



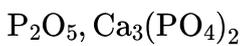
B.



C.



D.



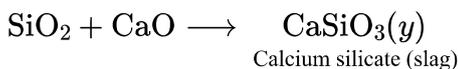
**Answer: A**

## Solution:

Haematite =  $\text{Fe}_2\text{O}_3$

The main impurity =  $\text{SiO}_2(x)$

This  $\text{SiO}_2$  is treated with calcium oxide



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## Question9

Which of the following sets are correctly matched?

	Metal	Refining Process
I.	Hg	Distillation
II.	Cu	Poling
III.	B	Zone refining
IV.	Ti	Liquation



# AP EAPCET 2025 - 21st May Evening Shift

## Options:

A.

I, III and IV only

B.

I, II and III only

C.

II, III and IV only

D.

I, II, III and IV

**Answer: B**

## Solution:

### I. Hg (Mercury) - Distillation

Distillation is a refining process used for volatile metals with low boiling points. Mercury is a liquid metal at room temperature and has a relatively low boiling point (356.7 °C), making it suitable for purification by distillation to separate it from non-volatile impurities.

This match is **correct**.

### II. Cu (Copper) - Poling

Poling is a pyrometallurgical refining process used to remove small amounts of oxygen from molten copper (blister copper). In this process, green wood logs are stirred into the molten copper. The hydrocarbons in the wood act as reducing agents, converting cuprous oxide ( $\text{Cu}_2\text{O}$ ) to metallic copper.

This match is **correct**.

### III. B (Boron) - Zone refining

Zone refining is a purification technique used for producing extremely pure metals and metalloids, especially for semiconductor applications. It works on the principle that impurities are more soluble in the molten state than in the solid state. Boron is a metalloid, and ultra-pure boron is vital for certain applications. Zone refining is indeed a method used for the purification of boron, as well as silicon and germanium.

This match is **correct**.

### IV. Ti (Titanium) - Liquation

Liquation is a refining process suitable for metals with low melting points that can be separated from higher melting point impurities (e.g., tin, lead). Titanium, however, has a very high melting point (1668 °C). Its refining typically involves methods like the Kroll process (to produce titanium sponge) followed by electron beam melting or vacuum arc remelting for further purification. Liquation is not appropriate for titanium.

This match is **incorrect**.

Based on the evaluation, pairs I, II, and III are correctly matched.

The final answer is **B**

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## Question10

**Kaolinite, a form of clay is the ore of metal  $x$  and malachite is the ore of metal  $y$ ,  $x$  and  $y$  respectively are**

### AP EAPCET 2025 - 21st May Morning Shift

**Options:**

A.

Cu, Zn

B.

K, Cu

C.

Al, Cu

D.

Zn, Al

**Answer: C**

**Solution:**

Kaolinite :  $\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$

$x$  = Aluminium ore

Malachite :  $\text{Cu}_2\text{CO}_3(\text{OH})_2$



$y =$  Copper ore

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## Question11

The alloy that contains copper and Zn is  $x$  and the one that contains copper and Ni is  $y$ . What are  $x$  and  $y$  respectively?

AP EAPCET 2025 - 21st May Morning Shift

Options:

A.

Brass, Bronze

B.

Bronze, 'Silver' UK coin

C.

German silver, Bronze

D.

Brass, 'Silver' UK coin

**Answer: D**

**Solution:**

Alloy of copper and zinc = Brass ( $x$  alloy)

Alloy of copper and nickel = Cupronickel ( $Y$  alloy) used for UK silver coins.

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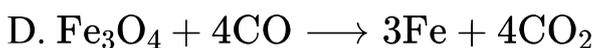
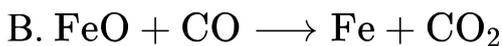
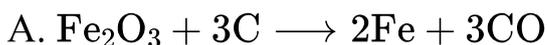
## Question12

In the extraction of iron, the reaction which occurs at 900 – 1500 K in the blast furnace is



## AP EAPCET 2024 - 23th May Morning Shift

Options:

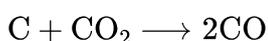


**Answer: B**

**Solution:**

During the extraction of iron in a blast furnace, the critical reactions occurring at temperatures between 900-1500 K are:

The reaction between carbon and carbon dioxide to produce carbon monoxide:



The reduction of iron(II) oxide by carbon monoxide:



These reactions are integral to the iron extraction process, as the carbon monoxide produced acts as a reducing agent, facilitating the transformation of iron ore into metallic iron.

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## Question13

**In which of the following metals extraction, impurities are removed as slag?**

**i. Al**

**ii. Fe**

**iii. Cu**

**iv. Zn**

**The correct option is**



## AP EAPCET 2024 - 22th May Morning Shift

**Options:**

A. i, ii, iv only

B. i, ii only

C. ii, iii only

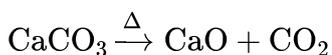
D. ii, iii, iv only

**Answer: C**

**Solution:**

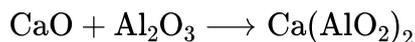
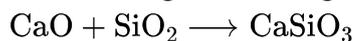
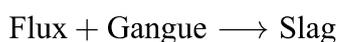
In the extraction of certain metals, impurities are removed as slag. Specifically, this process is used in the extraction of iron (Fe) and copper (Cu).

During this process, lime (calcium carbonate,  $\text{CaCO}_3$ ) is used and, upon heating, it decomposes into calcium oxide (CaO) and carbon dioxide ( $\text{CO}_2$ ):



The calcium oxide produced reacts with the impurities in the ore, commonly known as gangue, to form slag. This slag is a combination of compounds such as calcium silicate ( $\text{CaSiO}_3$ ) and calcium aluminate ( $\text{Ca}(\text{AlO}_2)_2$ ).

These reactions can be represented as:



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## Question14

**The flux used in the preparation of wrought iron from cast iron in reverberatory furnace is**

## AP EAPCET 2024 - 21th May Evening Shift

**Options:**

A.  $\text{SiO}_2$

B.  $\text{CaCO}_3$

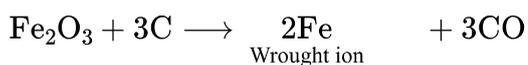
C. C

D. NaCN

**Answer: B**

**Solution:**

Wrought iron is prepared from cast iron by oxidising impurities in a reverberatory furnace lined with haematite.



Lime stone ( $\text{CaCO}_3$ ) is added as a flux, to remove sulphur, silicon and phosphorous impurities.

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## Question15

**The type of iron obtained from blast furnace in the extraction of iron is**

**AP EAPCET 2024 - 20th May Evening Shift**

**Options:**

A. wrought iron

B. pig iron

C. cast iron

D. steel

**Answer: B**

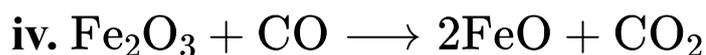
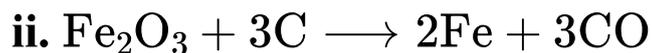
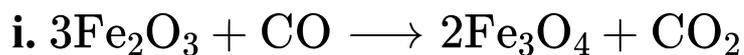
**Solution:**

In the extraction of iron, the type of iron obtained from a blast furnace is pig iron. Pig iron typically contains approximately 92% iron (Fe) and a carbon content ranging from 3.5% to 4.5%.

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## Question16

**The reactions which occur in blast furnace at 500 – 800 K during extraction of iron from haematite are**



### **AP EAPCET 2024 - 20th May Morning Shift**

**Options:**

A. i, ii, iii, iv

B. i, ii, iii only

C. i, iv only

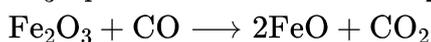
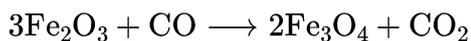
D. i, ii, iv only

**Answer: D**

**Solution:**

In extraction of iron from hematite ore, hot air is blown from bottom of blast furnace so that coke is to give high temperature of 2200 K .

At upper part of furnace, at 500 – 800 K, iron get reduced by CO .



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## **Question17**

**Lithium forms an alloy with ' X '. This alloy is used to make armour plates. What is ' X ' ?**

## AP EAPCET 2024 - 18th May Morning Shift

**Options:**

- A. Mg
- B. Pb
- C. Al
- D. Cr

**Answer: A**

**Solution:**

The alloy that is made up of lithium and magnesium is used to make amount plates.

In this alloy magnesium is around 84% and lithium is around 16%. It is very hard and light weight.

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## Question18

**Which one of the following sets in not correctly matched?**

## AP EAPCET 2024 - 18th May Morning Shift

**Options:**

- A. Cuprite, haematite - oxide ores
- B. Calamine, siderite - carbonate ores
- C. Magnetite. matachite - sticate ores
- D. Sphalerite, fool's gold - sulphide ores

**Answer: C**

**Solution:**

Let's analyze each option:

Option A:



Cuprite is a copper oxide (formula:  $\text{Cu}_2\text{O}$ ).

Haematite is an iron oxide (formula:  $\text{Fe}_2\text{O}_3$ ).

Both are oxide ores, so this match is correct.

Option B:

Calamine is a historical name used for zinc carbonate minerals like smithsonite (formula:  $\text{ZnCO}_3$ ).

Siderite is an iron carbonate (formula:  $\text{FeCO}_3$ ).

Both belong to the carbonate ore group, so this match is correct.

Option C:

Magnetite is an iron oxide (formula:  $\text{Fe}_3\text{O}_4$ ).

The term “matachite” is questionable and “sticate ores” is not a standard classification.

Magnetite belongs to oxide ores, not a supposed “sticate” category.

Therefore, this match is incorrect.

Option D:

Sphalerite is a zinc sulphide (formula:  $\text{ZnS}$ ).

“Fool's gold” refers to pyrite, which is an iron sulphide (formula:  $\text{FeS}_2$ ).

Both are sulphide ores, making this match correct.

Based on the above, the incorrectly matched set is in Option C.

Answer: Option C.

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## Question19

**The two major constituents of Portland cement are**

**AP EAPCET 2022 - 5th July Morning Shift**

**Options:**

A.  $\text{CaO}$ ,  $\text{SiO}_2$

B.  $\text{CaO}$ ,  $\text{Al}_2\text{O}_3$

C.  $\text{SiO}_2$ ,  $\text{MgO}$

D. CaO, MgO

**Answer: A**

## Solution:

The two major constituents of Portland cement are:

**Option A:** CaO, SiO<sub>2</sub>

Portland cement primarily consists of lime (calcium oxide, CaO) and silica (silicon dioxide, SiO<sub>2</sub>). These two components contribute to the strength and durability of the cement. While other oxides like Al<sub>2</sub>O<sub>3</sub> and Fe<sub>2</sub>O<sub>3</sub> are also present in Portland cement, they are not considered as major constituents compared to CaO and SiO<sub>2</sub>.

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## Question20

**A compound A is used in paints instead of salts of lead. Compound A is obtained when a white compound B is strongly heated. Compound B is insoluble in water but dissolves in NaOH solution forming a solution of compound C. The compound A on heating with coke gives a volatile metal D and a gas E which burns with a blue flame. Identify the possible species D and C can be respectively?**

### AP EAPCET 2021 - 19th August Morning Shift

**Options:**

A. D = Hg, C = Hg(OH)<sub>2</sub>

B. D = Cd, C = Na<sub>2</sub>(CdO<sub>2</sub>)

C. D = Zn, C = Na<sub>2</sub>ZnO<sub>2</sub>

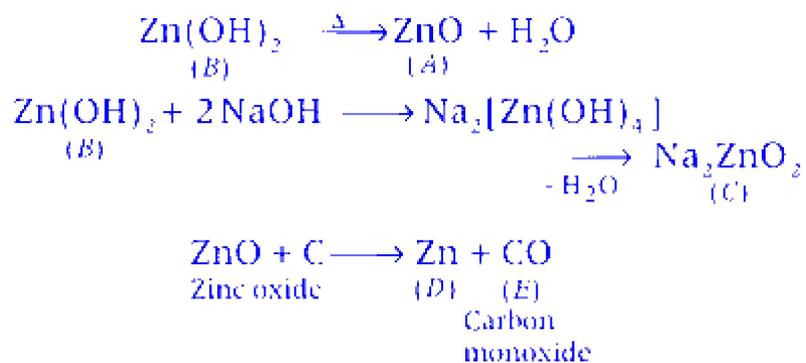
D. D = Zn, C = Zn(OH)<sub>2</sub>

**Answer: C**

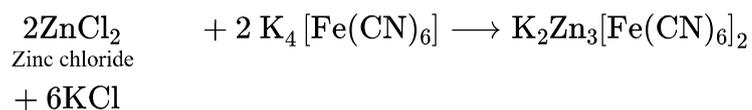
## Solution:

Reaction,





Hence,  $\text{ZnO} + \text{HCl} \longrightarrow \text{ZnCl}_2 + \text{H}_2\text{O}$



$\therefore$  D is Zn(zinc) and C is  $\text{Na}_2\text{ZnO}_2$ .

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