PDF Eraser Free

Chemistry of CARBON

PDF Eraser Free

A: CARBON

Carbon is an element in Group IV(Group 4)of the Periodic table .It has atomic number 6 and electronic configuration 2:4 and thus has four valence electrons(tetravalent).It does not easily ionize but forms strong covalent bonds with other elements including itself.

(a)Occurrence

Carbon mainly naturally occurs as:

(i)allotropes of carbon i.e graphite, diamond and fullerenes.

(ii)amorphous carbon in coal, peat ,charcoal and coke.

(iii)carbon(IV)oxide gas accounting 0.03% by volume of normal air in the atmosphere.

(b)Allotropes of Carbon

Carbon naturally occur in two main crystalline allotropic forms, carbon-graphite and carbon-diamond

Carbon-diamond	Carbon-graphite
Shiny crystalline solid	Black/dull crystalline solid
Has a very high melting/boiling point because it has a very closely packed giant tetrahedral structure joined by strong covalent bonds	Has a high melting/boiling point because it has a very closely packed giant hexagonal planar structure joined by strong covalent bonds
Has very high density(Hardest known natural substance)	Soft
Abrassive	Slippery
Poor electrical conductor because it has no free delocalized electrons	Good electrical conductor because it has free 4^{th} valency delocalized electrons
Is used in making Jewels, drilling and cutting metals	Used in making Lead-pencils,electrodes in batteries and as a lubricant
Has giant tetrahedral structure	Has giant hexagonal planar structure

c)Properties of Carbon

(i)<u>Physical properties of carbon</u>

Carbon occur widely and naturally as a black solid

It is insoluble in water but soluble in carbon disulphide and organic solvents.

It is a poor electrical and thermal conductor.

(ii)<u>Chemical properties of carbon</u>

I. Burning

PDF Eraser Free

Experiment
Introduce a small piece of charcoal on a Bunsen flame then lower it into a gas jar containing Oxygen gas. Put three drops of water. Swirl. Test the solution with blue and red litmus papers.
Observation
-Carbon chars then burns with a blue flame
-Colourless and odourless gas produced
-Solution formed turn blue litmus paper faint red. Red litmus paper remains red.
Explanation
Carbon burns in air and faster in Oxygen with a blue non-sooty/non-smoky flame forming Carbon (IV) oxide gas. Carbon burns in limited supply of air with a blue non-sooty/non-smoky flame forming Carbon (IV) oxide gas. Carbon (IV) oxide gas dissolve in water to form weak acidic solution of Carbonic (IV)acid.
Chemical Equation

$C(s) + O_2(g) \rightarrow CO_2(g)$ (in excess air)

$2C(s) + O_2(g) \rightarrow 2CO(g)$ (in limited air)

$CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$ (very weak acid)

II. Reducing agent
Experiment
Mix thoroughly equal amounts of powdered charcoal and copper (II)oxide into a crucible. Heat strongly.
Observation
Colour change from black to brown
Explanation
Carbon is a reducing agent. For ages it has been used to reducing metal oxide ores to metal, itself oxidized to carbon(IV)oxide gas. Carbon reduces black copper(II)oxide to brown copper metal

Chemical Equation

$2CuO(s) + C(s) \rightarrow 2Cu(s) + CO_2(g)$
(black) (brown)

$2PbO(s) + C(s) \rightarrow 2Pb(s) + CO_2(g)$
(brown when hot/ yellow when cool) (grey)

$2ZnO(s) + C(s) \rightarrow 2Zn(s) + CO_2(g)$
(yellow when hot/ (grey)

PDF Eraser Free

white when cool)

Fe_2O_3(s) + 3C(s) -> 2Fe(s) + $3CO_2$(g)
(brown when hot/cool (grey)

Fe_3O_4 (s) + 4C(s) -> 3Fe(s) + $4CO_2$(g)
(brown when hot/cool (grey)

PDF Eraser Free

B: COMPOUNDS OF CARBON

The following are the main compounds of Carbon

(i)Carbon(IV)Oxide(CO_2)
(ii)Carbon(II)Oxide(CO)
(iii)Carbonate(IV) (CO_3^{2-})and hydrogen carbonate(IV(HCO_3^-)
(iv)Sodium carbonate(Na_2CO_3)

(i) Carbon(IV)Oxide (CO_2)

(a)Occurrence

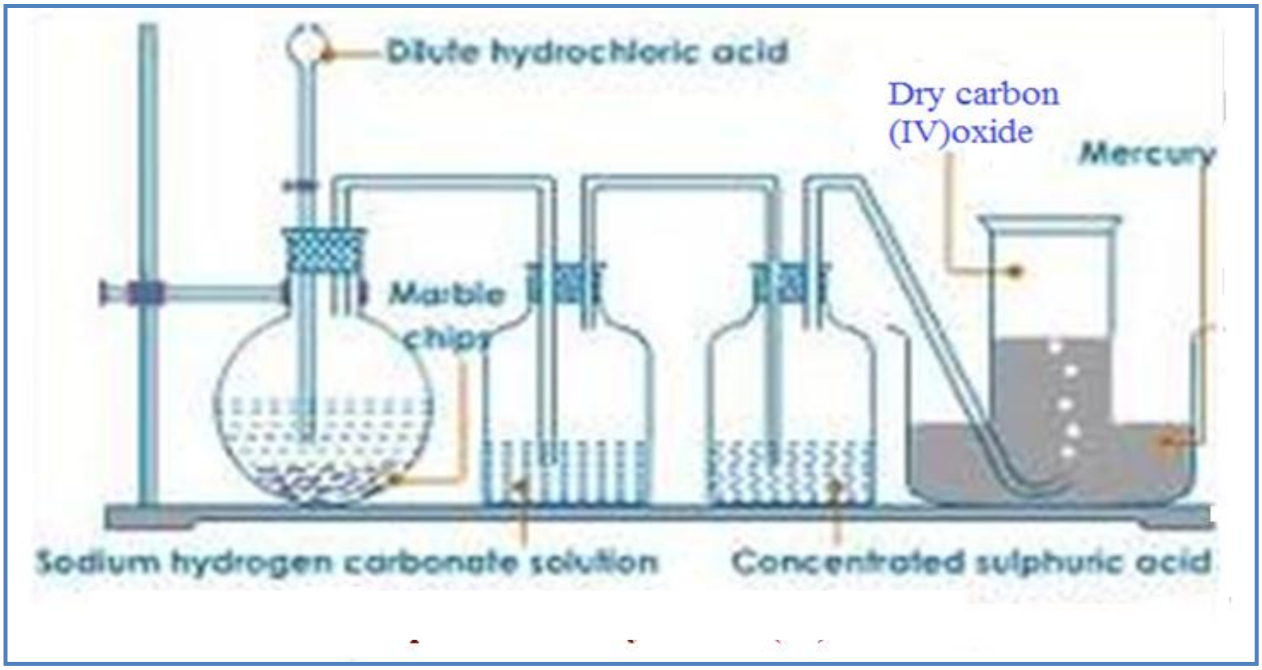
Carbon(IV)oxide is found:

-in the air /atmosphere as 0.03% by volume.
-a solid carbon(IV)oxide mineral in Esageri near Eldame Ravine and Kerita near Limuru in Kenya.

(b)School Laboratory preparation

In the school laboratory carbon(IV)oxide can be prepared in the school laboratory from the reaction of marble chips($CaCO_3$)or sodium hydrogen carbonate($NaHCO_3$) with dilute hydrochloric acid.

PDF Eraser Free



(c)Properties of carbon(IV)oxide gas(Questions)

1.Write the equation for the reaction for the school laboratory preparation of carbon (IV)oxide gas.

Any carbonate reacted with dilute hydrochloric acid should be able to generate carbon (IV)oxide gas.

<u>Chemical equations</u>

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCO_3(aq) + H_2O(l) + CO_2(g)$

$ZnCO_3(s) + 2HCl(aq) \rightarrow ZnCO_3(aq) + H_2O(l) + CO_2(g)$

$MgCO_3(s) + 2HCl(aq) \rightarrow MgCO_3(aq) + H_2O(l) + CO_2(g)$

$CuCO_3(s) + 2HCl(aq) \rightarrow CuCO_3(aq) + H_2O(l) + CO_2(g)$

$NaHCO_3(s) + HCl(aq) \rightarrow Na_2CO_3(aq) + H_2O(l) + CO_2(g)$

$KHCO_3(s) + HCl(aq) \rightarrow K_2CO_3(aq) + H_2O(l) + CO_2(g)$

2.What method of gas collection is used in preparation of Carbon(IV)oxide gas. Explain.

Downward delivery /upward displacement of air/over mercury

Carbon(IV)oxide gas is about 1½ times denser than air.

3.What is the purpose of :

(a)water?

To absorb the more volatile hydrogen chloride fumes produced during the vigorous reaction.

(b)sodium hydrogen carbonate?

PDF Eraser Free

To absorb the more volatile hydrogen chloride fumes produced during the vigorous reaction and by reacting with the acid to produce more carbon (IV)oxide gas .

Chemical equation

$NaHCO_3(s) + HCl(aq) \rightarrow Na_2CO_3(aq) + H_2O(l) + CO_2(g)$

(c)concentrated sulphuric(VI)acid?

To dry the gas/as a drying agent

4.Describe the smell of carbon(IV)oxide gas

Colourless and odourless

5. Effect on lime water.

Experiment

Bubbled carbon(IV)oxide gas into a test tube containing lime water for about three minutes

Observation

White precipitate is formed.

White precipitate dissolved when excess carbon(IV)oxide gas is bubbled .

Explanation

Carbon(IV)oxide gas reacts with lime water($Ca(OH)_2$) to form an insoluble white precipitate of calcium carbonate. Calcium carbonate reacts with more Carbon(IV) oxide gas to form soluble Calcium hydrogen carbonate.

Chemical equation

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

$CaCO_3(aq) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$

6. Effects on burning Magnesium ribbon

Experiment

Lower a piece of burning magnesium ribbon into a gas jar containing carbon (IV)oxide gas.

Observation

The ribbon continues to burn with difficulty

White ash/solid is formed.

Black speck/solid/particles formed on the side of gas jar.

Explanation

Carbon(IV)oxide gas does not support combustion/burning.Magnesium burn to produce/release enough heat energy to decompose Carbon(IV) oxide gas to carbon and oxygen.Magnesium continues to burn in Oxygen forming white Magnesium Oxide solid/ash.Black speck/particle of carbon/charcoal residue forms on the sides

PDF Eraser Free

of reaction flask. During the reaction Carbon(IV) oxide is reduced(Oxidizing agent)to carbon while Magnesium is Oxidized to Magnesium Oxide.

Chemical equation

$2Mg(s) \quad + \quad CO_2(g) \quad -> \quad C(s) \quad + \quad 2MgO(l)$

7. Dry and wet litmus papers were separately put in a gas jar containing dry carbon (IV)oxide gas. State and explain the observations made.

Observation

Blue dry litmus paper remain blue
Red dry litmus paper remain Red
Blue wet/damp/moist litmus paper turn red
Red wet/damp/moist litmus paper remain red

Explanation

Dry Carbon (IV) oxide gas is a molecular compound that does not dissociate/ionize to release $\mathbf{H^+}$ and thus has no effect on litmus papers.
Wet/damp/moist litmus papers contains water that dissolves/react with dry carbon (IV) oxide gas to form the weak solution of carbonic (IV) acid(H_2CO_3).
Carbonic (IV) acid dissociate/ionizes to a few /little free $\mathbf{H^+}$ and $\mathbf{CO_3^{2-}}$.
The few H^+ (aq) ions are responsible for turning blue litmus paper to faint red showing the gas is very weakly acidic.

Chemical equation

$H_2CO_3(aq) \quad -> \quad 2H^+(aq) \quad + \quad CO_3^{2-}(aq)$

8. Explain why Carbon (IV)oxide cannot be prepared from the reaction of:

(i) marble chips with dilute sulphuric(VI)acid.

Explanation

Reaction forms insoluble calcium sulphate(VI)that cover/coat unreacted marble chips stopping further reaction

Chemical equation

$CaCO_3(s) \quad + \quad H_2SO_4(aq) \quad -> \quad CaSO_4(\mathbf{s}) \quad + \quad H_2O(l) \quad + \quad CO_2(g)$
$PbCO_3(s) \quad + \quad H_2SO_4(aq) \quad -> \quad PbSO_4(\mathbf{s}) \quad + \quad H_2O(l) \quad + \quad CO_2(g)$
$BaCO_3(s) \quad + \quad H_2SO_4(aq) \quad -> \quad BaSO_4(\mathbf{s}) \quad + \quad H_2O(l) \quad + \quad CO_2(g)$

(ii) Lead(II)carbonate with dilute Hydrochloric acid.

Reaction forms insoluble Lead(II)Chloride that cover/coat unreacted Lead(II) carbonate stopping further reaction unless the reaction mixture is heated. Lead(II)Chloride is soluble in hot water.

Chemical equation

$PbCO_3(s) \quad + \quad 2HCl(aq) \quad -> \quad PbCl_2(\mathbf{s}) \quad + \quad H_2O(l) \quad + \quad CO_2(g)$

9. Describe the test for the presence of Carbon (IV)oxide.

PDF Eraser Free

Using burning splint
Lower a burning splint into a gas jar suspected to contain Carbon (IV)oxide gas.The burning splint is extinguished.
Using Lime water.
Bubble the gas suspected to be Carbon (IV)oxide gas.A white precipitate that dissolve in excess bubbling is formed.
<u>Chemical equation</u>

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

$CaCO_3(aq) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$

10.State three main uses of Carbon (IV)oxide gas
(i)In the Solvay process for the manufacture of soda ash/sodium carbonate
(ii)In preservation of aerated drinks
(iii)As fire extinguisher because it does not support combustion and is denser than air.
(iv)In manufacture of Baking powder.

(ii) Carbon(II)Oxide (CO)

(a)Occurrence

Carbon(II)oxide is found is found from incomplete combustion of fuels like petrol charcoal, liquefied Petroleum Gas/LPG.

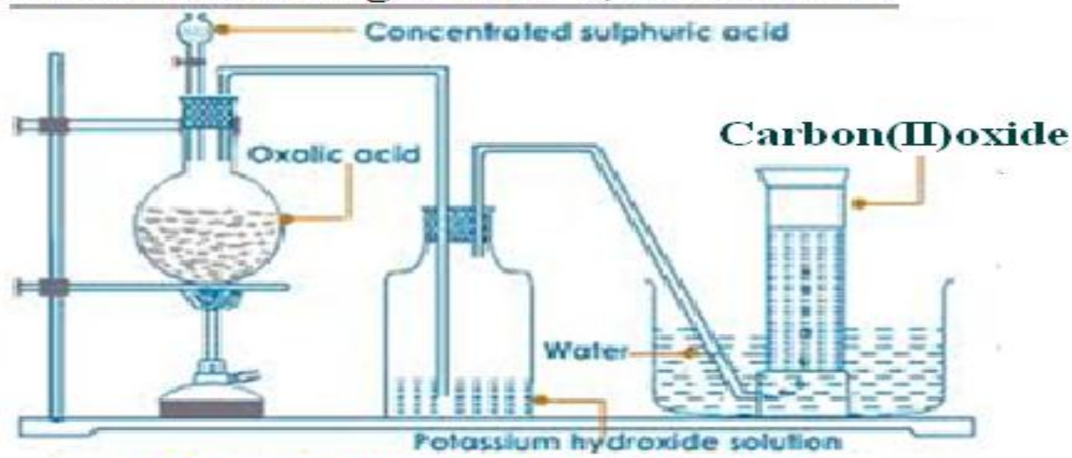
(b)School Laboratory preparation

In the school laboratory carbon(II)oxide can be prepared from dehydration of methanoic acid/Formic acid(HCOOH) or Ethan-1,2-dioic acid/Oxalic acid(HOOCCOOH) using concentrated sulphuric(VI) acid. Heating is necessary.

METHOD 1:<u>Preparation of Carbon (IV)Oxide from dehydration of Oxalic/ethan-1,2-dioic acid</u>

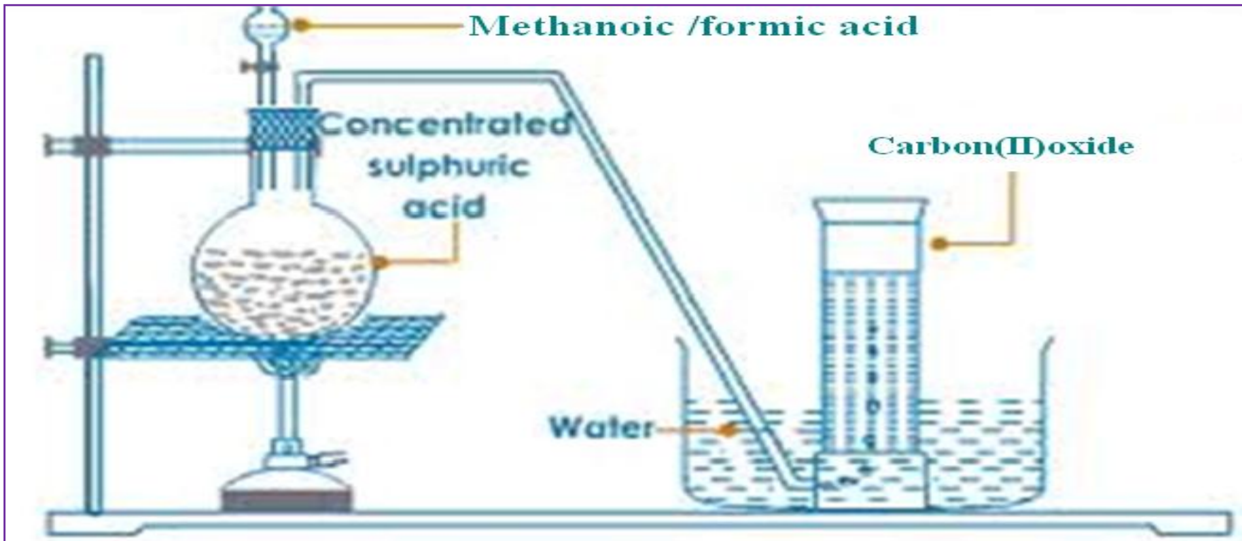
PDF Eraser Free

Method 1: Using Ethan-1,2-dioic acid



Preparation of Carbon(II)oxide

METHOD 2:<u>Preparation of Carbon (IV)Oxide from dehydration of Formic/Methanoic acid</u>



Preparation of Carbon(II)oxide using Methanoic acid

(c)Properties of Carbon (II)Oxide(Questions)

1.Write the equation for the reaction for the preparation of carbon(II)oxide using;

(i)Method 1;

<u>Chemical equation</u>

HOOCCOOH(s) –Conc.H_2SO_4--> CO(g) + CO_2 (g) + H_2O(l)

$H_2C_2O_4$(s) –Conc.H_2SO_4--> CO(g) + CO_2 (g) + H_2O(l)

(ii)Method 2;

<u>Chemical equation</u>

PDF Eraser Free

HCOOH(s) –Conc.H_2SO_4--> CO(g) + H_2O(l)
H_2CO_2(s) –Conc.H_2SO_4--> CO(g) + H_2O(l)

2.What method of gas collection is used during the preparation of carbon (II) oxide.
Over water because the gas is insoluble in water.
Downward delivery because the gas is 1 ½ times denser than air .

3.What is the purpose of :
(i) Potassium hydroxide/sodium hydroxide in Method 1
To absorb/ remove carbon (II) oxide produced during the reaction.
2KOH (aq) + CO_2 (g) -> K_2CO_3 (s) + H_2O(l)
2NaOH (aq) + CO_2 (g) -> Na_2CO_3 (s) + H_2O(l)

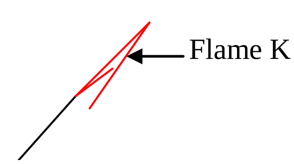
(ii) Concentrated sulphuric(VI)acid in Method 1 and 2.
Dehydrating agent –removes the element of water (Hydrogen and Oxygen in ratio 2:1) present in both methanoic and ethan-1,2-dioic acid.

4. Describe the smell of carbon(II)oxide.
Colourless and odourless.
5. State and explain the observation made when carbon(IV)oxide is bubbled in lime water for a long time.
No white precipitate is formed.

6. Dry and wet/moist/damp litmus papers were separately put in a gas jar containing dry carbon(IV)oxide gas. State and explain the observations made.

<u>Observation</u>
-blue dry litmus paper remains blue
-red dry litmus paper remains red
- wet/moist/damp blue litmus paper remains blue
- wet/moist/damp red litmus paper remains red

<u>Explanation</u>
Carbon(II)oxide gas is a molecular compound that does not dissociate /ionize to release H+ ions and thus has no effect on litmus papers. Carbon(II)oxide gas is therefore a **neutral** gas.
7. Carbon (II)oxide gas was ignited at the end of a generator as below.



PDF Eraser Free

(i)State the observations made in flame K.

Gas burns with a blue flame

(ii)Write the equation for the reaction taking place at flame K.

$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

8. Carbon(II)oxide is a reducing agent. Explain

<u>Experiment</u>

Pass carbon(II)oxide through glass tube containing copper (II)oxide. Ignite any excess poisonous carbon(II)oxide.

<u>Observation</u>

Colour change from black to brown. Excess carbon (II)oxide burn with a blue flame.

<u>Explanation</u>

Carbon is a reducing agent. It is used to reduce metal oxide ores to metal, itself oxidized to carbon(IV)oxide gas. Carbon(II)Oxide reduces black copper(II)oxide to brown copper metal

<u>Chemical Equation</u>

$CuO(s)$ (black)	+	$CO(g)$	->	$Cu(s)$ (brown)	+	$CO_2(g)$
$PbO(s)$ (brown when hot/ yellow when cool)	+	$CO(g)$	->	$Pb(s)$ (grey)	+	$CO_2(g)$
$ZnO(s)$ (yellow when hot/ white when cool)	+	$CO(g)$	->	$Zn(s)$ (grey)	+	$CO_2(g)$
$Fe_2O_3(s)$ (brown when hot/cool	+	$3CO(s)$	->	$2Fe(s)$ (grey)	+	$3CO_2(g)$
$Fe_3O_4(s)$ (brown when hot/cool	+	$4CO(g)$	->	$3Fe(s)$ (grey)	+	$4CO_2(g)$

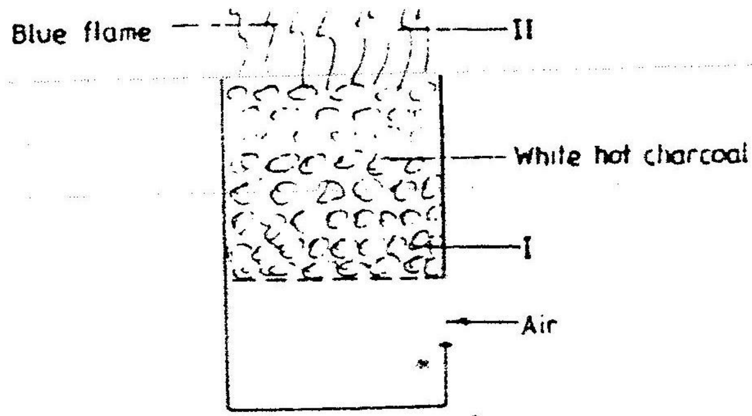
These reaction are used during the extraction of many metals from their ore.

9. Carbon (II) oxide is a pollutant. Explain.

PDF Eraser Free

Carbon(II)oxide is highly poisonous/toxic.It preferentially combine with haemoglobin to form stable carboxyhaemoglobin in the blood instead of oxyhaemoglobin.This reduces the free haemoglobin in the blood causing nausea , coma then death.

10.The diagram below show a burning charcoal stove/burner/jiko. Use it to answer the questions that follow.



Explain the changes that take place in the burner

Explanation

Charcoal stove has air holes through which air enters. Air oxidizes carbon to carbon(IV)oxide gas at region I. This reaction is exothermic(-ΔH) producing more heat.

Chemical equation

$$C(s) + O_2(g) \rightarrow CO_2(g)$$

Carbon(IV)oxide gas formed rises up to meet more charcoal which reduces it to Carbon(II)oxide gas.

Chemical equation

$$2CO_2(g) + O_2(g) \rightarrow 2CO(g)$$

At the top of burner in region II, Carbon (II)oxide gas is further oxidized to Carbon(IV)oxide gas if there is plenty of air but escape if the air is limited poisoning the living things around.

Chemical equation

$$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$$

(excess air)

11.Describe the test for the presence of carbon(II)oxide gas.

Experiment

Burn/Ignite the pure sample of the gas. Pass/Bubble the products into lime water/Calcium hydroxide .

Observation

PDF Eraser Free

Colourless gas burns with a blue flame. A white precipitate is formed that dissolve on further bubbling of the products.

Chemical equation

$2CO (g) + O_2(g) \rightarrow 2CO_2 (g)$ (gas burns with blue flame)

Chemical equation

$Ca(OH)_2 (aq) + CO_2 (g) \rightarrow CaCO_3 (s) + H_2O(l)$

Chemical equation

$CO_2 (g) + CaCO_3 (s) + H_2O(l) \rightarrow Ca(HCO_3)_2 (aq)$

12. State the main uses of carbon (II)oxide gas.

(i) As a fuel /water gas

(ii)As a reducing agent in the blast furnace for extracting iron from iron ore(Magnetite/Haematite)

(iii)As a reducing agent in extraction of Zinc from Zinc ore/Zinc blende

(iv) As a reducing agent in extraction of Lead from Lead ore/Galena

(v) As a reducing agent in extraction of Copper from Copper iron sulphide/Copper pyrites.

(iii)Carbonate(IV) (CO_3^{2-})and hydrogen carbonate(IV(HCO_3^-)

1.Carbonate (IV) (CO_3^{2-}) are normal salts derived from carbonic(IV)acid (H_2CO_3) and hydrogen carbonate (IV) (HCO_3^-) are acid salts derived from carbonic(IV)acid. Carbonic(IV)acid(H_2CO_3) is formed when carbon(IV)oxide gas is bubbled in water. It is a dibasic acid with two ionizable hydrogens.

$H_2CO_3(aq) \rightarrow 2H^+(aq) + CO_3^{2-}(aq)$

$H_2CO_3(aq) \rightarrow H^+(aq) + HCO_3^- (aq)$

2.Carbonate (IV) (CO_3^{2-}) are <u>insoluble</u> in water **except** Na_2CO_3 , K_2CO_3 and $(NH_4)_2CO_3$

3.Hydrogen carbonate (IV) (HCO_3^-) are <u>soluble</u> in water. Only five hydrogen carbonates exist. **$NaHCO_3$, $KHCO_3$,NH_4HCO_3 $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$**

$Ca(HCO_3)_2$ and $Mg(HCO_3)_2$ exist <u>only</u> in aqueous solutions.

3.The following experiments show the effect of <u>heat</u> on Carbonate (IV) (CO_3^{2-}) and Hydrogen carbonate (IV) (HCO_3^-) salts:

<u>Experiment</u>

In a clean dry test tube place separately about 1.0 of the following: Zinc(II)carbonate(IV), sodium hydrogen carbonate(IV), sodium carbonate(IV), Potassium carbonate(IV) ammonium carbonate(IV), potassium hydrogen carbonate(IV), Lead(II)carbonate(IV), Iron(II)carbonate(IV), and

PDF Eraser Free

copper(II)carbonate(IV). Heat each portion gently the strongly. Test any gases produced with lime water.

Observation

(i)Colorless droplets form on the cooler parts of test tube in case of sodium carbonate(IV) and Potassium carbonate(IV).

(ii)White residue/solid left in case of sodium hydrogen carbonate(IV), sodium carbonate(IV), Potassium carbonate(IV) and potassium hydrogen carbonate(IV).

(iii)Colour changes from blue/green to black in case of copper(II)carbonate(IV).

(iv) Colour changes from green to brown/yellow in case of Iron (II)carbonate(IV).

(v) Colour changes from white when cool to yellow when hot in case of Zinc (II) carbonate(IV).

(vi) Colour changes from yellow when cool to brown when hot in case of Lead (II) carbonate(IV).

(vii)Colourless gas produced that forms a white precipitate with lime water in all cases.

Explanation

1. Sodium carbonate(IV) and Potassium carbonate(IV) exist as hydrated salts with 10 molecules of water of crystallization that condenses and collects on cooler parts of test tube as a colourless liquid.

Chemical equation

$Na_2CO_3.10H_2O(s) \rightarrow Na_2CO_3(s) + 10H_2O(l)$

$K_2CO_3.10H_2O(s) \rightarrow K_2CO_3(s) + 10H_2O(l)$

2. Carbonate (IV) (CO_3^{2-}) and Hydrogen carbonate (IV) (HCO_3^-) salts decompose on heating except Sodium carbonate(IV) and Potassium carbonate(IV).

(a) Sodium hydrogen carbonate(IV) and Potassium hydrogen carbonate(IV) decompose on heating to form sodium carbonate(IV) and Potassium carbonate(IV).Water and carbon(IV)oxide gas are also produced.

Chemical equation

$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$

(white) (white)

$2KHCO_3(s) \rightarrow K_2CO_3(s) + H_2O(l) + CO_2(g)$

(white) (white)

(b) Calcium hydrogen carbonate(IV) and Magnesium hydrogen carbonate(IV) decompose on heating to form insoluble Calcium carbonate(IV) and Magnesium carbonate(IV).Water and carbon(IV)oxide gas are also produced.

Chemical equation

$Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + H_2O(l) + CO_2(g)$

(Colourless solution) (white)

$Mg(HCO_3)_2(aq) \rightarrow MgCO_3(s) + H_2O(l) + CO_2(g)$

(Colourless solution) (white)

PDF Eraser Free

(c) Ammonium hydrogen carbonate(IV) decompose on heating to form ammonium carbonate(IV) .Water and carbon(IV)oxide gas are also produced.

Chemical equation

$2NH_4HCO_3$ (s) -> $(NH_4)_2CO_3$ (s) + H_2O(l) + CO_2 (g)
(white) (white)

(d)All other carbonates decompose on heating to form the metal oxide and produce carbon(IV)oxide gas e.g.

Chemical equation

$MgCO_3$ (s) -> MgO (s) + CO_2 (g)
(white solid) (white solid)

Chemical equation

$BaCO_3$ (s) -> BaO (s) + CO_2 (g)
(white solid) (white solid)

Chemical equation

$CaCO_3$ (s) -> CaO (s) + CO_2 (g)
(white solid) (white solid)

Chemical equation

$CuCO_3$ (s) -> CuO (s) + CO_2 (g)
(blue/green solid) (black solid)

Chemical equation

$ZnCO_3$ (s) -> ZnO (s) + CO_2 (g)
(white solid) (white solid when cool/
Yellow solid when hot)

Chemical equation

$PbCO_3$ (s) -> PbO (s) + CO_2 (g)
(white solid) (yellow solid when cool/
brown solid when hot)

4.The following experiments show the presence of Carbonate (IV) (CO_3^{2-}) and Hydrogen carbonate (IV) (HCO_3^-) ions in sample of a salt:

(a)Using Lead(II) nitrate(V)

I. Using a portion of salt solution in a test tube .add four drops of Lead(II)nitrate(V)solution.Preserve.

Observation	inference
White precipitate/ppt	CO_3^{2-} ,SO_3^{2-} ,SO_4^{2-} ,Cl^- -

II. To the preserved solution ,add six drops of dilutte nitric(V)acid. Preserve.

Observation	inference

PDF Eraser Free

White precipitate/ppt persists White precipitate/ppt dissolves	SO_4^{2-} ,Cl^- CO_3^{2-} ,SO_3^{2-}

II. To the preserved sample(that forms a precipitate),heat to boil.

Observation	inference
White precipitate/ppt persists White precipitate/ppt dissolves	SO_4^{2-} Cl^-

II. To the preserved sample(that do not form a precipitate),add three drops of acidified potassium manganate(VII)/lime water

Observation	inference
Effervescence/bubbles/fizzing colourless gas produced Acidified $KMnO_4$ decolorized/no white precipitate on lime water	SO_3^{2-}
Effervescence/bubbles/fizzing colourless gas produced Acidified $KMnO_4$ not decolorized/ white precipitate on lime water	CO_3^{2-}

<u>Experiments/Observations:</u>

(b)Using Barium(II)nitrate(V)/ Barium(II)chloride

I. To about 5cm3 of a salt solution in a test tube add four drops of Barium(II) nitrate (V) / Barium(II)chloride. Preserve.

Observation	Inference
White precipitate/ppt	SO_4^{2-} , SO_3^{2-} , CO_3^{2-} ions

II. To the preserved sample in (I) above, add six drops of 2M nitric(V) acid . Preserve.

Observation 1

Observation	Inference
White precipitate/ppt persists	SO_4^{2-} , ions

Observation 2

Observation	Inference

PDF Eraser Free

White precipitate/ppt dissolves	SO_3^{2-} , CO_3^{2-} , ions

III.To the preserved sample observation 2 in (II) above, add 4 drops of acidified potassium manganate(VII) /dichromate(VI).

Observation 1

Observation	Inference
(i)acidified potassium manganate(VII)decolorized (ii)Orange colour of acidified potassium dichromate(VI) turns to green	SO_3^{2-} ions

Observation 2

Observation	Inference
(i)acidified potassium manganate(VII) not decolorized (ii)Orange colour of acidified potassium dichromate(VI) does not turns to green	CO_3^{2-} ions

Explanations

Using Lead(II)nitrate(V)

(i)Lead(II)nitrate(V) solution reacts with chlorides(Cl^-), Sulphate (VI) salts (SO_4^{2-}), Sulphate (IV)salts (SO_3^{2-}) and carbonates(CO_3^{2-}) to form the insoluble white precipitate of Lead(II)chloride, Lead(II)sulphate(VI), Lead(II) sulphate (IV) and Lead(II)carbonate(IV).

Chemical/ionic equation:

$Pb^{2+}(aq)$ + Cl^- (aq) -> $PbCl_2(s)$
$Pb^{2+}(aq)$ + SO_4^{2+} (aq) -> $PbSO_4$ (s)
$Pb^{2+}(aq)$ + SO_3^{2+} (aq) -> $PbSO_3$ (s)
$Pb^{2+}(aq)$ + CO_3^{2+} (aq) -> $PbCO_3$ (s)

(ii)When the insoluble precipitates are acidified with nitric(V) acid,

- Lead(II)chloride and Lead(II)sulphate(VI) do not react with the acid and thus their white precipitates remain/ persists.

PDF Eraser Free

- Lead(II) sulphate (IV) and Lead(II)carbonate(IV) reacts with the acid to form **soluble** Lead(II) nitrate (V) and produce/effervesces/fizzes/bubbles out **sulphur(IV)oxide** and **carbon(IV)oxide** gases respectively.

. Chemical/ionic equation:

$PbSO_3 (s) + 2H^+(aq) \rightarrow H_2O (l) + Pb^{2+}(aq) + SO_2 (g)$

$PbCO_3 (s) + 2H^+(aq) \rightarrow H_2O (l) + Pb^{2+}(aq) + CO_2 (g)$

(iii)When Lead(II)chloride and Lead(II)sulphate(VI) are heated/warmed;

- Lead(II)chloride dissolves in hot water/on boiling(recrystallizes on cooling)
- Lead(II)sulphate(VI) do not dissolve in hot water thus its white precipitate persists/remains on heating/boiling.

(iv)When sulphur(IV)oxide and carbon(IV)oxide gases are produced;

- **sulphur(IV)oxide** will decolorize acidified potassium manganate(VII) and / or Orange colour of acidified potassium dichromate(VI) will turns to green. **Carbon(IV)oxide will not.**

Chemical equation:

$5SO_3^{2-}(aq) + \underset{(purple)}{2MnO_4^-} (aq) + 6H^+(aq) \rightarrow 5SO_4^{2-}(aq) + \underset{(colourless)}{2Mn^{2+}}(aq) + 3H_2O(l)$

$3SO_3^{2-}(aq) + \underset{(Orange)}{Cr_2O_7^{2-}}(aq) + 8H^+(aq) \rightarrow 3SO_4^{2-}(aq) + \underset{(green)}{2Cr^{3+}}(aq) + 4H_2O(l)$

- **Carbon(IV)oxide** forms an insoluble white precipitate of calcium carbonate if three drops of lime water are added into the reaction test tube when effervescence is taking place. **Sulphur(IV)oxide will not.**

Chemical equation:

$Ca(OH)_2(aq) + CO_2 (g) \rightarrow CaCO_3(s) + H_2O(l)$

These tests should be done immediately after acidifying to ensure the gases produced react with the oxidizing agents/lime water.

Using Barium(II)nitrate(V)/ Barium(II)Chloride

(i)Barium(II)nitrate(V) and/ or Barium(II)chlo**ride** solution reacts with Sulphate (VI) salts (SO_4^{2-}), Sulphate (IV)salts (SO_3^{2-}) and carbonates(CO_3^{2-}) to form the insoluble white precipitate of Barium(II)sulphate(VI), Barium(II) sulphate (IV) and Barium(II)carbonate(IV).

Chemical/ionic equation:

$Ba^{2+}(aq) + SO_4^{2+} (aq) \rightarrow BaSO_4 (s)$

$Ba^{2+}(aq) + SO_3^{2+} (aq) \rightarrow BaSO_3 (s)$

$Ba^{2+}(aq) + CO_3^{2+} (aq) \rightarrow BaCO_3 (s)$

PDF Eraser Free

(ii)When the insoluble precipitates are acidified with nitric(V) acid,

- Barium (II)sulphate(VI) do not react with the acid and thus its white precipitates remain/ persists.
- Barium(II) sulphate (IV) and Barium(II)carbonate(IV) reacts with the acid to form **soluble** Barium(II) nitrate (V) and produce /effervesces /fizzes/ bubbles out **sulphur(IV)oxide** and **carbon(IV)oxide** gases respectively.

. Chemical/ionic equation:

$BaSO_3 (s) + 2H^+(aq) \rightarrow H_2O (l) + Ba^{2+}(aq) + SO_2 (g)$

$BaCO_3 (s) + 2H^+(aq) \rightarrow H_2O (l) + Ba^{2+}(aq) + CO_2 (g)$

(iii) When sulphur(IV)oxide and carbon(IV)oxide gases are produced;

- **sulphur(IV)oxide** will decolorize acidified potassium manganate(VII) and / or Orange colour of acidified potassium dichromate(VI) will turns to green. **Carbon(IV)oxide will not.**

Chemical equation:

$5SO_3^{2-}(aq) + 2MnO_4^-(aq) + 6H^+(aq) \rightarrow 5SO_4^{2-}(aq) + 2Mn^{2+}(aq) + 3H_2O(l)$
(purple) (colourless)

$3SO_3^{2-}(aq) + Cr_2O_7^{2-}(aq) + 8H^+(aq) \rightarrow 3SO_4^{2-}(aq) + 2Cr^{3+}(aq) + 4H_2O(l)$
(Orange) (green)

- **Carbon(IV)oxide** forms an insoluble white precipitate of calcium carbonate if three drops of lime water are added into the reaction test tube when effervescence is taking place. **Sulphur(IV)oxide will not.**

Chemical equation:

$Ca(OH)_2(aq) + CO_2 (g) \rightarrow CaCO_3(s) + H_2O(l)$

These tests should be done immediately after acidifying to ensure the gases produced react with the oxidizing agents/lime water.

(iii) Sodium carbonate(IV) (Na_2CO_3)

(a)Extraction of sodium carbonate from soda ash

Sodium carbonate naturally occurs in Lake Magadi in Kenya as Trona.trona is the double salt ; sodium sesquicarbonate. $NaHCO_3 .Na_2CO_3 .H_2O$.It is formed from the volcanic activity that takes place in Lake Naivasha, Nakuru ,Bogoria and Elementeita .All these lakes drain into Lake Magadi through underground rivers. Lake Magadi has no outlet.

PDF Eraser Free

Solubility of Trona decrease with increase in temperature.High temperature during the day causes trona to naturally crystallize .It is mechanically scooped/dredged/dug and put in a furnace.
Inside the furnace, trona decompose into soda ash/sodium carbonate.

<u>Chemical equation</u>

$2NaHCO_3 .Na_2CO_3 .H_2O$ (s) -> $3Na_2CO_3$ (s) + $5H_2O$(l) + CO_2 (g)
(trona) (soda ash)

Soda ash is then bagged and sold as Magadi soda.It is mainly used:

(i)in making glass to lower the melting point of raw materials (sand/SiO_2 from 1650^oC and CaO from 2500^oC to around 1500^oC)

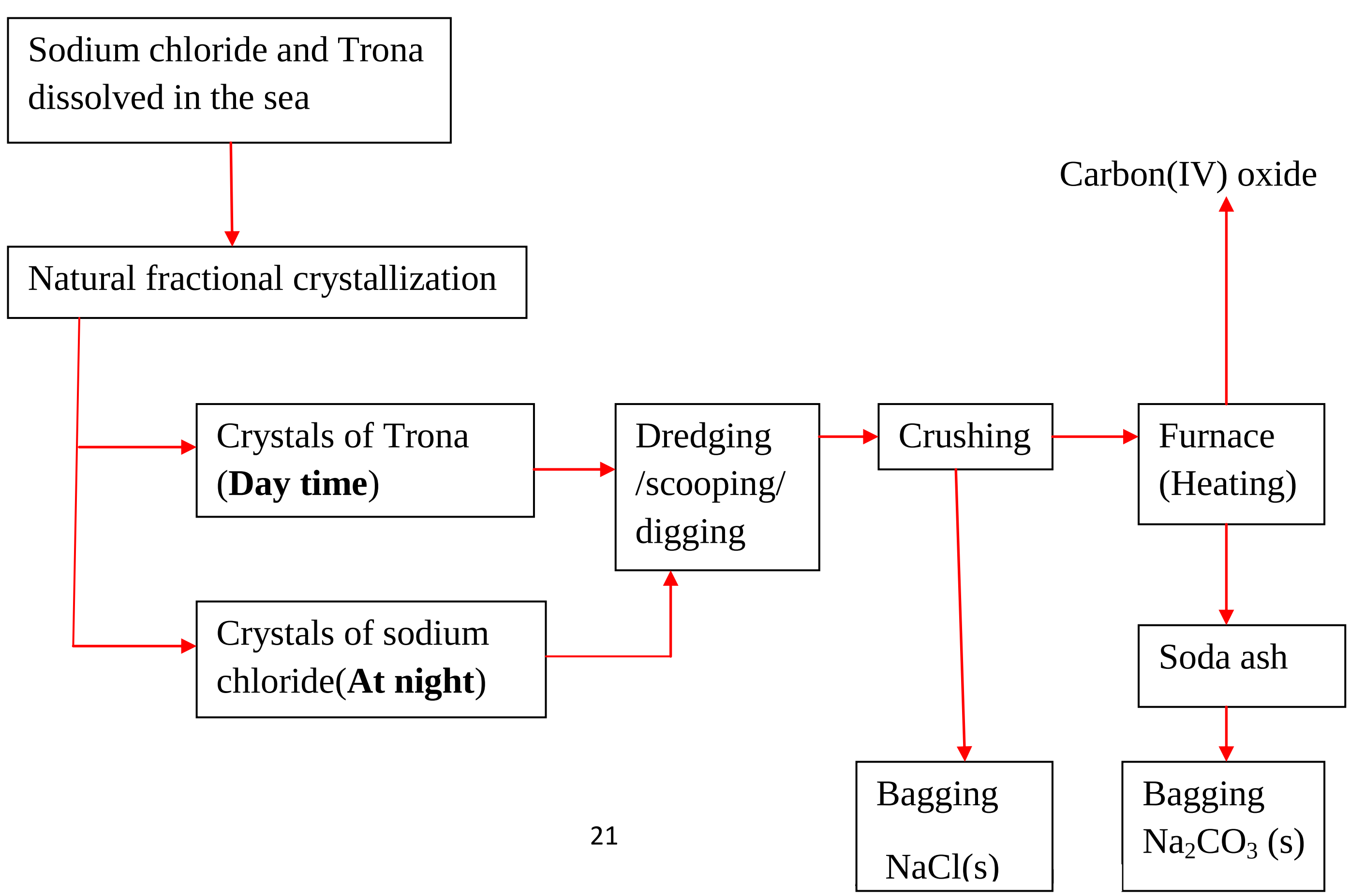
(ii)in softening hard water

(iii)in the manufacture of soapless detergents.

(iv)Swimming pool “pH increaser”

Sodium chloride is also found dissolved in the lake. Solubility of sodium chloride decrease with decreases in temperature/ sodium chloride has lower solubility at lower temperatures. When temperatures decrease at night it crystallize out .The crystals are then mechanically dug/dredged /scooped then packed for sale as animal/cattle feeds and seasoning food.

<u>Summary flow diagram showing the extraction of Soda ash from Trona</u>



PDF Eraser Free

b)The Solvay process for industrial manufacture of sodium carbonate(IV)

(i)Raw materials.

- **Brine** /Concentrated Sodium chloride from salty seas/lakes.
- **Ammonia** gas from Haber.
- **Limestone** /Calcium carbonate from chalk /limestone rich rocks.
- **Water** from rivers/lakes.

(ii)Chemical processes

Ammonia gas is passed **up** to meet a **downward** flow of sodium chloride solution / brine to form **ammoniated** brine/**ammoniacal** brine **mixture** in the **ammoniated brine chamber**

The ammoniated brine mixture is then pumped up, atop the carbonator/ solvay tower.

In the carbonator/ solvay tower, ammoniated brine/ammoniacal brine mixture slowly trickle down to meet an upward flow of carbon(IV)oxide gas.

The carbonator is shelved /packed with quartz/broken glass to

(i) reduce the rate of flow of ammoniated brine/ammoniacal brine mixture.

(ii)increase surface area of the liquid mixture to ensure a lot of ammoniated brine/ammoniacal brine mixture react with carbon(IV)oxide gas.

Insoluble sodium hydrogen carbonate and soluble ammonium chloride are formed from the reaction.

Chemical equation

$$CO_2(g) + H_2O(l) + NaCl\ (aq) + NH_3(g) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$$

The products are then filtered. **Insoluble** sodium hydrogen carbonate forms the **residue** while soluble ammonium chloride forms the **filtrate**.

Sodium hydrogen carbonate itself can be used:

(i) as baking powder and preservation of some soft drinks.

(ii) as a buffer agent and antacid in animal feeds to improve fibre digestion.

(iii) making dry chemical fire extinguishers.

In the Solvay process Sodium hydrogen carbonate is then heated to form Sodium carbonate/soda ash, water and carbon (IV) oxide gas.

PDF Eraser Free

<u>Chemical equation</u>

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

Sodium carbonate is stored ready for use in:

(i) during making glass/lowering the melting point of mixture of sand/SiO_2 from 1650^oC and CaO from 2500^oC to around 1500^oC

(ii) in softening hard water

(iii) in the manufacture of soapless detergents.

(iv) swimming pool "pH increaser".

Water and carbon(IV)oxide gas are recycled back to the ammoniated brine/ammoniacal brine chamber.

More carbon(IV)oxide is produced in the kiln/furnace. Limestone is heated to decompose into Calcium oxide and carbon(IV)oxide.

<u>Chemical equation</u>

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

Carbon(IV)oxide is recycled to the carbonator/solvay tower. Carbon (IV)oxide is added water in the **slaker** to form Calcium hydroxide. This process is called **slaking**.

<u>Chemical equation</u>

$$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$$

Calcium hydroxide is mixed with ammonium chloride from the carbonator/solvay tower in the **ammonia regeneration chamber** to form Calcium chloride , water and more ammonia gas.

<u>Chemical equation</u>

$$Ca(OH)_2(aq) + 2NH_4Cl(aq) \rightarrow CaCl_2(s) + 2NH_3(g) + H_2O(l)$$

$NH_3(g)$ and $H_2O(l)$ are recycled.

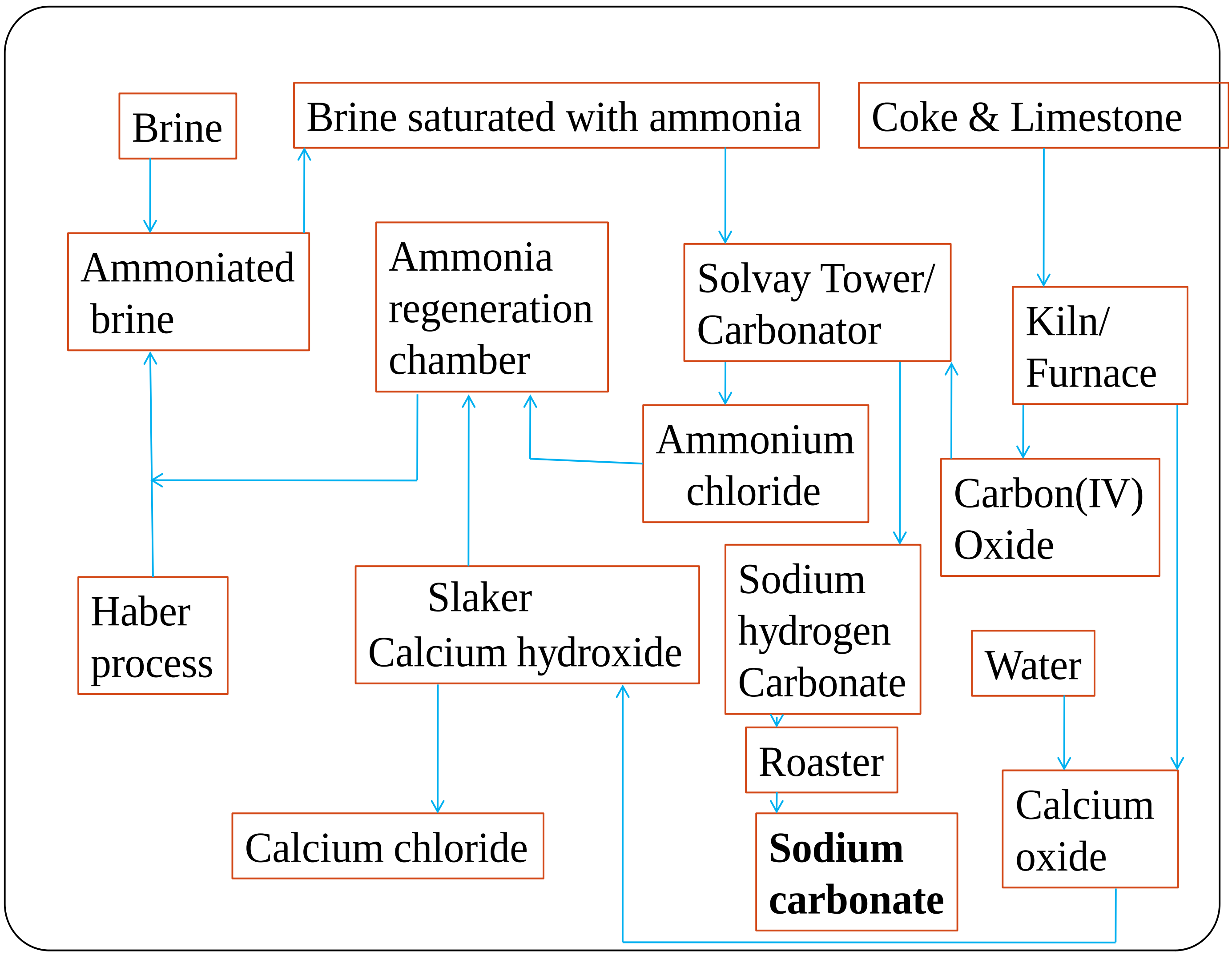
Calcium chloride may be used:

(i)as drying agent in the school laboratory during gas preparation (except ammonia gas)

(ii)to lower the melting point of solid sodium chloride / rock salt salts during the Downs process for industrial extraction of sodium metal.

PDF Eraser Free

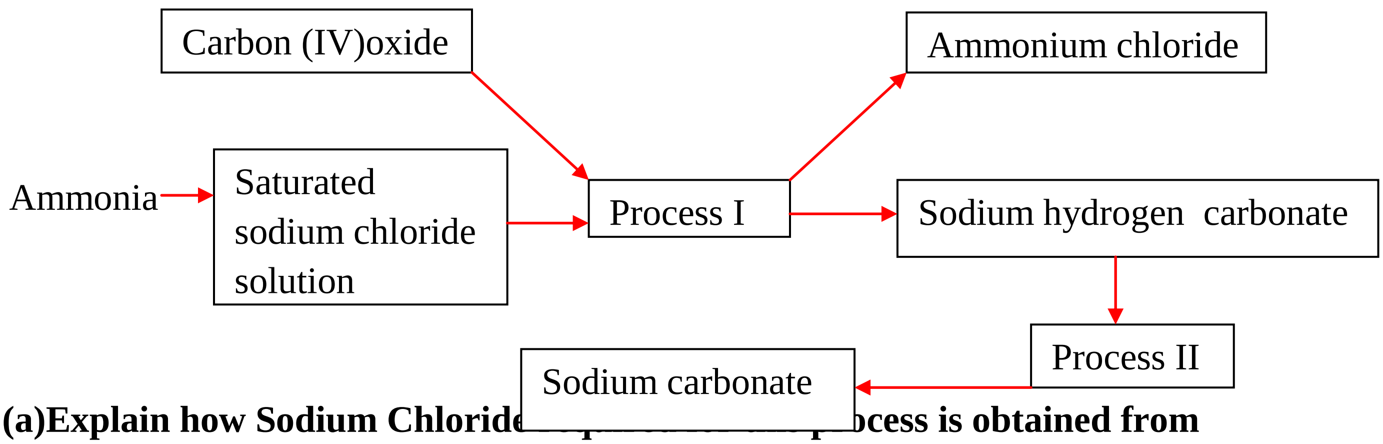
Detailed Summary flow diagram of Solvay Process



PDF Eraser Free

Practice

1. The diagram below shows part of the Solvay process used in manufacturing sodium carbonate. Use it to answer the questions that follow.



(a)Explain how Sodium Chloride used in the process is obtained from the sea.

Sea water is pumped /scooped into shallow pods. Evaporation of most of the water takes place leaving a very concentrated solution.

(b)(i) Name process:

I. Filtration

II. Decomposition

(ii) Write the equation for the reaction in process:

Process I

<u>Chemical equation</u>

$CO_2(g) + H_2O(l) + NaCl\ (aq) + NH_3(g) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$

Process II

<u>Chemical equation</u>

$2NaHCO_3\ (s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$

(c)(i) Name two substances recycled in the solvay process

Ammonia gas , Carbon(IV)Oxide and Water.

PDF Eraser Free

(ii)Which is the by-product of this process?

Calcium(II)Chloride /$CaCl_2$

(iii)State two uses that the by-product can be used for:

1. As a drying agent in the school laboratory preparation of gases.
2. In the Downs cell/process for extraction of Sodium to lower the melting point of rock salt.

(iv)Write the chemical equation for the formation of the by-products in the Solvay process.

Chemical equation

$Ca(OH)_2$ (aq) +$2NH_4Cl$ (aq) -> $CaCl_2$(s) + $2NH_3$(g) + H_2O(l)

(d)In an experiment to determine the % purity of Sodium carbonate produced in the Solvay process ,2.15g of the sample reacted with exactly 40.0cm3 of 0.5M Sulphuric(VI)acid.

(i)Calculate the number of moles of sodium carbonate that reacted.

Chemical equation

Na_2CO_3 (aq) +H_2SO_4 (aq) -> Na_2SO_4 (aq)+ CO_2(g) + H_2O(l)

Mole ratio Na_2CO_3 :H_2SO_4 => 1:1

Moles H_2SO_4 = $\frac{\text{Molarity x Volume}}{1000}$ => $\frac{0.5 \times 40.0}{1000}$ = **<u>0.02 Moles</u>**

Moles of Na_2CO_3 = **<u>0.02 Moles</u>**

(ii)Determine the % of sodium carbonate in the sample.

Molar mass of Na_2CO_3 = **<u>106g</u>**

Mass of Na_2CO_3 = moles x Molar mass => 0.02 x 106 = **<u>2.12 g</u>**

% of Na_2CO_3 = $\frac{(2.12 \text{ g} \times 100)}{2.15}$ = **<u>98.6047%</u>**

(e) State two uses of soda ash.

(i) during making glass/lowering the melting point of mixture of sand/SiO_2 from 1650^oC and CaO from 2500^oC to around 1500^oC

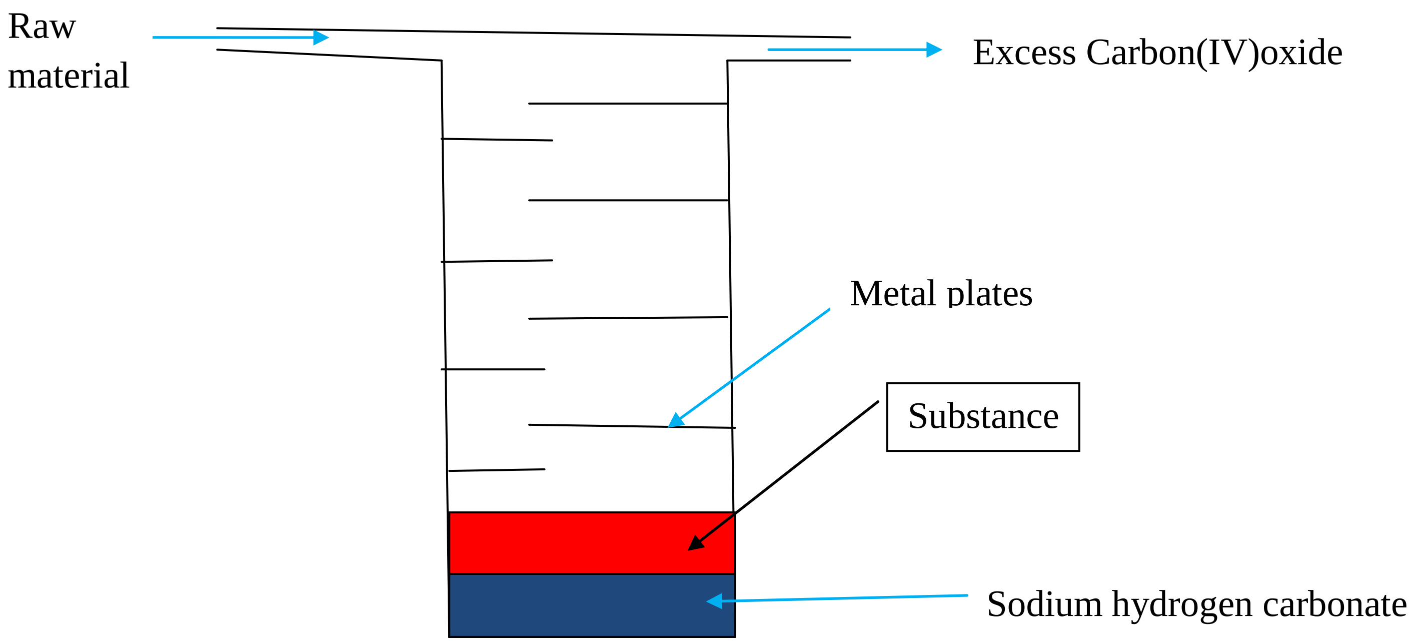
(ii) in softening hard water

(iii) in the manufacture of soapless detergents.

(iv) swimming pool "pH increaser".

(f)The diagram below shows a simple ammonia soda tower used in manufacturing sodium carbonate .Use it to answer the questions that follow:

PDF Eraser Free



(i)Name the raw materials needed in the above process

-Ammonia
-Water
-Carbon(IV)oxide
-Limestone
-Brine/ Concentrated sodium chloride

(ii)Identify substance A

Ammonium chloride /NH_4Cl

(iii) Write the equation for the reaction taking place in:

I.Tower.

Chemical equation

$CO_2(g) + NaCl\ (aq) + H_2O(l) + NH_3(g) \rightarrow NaHCO_3(s) + NH_4Cl(aq)$

II. Production of excess carbon (IV)oxide.

Chemical equation

$CaCO_3\ (s) \rightarrow CaO(s) + CO_2(g)$

III. The regeneration of ammonia

Chemical equation

$Ca(OH)_2\ (aq) + 2NH_4Cl\ (aq) \rightarrow CaCl_2(s) + 2NH_3(g) + H_2O(l)$

(iv)Give a reason for having the circular metal plates in the tower.

-To slow the downward flow of brine.
-To increase the rate of dissolving of ammonia.
-To increase the surface area for dissolution

PDF Eraser Free

(v)Name the gases recycled in the process illustrated above.

Ammonia gas , Carbon(IV)Oxide and Water.

2. Describe how you would differentiate between carbon (IV)oxide and carbon(II)oxide using chemical method.

Method I

-Bubble both gases in lime water/$Ca(OH)_2$
-white precipitate is formed if the gas is carbon (IV) oxide
- **No** white precipitate is formed if the gas is carbon (II) oxide

Method II

-ignite both gases
- Carbon (IV) oxide does **not** burn/ignite
- Carbon (II) oxide burn with a blue non-sooty flame.

Method III

-Lower a burning splint into a gas containing each gas separately.
-burning splint is extinguished if the gas is carbon (IV) oxide
-burning splint is **not** extinguished if the gas is carbon (II) oxide.

3.Using Magnesium sulphate(VI)solution ,describe how you can differentiate between a solution of sodium carbonate from a solution of sodium hydrogen carbonate

-Add Magnesium sulphate(VI) solution to separate portions of a solution of sodium carbonate and sodium hydrogen carbonate in separate test tubes
-White precipitate is formed in test tube containing sodium carbonate
-No white precipitate is formed in test tube containing sodium hydrogen carbonate.

<u>Chemical equation</u>

$Na_2CO_3\ (aq) + MgSO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + MgCO_3(s)$
(white ppt)

<u>Ionic equation</u>

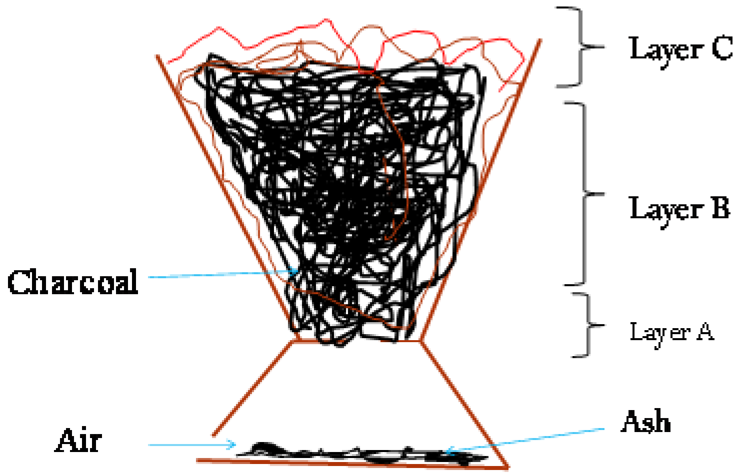
$CO_3^{2-}\ (aq) + Mg^{2+}\ (aq) \rightarrow MgCO_3(s)$
(white ppt)

<u>Chemical equation</u>

$2NaHCO_3\ (aq) + MgSO_4\ (aq) \rightarrow Na_2SO_4\ (aq) + Mg(HCO_3)_2\ (aq)$
(colourless solution)

4. The diagram below shows a common charcoal burner .Assume the burning take place in a room with sufficient supply of air.

PDF Eraser Free



(a)Explain what happens around:

(i)Layer A

Sufficient/excess air /oxygen enter through the air holes into the burner .It reacts with/oxidizes Carbon to carbon(IV)oxide

<u>Chemical equation</u>

$C(s) \quad + \quad O_2(g) \quad -> \quad CO_2\ (g)$

(ii)Layer B

Hot carbon(IV)oxide rises up and is reduced by more carbon/charcoal to carbon (II)oxide.

<u>Chemical equation</u>

$C(s) \quad + \quad CO_2(g) \quad -> \quad 2CO\ (g)$

(ii)Layer C

Hot carbon(II)oxide rises up and burns with a blue flame to be oxidized by the excess air to form carbon(IV)oxide.

$2CO\ (g) \quad + \quad O_2(g) \quad -> \quad 2CO_2(g)$

(b)State and explain what would happen if the burner is put in an enclosed room.

The hot poisonous /toxic carbon(II)oxide rising up will not be oxidized to Carbon(IV)oxide.

(c)Using a chemical test , describe how you would differentiate two unlabelled black solids suspected to be charcoal and copper(II)oxide.

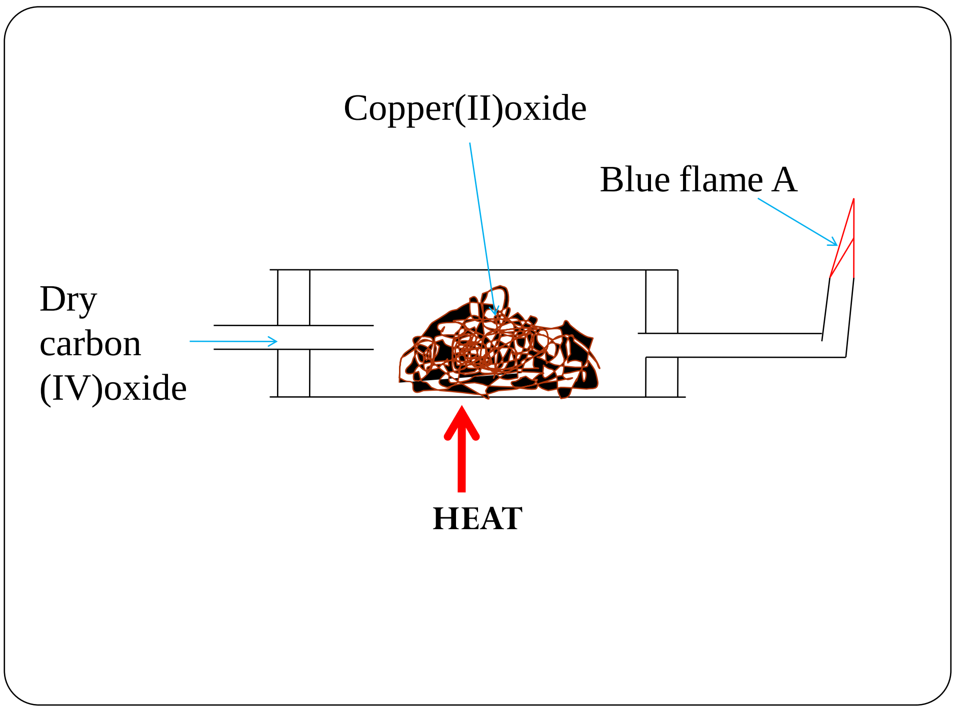
Method I

PDF Eraser Free

-Burn/Ignite the two substances separately.
-Charcoal burns with a blue flame
- Copper(II)oxide does not burn

Method II
-Add dilute sulphuric(VI)acid/Nitric(V)acid/Hydrochloric acid separately.
-Charcoal does not dissolve.
- Copper(II)oxide dissolves to form a colourless solution.

5. Excess Carbon(II)oxide was passed over heated copper(II)oxide as in the set up shown below for five minutes.



(a)State and explain the observations made in the combustion tube.

Observation
Colour change from black to brown

Explanation
Carbon (II)oxide reduces black copper(II)oxide to brown copper metal itself oxidized to Carbon(IV)oxide.

Chemical equation

$$\underset{}{CO(g)} + \underset{(black)}{CuO(s)} \rightarrow \underset{(brown)}{Cu(s)} + CO_2(g)$$

(b) (i)Name the gas producing flame A
Carbon(II)oxide

PDF Eraser Free

(ii)Why should the gas be burnt?

It is toxic/poisonous

(iii)Write the chemical equation for the production of flame A

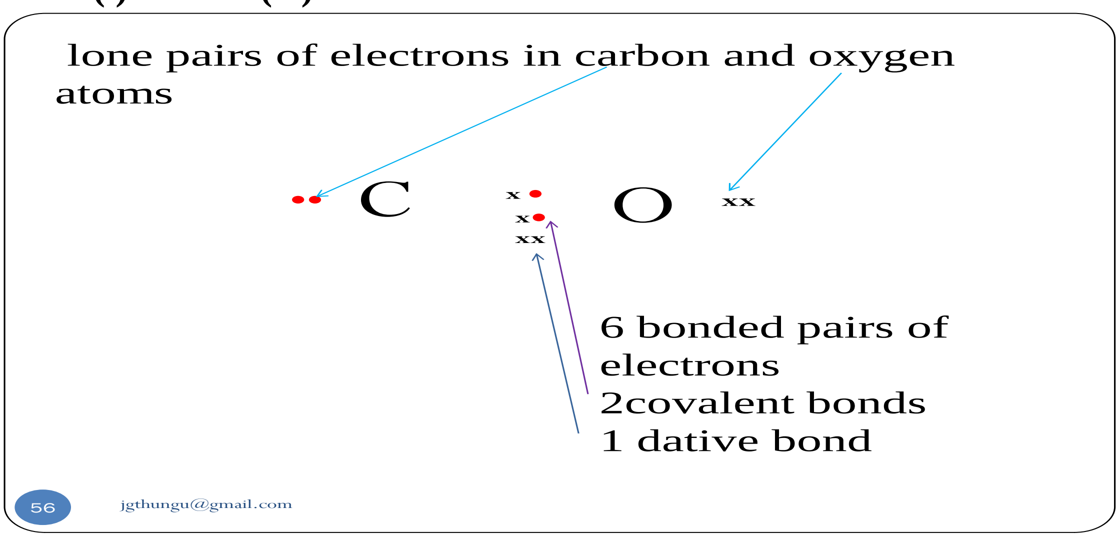
$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

(c)State and explain what happens when carbon(IV)oxide is prepared using Barium carbonate and dilute sulphuric(VI)acid.

Reaction starts then stops after sometime producing small/little quantity of carbon(IV)oxide gas.
Barium carbonate react with dilute sulphuric(VI)acid to form insoluble Barium sulphate(VI) that cover/coat unreacted Barium carbonate stopping further reaction to produce more Carbon(IV)oxide.

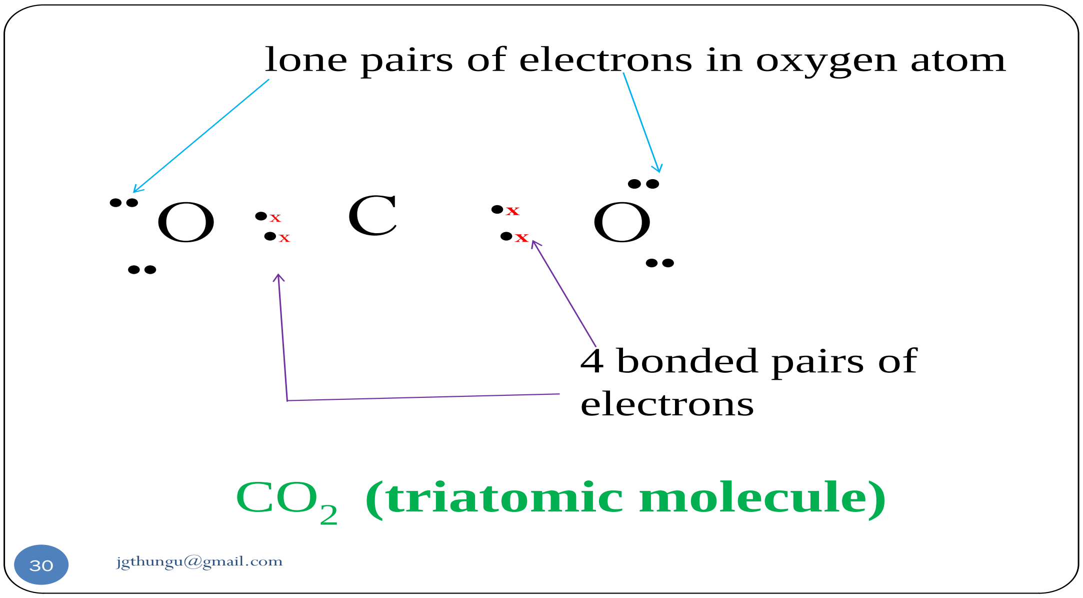
(d) Using dot () and cross(x) to represent electrons show the bonding in a molecule of :

(i) Carbon(II)oxide



(ii) Carbon(IV)Oxide.

PDF Eraser Free



(e) Carbon (IV)oxide is an environmental pollutant of global concern. Explain.

-It is a green house gas thus causes global warming.

-It dissolves in water to form acidic carbonic acid which causes "acid rain"

(f)Explain using chemical equation why lime water is used to test for the presence of Carbon (IV) oxide instead of sodium hydroxide.

Using lime water/calcium hydroxide:

- a visible white precipitate of calcium carbonate is formed that dissolves on bubbling excess Carbon (IV) oxide gas

<u>Chemical equation</u>

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

(white precipitate)

$CaCO_3(aq) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2(aq)$

Using sodium hydroxide:

- **No** precipitate of sodium carbonate is formed Both sodium carbonate and sodium hydrogen carbonate are soluble salts/dissolves.

<u>Chemical equation</u>

$2NaOH(aq) + CO_2(g) \rightarrow Na_2CO_3(s) + H_2O(l)$

(No white precipitate)

$Na_2CO_3(s) + H_2O(l) + CO_2(g) \rightarrow 2NaHCO_3(s)$

(g)Ethan-1,2-dioic acid and methanoic acid may be used to prepare small amount of carbon(II)oxide in a school laboratory.

(i) Explain the modification in the set up when using one over the other.

PDF Eraser Free

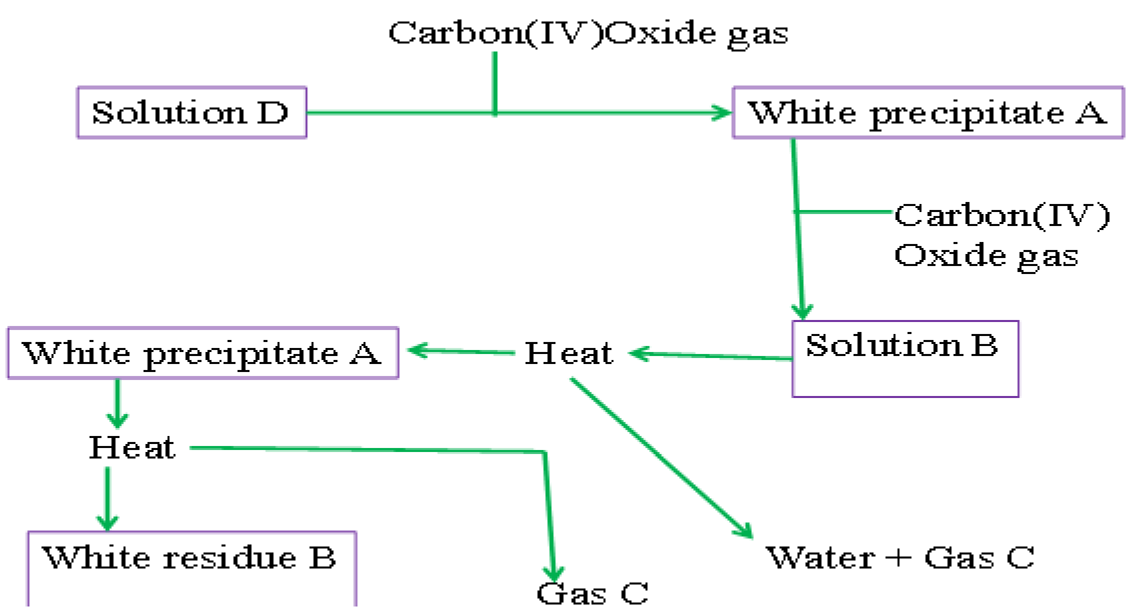
Before carbon(II)oxide is collected:
-when using methanoic acid, **no** concentrated sodium/potassium hydroxide is needed to absorb Carbon(IV)oxide.
-when using ethan-1,2-dioic acid, concentrated sodium/potassium hydroxide is needed to absorb Carbon(IV)oxide.

(ii)Write the equation for the reaction for the formation of carbon(II)oxide from:
I.Methanoic acid.
Chemical equation $HCOOH(aq) \rightarrow CO(g) + H_2O(l)$

II. Ethan-1,2-dioic acid
Chemical equation $HOOCCOOH(aq) \rightarrow CO_2(g)+CO(g)+H_2O(l)$

(h)Both carbon(II)oxide and carbon(IV)oxide affect the environment. Explain why carbon(II)oxide is more toxic/poisonous.
-Both gases are colourless,denser than water and odourless.
-Carbon(II)oxide is preferentially absorbed by human/mammalian haemoglobin when inhaled forming stable carboxyhaemoglobin instead of oxyhaemoglobin.This reduces the free haemoglobin in the blood leading to suffocation and quick death. -
-Carbon(IV)oxide is a green house gas that increases global warming.
-Carbon(II)oxide is readily oxidized to carbon(IV)oxide

6.Study the flow chart below and use it to answer the questions that follow.



(a)Name:

PDF Eraser Free

(i)the white precipitate A
Calcium carbonate
(ii) solution B
Calcium hydrogen carbonate
(iii) gas C
Carbon(IV)oxide
(iv) white residue B
Calcium oxide
(v) solution D
Calcium hydroxide/lime water

(b)Write a balanced chemical equation for the reaction for the formation of:
(i) the white precipitate A from solution D
Chemical equation
$Ca(OH)_2(aq) + CO_2 (g) \rightarrow CaCO_3 (s) + H_2O(l)$

(ii) the white precipitate A from solution B
Chemical equation
$Ca(HCO_3)_2(aq) \rightarrow CO_2 (g) + CaCO_3 (s) + H_2O(l)$

(iii) solution B from the white precipitate A
Chemical equation
$CO_2 (g) + CaCO_3 (s) + H_2O(l) \rightarrow Ca(HCO_3)_2(aq)$

(iv) white residue B from the white precipitate A
Chemical equation
$CaCO_3(s) \rightarrow CO_2 (g) + CaO (s)$

(iv) reaction of white residue B with water
Chemical equation
$CaO (s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$

*********************END*********************

PDF Eraser Free

The other documents available on this website include;

- *All secondary school schemes of work.*
- *Form 1-form 4 revision papers in all subjects.*
- *Marking schemes to most of the revision papers.*
- *K.C.S.E past papers.*
- *University past papers.*
- *K.A.S.N.E.B past papers e.g. C.P.A*
- *Primary school schemes of work.*
- *Primary school revision papers to all classes.*
- *Marking schemes to primary school past papers.*
- *K.C.P.E past papers.*