

CHEMICAL INDUSTRIES

MULTIPLE CHOICE QUESTIONS

Q.No.1 Encircle the correct option from the given multiple choices.

Introduction

- (1) Haematite is the ore of
 (a) Iron (b) Copper (c) Chromium (d) Tin
- (2) The chemical formula of magnesite is
 (a) Fe_2O_3 (b) FeO (c) Fe_3O_4 (d) None of these
- (3) The chemical formula of Halite ore of sodium is
 (a) Na_2CO_3 (b) NaCl (c) Na_2SO_4 (d) NaNO_3
- (4) Chalcopyrite is the ore of
 (a) Fe (b) Zn (c) Cu (d) Aluminium
- (5) Which of the following is chemical formula of Bauxite
 (a) Fe_3O_4 (b) Na_3AlF_6 (c) CaF_2 (d) $\text{Al}_2\text{O}_3 \cdot \text{XH}_2\text{O}$

Concentration of Ore

- (6) Concentration is a
 (a) Mixing technique (b) Boiling technique
 (c) Separating technique (d) Condensation technique
- (7) Froth flotation process is used to concentrate the ore on
 (a) Wetting basis (b) Magnetic basis (c) Separating basis (d) Density basis
- (8) The separation of minerals from gangue is called concentration. Which of the following method is used for concentration
 (a) Smelting (b) Roasting (c) Refining (d) Flotation

Extraction of metal

- (9) Matte is a mixture of
 (a) FeS and CuS (b) Cu_2S and FeS (c) $\text{Cu}_2\text{O} \cdot \text{FeO}$ (d) $\text{FeO} \cdot \text{CuS}$
- (10) The method to reduce metal ions to free metal is called
 (a) Roasting (b) Smelting (c) Bessemerization (d) All of these
- (11) The mixture of Cu_2S and FeS called matte is produced is one of the metallurgical operation in the extraction of copper. The name of this operation is
 (a) Smelting (b) Roasting (c) Bessemerization (d) Electro-refining
- (12) Which of the following step is not used in extraction of metals
 (a) Roasting (b) Smelting (c) Flotation (d) Bessemerization

Refining of metals

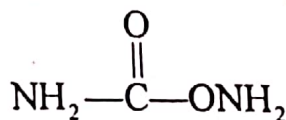
- (13) In electrolytic refining of copper _____ is used as anode
 (a) Pure copper (b) Impure copper (c) Copper sulphate (d) Zinc
- (14) In the electro refining of copper, the electrolyte used is
 (a) $ZnSO_4$ (b) $CuSO_4$ (c) Na_2SO_4 (d) $PbCl_2$

Solvay's Process

- (15) When CO_2 is passed through the ammonical brine the only salt that is precipitate out
 (a) Na_2CO_3 (b) $NaCl$ (c) $NaHCO_3$ (d) NH_4Cl
- (16) In solvay process slaked lime is used to
 (a) Prepare ammonia (b) To prepare CaO
 (c) To prepare $NaHCO_3$ (d) recover ammonia
- (17) Which of the following is used as raw material in solvay process.
 (a) Brine (b) Lime stone (c) Ammonia (d) All of these
- (18) When ammonium chloride is heated with calcium hydroxide, the gas produced is
 (a) NH_3 (b) PH_3 (c) CO_2 (d) H_2S
- (19) Which of the following is not raw material for manufacture of soda ash
 (a) Ammonia (b) Carbon monoxide
 (c) Brine (d) Lime stone
- (20) Chemical formula of slaked lime is
 (a) CaO (b) $CaCO_3$ (c) $CaCl_2$ (d) $Ca(OH)_2$
- (21) Calcination is the process in which $NaHCO_3$ is heated to get sodium carbonate. Which is not obtained in this process
 (a) CO_2 (b) CO (c) Na_2CO_3 (d) H_2O
- (22) Na_2CO_3 is used in the manufacture of
 (a) Glass (b) Soaps (c) Detergent (d) All of these
- (23) When $NaHCO_3$ is heated it forms
 (a) Na_2CO_3 (b) CO_2 (c) H_2O (d) All of these

Urea

- (24) The chemical formula of urea is



- (a) NH_2CONH_2 (b) _____
 (c) $(NH_4)_2CO$ (d) None of these
- (25) The percentage of nitrogen in ammonium nitrate fertilizer is
 (a) 21% (b) 35% (c) 46.6% (d) 60%
- (26) What happens when ammonium carbamate is distilled with steam
 (a) Ammonia is produced (b) CO_2 is released
 (c) Urea is produced (d) Urea solution is produced

- (27) The Haber's process is used for the preparation of
 (a) H_2SO_4 (b) NH_3 (c) HNO_3 (d) None of these
- (28) Urea is prepared by the dehydration of
 (a) Ammonium hydroxide (b) Ammonium carbonate
 (c) Ammonium carbamate (d) Ammonium sulphate
- (29) The percentage of nitrogen in urea is
 (a) 46.6% (b) 40% (c) 36% (d) 56%
- (30) The nitrogen present in urea is used by plant to synthesize
 (a) Carbohydrates (b) Sugar (c) Protein (d) Cellulose

Petroleum

- (31) The crude oil is heated in fractionating tower upto
 (a) $200^\circ C$ (b) $300^\circ C$ (c) $400^\circ C$ (d) $450^\circ C$
- (32) Which of the following is used as Jet fuel
 (a) Kerosine oil (b) Lubricating oil (c) Diesel (d) Gasoline
- (33) Which of the following is not the fraction of residual oil
 (a) Kerosene oil (b) Paraffin wax (c) Asphalt (d) Petroleum coke
- (34) Which of the organic compound is found in gasoline
 (a) C_3H_6 (b) C_2H_2 (c) C_8H_{18} (d) $C_{10}H_{22}$
- (35) The naturally occurring metallic compound are called as
 (a) Ore (b) Gangue (c) Mineral (d) Rock

ANSWER KEY

Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.
1	a	11	a	21	b	31	c
2	c	12	c	22	d	32	a
3	b	13	b	23	d	33	a
4	c	14	b	24	a	34	c
5	d	15	c	25	b	35	c
6	c	16	d	26	d		
7	a	17	d	27	b		
8	d	18	a	28	c		
9	b	19	b	29	a		
10	b	20	d	30	c		

TOPICAL SHORT QUESTIONS

Introduction

Q.1 Write the name and formulas of ores of iron and chromium.

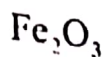
Ans: Metal

Name of Ore

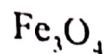
Formula

Iron:

Hematite

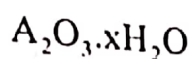


Magnetite



Aluminum:

Bauxite



Chromium:

Chromite



Basic metallurgical operations

Q.2 What is different between minerals and ores?

Ans: Minerals

The naturally occurring metallic compound is called minerals. or

The solid natural materials found beneath the earth surface, which contains compounds of metals in the combined state along with earthly impurity are called minerals.

Ores

Ore is a solid deposit containing a sufficiently high percentage of a mineral to make extraction of metal economically feasible.

Q.3 Define metallurgy; also write the steps involved in metallurgy.

Ans: Metallurgy

The process of extraction of pure metal from its ore is called metallurgy. The main steps involved in metallurgy are

- Crushing, grinding or pulverizing of the ore.
- Concentration of the ore (magnetic separation, cyclone separation, froth flotation process)
- Extraction of metal (roasting, smelting, basissmerization)
- Refining of metal

Extraction of metals

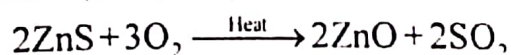
Q.4 Refine Roasting? Give example.

Ans: Roasting

Some minerals are converted to oxide by heating in the air at temperature below their melting point. This process is called roasting.

Example

The roasting of Zinc blend (ZnS)



Q.5 Define smelting with example.

Ans: Smelting

The method to reduce metal ions to free metal with the help of reducing agents is called smelting

The most common reducing agents are coke, carbon monoxide and hydrogen.

Examples



Q.6 Define matte.

Ans: Matte:-

As a result of smelting process, slag is separated out on the molten mixture of two compounds i.e. Cu_2S and FeS . This molten mixture of Cu_2S and FeS is called matte.

Solvay's Process

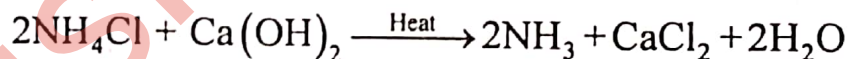
Q.7 Write the raw material of solvay process?

Ans: The raw material of ammonia sole process are as under.

- Ammonia
- Brine (Concentrated NaCl solution)
- Lime stone as a source of CO_2 and slaked lime. $\text{Ca}(\text{OH})_2$

Q.8 How ammonia is recovered in solvay process?

Ans: Ammonia is recovered in solvay ammonia process when solution containing ammonium chloride produced in the carbonating tower is heated with slaked lime in ammonia recovery chamber



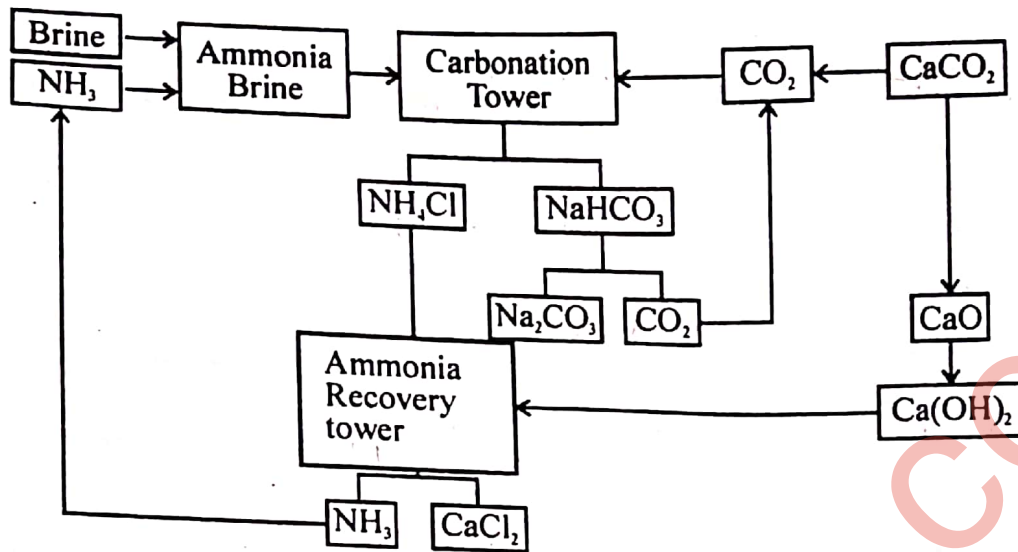
Almost all the ammonia is recovered in this process and reused.

Q.9 Write three advantages of solvay ammonia process.

- Ans:**
- It is a cheap process. The raw materials are cheap and easily available.
 - It is pollution free process. No harmful products are produced.
 - CO_2 and NH_3 is recovered and reused in this process.
 - It produces pure NaHCO_3 and Na_2CO_3
 - It consumes less fuel. This is because there is no solution to be evaporated

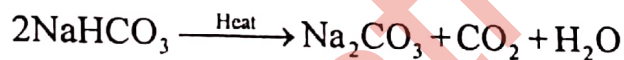
Q.10 Draw a the flowchart diagram of solvay's process

Ans:



Q.11 What is calcinations?

Ans: When sodium hydrogen carbonate (NaHCO_3) is heated than it is converted into sodium carbonate (Na_2CO_3) with the evolution of CO_2 and H_2O . This process is called calcinations.



Urea

Q.12 Write the raw material for the preparation of Urea?

Ans: The raw material which are used for manufacture of urea are

- (i) Ammonia (NH_3) (ii) CO_2

Q.13 How granulations of urea take place?

Ans: The liquid urea is evaporated to form Granules.

Method

When liquid urea is sprayed from top of a tower under pressure and hot current of air is introduced from the base, it evaporates the water to form granules.

Q.14 Write the name of stages which are involved for the manufacture of urea?

Ans: The name of stages involved in manufacture of urea are

- (i) Reaction of NH_3 and CO_2
- (ii) Urea formation (Distillation of ammonium carbamate)
- (iii) Evaporation of liquid urea and granulation

Chapter-16

Interesting informations

Q.15 Compare natural fertilizers with artificial fertilizers

Ans:

Natural Fertilizers	Artificial fertilizers
⇒ Insoluble in water	⇒ Soluble in water
⇒ Decompose slowly	⇒ Excess fertilizer is not absorbed and washed off by rain
⇒ Do not contain toxic chemicals hence do not damage plants or soil.	⇒ Caused eutrophication (hazards)
⇒ It is economical	⇒ Uneconomical

Q.16 What do you know about % of nitrogen in various fertilizers?

Ans:

Fertilizer	Formula	Molecular mass	%age of nitrogen
Ammonium sulphate	$(\text{NH}_4)_2\text{SO}_4$	132	21.2
Ammonium nitrate	NH_4NO_3	80	35.0
Urea	NH_2CONH_2	60	46.6

Q.17 Compare natural fertilizers with synthetic fertilizers. Also discuss the harmful effects of synthetic fertilizers.

Ans: Natural fertilizers are better than synthetic fertilizers. Natural fertilizers are insoluble in water. They decompose slowly and gradually by bacterial and liberate useful water soluble nutrients for plants. They do not contain toxic chemicals and hence do not damage the soil crops and plants. On the other hand synthetic fertilizers are water soluble. When more fertilizer is applied than the soil can absorb, rain washes off the excess fertilizer. This is not only uneconomical but also hazardous to the environment.

Harmful effect of synthetic fertilizers:

The dissolved nutrients flow into stream, lakes and rivers and contribute in the eutrophication of their waters. It results in over growth of water plants, algae and bad odour in these waters. A bloom of algae can spread across the surface, blocking light for other plant life in the water. When plants and algae die, bacteria multiply rapidly with so much food available. They remove the dissolved oxygen in the water. Without oxygen, fish die affecting the whole ecosystem. Nitrates in drinking water cause stomach cancer.

Petroleum industry

Q.18 What is petroleum?

Ans: Petroleum

It is a thick dark brownish complex mixture of several gaseous, liquids and solid hydrocarbons having water, salt and earth particles with it. The name petroleum is derived from latin words *petra* (rock) and *oleum* (oil). It is also known as crude oil. It is lighter than water and is insoluble in it.

Q.19 What the origin of petroleum and natural gas?
Ans: It is believed that petroleum was formed from organisms that lived hundreds of millions of years ago. Plants and animals in the seas died. Their remains piled up. Layers of sand, rock and mud buried the dead organisms. Over time, in the absence of air, heat and pressure of sediments and bacterial effect changed the material into dark brownish viscous liquid called petroleum. It is also called crude oil. The gaseous products accumulated over the petroleum, is called as natural gas.

Q.20 Write the name of fractions which are obtained by fractional distillation of petroleum?

Ans: The names of fractions obtained by fractional distillation of petroleum are.

- Liquefied petroleum gas (LPG)
- Kerosine
- Diesel
- Lubricating
- Petrol
- Fuel oil
- Naphtha
- Bitumen

Interesting information

Q.21 Wood, oil or electric fires required different techniques to put them out why?

Ans: Wood oil or electric fires required different techniques to put them out. Wood, fire is generally extinguished by throwing water on it. Water has high heat of vaporization. So it absorbs considerable amount of heat from the fire before it vaporizes. So it gradually cools burning wood and extinguishes fire. Oil fire, on the other hand cannot be put off by water. This is because oil and water do not mix. At the same time oil is lighter than water. It floats over water. The fire also spreads with flowing water. Water cannot out of contact between burning oil and oxygen. Oil fire is usually put off by throwing sand on it. Electric fires can only be put out by fire extinguishers.

Q.22 Relate the study of chemistry to career in industry.

Ans: A person who studies chemistry and works with chemical is called as chemist. Chemicals have opportunities in at the field of chemistry. For instance, organic chemists have good opportunities to work in industries like petroleum, petrochemical and pharmaceutical. They can research on new products, more effective medicines new pesticides for better crops, new ways to help people reduce environmental pollution etc. As a food chemist you can work in food processing industry. You can discover new methods to store, improve texture and flavour of foods. In hospitals, chemists analyze blood, urine and stool samples to detect any disease, disease causing bacteria, virus, to other micro organisms. A nuclear chemist you can work in the development of new nuclear medicines besides giving chemotherapy and radiation therapy to cancer patients. As inorganic chemist you can work in chemical industries such as manufacturing cement, glass, soap and detergent, fertilizer, acids, alkalis, soda as, dyes, explosive etc

Q.23 What are the modern application of chemical technology? And how we save us form its drawbacks and risks?

Ans: Chemical firms spent billions of dollars on chemical research and development. The industrial use of chemistry brings us new medicine life saving drugs, effective pesticides, germicides, fungicides, synthetic fertilizers, paints, cosmetics, artificial flavours, sweeteners, etc These chemical have raised our standard of living. However, besides benefits, these substances have some drawbacks and risks; it is the job of sales officer to keep you aware of such drawbacks basses explaining benefits. It is important to express benefits of chemicals in a way that everyone can understand. In order to share information he needs to develop good communication skills to promote chemical sales.

SELF ASSESSMENT EXERCISES**16.1**

1. List important ores of iron, copper, Zinc and mercury.

Ans: Important areas of iron, copper, zinc and mercury are given below

Metal	Name of ore	Formula
Iron	Haematite	Fe_2O_3
	Magnetite	Fe_3O_4
Copper	Chalcopyrite	$CuFeS_2$
Zinc	Zinc blende	ZnS
Mercury	Cinnabar	HgS

2. List out basic metallurgical operations.

Ans: The process of extraction of pure metal from its ore is called metallurgy. The main steps involved in metallurgy are

- Crushing, grinding or pulverizing of the ore.
- Concentration of the ore (magnetic separation, cyclone separation, froth flotation process)
- Extraction of metal (roasting, smelting, basissmerization)
- Refining of metal

3. List main processes used to concentrate the ore.

Ans: Concentration of ore:

- Magnetic separation
- Cyclone separation
- Froth flotation process

4. Write names of methods used in the extraction of a metal from its concentrated ores.

Ans: Roasting and smelting are the methods used in the extraction of metal from its concentrated ores.

5. List methods used to purify metals

Ans: Following are the methods which are used to purify metals,

- Electro-refining
- Distillation

16.2

1. Make a list of raw materials of solvay process.

Ans: Raw materials of solvay process

- Ammonia
- Brine solutions (concentrated solution of NaCl)
- Lime stone

Outline the basic reactions of Solvay process

Ans: Basic reactions of solvay process are given below,

- (i) $\text{CaCO}_3 \xrightarrow{\text{Heat}} \text{CaO} + \text{CO}_2$
- (ii) $\text{CO}_2 + \text{NH}_3 + \text{H}_2\text{O} \longrightarrow \text{NH}_4\text{HCO}_3$
- (iii) $\text{NH}_4\text{HCO}_3 + \text{NaCl} \longrightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$
- (iv) $\text{CaO} + \text{H}_2\text{O} \longrightarrow \text{Ca(OH)}_2$
- (v) $2\text{NH}_4\text{Cl} + \text{Ca(OH)}_2 \longrightarrow \text{CaCl}_2 + 2\text{NH}_3 + 2\text{H}_2\text{O}$
- (vi) $2\text{NaHCO}_3 \xrightarrow{\text{Heat}} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

3. List out main steps of Solvay process.

Ans: Main steps of solvay process

- (i) Preparation of ammonical solution
- (ii) Carbonation
- (iii) Filtration
- (iv) Calcination
- (v) Preparation of CO_2 and slaked lime
- (vi) Recovery of ammonia

6.3

1. Calculate percentage of nitrogen in urea.

Ans: Molar mass of urea is 60 g /mole.

In one mole of urea ($\text{NH}_2)_2\text{CO}$) amount of nitrogen is $14 \times 2 = 28\text{g}$. So the percentage of nitrogen in urea is calculated as

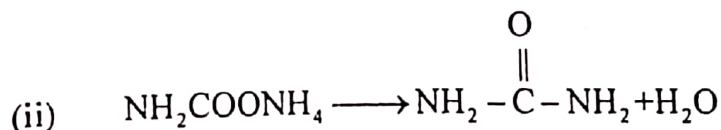
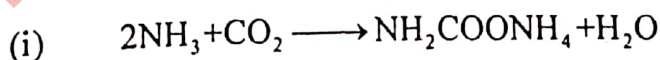
60 g of urea contains nitrogen = 28g

100g of urea contain nitrogen = $(28/60) \times 100 = 46.6$

So, 46.6 % nitrogen is present in urea.

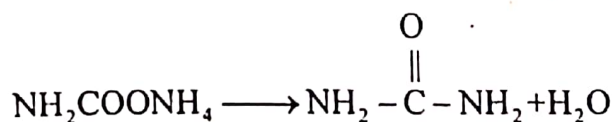
2. Outline the basic reactions that take place in the synthesis of urea.

Ans: Basic reactions for the synthesis of urea are given below



3. What happens when ammonium carbamate is distilled with steam?

Ans:



16.4

1. Define petroleum.

Ans: Petroleum:

The name petroleum is derived from latin word *petra* (rock) and *oleum* (oil). It is thick dark brownish viscous liquid which is composed mostly of hydrocarbons. It is also known as crude oil it is present in between the non-porous rocks.

2. List names of fractions obtained by the fractional

Ans: Name of fractions of petroleum:

- (i) Liquefied petroleum gas (LPG)
- (ii) Petrol
- (iii) Naphtha
- (iv) Kerosene
- (v) Diesel
- (vi) Lubricating oil
- (vii) Fuel oil
- (viii) Bitumen

3. List one use of each petroleum fraction

Ans: See in question answers of this chapter

4. How is petroleum obtained?

Ans: It is believed that petroleum was formed from organisms that lived hundreds of millions of years ago. Plants and animals in the seas died. Their remains piled up. Layers of sand, rock and mud buried the dead organisms. Over time, in the absence of air, heat and pressure of sediments and bacterial effect changed the material into dark brownish viscous liquid called petroleum. It is also called crude oil. The gaseous products accumulated over the petroleum, is called as natural gas.

LONG QUESTION

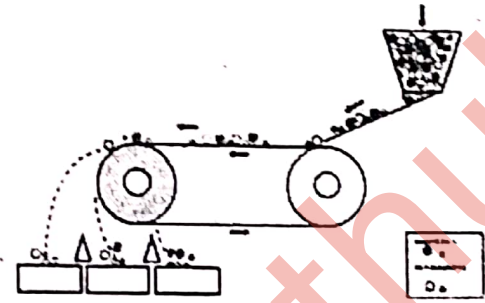
Q.1
Ans:

How we concentrate (purify) ore for mineral (Impure from)?
Concentration

After mining ore through crushing, grinding or pulverizing steps is converted into the powdered. Then mineral is separated from gangue by some physical method. This process is called concentration. Some of these methods are as follows.

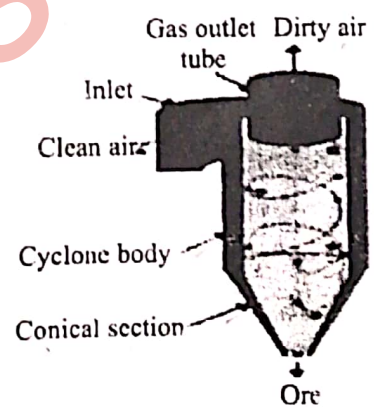
(a) **Magnetic separation**

For magnetic ore, a magnet is used to remove mineral, leaving the gangue behind. The powdered ore is dropped over a moving belt. Belt moves over two wheels, one of which is magnetic. It attracts the magnetic ore, so it falls nearer to the magnetic wheel. While non-magnetic impurities fall further away,



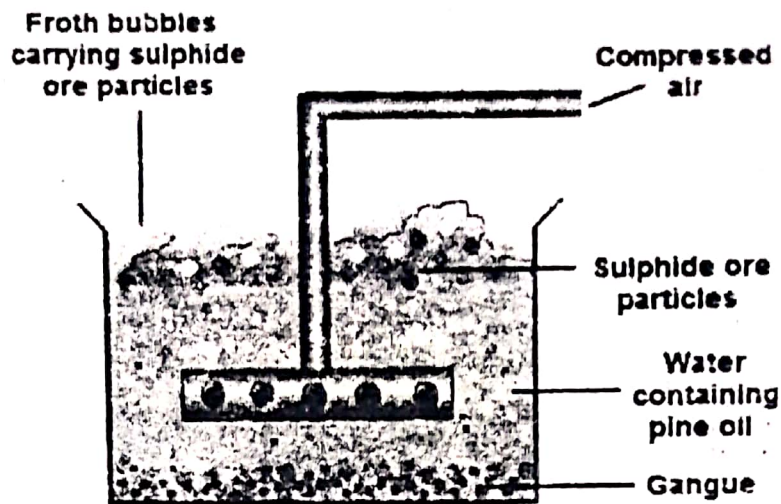
(b) **Cyclone separation**

Where large density difference exist between ore and impurities, a cyclone separator is used. In this method air under high pressure is blown through the pulverized ore. The lighter gangue is blown away through the top. But the denser mineral rich particles hit the walls by centrifugal force. They fall down the funnel.



(c) **Flotation process**

Pulverized ore is fed into a tank containing water and an oil-detergent mixture. The mixture is agitated with air. Detergents wet the mineral particles but not the silicate gangue. The mineral particles rise to the top of the mixture as a froth, from where they are skimmed off. Particles of the gangue fall down to the bottom. The copper ore is concentrated generally by flotation process.



Froth flotation process for the concentration of sulphide ores.

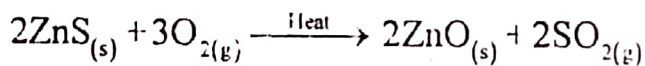
2.2 How we extract metals ores?

Ans: Extraction of metals

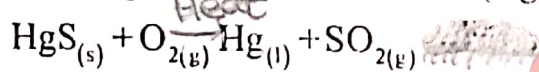
After the mineral has been freed of gangue and concentrated it is passed through some chemical process to extract metal.

(a) Roasting

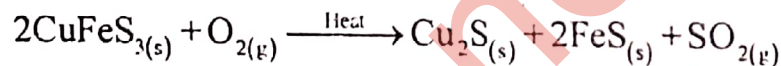
Some minerals are converted to oxide by heating in the air at temperature below their melting point. This process is called roasting. For example, the roasting for zincblende (ZnS) is



Roasting reaction for cinnabar (HgS) is



Roasting reaction of copper pyrite ore is



(b) Smelting

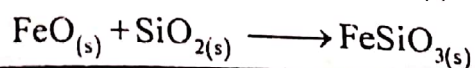
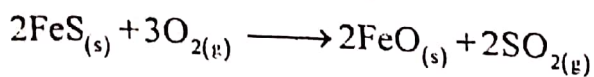
The method to reduce metal ions to free metal is called smelting

The most common reducing agents are coke, carbon monoxide and hydrogen. Some examples are:



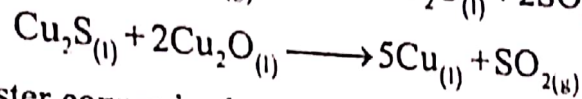
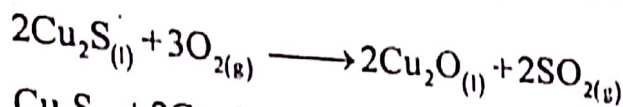
However, smelting of copper ore is done in two steps.

(i) The roasted copper ore is heated with coke and sand at about 1100°C. The materials melt and separate into two layers. The bottom layer that contains mixture of Cu₂S and FeS is called matte. While the upper layer is a silicate slag formed by the reaction of FeO and sand

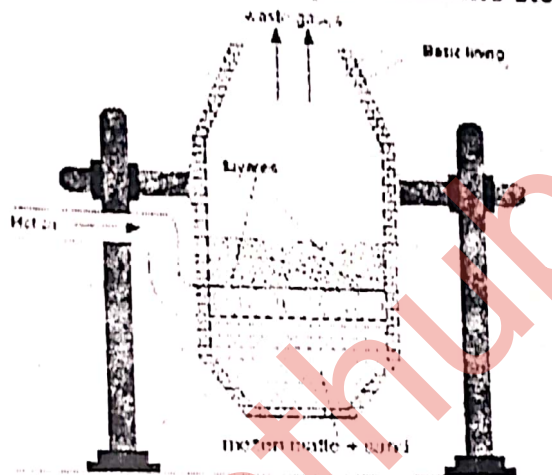


(ii) Bessemerization

In this process air is blown through the molten copper matte in-through the molten copper matte in a Bessemer converter. Any remaining iron sulphide (FeS) is oxidized and removed as slag (FeSiO₃). In the final smelting step cuprous sulphide (Cu₂S) is oxidized to form cuprous oxide, which reacts with remaining cuprous sulphide to form metallic copper.



The product, called blister copper is about 97 to 99% pure Cu, with entrapped bubbles of SO_{2(g)}. Bessemerization is also used to convert pure iron into steel.



Q.3 How we purify metals?

Ans: Refining or purification of metals

The metal obtained as a result of smelting contains some impurities. So it must be refined. Following methods may be used.

(i) Electro-refining

An electrolytic cell is used in electro-refining, in which impure metal acts as the anode and a sample of pure metal acts as the cathode. For example, electrolytic refining of copper is carried out in a electrolytic tank containing acidified copper sulphate solution as electrolyte (Figure 16.5). Impure slabs of copper acts as anode and pure copper sheets as cathode.

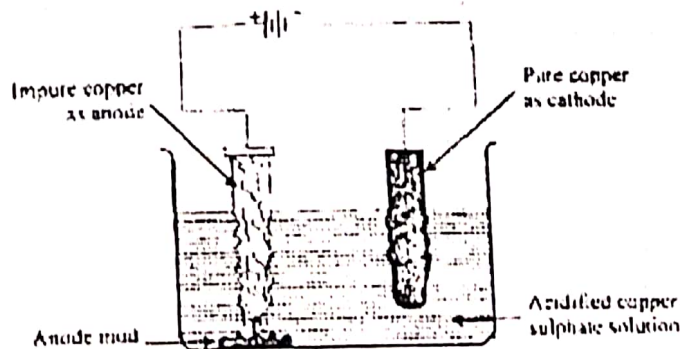


Fig. 6.2 Electro refining

On passing electric current through the solution, impure copper dissolves forming Cu⁺² ions. These Cu⁺² ions gain electrons at cathode and form Cu atoms, which are deposited on the cathode. In this way pure copper is collected at cathode. The impurities like Au and Ag fall off the anode as anode mud.



(ii) Distillation:

Metals with relatively low melting points, such. As and Hg are refined by distillation.

Q.4 Write a detail note on Solvay's process also discuss that why it is important?

Ans: Solvay process

Sodium carbonate (Na_2CO_3) or soda ash is an important industrial chemical. It is used in the manufacturing of glass, soaps, detergents, paper and many other important chemicals. Sodium carbonate is manufactured in a continuous process known as the Solvay process.

Raw materials

Commercially, sodium carbonate is manufactured in a continuous process that uses

- (a) Ammonia (b) Brine (concentrated sodium chloride solution)
(c) Lime stone as a source of carbon dioxide and slaked lines, $\text{Ca}(\text{OH})_2$

Basic reactions

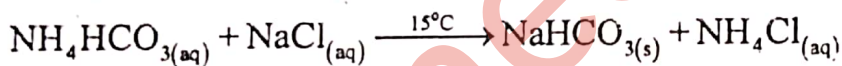
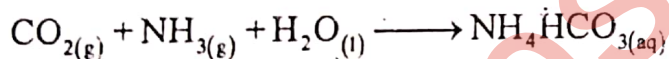
Solvay process consist of following steps

(i) Preparation of ammonical brine

Ammonical brine is prepared by dissolving ammonia gas in brine. Ammonical brine is fed into the carbonating tower.

(ii) Carbonation

In the carbonating tower, carbon dioxide is passed through ammonical brine. Following reaction takes place in it.



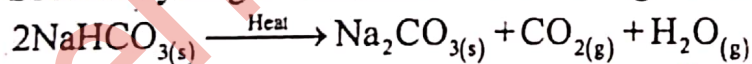
In the lower compartments of carbonating tower, the temperature of the mixture is lowered to 15°C . At this temperature, NaHCO_3 precipitates out.

(iii) Filtration

Precipitates of NaHCO_3 are separated from the milky solution by filtration. It is used as baking soda.

(iv) Calcinations

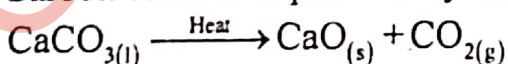
Sodium hydrogen carbonate is heated to get sodium carbonate



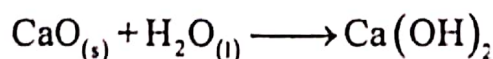
Carbon dioxide released is re-cycled in the progress.

(v) Preparation of carbon dioxide and slaked lime

Carbon dioxide is produce by heating limestone in a kiln



Carbon dioxide is fed into the carbonating tower from the top-equal amounts of lime (CaO) and water are mixed to produce slaked lime, $\text{Ca}(\text{OH})_2$



Slaked lime is pumped to the ammonia recovery tower.

(vi) Recovery of ammonia

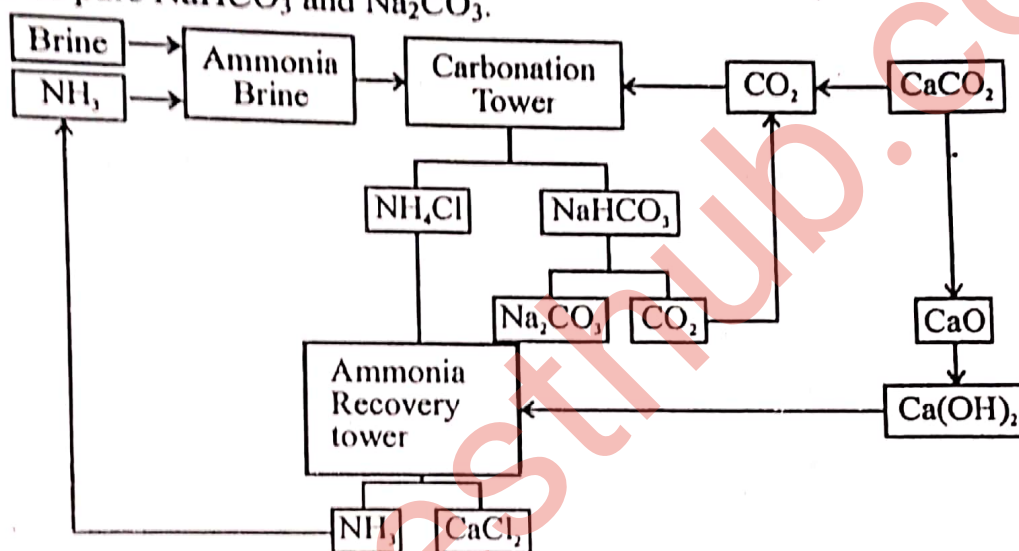
Solution containing ammonium chloride produced in the carbonation tower is heated with slaked lime.



Almost all the ammonia is recovered in this process. It is reused in the process.

Advantages of Solvay process

- (i) It is a cheap process. The raw materials are cheap and easily available.
- (ii) It is a pollution free process. No harmful products are produced.
- (iii) It consumes less fuel. This is because there is no solution to be evaporated.
- (iv) Carbon dioxide and ammonia are recovered and re-used in the process.
- (v) It produces pure NaHCO_3 and Na_2CO_3 .



Q.5 What do you know about urea? And how we prepare it industrially?

Ans: Urea

As the world population has increased the demand for food has increased. The world population was 3.5 billion in 1965. By 2050, it will reach 10 billion. Many people today are hungry and many more are under-nourished. Crops take nutrients from the soil, and these must be replaced before the next crop is sown. Fertilizers are the compounds which are put in the soil to provide elements essential for plant's life. They are added to the soil to make up the deficiency caused by the previous crops. Fertilizers are classified into two categories.

(1) Natural fertilizers or manures derived from animals and human wastes.

(2) Synthetic fertilizers i.e. urea, ammonium sulphate, ammonium phosphate,

Super Phosphate and di-ammonium phosphate. Urea is one of the widely used fertilizers because of the following qualities.

- (i) Percentage of nitrogen is highest among all the synthetic nitrogen fertilizers i.e. 46%.
- (ii) It does not affect the texture of the soil.
- (iii) In the soil it hydrolyses quickly to ammonium carbamate which eventually changes into NH_3 which decomposes into N_2 and H_2 . Nitrogen is the main constituent of

proteins' it is required by the stems and leaves during the early stages of the plant development. It imparts green colour to the leaves and increases the yield and quality of the crop.

Raw materials

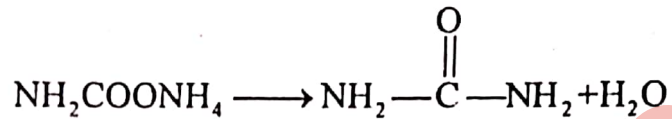
The raw materials for the manufacture of urea are

Manufacturing of urea consists of following steps.

- (i) Ammonia (NH₃) (ii) Carbon dioxide (CO₂)
 (i) Reaction between NH₃ and CO₂ to form ammonium carbamate.

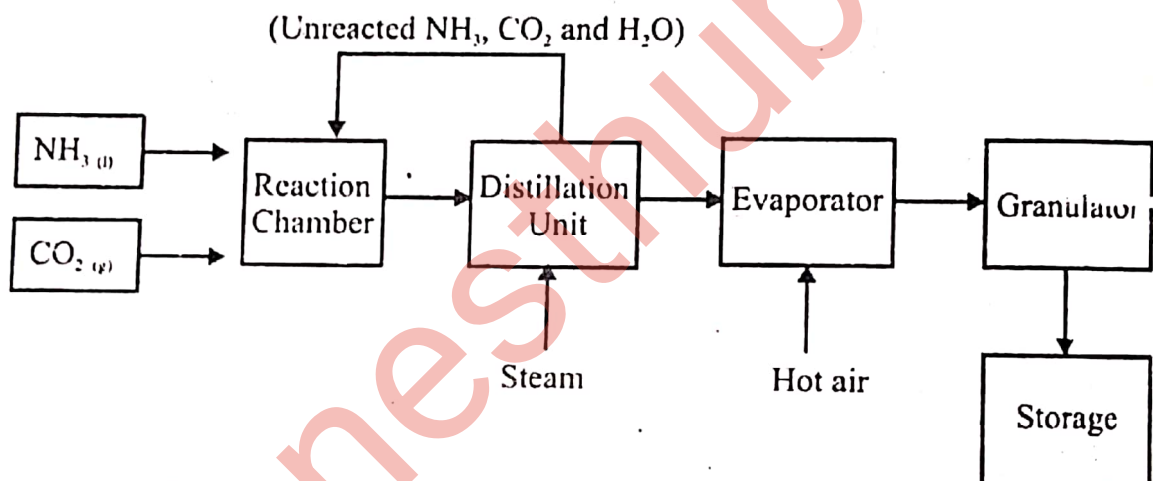


- (ii) Distillation of ammonium carbamate



Evaporation of liquid urea and its granulation

The urea solution is concentrated in vacuum evaporators, which is then rapidly cooled and sent to the Prilling tower. Urea prills thus produced are packed and then marketed.



Q.6 Compare natural fertilizers with synthetic fertilizers. Also discuss the harmful effects of synthetic fertilizers.

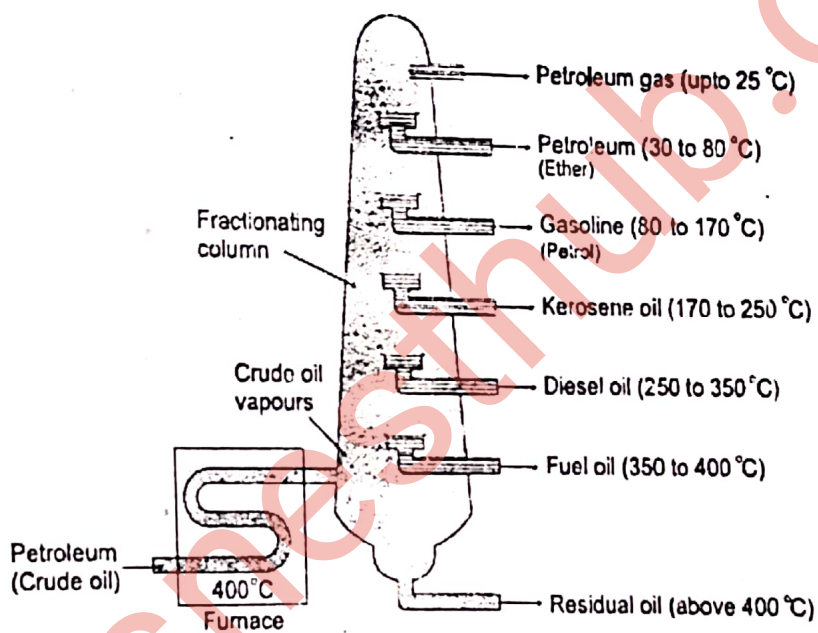
Ans: Natural fertilizers are better than synthetic fertilizers. Natural fertilizers are insoluble in water. They decompose slowly and gradually by bacterial and liberate useful water soluble nutrients for plants. They do not contain toxic chemicals and hence do not damage the soil crops and plants. On the other hand synthetic fertilizers are water soluble. When more fertilizer is applied than the soil can absorb, rain washes off the excess fertilizer. This is not only uneconomical but also hazardous to the environment.

Harmful effects of synthetic fertilizers:

The dissolved nutrients flow into stream, lakes and rivers and contribute in the eutrophication of their waters. It results in over growth of water plants, algae and bad odour in these waters. A bloom of algae can spread across the surface, blocking light for other plant life in the water. When plants and algae die, bacteria multiply rapidly with so much food available. They remove the dissolved oxygen in the water. Without oxygen, fish die affecting the whole ecosystem. Nitrates in drinking water cause stomach cancer.

Write a note on refining of petroleum through fractional distillation.

The conservation of crude oil into useful products is called refining. These useful products are called fractions. Each fraction consists of a mixture of hydrocarbons which boils in a certain range of temperature. Petroleum is refined by fractional distillation in a tall fractionating tower. The crude oil is heated up to 400°C under high pressure in a furnace. Then it is passed through the fractional distillation column. Its vapours rise through the column. As hot vapours move up, they condense according to their boiling points into various fraction. Compounds with highest boiling points condense first near the bottom. Compounds with lowest boiling point condense last near the top. Compounds which do not boil collect at the bottom as residue. In this way vapour condense gradually at different levels according to their boiling points. Therefore. Crude oil is separated into various fractions. Each fraction has its own specific boiling range and composition. How many fractions are obtained?



The physical properties and uses of petroleum fractions are given in table.

Fraction	Number of carbon atoms per molecule	Boiling point °C	Important uses
Liquefied petroleum gas (LPG)	1-4	Below 20	Cylinder gas for cooking
Petrol	4-10	35-70	Fuel for motor cars and vehicles
Naphtha	8-12	70-120	Chemicals feedstock for making drugs, plastics and other chemicals
Kerosene	10-16	170-250	Fuel for jet planes, fuel for heating, lighting and cooking
Diesel	14-20	270-340	Fuel for buses, truck and trains
Lubricating oil	20-50	350-500	Lubricants for machines and engines, waxes and polishes
Fuel oil	50-70	500-600	Fuel for power stations, factories and ships
Bitumen	More than 70	More than 500	Paving roads and making roofing materials

Q.8 Wood, oil or electric fires required different techniques to put them out why?

Ans: Wood, oil or electric fires required different techniques to put them out. Wood, fire is generally extinguished by throwing water on it. Water has high heat of vaporization. So it absorbs considerable amount of heat from the fire before it vaporizes. So it gradually cools burning wood and extinguishes fire. Oil fire, on the other hand cannot be put off by water. This is because oil and water do not mix. At the same time oil is lighter than water. It floats over water. The fire also spreads with flowing water. Water cannot get in contact between burning oil and oxygen. Oil fire is usually put off by throwing sand on it. Electric fires can only be put out by fire extinguishers.

Q.9 Relate the study of chemistry to career in industry.

Ans: A person who studies chemistry and works with chemicals is called as chemist. Chemicals have opportunities in all the fields of chemistry. For instance, organic chemists have good opportunities to work in industries like petroleum, petrochemical and pharmaceutical. They can research on new products, more effective medicines, new pesticides for better crops, new ways to help people reduce environmental pollution etc. As a food chemist you can work in food processing industry. You can discover new methods to store, improve texture and flavour of foods. In hospitals, chemists analyze blood, urine and stool samples to detect any disease, disease causing bacteria, virus, and other micro organisms. A nuclear chemist you can work in the development of new nuclear medicines besides giving chemotherapy and radiation therapy to cancer patients. As an inorganic chemist you can work in chemical industries such as manufacturing cement, glass, soap and detergent, fertilizer, acids, alkalis, soda ash, dyes, explosives etc.

Q.10 What are the modern applications of chemical technology? And how we save us from its drawbacks and risks?

Ans: Chemical firms spent billions of dollars on chemical research and development. The industrial use of chemistry brings us new medicines, life saving drugs, effective pesticides, germicides, fungicides, synthetic fertilizers, paints, cosmetics, artificial flavours, sweeteners, etc. These chemicals have raised our standard of living. However, besides benefits, these substances have some drawbacks and risks, it is the job of a sales officer to keep you away from such drawbacks besides explaining benefits. It is important to express benefits of chemicals in a way that everyone can understand. In order to share information he needs to develop good communication skills to promote chemical sales.

REVIEW QUESTIONS FROM TEXT BOOK

Select the correct answer

The naturally occurring metallic compounds are called as

- (a) Ore
(b) Gangue
(c) Mineral
(d) Rock

The separation of minerals from gangue is called concentration. Which of the following methods is used for concentration?

- (a) Smelting
(b) Roasting
(c) Refining
(d) Flotation

Which of the following steps is not used in the extraction process of metals

- (a) Roasting
(b) Smelting
(c) Flotation
(d) Bessemerization

In electrolytic refining of copper, _____ is used anode.

- (a) Pure copper
(b) Impure copper
(c) Copper sulphate
(d) Electrolytic tank

Which of the followings is not a raw material for the manufacture of soda ash

- (a) Ammonia
(b) Carbon monoxide
(c) Brine
(d) Lime stone

A mixture of Cu_2S and FeS called matte is produced in one of the metallurgical operations in the extraction of copper. The name of this operation is

- (a) Smelting
(b) Roasting
(c) Bessemerization
(d) Electro-refining

Chemical formula of slaked lime is

- (a) CaCO_3
(b) CaO
(c) Ca(OH)_2
(d) CaCl_2

Calcination is the process in which sodium hydrogen carbonate is heated to get sodium carbonate. Which is not obtained in this process?

- (a) CO_2
(b) CO
(c) Na_2CO_3
(d) H_2O

Percentage of nitrogen in urea is

- (a) 35
(b) 21.2
(c) 80
(d) 46.6

What happens when ammonium carbamate is distilled with steam?

- (a) Ammonia is produced
(b) Carbon
(c) Urea is produced
(d) Urea solution is produced

ANSWER KEY

Q.	Ans.	Q.	Ans.	Q.	Ans.	Q.	Ans.
1	c	4	b	7	c	10	d
2	d	5	b	8	b		
3	c	6	a	9	d		

SHORT QUESTIONS

Q.2 Give short answers.

(i) How are urea prills produced?

Ans: Urea solution is concentrated in vacuum evaporators which is then rapidly cooled and sent to 100 feet high periling tower. Urea perils thus produced there and then sent for packing

(ii) What is slaked lime? How is it produced?

Ans: See short questions answers

(iii) Write chemical reactions that take place during carbonating in solvay process.

Ans: See short questions answers

(iv) Explain the process "Roasting" with two examples.

Ans: See short questions answers

(v) Write chemical reactions that take place during urea formation.

3. Describe the following with an example

(a) Roasting

(b) Smelting

(c) Flotation

Ans: See question answers

4. Make a list of metallurgical Operations.

Ans: See questions answers

5. How was crude oil formed?

Ans: See questions answers

6. State five specific products made form rude oil.

Ans: See questions answers

7. Outline basic reactions of Solvay process.

Ans: See questions answers

8. Draw flow sheet diagram of Solvay process.

Ans: See questions answers

9. Describe composition of urea

Ans: urea consists of four elements C, H, O and nitrogen percentage composition of these elements are given below

%age composition of nitrogen = 46.6%

%age composition of Oxygen = 26.7%

%age composition of Carbon	=	20%
%age composition of Hydrogen	=	6.7%

10. **Make a list of raw materials for Solvay process.**

Ans: See Question answer of this chapter

11. **Describe the composition of petroleum**

Ans: See Question answer of this chapter

12. **Relate the study of chemistry to careers in industry.**

Ans: See Question answer of this chapter

13. **Draw flow sheet diagram for manufacture of urea.**

Ans: See Question answer of this chapter

14. **Petroleum is a mixture of several compounds, which are separated in a refinery.**

(a) **What is the name of the apparatus used for this purpose?**

Ans: Fractional distillation chamber or tower

(b) **What is the name of the process used in separating crude oil?**

Ans: Fractional distillation process

(c) **Write name of the fraction that represents gases.**

Ans: Liquefied petroleum gas (LPG)

(d) **Which fractions represent liquids with the lowest boiling points?**

Ans: Petrol or gasoline is that fraction which represent as liquid with the lowest boiling points

15. **Petroleum is a source of fuels. Name two fuels which are not obtained from petroleum.**

Ans: (i) Coal (ii) Biogas

16. **What has to be done to crude oil before it is useful?**

Ans: Before the use of crude oil, its is refined by fractional distillation

THINK-TANK

17. The table below lists some petroleum fractions with their approximate boiling points.

Fraction	Approximate Boiling Point /°C	
	Below 20	
P	35-710	
Q	170-250	
R	350-500	
S		

- (a) Name the process by which the fractions are obtained from petroleum?

Ans: Fractional distillation process

- (b) Which fraction will contain the shortest chain molecules?

Ans: p (liquid petroleum gas (LPG))

- (c) Which fraction will contain the longest chain molecules?

Ans: S fraction

- (d) In what state will fraction P be at room temperature and pressure?

Ans: Fraction P is a gas at room temperature

18. Should fossil fuels be burned to provide energy, or should they be used to make useful products like drugs, plastics and chemicals?

Ans: Yes, fossil fuels should be used to make useful products like drugs, plastic and chemical naphtha, lubricating oil and bitumen are the fractions of petroleum which are used other than fuels.

Naphtha is used as chemicals feed stock for making drugs, Plastics and other chemicals

Lubricating oil is used as lubricants for machines and engines, waxes and polishes.

Bitumen is used for paring roads and making roofing materials