Name:_____ ( ) Class:_____ Date:_____

WORKSHEET

Chapter 14: Metals

14.1 Metals and Alloys

Metals

1. Metals are characterised by normally being shiny, strong solids with _____ melting points, which are _____ conductors of heat and _____.

2. Metals are _____ conductors of electricity because the _____ electrons in metallic atoms are not bound to any particular atom. The _____ ions of the metal are surrounded by a _____. Mobile electrons allow metals to conduct _____ and _____.

3. Metals have high _____, _____ and _____. This is because the atoms in metal are packed _____ in _____ and held together by _____. A large amount of _____ is required to break these bonds.

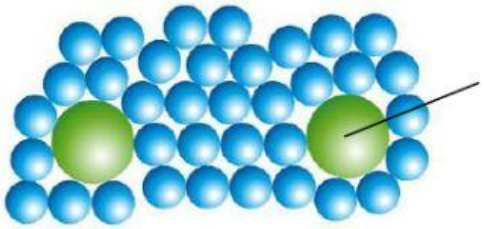
4. Metals are _____ and _____ because their atoms are of the same size and are closely packed in neat _____. When a _____ is applied, the layers _____ over one another.

Alloys

1. The properties of a particular metal can be improved if it is mixed with another element. We call these mixtures _____.

2. Compared to pure metals, _____ are _____ and _____, have a better _____, have _____ melting points and are _____ resistant to corrosion.

3. The atoms of a metal are arranged in regular _____. However if another element is added, this prevents the atoms from _____ one another. Thus, alloys tend to be _____ and _____ than pure metals.



Different sized atom of another element prevents atoms from _____ _____ one another.

4. When zinc is added to copper the alloy formed is much _____ than pure copper. This alloy is called _____.

5. Another _____ of copper is _____ which consists of copper (90%) and tin (10%). The presence of _____ makes the copper _____ and less likely to corrode.

14.2 The Reactivity Series

1. In the reactivity series, metals are arranged from the _____ reactive to the _____ reactive.

2. Reaction of metals with cold water:

Potassium	Reacts _____. Highly _____. H_2 burns with a _____ flame. $2K(s) + 2H_2O(l) \rightarrow 2$_____$(aq) + H_2(g)$
Sodium	Reacts _____. Highly _____. H_2 burns with a _____ flame. $2Na(s) + 2H_2O(l) \rightarrow 2$_____$(aq) + H_2(g)$
Calcium	Reacts _____. $Ca(s) + 2H_2O(l) \rightarrow$ _____
Magnesium	Reacts _____. $Mg(s) + 2H_2O(l) \rightarrow$ _____
No reaction with zinc, iron, lead, copper and silver.	

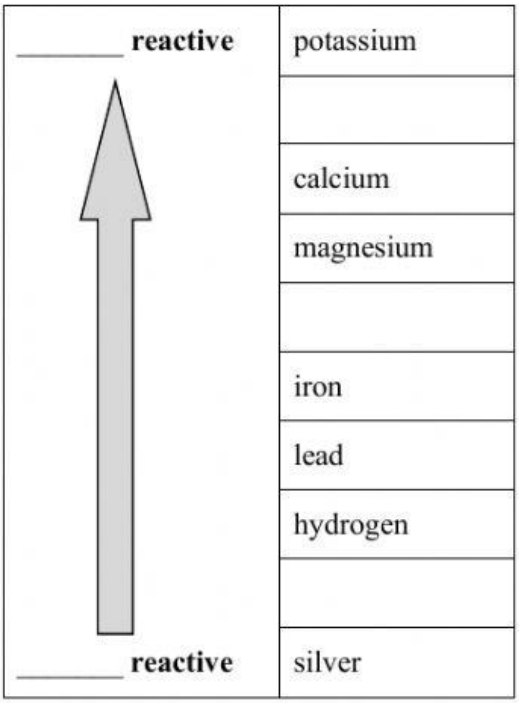
3. Reaction of metals with steam:

Potassium	Reacts explosively. This reaction should not be carried out in the school laboratory.
Sodium	
Calcium	
Magnesium	Reacts _____ to produce a white glow. $Mg(s) + H_2O(l) \rightarrow$ _____ $+ H_2(g)$
Zinc	Reacts _____. ZnO formed is yellow when hot, white when cold. $Zn(s) + H_2O(l) \rightarrow$ _____
Iron	Reacts _____. $Fe(s) + 4H_2O(l) \rightarrow Fe_3O_4(s) + H_2(g)$
No reaction with lead, copper and silver.	

4. Reaction of metals with dilute hydrochloric acid:

Potassium **Sodium**	Reacts _____. $2K(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2(g)$ $2Na(s) + 2HCl(aq) \rightarrow$ _____
Calcium	Reacts _____. $Ca(s) + 2HCl(aq) \rightarrow CaCl_2(aq) +$ _____
Magnesium	Reacts _____. $Mg(s) + 2HCl(aq) \rightarrow$ _____ $+ H_2(g)$
Zinc	Reacts _____. $Zn(s) + 2HCl(aq) \rightarrow$ _____
Iron	Reacts _____. _____
No reaction with lead, copper and silver.	

5. Metals at the top of the reactivity series, like _____ and _____ react violently with cold water. As you go down the series metals like _____ and _____ will only react with steam. Metals below lead, like _____, have no reaction at all with water or steam and will not displace _____ from water or steam.



6. With dilute hydrochloric acid, the metals at the top of the series react very _____. As we go down the series, they react with decreasing ease. Metals below _____ in the series, like _____, will not displace hydrogen from dilute hydrochloric acid.

14.3 Using the Reactivity Series

1. The reactivity series is related to the _____ of a metal to form _____ ions. Reactive metals tend to form _____ ions easily by _____ electrons and forming compounds. Unreactive metals prefer to remain uncombined as _____ of the element.

2. One application of the reactivity series is the ability to predict the _____ power of a metal. A metal is capable of displacing another metal _____ in the reactivity series from its _____, or from its _____ solution.

3. Metal oxides that are _____ in the reactivity series are easier to reduce to the metal with carbon or hydrogen.

4. The _____ a metal is, the _____ it is to decompose its carbonate by heat. Carbonates of reactive metals are stable to heat. Carbonates of _____ metals decompose to form oxides of the metals and _____ _____.

14.4 Extracting Metals

1. Most metals are found in the ground combined with non-metals like _____, sulfur or carbon. These compounds are called _____.

2. Metals in their combined states, such as metal oxides, metal sulfides, metal chlorides and metal carbonates can be extracted by:
   - _____ with carbon, i.e. _____ the metal compound with carbon;
   - _____, which is using _____ to decompose the molten metal compound.

3. The stability of an ore of a metal higher up the reactivity series is _____ than one which is lower down. Therefore, it is much more _____ to extract sodium metal from its ore than it is to extract copper metal from its ore.

4. Every time a metal is extracted from its ore it involves _____ of the metal because the metal has to _____ electrons.

5. Metals which are _____ up in the reactivity series require strong reduction of their ores. This is usually achieved by _____. Middle order metals, such as _____, can be reduced by heating strongly with _____. Metals at the bottom of the reactivity series can be extracted from their ores simply by _____.

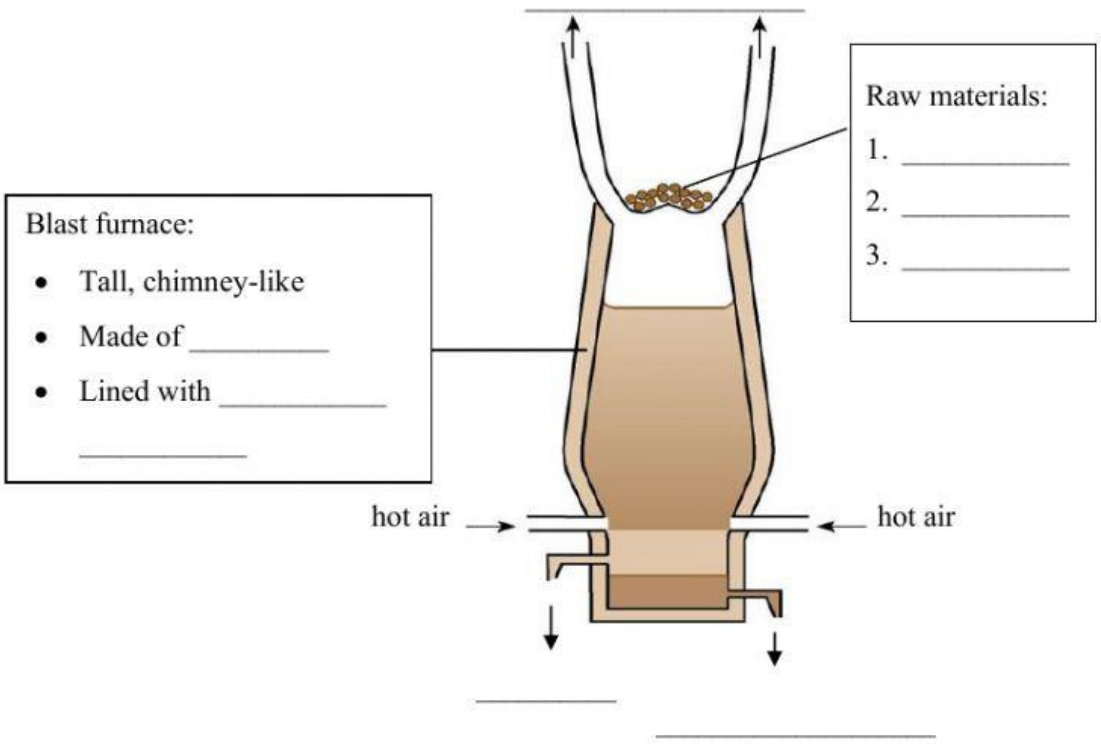
6. Some metals like _____ are so unreactive they occur in the ground as the metal itself.

Extraction of Iron

1. Iron is extracted from its ores like _____ (Fe_2O_3) in the blast furnace.

2. The furnace is charged at the top with three raw materials — _____, _____ and _____.

3.



Chemical Reactions in the Blast Furnace

1. Production of carbon dioxide

   Coke burns in hot air. Carbon dioxide is produced. Heat is given off as the reaction is highly _____ and the temperature in this part of the furnace rises to 1900°C.

   $$C(s) + O_2(g) \rightarrow \_\_\_\_\_$$

2. Production of carbon monoxide

   Carbon dioxide reacts with hot _____ to produce _____.

   $$CO_2(g) + C(s) \rightarrow \_\_\_\_\_$$

3. Reduction of iron ore

Carbon monoxide gas is a powerful _____ and it reduces the iron ore at the top of the furnace to molten iron. The molten iron falls to the bottom of the furnace where it is tapped off.

$$Fe_2O_3(s) + 3CO(g) \rightarrow \_\_\_\_\_$$

4. Removal of impurities

The _____ present in the furnace helps to remove impurities. The main impurity in the iron is sand (_____). Inside the furnace, the _____ (calcium carbonate) decomposes to _____ (calcium oxide) and _____.

$$CaCO_3(s) \rightarrow \_\_\_\_\_$$

Calcium oxide reacts with _____ from sand in iron ore to form calcium silicate, also known as _____. Slag floats on top of _____ and is used in _____.

$$CaO(s) + SiO_2(s) \rightarrow \_\_\_\_\_$$

Carbon dioxide escapes as _____ from the top of the furnace together with _____ and _____.

14.5 Uses of Steel

1. The iron produced in the blast furnace is _____ and contains impurities of mainly _____ and other non-metals. It is called _____ or pig iron. Such iron is very brittle and has limited uses. Most of this iron is converted into _____.

2. Steel is produced in a _____. Here under high pressure _____ is blown into the molten cast iron. This oxidises the _____ like carbon and sulfur to gases which then escape. Other impurities like phosphorus and silicon are converted into _____ which can be neutralised by the addition of a base such as _____.

3. When all the impurities have been _____ we are left with a very pure form of iron called _____.

4. Calculated amounts of _____ are then added to produce the various steels. _____ is low carbon steel and contains about _____ carbon. It is _____ and therefore easy to shape. It is ideal for making _____ and machinery.

5. The more carbon that is added, the _____ the steel becomes. This is because the carbon impurity strengthens the iron lattice, making it more difficult for the atoms to _____ one another. High carbon steel contains between 0.5 to 1.5% carbon and is _____ but_____. It is used for making _____ and _____ tools.

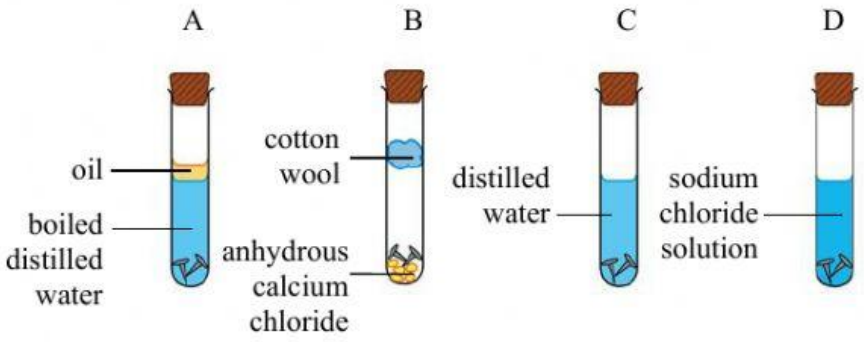
6. Other alloys of steel are also made by the addition of the correct amount of the appropriate metal. Stainless steel contains iron, carbon, _____ and _____. It is attractive and very resistant to_____. It is therefore useful in making _____, _____ and equipment in chemical plants.

14.6 Rusting

1. The essential conditions for the rusting (_____) of iron are the presence of _____ and _____. This results in the flaky brown coating, commonly called rust but chemically known as _____ ($Fe_2O_3.xH_2O$). The presence of _____ and _____ substances speed up rusting.

$$4Fe(s) + 3O_2(g) + 2xH_2O(l) \rightarrow \_\_\_\_\_$$

2. In which test tube will the nails be most heavily rusted after one week?



	Rust
	No rust

	Rust
	No rust

	Rust
	No rust

	Rust
	No rust

The nails in test tube ___ will be most heavily rusted.

2. Prevention of rusting can be achieved by placing a barrier around the metal. Examples are _____, greasing, covering with _____ and _____.

3. An alternative way of preventing rusting is by _____. A more reactive metal (like magnesium or _____) is attached to the iron object. The more reactive metal _____ in preference to the iron.

4. Sacrificial protection is useful with underground steel or iron objects like _____ or _____ in petrol stations. These are difficult to paint and grease, but it is easy to attach a piece of _____ or _____ to such objects.

5. Rusting can also be prevented by using rust-resistant alloys such as _____.