Question 1 Name one metal which has a low melting point?

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Question 9 Why metals are used for making bells?

Question 1 What happens when metals react with chlorine?

Question 2 What happens when metals react with hydrogen?

**Reaction of metal with chlorine**

Metals react with chlorine to form ionic chlorides.  
2Na(s) + Cl2(g) —–> 2 NaCl(s)

Ca (s) + Cl2(g) —–> CaCl2

Mg (s) + Cl2(g) —-> MgCl2

**Reaction of metals with hydrogen**

Most of the metals do not combine with hydrogen.Only a few reactive metals like sodium,potassium,calcium and magnesium react with hydrogen to form metal hydrides

Question 1 What is an alloy?

Question 2 Give two examples of alloys?

Question 3 How are the properties of an alloy different from those of the constituent metals?

Question 4 What elements are present in steel?

Question 5 What are the constituents of stainless steel?

Question 6 State an alloy of copper?

 Question 7 Give the constituent of brass?

Question 8 Name an alloy of tin and lead?

Question 9 How is an alloy made?

Question 10 What is an amalgam?

Question 11 How many carats is pure gold?

Question 12 Why is pure gold not suitable for making ornaments?

Question 13 What is meant by 22 carat gold?

Alloys  
The various properties of metals can be improved by mixing other metals in it.  
The homogeneous mixture of two or more metals is called alloy.

Duralumin is an alloy of Al,Cu,Mg,Mn

Steel is an alloy of C,Fe

Pure iron is very soft and stretches when hot but with c it forms steel which is hard and strong.  
  
Stainless steel is a mixture of Fe,Cr,Ni.It is very strong and do not rust.It is used in making cooking utensils,surgical instruments,dairy industry etc.

Brass is a mixture of Cu and Zn.

Bronze is a mixture of Cu and Tin.It is tough,resistant to corrosion,used to make statues,coins,medals,utensils.

**The properties of alloys are different from the properties of constituent metals.**  
1)Alloys are stronger than the metal which they are made.  
2)More resistant to corrosion.  
3)Have lower melting point .  
4)Have lower electrical conductivity.

An alloy is prepared by mixing various metals in molten state in required proportion and then cooling their mixture to the room temperature.

Amalgam:An alloy of mercury metal with one or more other metal is called amalgam.  
Solution of sodium metal in liquid mercury is called sodium amalgam.  
Purity of gold is expressed in carats.  
Pure gold is 24 carats.It is very soft due to which it is not suitable for jewellery.  
22 carats of gold consist of 22 parts of gold and 2 parts of copper.

Question 1 Define the term corrosion?

Question 2 What is meant by rusting of iron?

Question 3 State the conditions necessary for rusting of iron?

Question 4 State the ways to prevent the rusting of iron?

Question 5 Name the metal used for galvanising iron?

Question 6 Why copper objects lose their shine after sometime?

Question 7 Why silver articles became black when exposed to air?

Question 8 Why gold ornaments look new even after several years of use?

**Corrosion**

The eating up of metals by the action of air,moisture or a chemical on their surface is called corrosion.

The **copper objects lose their shine after sometime** due to the formation of copper oxide on them.When a copper object reacts with moist carbon dioxide,it loses its shiny brown surface and gains a green coat(basic copper oxide which is a mixture of copper carbonate and copper hydroxide)

**Silver articles became black** after sometime when exposed to air because it react with sulphur in air to form a coating of silver sulphide.

**The corrosion of iron is called rusting**.When an iron object is left in damp air for a considerable time,it gets covered with a red brown flaky substance called rust.  
Rust is hydrated iron(III) oxide.The formula of rust is Fe2O3.nH2O  
The two conditions necessary for rusting of iron is presence of air and water.  
 **Prevention of rusting**  
1)By painting  
2)BY applying grease or oil.  
3)**By galvanisation**:The process of depositing a thin layer of zinc metal on iron.  
4)By tin plating and chromium plating.  
5)By alloying it

Question 1 What is meant by refining of metals?

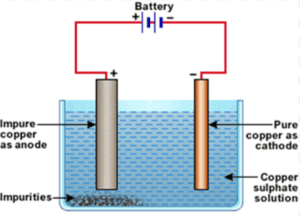
Question 2 Define the term electrolytic refining?

Question 3 How will you refine copper by electrolytic refining?

**Refining**  
The process of purifying impure metal is called **refining of metal.**  
The most important and most widely used method for refining impure metals is called**electrolytic refining.**  
Many metals like **copper,zinc,tin,lead,nickel,silver,gold** are refined electrolytically.  
For the refining of an impure metal by electrolysis:  
1)A thick block of impure metal is made anode(It is connected to the positive terminal of the battery)  
2)A thin strip of the pure metal is made cathode(It is connected to the negative terminal of the battery)  
3)A water soluble salt(of the metal to be refined)is taken as electrolyte.

On passing electric current,impure metal dissolves from the anode and goes into the electrolytic solution.And pure metal from the electrolyte deposits on the cathode.The soluble impurities present in the impure metal go into the solution whereas the insoluble impurities settle down at the bottom of the anode as anode mud.

**Electrolytic refining of copper**

  
1)The electrolytic tank containing acidified copper sulphate solution as electrolyte.  
2)A thick block of impure copper metal is made anode.  
3)A thin strip of pure copper metal is made cathode.

On passing electric current,impure copper from the anode dissolves and goes into copper sulphate solution and pure copper from copper sulphate deposits on cathode.Thus pure copper metal is produced on the cathode.The soluble impurities go into the solution whereas insoluble impurities collect below the anode as **anode mud.**  
At cathode

Cu2+ + 2 e– —> Cu

At anode

Cu – 2 e–—–> Cu2+

Question 1 Name one ore of mercury and zinc?

Question 2 Give the chemical formula of ore of iron and copper?

Question 3 Name one metal which is extracted by reduction with carbon?

Question 4 Name one metal which is extracted by electrolytic reduction?

Question 5 Name one metal which is extracted by reduction with aluminium?

Question 6 How is copper extracted from copper glance.Give equations involved?

Question 7 How is mercury extracted from cinnabar.Give equations involved?

Question 8 Differentiate between calcination and roasting?

Question 9 How are the less reactive metals extracted?

Question 10 How are the highly reactive metals extracted?

Question 11 How does the method of extracting a metal from its ore depend on the position in the reactivity series?

**Conversion of ore into metal**  
a) The less reactive metals are extracted by reduction of their oxides by heat alone.  
For Ex:Copper and mercury  
1)**Ore of mercury is cinnabar**  
Mercury oxide is reduced to mercury on heating.

HgS(s) + 3 O2 (g) —–> 2 HgO (s) + 2 SO2(g)

2 Hg(s) ——> 2 Hg(l) +  O2 (g)

**2)Ore of copper is copper glance**

2 Cu2S (s)  + 3 O2 (g) —–> 2 Cu2O (s) + 2 SO2 (g)

2 Cu2O (s) + Cu2S (s) —-> 6 Cu (s) + SO2 (g)

b) Moderately reactive metals(Cu,Zn,Pb,Cu)are present as carbonate or sulphides in nature.

1)**Concentrated ore is converted to metal oxide**  
The carbonate or sulphide ore is first converted to oxides by the process of calcination or roasting.

|  |  |
| --- | --- |
| Calcination | Roasting |
| 1) It is the process by which a carbonate ore is heated strongly in the absence of air to convert into metal oxide. | It is a process in which sulphide ore is heated in the presence of air to convert into metal oxide. |
| 2) ZnCO3—->ZnO + CO2 | 2ZnS—->2ZnO+2 SO2+ 3 O2 |

2)**Metal oxide are reduced to metal**

They are extracted by the reduction of their oxides with C,Al,Ca or Na.

**a)Reduction of metal oxide with carbon(Zn,Fe,Ni,Sn,Pb,Cu) as reducing agent**  
The metal oxide is mixed with carbon and heated in a furnace.Carbon reduces metal oxide to free metal.  
ZnO(s) + C(s)——->Zn(s) + CO(g)

**b)Reduction of metal oxide with aluminium**  
This is used as a reducing agent in those cases where metal oxide is of comparatively more reactivity metal than zinc.  
This is because a more reactive metal can displace a less reactive metal from its metal oxide to give free metal.  
Manganese and chromium metals are extracted by the reduction of their oxides with aluminium powder.

3 MnO2+ 4Al —>3Mn + 2 Al2O3 +heat

Fe2O3 + 2Al —->2Fe + Al2O3+ heat

The reduction of metal oxide to metal by using Al powder as reducing agent is called**Thermite process.**  
These reactions are highly exothermic.  
Metals are produced in molten state.

**c)Highly reactive metals(Na,K,Ca,Mg,Al)**  
The oxides of highly reactive metals are very stable and cannot be reduced by carbon or aluminium.  
They are extracted by electrolytic refining of their of molten oxides or chlorides.  
It is brought about by passing electric current through molten salt.During electrolysis metals are deposited at cathode(negatively charged electrode)and chlorine is liberated at anode(positively charged electrode)

NaCl(l) —> 2Na(s) + Cl2(g)  
At cathode  
Na++ e– —> Na  
At anode

2Cl —> Cl2+ 2 e–

Al2O3(l)–> 4 Al(s) +3 O2(g)

At Cathode

Al3++ 3 e––>Al

At anode

2O2-– 4 e–—> O2

Question 1 Why most of the metals do not occur as free elements?

Question 2 What are minerals?

Question 3 Define the term ore?

Question 4 Define the term metallurgy?

Question 5 Define the term extraction?

Question 6 Name the three steps of metallurgy?

Question 7 What is gangue?

Question 8 What do you mean by concentration of ore?

**Occurrence of Metals**  
Most of the metals are quite reactive and hence they do not occur as free elements in nature but in the form of their compounds.  
The compounds of metals are present in the form of oxides,sulphides,carbonates,chlorides.  
The natural material in which the metals or their compounds are found in earth are called**minerals**.  
Some of the minerals may contain a large percentage of metal whereas others may contain only a small percentage .  
Those minerals from which metals can be extracted conveniently and profitably are called**ores.**  
All ores are minerals but all minerals are not ores.

|  |  |
| --- | --- |
| **Metals** | **Ore** |
| Sodium | Rock Salt |
| Aluminium | Bauxite |
| Manganese | Pyrolusite |
| Zinc | Calamine  Zinc blende |
| Iron | Hematite |
| Copper | Cuprite  Copper glance |
| Mercury | Cinnabar |

The metals at the bottom of activity series are least reactive and are often found in free state.

Metals at the top of activity series are reactive and never found in free state.

To obtain a metal from its ore is called **extraction** of metal.

The processes involved in the extraction of metal from their ores and refining is called **metallurgy**.

The three steps of metallurgy are:

1)Concentration of ore

2)Conversion of ore into metal

3)Refining of impure metal.

Concentration of ore  
The unwanted impurities such as sand,rocky material,earthy particles etc present in an ore are called **gangue.**  
The method for removing gangue from ore depend on some differences in physical or chemical properties of ore and gangue.

Question 1 Define covalent bond?

Question 2 Why non-metals form covalent bond?

Question 3 What is a single covalent bond.Give example?

Question 4 What is a double covalent bond.Give example?

Question 5 What is a triple covalent bond.Give example?

Question 6 Give few properties of covalent compounds?

Covalent bond  
The chemical bond formed by sharing of electrons between two atoms is called covalent bond.  
Non-metals have usually 5,6 or 7 electrons in the outermost shells of their atoms.So non-metals need electrons to achieve to achieve inert gas configuration.They get these electrons by mutual sharing.  
Covalent bonds are of 3 types:  
1)Single covalent bond:It is formed by sharing of one pair of electron between two atoms.  
For Ex:Formation of chlorine ,Hydrogen,Hydrogen chloride,Methane molecule etc.

2)Double covalent bond:It is formed by sharing of two pair of electron between two atoms.  
For Ex:Oxygen,Carbondioxide,Ethene molecule etc.

3)Triple Covalent bond:It is formed by sharing of three pair of electron between two atoms.  
For Ex:Nitrogen,Ethyne molecule etc.  
  
Properties of covalent compound  
1)Covalent compounds are usually liquids or gases.Only some of them are solids.  
2)Covalent compounds have usually low melting and low boiling point.  
3)Covalent compounds are usually insoluble in water but they are soluble in organic solvents.  
4)They do not conduct electricity.

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Question 9 Why metals are used for making bells?

There are 115 elements known at present.

All the elements are divided into two main groups  
1)Metals  
2)Non-metals  
  
Metals  
For Ex:Iron,Gold,Silver,copper,Aluminium,Zinc,Lead,Mercury,potassium,calcium,  
Sodium,Magnesium.

Metals are the elements which form positive ions by losing electrons.They are electropositive elements because they can form positive ions by losing electrons.  
Most abundant metals on earth crust are Al(7%),Fe(4%).

Physical properties  
1)Metals are malleable(can be beaten with hammer to form thin sheets)  
For Ex:Gold,silver,Aluminium.  
They are used in very thin sheets called foils.  
Al foils are used for packing food items.Al sheets are used to make utensils.  
Fe sheets are used to make buckets,boxes,water tanks etc.

2)Metals are ductile(Drawn into wires)  
For Ex:Cu,Al,Mg,Fe,Gold,Silver etc.  
Cu and Al are used to make electric wires,Mg wires are used in laboratory,Tungsten metals are used to make filaments of electric bulb.

3)Good conductor of heat and electricity.  
They allow heat and electricity to pass through them easily.  
For Ex:Silver,Copper,aluminium,tungsten,gold etc.  
Silver is the best conductor of heat.  
Copper and aluminium are used in cooking utensils,water boilers.  
Mercury and lead are poor conductors of heat.  
Copper and aluminium wires are used.  
Metals are good conductor of electricity because they contain free electrons.These free electrons can move easily through the metal and conduct electric current.

4)Metals are lustrous  
This means they have shiny surface.  
For Ex:Gold ,silver,copper  
The shiny appearance of metals makes them useful in making jewellery and decorative pieces.  
The metals lose their shine on keeping in air for a long time and acquire a dull appearance due to the formation of thin layer of oxide,carbonate or sulphide on their surface.

5)Metals are generally hard except Na and k.  
Fe,Cu,Al are hard and cannot be cut with a knife whereas Na and K can be easily cut with a knife.

6)Metals are solid at room temperature except mercury.

7)Metals have high melting and boiling point except Na and K.

8)Metals have high densities except Na and K.

9)Metals are sonorous ie. make sound when hit with an object.That is why they are used for making bells,strings of musical instruments.

10)They have silver or grey colour except copper which is reddish-brown and gold is yellow in colour.

Question 1 What happens when metals react with chlorine?

Question 2 What happens when metals react with hydrogen?

**Reaction of metal with chlorine**

Metals react with chlorine to form ionic chlorides.  
2Na(s) + Cl2(g) —–> 2 NaCl(s)

Ca (s) + Cl2(g) —–> CaCl2

Mg (s) + Cl2(g) —-> MgCl2

**Reaction of metals with hydrogen**

Most of the metals do not combine with hydrogen.Only a few reactive metals like sodium,potassium,calcium and magnesium react with hydrogen to form metal hydrides.

Question 1 Name one non-metal which is used to preserve food materials? Question 2 Name one non-metal which is used to make electrodes of dry cell?

Question 3 Name one non-metal which is used in the manufacture of sulphuric acid?

Uses of Non-metals  
1)Hydrogen is used in the hydrogenation of vegetable oil to make vegetable ghee,manufacture of ammonia.  
2)Liquid hydrogen is used as rocket fuel.  
3)Carbon is used in the manufacture of electrolytic cell and dry cell.  
4)Nitrogen is used in the manufacture of ammonia,nitric acid and fertilisers.  
5)Sulphur is used for manufacturing sulphuric acid,gun powder,vulcanisation of rubber.

Question 1 What happen when carbon react with oxygen?

Question 2 What happen when sulphur react with oxygen?

**Reaction Of Non-Metals with oxygen**  
Non-Metals react with oxygen to form acidic oxides or neutral oxides.  
Carbon form an acidic oxide carbon dioxide.  
Sulphur form an acidic oxide sulphur dioxide.  
Hydrogen form a neutral oxide water.  
The acidic oxides of non-metals turn blue litmus solution to red.

C(s) + O2 (g) ——> CO2 (g)

CO2 (g) + H20 (l) —–> H2CO3 (aq)

S (s) + O2 (g) ——> SO2 (g)

SO2 (g) + H20 (l) —–> H2SO3 (aq)

Reaction of non-metal with water  
They do not react with water to evolve hydrogen gas.

Reaction of non-metals with acids  
They do not react with dilute acids.They do not displace hydrogen from acids.

Reaction of Non-metals with salt solution  
A more reactive non-metal displaces a less reactive non-metal from its salt solution.

Reaction of Non-metal with chlorine  
Non-Metals react with chlorine to form covalent chlorides which are non-electrolytes.

Reaction of Non-metals with hydrogen  
Non-Metals react with hydrogen to form covalent hydrides.

Question 1 Name the metal which is used in making thermometers?

Question 2 Name the metal which are used in making electric wires?

Question 3 Name three metal which are used in atomic energy?

Question 4 Name the metal which are used in making jewellery?

Question 5 Name the metal which are used in making house hold utensils?

Uses of Metals

1)Cu and Al metals are used to make wires because they are good conductors.

2)Fe,Cu and Al metals are used to make house hold utensils and factory equipments.  
3)Zn is used for galvanising iron to protect it from rusting.  
4)The Al foils are used in packaging of medicines,cigarettes and food material.  
5)Gold and Silver are used to make jewellery.  
6)Mercury is used in thermometers.  
7)Na,Ti,Zr are used in atomic energy.

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Question 1 Name the metal which has been placed at the top of reactivity series?

Question 2 Name the metal which has been placed at the bottom of reactivity series?

Question 3 Which of the two metals is more reactive:Copper or silver?

Question 4 What happens when sodium react with HCl?

Question 5 What happens when magnesium react with HCl?

Question 6 What happens when aluminium react with HCl?

Question 7 What happens when zinc react with HCl?

Question 8 What happens when iron react with HCl?

Question 9 Write an equation for reaction of sodium with sulphuric acid?

Question 10 Write an equation for reaction of zinc with sulphuric acid?

Question 11 Write an equation for reaction of magnesium with sulphuric acid?

Question 12 What is an activity series?

**Reaction of metals with dilute acids**

Metals usually displace hydrogen from dilute acids.

Less reactive metal(Cu,Au,Ag) do not displace hydrogen from dilute acid.

2Na+2HCl——>2NaCl + hydrogen (react violently)

Mg(s) + + 2 HCl (aq) —–> MgCl2(aq) + H2 (g)

Al(s) + 6 HCl (aq) —-> AlCl3(aq) + 3 H2 (g)

Zn(s) + 2 HCl (aq) —-> ZnCl2 (aq) + H2 (g)

Fe (s) + 2 HCl (aq) —-> FeCl2 (aq) + H2 (g)

Silver and gold do not react with dilute acids.

The metals like Cu,Au,Ag are less reactive than hydrogen.They do not displace hydrogen from dilute acids.

Those metals which are above in the reactivity series displace hydrogen from dilute acids.

2Na (s) + H2SO4 (aq) ——> Na2SO4(aq) + H2 (g)

Mg (s) + H2SO4 (aq) ——> MgSO4(aq) + H2 (g)

2Al (s) + 3 H2SO4 (aq) ——> Al2(SO4)3 (aq) + H2 (g)

Zn(s) + H2SO4 (aq) ——>  ZnSO4 (aq) + H2 (g)

Cu (s) + H2SO4 (aq) ——>  no reaction

When a metal react with dilute nitric acid,then hydrogen gas is not evolved.Nitric acid is a strong oxidising agent.As soon as hydrogen gas is formed in reaction between metal and dilute nitric acid,the nitric acid oxidises this hydrogen to water.Nitric acid itself is reduced to nitrogen oxides such  
as nitrogen monoxide,dinitrogen monoxide.  
The arrangement of metals in decreasing order of their reactivities is called **reactivity series or activity series** of metals.

K

Na

Ca

Al

Zn

Fe

Sn

Pb

H

Cu

Hg

Ag

This is a decreasing order of chemical reactivity.K is most reactive whereas Au is least reactive.

1)If a metal atom can lose electron easily to form positive ion,it will react rapidly with other substances and hence is a reactive metal.

2)If a metal atom losses electron less readily to form positive ion,it will react slowly with other substances and hence is less reactive metal.

3)Those metals which lose electrons more readily than hydrogen are said to be more reactive than hydrogen (metals placed above hydrogen are more reactive than hydrogen)

4)Those metals which lose electrons less readily than hydrogen are said to be less reactive than hydrogen (metals placed below hydrogen are more reactive than hydrogen)

Question 1 What happens when potassium react with water?

Question 2 What happens when sodium react with water?

Question 3 What happens when aluminium react with water?

Question 4 What happens when zinc react with water?

**Reaction of Metals with water**

Metals react with water to form hydroxide,hydrogen gas and heat is evolved.

2K +2H2O ———-> 2KOH + H2 +heat  
cold

2Na +2H2O ———-> 2NaOH + H2 +heat  
cold

2Na (s) + 2 H20 (l) —-> 2 NaOH (aq) + H2 (g) +heat

Ca(s) + 2 H20 (l) —–> Ca(OH)2 (aq) +  H2 (g)

Mg(s) + 2 H20 (l) —–> Mg(OH)2 (aq) + H2 (g)

2Al (s) + 3 H20 (l) —–> Al2O3 (s) + 3 H2 (g)

Zn (s) + H20 (l) —–> ZnO(s) + H2 (g)

3 Fe (s) + 4 H20 (l) —–> Fe3O4 (s) + 4 H2 (g)

Zn,Al,Fe react with water to form metal oxide.

The reaction of Ca with water is less violent.The heat evolved in not sufficient for hydrogen to catch fire.

Ca starts floating because bubbles of hydrogen gas formed stick to the surface of metal.

Question 1 Why sodium and potassium are stored under kerosene oil?

Question 2 Give equation for reaction of sodium with oxygen?

Question 3 Give equation for reaction of potassium with oxygen?

Question 4 What happens when sodium oxide reacts with water?

Question 5 What happens when potassium oxide reacts with water?

Question 6 What are amphoteric oxides?

**Reaction of metals with oxygen**  
When metals are burnt in air,they react with oxygen of air to form metal oxide.  
Metal oxides are basic in nature.They turn red litmus to blue.

Sodium and potassium metal are stored under kerosene oil to prevent their reaction with the oxygen,moisture and carbon dioxide of air.They are so reactive that they react vigorously with oxygen.They catch fire and start burning when kept open in the air.

4Na(s) + O2 (g) —>2 Na2O (s)

4K(s) + + O2 (g) —>2 K20 (s)  
Most of the metal oxides are insoluble in water except sodium oxide and potassium oxide.

Na2O (s) + H20 (l) —> 2NaOH (aq)

K20 (s) + + H20 (l) —–>2 KOH(aq)

2 Mg(s) + O2 (g) —–> 2MgO(s)

4Al(s) + 3 O2 (g) —-> 2 Al2O3 (s)

There are certain metal oxides which are basic as well as acidic.Those metal oxides which show acidic and basic behaviour are called as **amphoteric oxides**.

For Ex:Al and Zn metal form Al2O3  and ZnO..They are amphoteric in nature.  
Al2O3 (s) +6 HCl —->2 AlCl3 (aq) +3 H20 (l)

Basic oxide

Al2O3 (s) + 2NaOH —–> 2 Na2ZnO2 + H20 (l)

Acidic oxide

ZnO(s) + 2HCl (aq) —–> ZnCl2 (aq) + H20 (l)

Basic oxide

ZnO(s) + 2NaOH (aq) —-> Na2ZnO2 (aq) + H20 (l)

Acidic oxide

3Fe(s) + O2 (g)—–> Fe2O3 (s)

2Cu(s) + + O2 (g) —–> 2CuO(s)

Gold and silver do not react with oxygen even at high temperature.