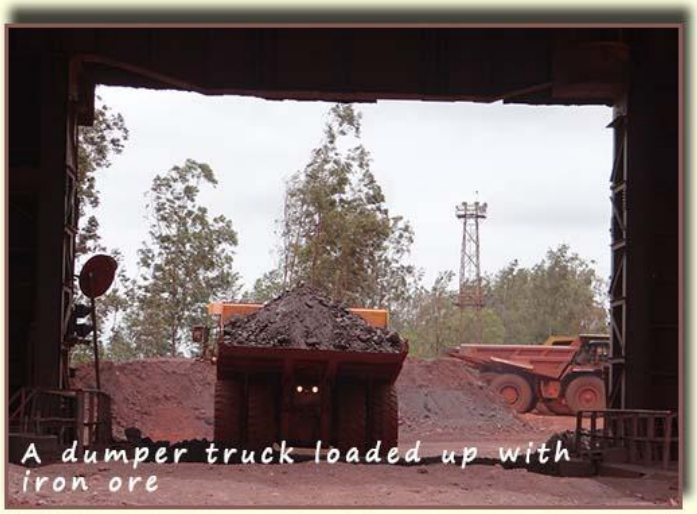
Answer the following questions then check your answers

1. What is a metal ore?

2. What do the words oxidation and reduction mean?

3. Haematite is a common ore of iron. It consists mainly of iron oxide.


A dumper truck loaded up with iron ore

i. Iron is a metal found around the middle of the reactivity series. Below are two equations which show the reduction of iron oxide to metallic iron.

Equation 1 Iron oxide + carbon ⟶ iron + carbon dioxide

Equation 2 Iron oxide + hydrogen ⟶ iron + hydrogen oxide

ii. Explain why only equation 1 above will produce iron, why does equation 2 not produce any iron?

4. Iron is traditionally extracted from its ore in a blast furnace, shown opposite.


Iron is traditionally extracted from its ore in a blast furnace

i In the blast furnace iron oxide is reduced to iron by carbon monoxide. Write a word equation to show this reaction.

ii. The carbon monoxide needed to produce iron in the furnace forms when carbon reduces carbon dioxide to form the carbon monoxide. Write a word and balanced symbolic equation to show this reaction.

5. The method used to extract a metal from its ore depends on the reactivity of the metal. This is shown in the table below.

a. Name 3 metals that can only be extracted by electrolysis.

b. zinc oxide (ZnO) can be obtained from its ore by heating with carbon. Write a word and symbolic equation to show this reaction.

c. When lead sulfide (PbS) is heated it forms lead oxide (PbO) and sulfur dioxide gas. The lead oxide can be reduced to lead by heating with carbon.

i. write word and symbolic equations for these 2 reactions.

metal	Method used to extract the metal
Potassium	Electrolysis of the molten compound
Sodium	
Lithium	
Magnesium	
Aluminium	
Carbon	Heat the metal ore with carbon
zinc	
Iron	
Tin	
lead	
hydrogen	Heat the metal ore with carbon or hydrogen
Copper	
Silver	
gold	Found as a pure element in the earth.
platinum	

6. What is the difference between a high and low grade metal ore?

7. An old chemical works is to be demolished and the land reused to build houses on. What would be a suitable method to decontaminate the land of any heavy metal residues left by the chemical factory?

a. What are the advantages and disadvantages of this method used to decontaminate the land?

Answers

1. What is a metal ore?

   A rock that contains a high enough % of metal to make it profitable to extract it.

2. What do the words oxidation and reduction mean?

   Reduction: remove oxygen

   Oxidation: add oxygen

3. Haematite is a common ore of iron. It consists mainly of iron oxide.

i. Iron is a metal found around the middle of the reactivity series. Which of the equations below will reduce iron oxide to iron?

   Equation 1 Iron oxide + carbon ⟶ iron + carbon dioxide

   Equation 2 Iron oxide + hydrogen ⟶ iron + hydrogen oxide

   Equation 2 will work and produce iron because carbon is above iron in the reactivity series, equation 1 will NOT produce any iron because hydrogen is less reactive than iron.

ii. Iron is a metal found around the middle of the reactivity series. Below are two equations which show the reduction of iron oxide to metallic iron.

   Hydrogen is a less reactive than iron so cannot be used to displace it from iron oxide.

4. Iron is traditionally extracted from its ore in a blast furnace.

i In the blast furnace iron oxide is reduced to iron by carbon monoxide. Write a word equation to show this reaction.

Iron oxide + carbon monoxide ⟶ iron + carbon dioxide

ii. The carbon monoxide needed to produce iron in the furnace forms when carbon reduces carbon dioxide to form the carbon monoxide. Write a word and balanced symbolic equation to show this reaction.

Carbon dioxide + carbon ⟶ carbon monoxide

$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$

5. The method used to extract a metal from its ore depends on the reactivity of the metal. This is shown in the table below.

a. Name 3 metals that can only be extracted by electrolysis.

Any 3 from Potassium, sodium, lithium, magnesium, aluminum

metal	Method used to extract the metal
Potassium	Electrolysis of the molten compound
Sodium	
Lithium	
Magnesium	
Aluminium	
Carbon	Heat the metal ore with carbon
zinc	
Iron	
Tin	
lead	
hydrogen	Heat the metal ore with carbon or hydrogen
Copper	
Silver	
gold	Found as a pure element in the earth.
platinum	

b. zinc oxide (ZnO) can be obtained from its ore by heating with carbon. Write a word and symbolic equation to show this reaction.

Word equation

Zinc oxide + carbon ⟶ Zinc + carbon dioxide

Symbolic equation:

$ZnO + C \longrightarrow Zn + CO_2$

c. When lead sulfide (PbS) is heated it forms lead oxide (PbO) and sulfur dioxide gas. The lead oxide can be reduced to lead by heating with carbon.

i. write word and symbolic equations for these 2 reactions.

Lead sulfide ⟶ lead oxide + sulfur dioxide

$PbS \longrightarrow PbO + SO_2$

Lead oxide + carbon ⟶ lead + carbon dioxide

$2PbO + C \longrightarrow 2Pb + CO_2$

6. What is the difference between a high and low grade metal ore?

High grades ores contain a high% of metal, low grades ores contain little metal

7. An old chemical works is to be demolished and the land reused to build houses on. What would be a suitable method to decontaminate the land of any heavy metal residues left by the chemical factory? Phytomining would be a suitable method to clear the contaminated ground.

a. What are the advantages and disadvantages of this method used to decontaminate the land?

- Plants are slow growing and growth depends on weather conditions so is unpredictable. Also may take many years to clear a large contaminated area of land.
- More environmentally friendly and cheaper than simply digging up the contaminated land and taking it to landfill.