

Chapter

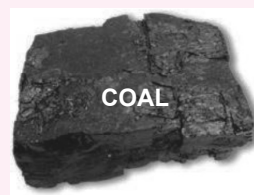
1

Coal and Petroleum



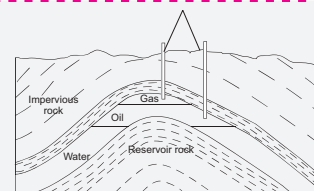
Learning Objectives

- Types of Natural Resources
- Coal and Formation of Coal
- Products of Destructive Distillation of Coal
- Petroleum and Refining of Petroleum
- Natural Gas
- Conservation of Natural Resources



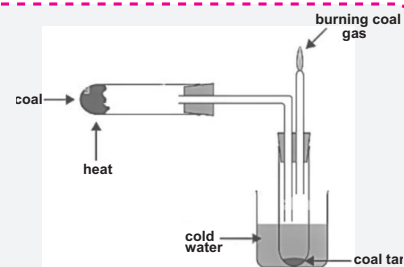
Exam Mirror

- Petroleum
 - Formation
 - Refining



Critical Concepts

- ✦ Destructive Distillation of Coal
- ✦ Refining of Petroleum



COAL AND PETROLEUM

Mankind is utilizing available resources at rapid rate in order to meet its basic (food, clothes and shelter) and advance needs. Thus, use of resources by human being is much faster in comparison to rate at which these resources can be replenished by nature. Some of the resources used by humans are natural like the air we breathe, water we drink, sunlight, soil, forests, fossil fuels, etc., and others are man-made resources like plastic, paper, metal alloys, glass, fabric etc.

Plants and animals are living natural resources. Air, water, soil and minerals are non-living natural resources.

Types of Natural Resources

- (i) **Inexhaustible/renewable resources :** Those natural resources which can be replenished or reproduced easily. For example, sunlight is a resource which will never run out as the sun is expected to last for another 5 billion years. Oxygen is renewable because it is replaced in the atmosphere as plants release oxygen during photosynthesis. Many of the inexhaustible resources gets replenished with time quickly. But some of the inexhaustible resources also depleting as they take longer time to replenish like ground water, etc.
- (ii) **Exhaustible resources :** Those natural resources which take very long time to replenish. Thus once used they cannot be replenished for mankind. For example sources like fossil fuels, top fertile layer of soil, minerals, forests, etc.

DID YOU KNOW?

Some non-renewable resources such as metal can be used again and again. These non-renewable resources can be recycled.



Coal, Petroleum and Natural Gas are very important natural resources, and play a vital role in modern society. They are found in the earth's crust.

Their easy availability and specific characteristics make them very important in the growth of industry. At present they are the chief sources of energy worldwide.



Illustration 1 :

Classify the following as exhaustible and inexhaustible natural resources :

Water, Minerals, Coal, Natural Gas, Petroleum, Sunlight, Wind, Forests

Solution :

Exhaustible natural resources :

Minerals, Coal, Natural Gas, Petroleum, Forests

Inexhaustible natural resources :

Water, Sunlight, Wind

COAL

Coal, a fossil fuel, is black in colour and hard as stone. Earlier it was used to cook food and to run railway engines.

It is the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic sources of carbon dioxide emissions. Gross carbon dioxide emissions from coal usage are slightly more than those from petroleum and about double the amount from natural gas. Coal is our most abundant fossil fuel resource.

Composition of Coal

Coal is a complex mixture of organic chemical substances containing carbon, hydrogen and oxygen in chemical combination, together with smaller amounts of nitrogen and sulphur.



Coal

Deposits

The distribution of coal deposits is not uniform in the earth's crust. To the total coal reserves in the world, Asia contributes about one third whereas North and South America contribute more than half. India has large deposits of coal. It is estimated that India has about 80 billion tones of proven coal deposits. The coal deposits are spread over in the states of Jharkhand, Madhya Pradesh and West Bengal.

DID YOU KNOW?

The electricity formed by using coal, is known as thermal electricity and about 50% of the electricity in the United States is generated from coal.



CONNECTING TOPIC

Different Types of Coal and their Uses

Different varieties of coal known as peat, lignite or brown coal, sub-bituminous coal, bituminous coal, and anthracite are formed as a result of carbonisation.

The carbon content, also called the rank of the coal, increases progressively from lignite, a low rank coal to anthracite, a high rank coal. Different amounts of heat and pressure during the geochemical stage of coal development cause these differences in rank. It is not due to the kind of plants the coal is formed from.

Out of these four, anthracite coal is the hardest coal which has the highest content 94-98% of carbon. Anthracite and bituminous coal are the most important and are mainly used in industries. Bituminous coal is softer than anthracite and contains about 82% carbon. Lignite is youngest variety of coal and is brown in colour. It contains 70% carbon. Since coal is of low cost and reliable source of energy, it is used for the generation of electricity.

Let's Connect

- Which type of coal has highest percentage of carbon?
(a) Anthracite (b) Bituminous (c) Peat (d) Lignite
- Which is the best variety of coal?
(a) Peat (b) Lignite (c) Anthracite (d) Bituminous
- Lignite coal contains how many percentage of carbon?
(a) 60% (b) 67% (c) 64% (d) 88%

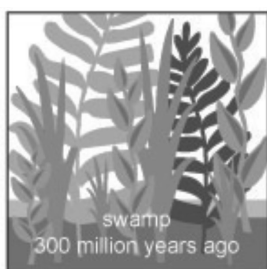
Sol. 1. (a) Anthracite is hard coal and contains about 96% carbon whereas peat, lignite and bituminous contain 60, 67-70 and 82% of carbon respectively.

2. (c) 3. (b)

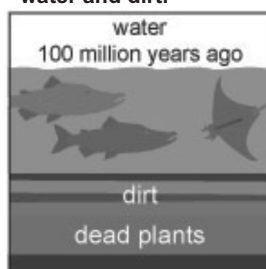
Formation of Coal

It is believed that millions of years ago the ground below the forests was split open by natural forces such as earthquakes and volcanoes. The forests were buried in the earth. Thus, the plants had no contact with oxygen. Successive layers of sediments sealed the buried plants. Over millions of years these deposits were subjected to tremendous pressure and heat which finally transformed them into coal. The chemical process involved in the transformation of plant matter into coal is called the **carbonisation**.

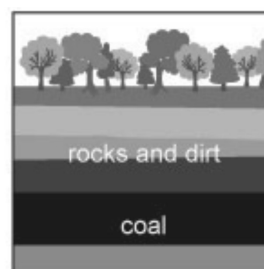
Before the dinosaurs, many giant plants died in swamps.



Over millions of years, the plants were buried under water and dirt.



Heat and pressure turned the dead plants into coal.



Formation of Coal

Destructive distillation of coal: Heating coal in absence of air is called destructive distillation of coal. It produces coke (non-volatile residue), coal tar (black thick viscous liquid), coal gas (mixture of combustible gases) and ammoniacal liquor (solution of ammonia in water). Destructive distillation of coal is carried out by heating coal strongly to 1000°C in the absence of air.

Now let us discuss about various products obtained from destructive distillation of coal and their uses.

Coke

Coke is the solid carbonaceous material derived from destructive distillation of low-ash, low-sulphur bituminous coal. It is an almost pure form of carbon. It is a good fuel and burns with no smoke. Cokes obtained from coal are grey, hard, and porous.

Volatile constituents of the coal—including water, coal-gas, and coal-tar—are driven off by baking in an airless furnace or oven at temperatures as high as $2,000$ degrees Celsius. The greater the volatile matter in coal, the more by-product can be produced, but too low or too high a level of volatile matter in the coal results in inferior coke produced in respect to coke quality properties. It is generally considered that levels of 26-29 % of volatile matter in the coal blend is good for coking purposes. Thus different types of coal are proportionally blended to reach acceptable levels of volatility before the coking process begins.

Uses : Coke is used as a fuel and as a reducing agent in smelting iron ore in a blast furnace.

Since smoke-producing constituents are driven off during the coking of coal, coke forms a desirable fuel for furnaces in which conditions are not suitable for the complete burning of bituminous coal itself.

DID YOU KNOW?

When coal is preserved under the right pressure and temperature for ten thousands of years you may get diamonds from these coal pieces. Diamond and coal are both made up of carbon particles.



DID YOU KNOW?

Coke may burn little or with no smoke under combustible conditions, while bituminous coal would produce much smoke.



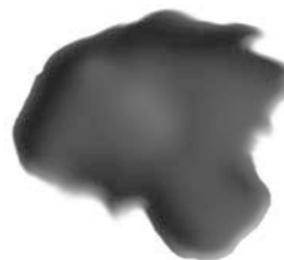
Coal Tar

Coal tar is a mixture of different carbon compounds. It is a thick, black liquid. The fractional distillation of coal tar gives many chemical substances which are used in the preparation of dyes, explosives, paints, synthetic fibres, drugs and pesticides. Some of these chemical substances are benzene, toluene, phenol and aniline. Naphthalene balls which are used to repel moths or insects are obtained from coal tar.

On further fractionation of coal tar, a large number of compounds are obtained, out of which 200 compounds have been isolated yet.

Coal Gas

Coal gas is mainly a mixture of hydrogen, methane and carbon monoxide. The gases present in coal gas are combustible, and hence it is an excellent fuel. It has a high calorific value. It was used for lighting houses, factories and streets in Mumbai (Bombay) until 1950. It was also used for cooking until recently.



Coal tar

Ammoniacal Liquor

The ammonia produced as a result of destructive distillation of coal is absorbed in water. The aqueous solution of ammonia, i.e. ammonium hydroxide solution is called ammoniacal liquor. It is used in the preparation of nitrogenous fertilizers such as ammonium sulphate and ammonium superphosphate.

DID YOU KNOW?

Coke was one of the materials used in the heat shielding on NASA's Apollo program space vehicles. This material has been used most recently as the heat shielding on the Mars Pathfinder vehicle. Although not used in modern day space shuttles, NASA had been planning to utilize coke and other materials for the heat shield for its next generation space craft, named Orion.



Illustration 2 :

How many substances are found in coal tar ?

Solution : Approximately 200 substances are present in coal tar.

**CHECK POINT-1**

- The conversion of wood into coal occurs by a biochemical process that takes over millions of years and is known as
 (a) catenation (b) carbonisation
 (c) pyrolysis (d) destructive distillation
- Coal gas is a mixture of –
 (a) $\text{CH}_4 + \text{H}_2 + \text{CO}$ (b) $\text{C}_4\text{H}_{10} + \text{H}_2$
 (c) $\text{C}_4\text{H}_{10} + \text{H}_2\text{O}$ (d) $\text{C}_2\text{H}_6 + \text{H}_2 + \text{O}_2$
- Coal tar is a
 (a) black, thick liquid. (b) dark, oily liquid.
 (c) tough, porous and black substance. (d) gas.
- Mark the correct statement.
 (a) Coke starts burning when exposed to air.
 (b) Coal gas is obtained as a gaseous product during destructive distillation of coal.
 (c) Coal gas can be condensed back to give coal.
 (d) Coal tar and ammoniacal liquor are useless product.

Sol. 1. (b) 2. (a)
3. (a) Coal tar is a black, thick liquid. 4. (b)

**CONNECTING TOPIC****Allotropy**

Allotropy is a phenomenon in which an element exhibits different physical forms with almost similar chemical properties.

Carbon is an element that can exhibit various allotropic forms which have a wide variety of applications.

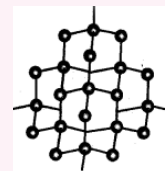
Allotropic forms of Carbon

They have well-defined regular geometrical arrangements of carbon atoms. Diamond and graphite are the widely known crystalline allotropes of carbon. A third form of allotropes of carbon called fullerene was discovered in recent times.

Diamond

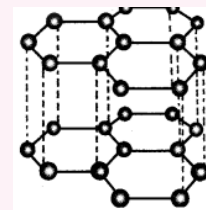
Diamond has regular tetrahedral arrangement where each atom of carbon is bonded with four other carbon atoms, forming a single unit of crystal. These crystals unit lie in different planes accounting for a rigid three-dimensional structure.

Diamond is a good conductor of heat and a bad conductor of electricity.

**Diamond****Graphite**

In graphite, each carbon atom is bonded covalently to three other carbon atoms resulting in the arrangement of hexagonal rings in a single plane. The bonds between the atoms of two crystals, in the parallel planes are weak. Each carbon is bonded to three carbon atoms only leaving behind one free valency. A three-dimensional arrangement of hexagonal ring is resulted. These rings lie on a single plane. The entire structure is such that the layers of hexagonal ring are arranged parallel to each other.

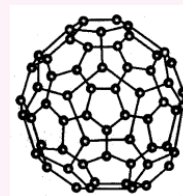
It is a good conductor of heat and electricity because of free valency.

**Graphite**

Fullerenes

Fullerenes are large spherical carbon cage molecules consist of mainly C_{60} and minorly C_{70} . Its has a shape like soccer ball and was named Buckminster fullerene in honour of American architect R. Buckminster Fuller. The name fullerene orginiated from the structure that was similar to the geodesic dome structures designed by the architect. It contains 20 six-membered ring and 12 five-membered ring. It is the purest form of carbon.

It becomes a super conductor when it forms compound with noble gases.



Fullerenes

Charcoal

Charcoal is the light, black residue consisting of impure carbon and remaining ash obtained by removing water and other volatile constituents from animal and vegetation substances. Charcoal is usually produced by slow pyrolysis, the heating of substances like wood, sugar, bones or other organic matter in the absence of oxygen. The resulting soft, brittle, lightweight, black, porous material resembles coal.

Let's Connect

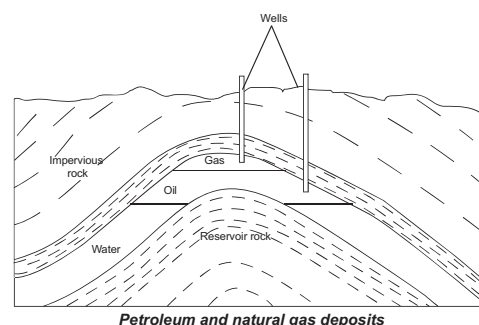
- Which one of the following statement is incorrect about graphite and diamond ?
 - Graphite is smooth and slippery.
 - Diamond is good conductor of heat.
 - Graphite is a good conductor of electricity.
 - Physical and chemical properties of graphite and diamond are different.
 - Which of the following is a hardest substance on the earth ?
 - Sodium
 - Calcium
 - Graphite
 - Diamond
- Sol. 1. (d)** Graphite and diamond show different physical properties. Diamond is colourless transparent substance. It does not conduct electricity. Graphite is greyish black. It is good conductor of electricity. Chemical properties of graphite and diamond are same.
- 2. (d)**

PETROLEUM

Petroleum is a naturally occurring oil that consists chiefly of hydrocarbons (compounds containing carbon and hydrogen) with some other elements, such as sulphur, oxygen and nitrogen. It is now known that petroleum contains hydrocarbons of the paraffin series, with upto 100 or more carbon atoms in the chain. The unrefined form of petroleum is called crude oil.

Petroleum is also called rock oil i.e. petro = rock, oleum = oil.

It is believed that petroleum was formed from organisms living in the sea. The remains of these organisms were deposited in shallow depressions in the sea bed long, long, ago. These were covered by layers of sand and clay which compressed these remains. Over a period of millions of years, the organic matter present in the dead organisms underwent a series of processes before being finally transformed into petroleum. The petroleum migrated from the source rock to be entrapped in large underground reservoirs beneath impervious or impermeable rocks. It often floats over a layer of water and is held in this position under pressure beneath a layer of natural gas.



Petroleum and natural gas deposits

DID YOU KNOW?

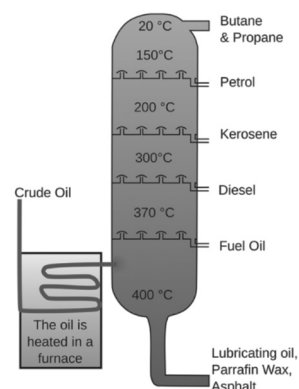
Petroleum is obtained by drilling through the earth and impervious (non-porous) rock above it. The world's first oil well to yield petroleum was dug in Pennsylvania, USA, in 1859. In India, oil was first struck in Madum in Assam in 1867. The crude oil pumped out form a well is a black liquid. Because of its importance in today's world, it is referred to as black gold.



Refining

Petroleum is a mixture of several hydrocarbons. It is a foul - smelling brown black liquid. It also contains water, salt and rocky materials. It cannot be used in this crude form either as a fuel or as a basic material to produce other useful components. Before being put to use, it has to be purified or refined. The process of separating the various components of petrol from one another is known as the refining of petroleum. This is done by a process called fractional distillation which is based on the fact that the different components of petroleum have distinctly different boiling points.

They are separated in a large fractionating column. Crude oil is piped to the refinery from a well. It is washed with acid and alkali solutions to remove the basic and acidic impurities respectively. Crude oil is then heated to about 673 K and fed at the base of fractionating column. All the components except asphalt are in the vapour state. As the mixture of hot vapours rises up in the column, it begins to cool. The component with the highest boiling point condenses first and is collected. Those with low boiling points condense later. The residual gases escape uncondensed from the upper part of the column. The various components condensed at different heights of the column are collected separately. The components obtained at different heights in order from the bottom are asphalt, lubricating oil, paraffin wax, fuel oil, diesel, kerosene, petrol and petroleum gas.



Refining of Petroleum

Some Important Fractions of Petroleum and their Uses

Fraction	Boiling Point	Number of Carbon /Atom	Products Obtained/Uses
Petroleum gas	below 40° C	1–4	LPG (Liquefied petroleum gas)– fuel for home and industry
Gasoline (petrol) and naphtha	40°–160° C	5–12	Petrol–motor fuel, aviation fuel, solvent for dry-cleaning
Kerosene	160°–250° C	10–16	Kerosene–domestic fuel, jet engine fuel
Diesel oil	250°–300° C	14–20	Diesel–fuel for motor vehicles (especially heavy vehicles), electric generators
Lubricating oil	300°–350° C	20–50	Lubricating oil–lubricating machinery;
Fuel oil, Paraffin wax, Bitumen (Asphalt/residue)	over 350° C	Above 50	Fuel oil- in many industries Paraffin wax–candles, vaseline, ointments etc; Asphalt (bitumen)–paints, road surfaces



Illustration 3 :

Why is petroleum refined?

Solution :

Petroleum or crude oil that is pumped out from oil wells is not pure. It is a mixture of several compounds. It is refined and converted into various components so that they can be used for various purposes.

Petrochemicals

The substances which are obtained from petroleum and natural gas are called petrochemicals. These are used in the manufacture of detergents, synthetic fibres like polyester and nylon, polythene and plastics. Petroleum is also called black gold because of its wide application as a fuel in industry and home.

**Illustration 4 :**

Coal and petroleum are the source of energy. How is energy useful to us?

Solution :

Energy is required in almost every field of our life, some of the uses of energy are

- We need energy of fuels to generate electricity and to supply power to various factories, industries, agricultural devices.
- Energy is required to run vehicles.
- We need energy to run our electrical appliances like refrigerator, TV, computer, etc.

**CHECK POINT-2****1. Column-I**

- (A) Kerosene
- (B) Paraffin wax
- (C) Bitumen
- (D) Gasoline

Column-II

- (p) Road surfacing
- (q) Fuel for vehicles
- (r) Manufacturing candles
- (s) Jet engine fuel

2. Petroleum refining is –

- (a) distillation of petroleum to get different fractions of it.
- (b) obtaining aromatic compounds from aliphatic compounds present in petroleum.
- (c) cracking of petroleum to get gaseous hydrocarbons.
- (d) purification of petroleum.

3. The natural petroleum contains

- (a) saturated hydrocarbons.
- (b) cyclic saturated hydrocarbons.
- (c) compounds of sulphur.
- (d) All of these

4. Kerosene is used as fuel because it is

- (a) more volatile
- (b) less volatile
- (c) cheap
- (d) abundantly available

Sol. 1. (b) A → (s), B → (r), C → (p), D → (q)

2. (a)

3. (d) Petroleum is a naturally occurring crude oil containing saturated, cyclic, unsaturated hydrocarbons with some other elements, such as sulphur, oxygen and nitrogen.

4. (b) Kerosene also known as paraffin, a combustible substance derived from petroleum. It is less volatile than gasoline and its flash point (the temp. at which it will generate a flammable vapours near its surface) is 38° C. So, it is easy to store to be used as fuel.



CONNECTING TOPIC

Chemical Composition of Crude Oil

Crude oil is an organic compound mainly consists of alkane (single bond hydrocarbon) with general formula C_nH_{2n+2} , alkene (double bond hydrocarbon) with general formula C_nH_{2n} and aromatic compound. Crude oil is a mixture of all these compound in different proportions. No two crude oil samples from different sources are completely identical.

The **alkane paraffinic** series of hydrocarbon comprises the most common hydrocarbons in the crude oil. The major constituents of gasoline are the paraffins. These are liquid at room temperature and boiling point between 40°C and 200°C . Plastic and solid paraffin waxes are the residue obtained by refining lower density paraffins.

The **naphthenic series** has the general formula C_nH_{2n} this series forms most of the complex residue from the higher boiling point ranges. The residue of the refining series is an asphalt and the crude oils in which this series predominates are called asphalt base crudes.

The aromatic series is an unsaturated closed ring series. Its common member benzene C_6H_6 is present in all crude oils.

Aromatic series generally constitute small percentage of most crudes.

Non hydrocarbon content: In addition to hydrocarbons, sulphur, nitrogen and oxygen are usually present in small but important quantities.

Let's Connect

- Gasoline is the name of
 - crude oil
 - the fraction of petroleum condenses with in the range of $343\text{--}393\text{ K}$ and has a composition of $C_5 - C_{10}$.
 - the mixture of uncondensed gases produced in the distillation of crude oil.
 - the mixture of residue and gas oil obtained in the distillation of crude oil.
 - LPG is a mixture of

(a) $C_6H_{12} + C_6H_6$	(b) $C_4H_{10} + C_3H_8$
(c) $C_2H_2 + C_2H_4$	(d) $CH_4 + C_2H_4$
- Sol. 1. (b)**
- 2. (b)** LPG is a mixture of C_4H_{10} (Butane), C_3H_8 (propane) and C_2H_6 (ethane). Main constituent is butane (C_4H_{10}).

NATURAL GAS

Occurrence

Natural gas is naturally occurring mixture of gaseous hydrocarbons. It is found in porous sedimentary rock in the earth's crust, usually in association with petroleum deposits.

Some times natural gas is also found at places where there are no petroleum deposits. But most wells produce natural gas as well as petroleum. Infact natural gas is obtained as a co-product in petroleum mining.

Natural gas is found along with petroleum in reservoirs under the ground. It is chiefly made up of methane, though butane and propane are also present in small proportions. It can be easily transported through pipes and is a clean non-polluting fuel. It is stored under high pressure as **compressed natural gas (CNG)**. CNG is used for power generation.

Deposits of natural gas are found in India in Tripura, Rajasthan, Maharashtra and in the Krishna-Godavari delta.

Formation

Natural gas is formed from the decomposition of organic matter buried under sea beds millions of years ago, by a process called anaerobic fermentation. Anaerobic fermentation is the process of decomposition of complex organic matter, in absence of air by means of micro-organisms.

Composition

Natural gas consists mainly of methane (about 85%), ethane (up to about 10%), propane (about 3%) and traces of butane. Carbon dioxide, nitrogen, oxygen, hydrogen sulphide and sometimes helium may also be present.

- 



CNG is cost effective alternative to regular fuel. It is known as green fuel; because of its benefits to the environment. It does not pollute the environment.



4. $A \rightarrow (q), B \rightarrow (r), C \rightarrow (s), D \rightarrow (p)$

Column-II

CASE STUDY-1:**Petroleum Refining****Case I :**

At the time of refining of petroleum, petroleum gas is obtained at the top in the temperature range $<40^{\circ}\text{C}$. Petroleum gas has carbon atoms 1-4. It is a mixture of methane, ethane, propane and butane. But major component is butane C_4H_{10} . Petroleum gas can be liquified by compression and delivered for household work through cylinders. LPG (liquified petroleum gas) is a cleaner fuel with high calorific value. It burns smokelessly and hence make good kitchen fuel.

Case-II :

During the refining of petroleum paraffin wax and bitumen (asphalt) are obtained as residue because they have high boiling point ($>350^{\circ}\text{C}$) and tends to condense more easily lower down the group. Paraffin wax is used in ointment, candle, vaseline. Bitumen is used in paints and road surfacing.

Case-III :

In the middle of the fractionating column, petrol and kerosene are obtained. Petrol has obtained in the temperature range $40^{\circ} - 160^{\circ}\text{C}$ and kerosene at $160^{\circ} - 250^{\circ}\text{C}$. Kerosene is widely used as jet engine fuel while petrol is used as vehicle fuel. Kerosene is a complex mixture of paraffins (55.2%), naphthenes (40.9%) and aromatic hydrocarbons (3.9%). Kerosene has hydrocarbon having 11-13 carbons. Petrol or gasoline is a mixture of combustible hydrocarbons.

**Think Out of the Box**

Q 1. When the crude oil is referred as sweet?

Q 2. Which gas is found above the petroleum reservoir?

Q 3. How is Petroleum formed?

Q 4. What is known as black gold?

Ans.1 Crude oil is referred as sweet when the sulphur content is low. If the sulphur content is below 0.5% then crude oil is called as sweet and if the sulphur content is above 5% then crude oil is said to be sour.

Ans.2 Natural gas is found above the petroleum reservoir.

Ans.3 Over a period of millions of years, the organic matter present in the dead organisms undergo a series of processes and transformed into petroleum.

Ans.4 Petroleum is known as black gold because of its great commercial importance.

● CONSERVATION OF NATURAL RESOURCES ●

Why do we need to conserve our natural resources ?

- These natural resources are essential to meet our routine needs.
- With the rapid increase in population these days the amount or quantity of resources required to meet our needs also increases vastly.
- Rapid industrialisation and urbanisation results into depletions of forests and other natural resources.
- Mismanagement or inefficient use of natural resources as a result of unawareness of their importance.
Many of the important natural resources like minerals, coal and petroleum are exhaustible and takes millions of years to replenish.

DID YOU KNOW?

In India, the Petroleum Conservation Research Association (PCRA) advises people with methods of saving petrol/diesel while driving.

Some tips:

- *Drive at a constant and moderate speed as far as possible.*
- *Switch off the engine at traffic signals or at places where you have to wait.*
- *Ensure correct tyre pressure.*
- *Ensure regular maintenance of the vehicle.*



Excessive use of many natural resources like coal, petroleum, forests results into contamination of environment. Following are some examples,

- (i) Burning of fossil fuels, cutting forests leads to air pollution and global warming.
- (ii) When petroleum products comes into contact with soil and water it results into their contamination.
- (iii) Accidental oil spillages on sea leads to massive water pollution.



Let's Do Activity

Find ways in the classroom to reduce, reuse, and recycle. Brainstorm different ideas together and create guidelines to share to your classmates and family members. You can find ways to reduce waste in your school, and reuse materials to conserve natural resources. If possible, with the help of your teacher start a recycling drive and challenge schoolmates to see how much they can recycle. Nearly everything we use can be reduced, reused, or recycled!



Illustration 6 :

List the steps to conserve the resources.

Solution :

One thing we should keep in mind that the resources are limited in nature. If we misuse these resources this will result in no resources for our future generation. We can take the following steps to conserve the resources.

- Car pooling and use of public transfer should be encouraged.
- CFL's and LED lights should be preferred.
- We should not waste electricity.
- We should cover the cooking utensils at the time of cooking.
- Solar, tidal, and hydroelectric power should be developed.
- We should also focus on developing energy from biogas.
- Public awareness programmes should be conducted.

**CHECK POINT-4**

1. What does PCRA stand for?
 - (a) Petroleum conservation and Research Association.
 - (b) Petroleum and crude Resource Agency.
 - (c) Petroleum control and Regulatory Authority.
 - (d) Petroleum conservation and Resources Association.
2. Which of the following is the primary objective of the petroleum conservation research association (PCRA)
 - (a) Oil exploration and production
 - (b) Petroleum pricing regulation
 - (c) Conservation of petroleum products
 - (d) Petroleum research and development

Sol. 1. (a) 2. (c)

CASE STUDY-2 :

Save Natural Resources

CASE I :

Some natural resources are exhaustible like fossil fuels, forest minerals etc. Coal and petroleum are fossil fuels. It required the dead organisms millions of years to get converted into these fuels. The known reserves of these will last only a few hundred years. Also burning of these fuels is a major cause of air pollution. Burning of fossil fuel is also responsible for global warming. It is therefore necessary that we are these fuels only when absolutely required. This will result in better environment, smaller risk of global warming and their availability for a longer period of times.

CASE II :

Petroleum Conservation Research Association (PCRA) awares people how to save petrol / diesel judiciously. Petrol and diesel are fossil fuels and they are present in limited amount on earth. Some suggestions are given by Petroleum Conservation Research Association as, we should drive at a constant and moderate speed. Engine should be switch off at traffic light if signal is a red. Ensure correct type pressure and regular maintenance of vehicle.



Think Out of the Box

Q.1 How can we control global warming ?

Q.2 Name the gas which is produced on burning of fossil fuels.

Q.3 How does PCRA helps in conservation of petrol and diesel?

Q.4 Why is it necessary to conserve fossil fuels?

Ans.1 We can control global warming by minimise the use of fossil fuels.

Ans.2 Generally CO_2 is produced on burning of fossil.

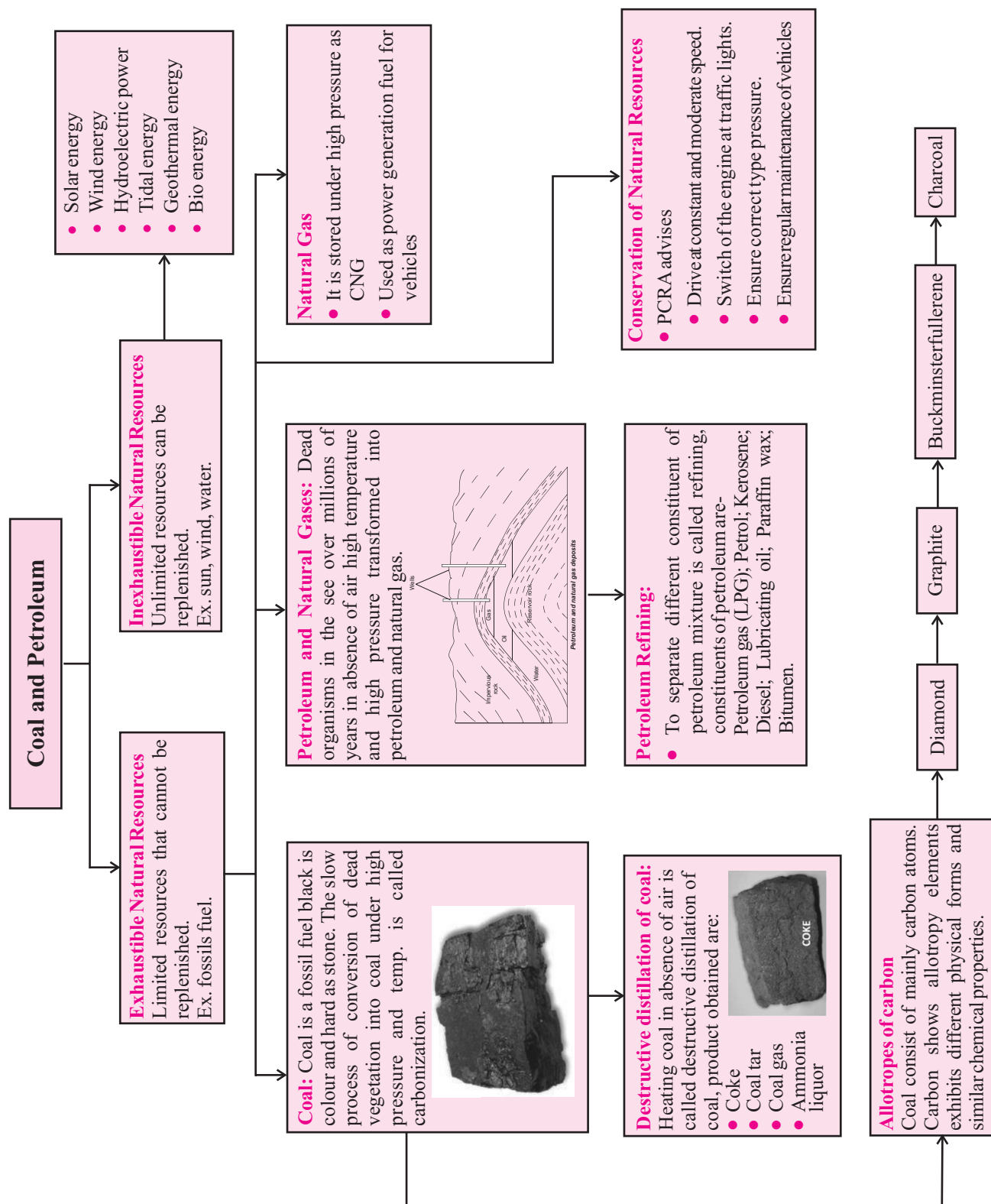
Ans.3 PCRA gives advises people which help in conservation of petrol and diesel as

- (i) drive at constant and moderate speed as far as possible.
- (ii) switch off the engine at traffic lights or at a place where you have to wait.
- (iii) ensure correct tyre pressure and regular maintenance of the vehicle.

Ans.4 Fossil fuels are limited in amount on earth, so they should be conserve.



Walk Through the Chapter



**Let's Revise Through FIB & T/F**

1. Coal is the purest form of carbon. [T/F]
2. The main products obtained from the destructive distillation of coal are compounds tar and gas.
3. The destructive distillation of coal gives coke, coal tar, coal gas, etc. [T/F]
4. Ammoniacal liquor contains ammonia produced as a result of destructive distillation of coal is absorbed in water. [T/F]
5. is the variety of coal with maximum carbon content.
6. Coal gas containsand gases.
7. The percentage of carbon in *anthracite* is 60%. [T/F]
8. Coal mining causes many impacts on environment.
9. Lignite contains about percent carbon.
10. Methane is released during mining of coal. [T/F]
11. We can separate petroleum into its various fractions by fractional/distillation because the different fraction have different
12. The distribution of coal deposits is uniform in the earth's crust. [T/F]
13. Carbonisation is formation of coal from the carbon content of dead plants. [T/F]
14. In fractional distillation, hydrocarbons with the (highest/lowest) boiling points condense first.
15. Bituminous coal is softer than anthracite. [T/F]
16. Petroleum is a fossil fuel. [T/F]
17. Petroleum is formed by the decomposition of remains of marine. [T/F]
18. Petroleum and natural gas were formed from dead
19. Petroleum or crude oil pumped out from is not pure.
20. Petroleum gets its name from *petra* and *oleum* means rock oil. [T/F]
21. Petroleum is formed from the fossils remains of dead animals. . [T/F]
22. Peat contains 96% carbon and burns without smoke. [T/F]
23. The refined form of petroleum is called crude oil. [T/F]
24. The process of conversion of wood into coal is called
25. The crude oil is heated to a high temperature and passed into column.
26. The black thick liquid with smell is known as coal tar.
27. Inhaling coal dust is useful for humans. [T/F]
28. These days is being used in vehicles in place of petrol and diesel.
29. Natural gas mainly consists of
30. Excessive burning of fossil fuels is a major cause of
31. Petrol and diesel are obtained from a natural resources called petroleum.
32. Natural gas can be sent to the houses through pipes. [T/F]
33. Oxygen in air is an exhaustible natural resource. [T/F]
34. CNG is less polluting fuel than petrol and diesel. [T/F]
35. Wildlife is an exhaustible natural resource. [T/F]
36. Producer gas is a mixture of and
37. Formation of fossil fuels is a very process.
38. Coke is 98% carbon like charcoal it is good fuel and burns without smoke. [T/F]
39. Coal tar is a mixture of different carbon compounds. It is a thick, black liquid. [T/F]
40. Petroleum is called black gold. [T/F]
41. Compressed natural gas is a non polluting fuel. [T/F]

EXERCISE-1

Master Board

Multiple Choice Questions (MCQs)

DIRECTIONS : This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. Descriptions of unknown compounds 'X', 'Y' and 'Z' are given below.

- X. A petroleum product used in place of coal tar for metalling the road.
Y. Hard as stones, used to cook food and to produce electricity in thermal power plants.
Z. A pure form of carbon used in the extraction of many metals also in the manufacture of steel. 'X', 'Y', 'Z' respectively are

X	Y	Z
(a) Coal	Bitumen	Coke
(b) Bitumen	Coal	Coke
(c) Bitumen	Coke	Coal
(d) Coal	Coke	Bitumen

2. (i) Natural gas is an exhaustible source of energy.
(ii) Fossil fuels can be prepared in laboratory.
(iii) LPG is considered to be a good fuel for domestic uses.
(iv) Natural gas is obtained by fractional distillation of crude oil.

Which of the above statements are correct.

- (a) (i), (iii) (b) (i), (ii), (iv)
(b) (i), (iii), (iv) (d) All of the above
3. The correct statement for the gaseous fuels is/are
(A) They burn without producing smoke and CO_2 .
(B) They have two calorific value.
(C) They are easy to ignite
(D) They have high calorific value.
(a) B and C (b) C and D
(b) A and B (d) B and D

4. The world's first oil well was drilled in
(a) Kazakhstan (b) Venezuela
(c) Pennsylvania (d) Brazil

5. Mark the incorrect statement.
(a) Coking is the process to convert coal into coke.
(b) Very high level of volatile matter in the coal results in the formation inferior quality coke.
(c) Different types of coal are blended to reach acceptable levels of volatility before coking.

- (d) Since smoke producing constituents are present in coke, it is used as fuel.

6. Select the one that is not derived from fossil fuel.

- (a) LPG (b) Kerosene
(c) Diesel (d) Biogas

7. Water gas is

- (a) $\text{CO} + \text{CO}_2$ (b) $\text{CO} + \text{N}_2$
(c) $\text{CO} + \text{H}_2$ (d) $\text{CO} + \text{N}_2 + \text{H}_2$

8. Main constituent of marsh gas is

- (a) ethane (b) acetylene
(c) ethyne (d) methane

9. The origin of petroleum is indicated by the fact that

- (a) its constituents can be separated by fractional distillation.
(b) petroleum was formed from living sea organisms which after death get deposited in sea bed for long period of time.
(c) petroleum contains traces of chlorophyll.
(d) oil fields are located with the help of seismograph.

10. Gasoline is obtained from crude petroleum oil by its

- (a) fractional distillation
(b) vacuum distillation
(c) steam distillation
(d) pyrolysis

11. Kerosene is used as fuel

- (a) in home and industry
(b) for heavy motor vehicles
(c) for stove, lamps and jet aircraft
(d) for electric generator.

12. We can use coke

- (a) as an oxidising agent (b) as a reducing agent
(c) in printers ink (d) as electrode

13. The order of appearance of the following with rising temperature during the refining of crude oil is

- (a) kerosene oil, gasoline, diesel
(b) diesel, gasoline, kerosene oil
(c) gasoline, diesel, kerosene oil
(d) gasoline, kerosene oil, diesel.

14. The most important use of coal tar is

- (a) as a reducing agent in metallurgy
(b) as a fuel
(c) as a source of aromatic hydrocarbons
(d) for making shoe polish.

15. The process of heating coal in the absence of air is called
(a) fractional distillation
(b) distillation
(c) destructive distillation
(d) none of these.
16. The non-combustible element of producer gas is
(a) CO (b) N₂
(c) H₂ (d) H₂O
17. Destructive distillation of coal produces
(a) coal gas (b) natural gas
(c) biogas (d) None of these
18. What is the actual composition of natural gas.
(a) CH₄(85%), C₂H₆(10%), C₃H₈ (3%) and small amount of C₄H₁₀
(b) CH₄ (10%), C₂H₆ (85%), C₃H₈ (3%) and small amount of C₄H₁₀
(c) CH₄ (88%), C₃H₈ (10%) and small amount of C₂H₆ and C₄H₁₀
(d) CH₄ (65%), C₂H₆ (20%), C₃H₈ (10%) and 5% of C₄H₁₀
19. Which of the following is boiling range of diesel oil?
(a) 573 K to 723 K (b) 523 K to 573 K
(c) 622 K to 673 K (d) 373 K to 623 K
20. Read the following statements and mark the correct ones from the given options.
(i) Coal, petroleum and natural gas are called fossil fuels.
(ii) Coal and natural gas are two exhaustible substances.
(iii) Coke is used in manufacture of steel.
(iv) Fossil fuels are present in limited quantities.
(a) (i) and (ii)
(b) (i) and (iv)
(c) (i), (ii) and (iii)
(d) (i), (ii), (iii) and (iv)
21. Besides the risk of pollution, fossil fuels also pose a risk of
(a) global warming (b) water pollution
(c) leakage (d) explosion
- (b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If Assertion is incorrect but Reason is correct.
1. **Assertion :** Natural gas deposits are often found near oil deposits.
Reason : Petroleum and natural gas are formed when layers of decomposing plants and animals matter are exposed to intense heat and pressure under the surface of the earth over millions of years.
2. **Assertion :** Petroleum floats over water.
Reason : Petroleum is less dense than water.
3. **Assertion :** Petroleum conservation research association (PCRA) advises people how to save petrol and diesel.
Reason : PCRA suggests for a regular insurance of vehicle.
4. **Assertion :** CNG is used for power generation.
Reason : Natural gas is easy to transport through pipes.
5. **Assertion :** Coal and petroleum resource are limited. We should use them judiciously.
Reason : Fossils fuels are inexhaustible resources.

Passage/Case Based Questions

DIRECTIONS : Study the given paragraph (s) and answer the following questions.

Passage

Coal is one of the fuel used to cook food. Earlier it was used in railway engines to produce steam to run the engine. It is also used in thermal power plants to produce electricity. Coal is used as a fuel in various industries. It was formed from the remains of vegetation coal is also called fossil fuel. When heated in air, coal burns and produces mainly carbon dioxide. Coal is processed in industry to get some useful product such as coke, coal for and coals gas.

1. Coke burns without smoke and does not cause air pollution because.
(a) It has lot of impurities in it.
(b) It is light and blank in colour.
(c) It in non porous and semi-solid.
(d) It consists of only carbon and all other impurities are removed from it.
2. Which of the following is used to prepare naphthalene balls?
(a) Coal gas
(b) Coal tar
(c) Natural gas
(d) Ammonical liquor

Assertion & Reason Questions

DIRECTIONS : Each of these questions contains an assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

- (a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

Very Short Answer Questions

1. What is producer gas ?
2. What is water gas ?
3. What is meant by carbonisation ?
4. On the basis of the data given in the table above what was the primary source of energy in India in 2011?

Fuel	In year 2011
Petroleum	23
Nuclear power	5
Solid biomass and organic waste	23
Natural gas	8
Coal	41

5. Give name of a non-polluting fuel which can be used in vehicles.
6. Name the gas which is produced when coal is heated in absence of air.
7. Where was the first oil well drilled ?
8. Expand PCRA.
9. Which gas is produced when coal burns in air ?
10. Is kerosene a fossil fuel ?
11. Which fuel is used in jet aeroplanes ?
12. Name the petroleum product used to manufacture candles, vaseline, grease, polish, etc.

Short Answer Questions

1. (a) What is coal?
(b) Where is coal found?
2. List five things that you can do to help in preventing an energy crisis.
3. Why do different gases condense to liquids on different trays in the fractionating column ?
4. What do you mean by emission standard used in automobiles?
5. What are the measures given by PCRA for saving petrol and diesel ?

6. Why is kerosene a fossil fuels. (Reasoning)
7. Why cannot we prepare petroleum in laboratory? (Reasoning)
8. Why is petroleum called black gold ? (Reasoning)
9. Why are coal, petroleum and natural gas called fossil fuels? (Reasoning)
10. Why is depletion of coal, petroleum and forest a matter of concern ? (Reasoning)

Long Answer Questions

1. Discuss some important methods to conserve our natural resources.
2. Sunlight and water are inexhaustible natural resources. How can they help in saving exhaustible resources ?
3. Write down two uses of each of the natural resources given in table:

S.No.	Natural Resources	Uses
1	Coal	
2	Coke	
3	Coal tar	
4	Coal Gas	

HOTS Questions

1. What is meant by refining of petroleum ? What is a refinery?
2. How does coal mining affect the environment ?
3. Justify that water is a limitless resource.
4. In a petroleum well, crude oil is found above water. Which two properties must petroleum have to form a layer above water ?
5. Name some non-conventional or alternative sources of energy.
6. All renewable resources are inexhaustible. Do you agree?

EXERCISE-2**NCERT Questions****Text-Book Exercise**

- What are the advantages of using CNG and LPG as fuels?
- Name the petroleum product used for surfacing of roads.
- Describe how coal is formed from dead vegetation. What is this process called?
- Fill in the blanks :
(a) Fossil fuels are _____, _____ and _____.
(b) Process of separation of different constituents from petroleum is called _____.
(c) Least polluting fuel for vehicle is _____.
- Tick True/False against the following statements :
(a) Fossil fuels can be made in the laboratory. **(T/F)**
(b) CNG is more polluting fuel than petrol. **(T/F)**
(c) Coke is almost pure form of carbon. **(T/F)**
(d) Coal tar is a mixture of various substances. **(T/F)**
(e) Kerosene is not a fossil fuel. **(T/F)**
- Explain why fossil fuels are exhaustible natural resources.
- Describe characteristics and uses of coke.
- Explain the process of formation of petroleum.
- The following Table shows the total power shortage in India from 1991– 1997. Show the data in the form of a graph. Plot shortage percentage for the years on the Y-axis and the year on the X-axis.

S. No.	Year	Shortage (%)
1	1991	7.9
2	1992	7.8
3	1993	8.3
4	1994	7.4
5	1995	7.1
6	1996	9.2
7	1997	11.5

Exemplar Questions

- Various materials which are obtained from nature are called natural resources. Which of the following is not a natural resource?
(a) minerals (b) water
(c) soil (d) plastic
- Air is a natural resource and cannot be exhausted

by human activities. It is known as inexhaustible natural resource. Which of the following is another inexhaustible natural resource?

- coal (b) petroleum
 - sun-light (d) minerals
- Which of the following is a pair of exhaustible natural resources.
(a) coal and soil
(b) air and sun-light
(c) water and petroleum
(d) wild life and minerals
 - Coal is processed in industries to get some useful products. Which of the following is not obtained from coal?
(a) coke (b) coal tar
(c) coal gas (d) CNG
 - Exhaustible natural resources are:
(a) unlimited in quantity.
(b) not dependent on nature.
(c) limited in quantity.
(d) not exhausted by human activities.
 - Fossil fuels are obtained from:
(a) remains of non-living materials.
(b) dead remains of birds only.
(c) dead remains of insects only.
(d) dead remains of living organisms.
 - Coal is formed from the remains of
(a) vegetation only
(b) animals only
(c) both vegetation and animals
(d) neither vegetation nor animals
 - Which substance is formed by the carbonisation of dead vegetation?
(a) coal (c) coal gas
(b) coke (d) coal tar
 - Naphthalene balls are obtained from coal tar and are used as
(a) mosquito repellent
(b) honey bee repellent
(c) moth repellent
(d) snake repellent

10. Which of the following is not a constituent of petroleum?
 (a) paraffin wax (b) lubricating oil
 (c) petrol (d) coke
11. Petroleum was formed from organisms:
 (a) living on the land
 (b) living on the plants
 (c) living in the sea
 (d) living on the rocks
12. Choose the incorrect statement from the following:
 (a) It is difficult to transport natural gas through pipes.
 (b) The disadvantage of natural gas is that it can not be used directly for burning in homes.
 (c) Natural gas is stored under high pressure as compressed natural gas.
 (d) Natural gas cannot be used for power generation.
13. What does CNG stand for and why is it considered to be a better fuel than petrol ?
14. Write two important uses of coke.
15. Name the products obtained and their uses when coal is processed in industry.
16. Write some important uses of the various constituents of petroleum.
17. Name the petroleum product used as the fuel for stoves, lamps and jet aircrafts.

EXERCISE-3

Foundation Builder

Multiple Choice Questions (MCQs)

DIRECTIONS : This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which ONLY ONE is correct.

1. Coal is a fossil fuel and it cannot be prepared in a laboratory or industry because the formation of coal
 1. is a very slow process
 2. need very low pressure and low temperature
 3. need very high pressure and high temperature
 4. causes air pollution
 Select the correct alternative
 (a) 1 and 2 (b) 2 and 4
 (c) 1 and 3 (d) 4 and 3
2. Which among the following is highly toxic and inflammable gas ? **[NTSE]**
 (a) CO (b) CO₂
 (c) CS₂ (d) CaC₂
3. Activated charcoal is used in gas masks because
 (a) it is a good adsorbent
 (b) it is a good reducing agent
 (c) it burns without smoke
 (d) it is highly active.
4. On the basis of following features identify the correct process
 I. This process can be carried out with or without catalyst.
 II. This process is carried out to meet the increasing demands of gasoline.
 III. In this process higher hydrocarbons breakdown to give smaller hydrocarbons.
 (a) Refining (b) Destructive distillation
 (c) Cracking (d) Reforming
5. On the basis of following features identify the correct gas.
 I. This gas is commonly known LPG.
 II. This gas is commonly used as domestic fuel.
 III. A strong smelling substance called ethyl mercaptan is added to detect the leakage of this gas.
 (a) Ethene (b) Butane
 (c) Pentane (d) Butene
6.
$$\text{C}_{12}\text{H}_{22}\text{O}_{11} \xrightarrow[\text{H}_2\text{SO}_4]{\text{Conc.}} 12\text{C} + 11\text{H}_2\text{O}$$

 Which of the following is obtained in the above reaction?
 (a) Animal charcoal (b) Sugar charcoal
 (c) Coke (d) Wood charcoal
7. Ethyl mercaptan is added to LPG
 (a) to give colour to it (b) to give volume to it
 (c) to give smell to it (d) to make it liquid.
8. Mark the incorrect statement.
 (a) Burning of coal in a sufficient amount of oxygen produces carbon dioxide.
 (b) When coal burns in insufficient amount of oxygen, carbon monoxide is formed.
 (c) Charcoal is a better fuel than kerosene to be used as fuel for cooking at home.
 (d) LPG is considered to be a good fuel for domestic use.

9. Butane gas is used for filling cylinders to be used as LPG because
- it is easily available.
 - it is easily compressed into a liquid and stored in cylinders.
 - it is stored in gaseous state only in the cylinder.
 - it is the cheapest available gas.

10. Which among the following coal contains highest % of carbon?

- Peat
- bituminous
- anthracite
- lignite

11. Renewable source of energy is:

- Coal
- Petroleum
- Natural gas
- Energy of flowing water

12. Coal is called fossil fuels because:

- In future coal will become completely exhausted.
- It was formed 300 million years ago.
- Fossils are obtained along with mining of coal.
- It was formed from the dead remains of living organisms.

13. Select the correct statements.

[Olympiad]

- Coal is a mixture of chemical substances containing carbon, hydrogen, oxygen and small amount of nitrogen and sulphur.
- Inexhaustible natural resources cannot be replenished continually.
- When coal is heated in the absence of air, carbon monoxide is produced which is a poisonous gas.
- Coal is used as a source of energy in various industries like cement, paper, steel etc.

- I and III only
- II and III only
- II and IV only
- I, II, III and IV

14. Which of the following represents the correct decreasing order of boiling points of the given liquids ?

[Olympiad]

- Paraffin wax > Diesel > kerosene > Petrol
- Diesel > Kerosene > Petrol > Paraffin wax
- Kerosene > Petrol > Paraffin wax > Diesel
- Petrol > Paraffin wax > Diesel > Kerosene

15. Select the correct statement(s).

- Natural gas is used for the manufacture of fertilisers.
- Petrochemicals are used in the manufacture of detergents.

- Naphthalene balls are obtained from coal tar.

- I and II only
- III only
- II and III only
- I, II and III

16. Which combination of statements is corrects?

- If a fuel left lots of solid residue after burning, then it is not a good fuel.

- Petrol is not a fuel.

- Wood and coals are ideal fuels.

- Only II and III
- Only I and IV
- Only I, III and IV
- All I, II, III and IV

More than One Option Correct

DIRECTIONS : This section contains Multiple Choice Questions. Each question has 4 choices (a), (b), (c) and (d) out of which ONE OR MORE may be correct.

1. Select the correct statements about coke.

- It is a crystalline form of carbon.
- It contains about 90% carbon.
- It is used as reducing agent.
- It is a black porous substance.

2. Choose the products obtained from fossil fuels.

- Coal
- Coke
- Coal tar
- Oxygen

3. Which of the following is not obtained on fractional distillation of petroleum?

- Gasoline
- Light oil
- Coal gas
- Kerosene

4. Which of the following are produced from coal tar?

- Synthetic dyes
- Drugs
- Perfumes
- Soap and detergent

5. Which of these are fossil fuels ?

- Coal
- Petroleum
- Biogas
- Natural gas

6. Which of the following statements is/are true ?

- Petroleum is a fossil fuel.
- Petroleum is formed by the decomposition of remains of marine.
- The refined form of petroleum is called crude oil.
- Petrol and diesel are obtained from a natural resource called petroleum.

7. Mark the incorrect statements.

- Fossil fuels can be made in laboratory.
- CNG is more polluting than petrol.
- Petroleum is a mixture of various oxides of carbon.
- Coal tar is a mixture of various substances.

8. Choose the correct statements :
- Animal charcoal is obtained by heating bones in a retort in absence of air.
 - Animal charcoal is used for decolourising brown sugar.
 - Sugar charcoal is used in preparation of synthetic diamonds
 - Adsorption is a surface phenomenon.
9. On dehydration of cane sugar with concentrated sulphuric acid, we get
- Sugar charcoal
 - an allotrope of carbon that is amorphous
 - an allotrope of carbon that is a very pure form of carbon.
 - wood charcoal.
10. Which of the following precaution (s) should be taken if in case there is any leakage of gas.
- All doors and windows of the room in which cylinder is kept should be opened.
 - All lights of the room should be turned on.
 - Any open flame nearby should be immediately extinguished.
 - All of the above are incorrect.

Passage/Case Based Questions

DIRECTIONS : Study the given paragraph(s) and answer the following questions.

Passage-I

When petroleum is heated in a fractionating column, various fractions are obtained at various heights of the column. More volatile liquid goes upto the top and least volatile liquid remains at the bottom. Various gaseous fractions are condensed according to their boiling points.

- Which will condense near the top, petrol, diesel oil, fuel oil or kerosene ?
 - Petrol
 - Diesel oil
 - Fuel oil
 - Kerosene
- What can you say about the boiling points of liquids that collect at the bottom as residue ?
 - Their boiling points must be very low.
 - Their boiling points must be much higher.
 - Their temperature is equal to the temperature of column.
 - None of the above.
- As the gas reaches at the height where temperature is equal to or just below its boiling point it will
 - condense to form a liquid
 - remain in gaseous state

- condense to form a solid
- escape from the column.

Passage-II

Liquefied petroleum gases are a feedstock for the petrochemical industry. LPGs undergo a very complex process called pyrolysis, taking place at very high temperatures. The resulting products are called olefins - ethylene and propylene. These are subsequently polymerized and transformed into polymers or plastic, such as polyethylene, polypropylene, or other products. Thus, the polyethylene bags, disposable dishware, food packing and wrapping materials we use in everyday life are produced from liquefied gases.

- Liquefied Petroleum Gas (LPG) consists of mainly ?
 - Methane, Ethane and Hexane
 - Ethane, Hexane and Nonane
 - Ethane, Butane and Propane
 - Ethane, Nonane and Methane
- Products obtain during pyrolysis of Liquefied Petroleum Gas are
 - Ethylene and propylene
 - Methylene and Ethylene
 - Butylene and Propylene
 - Ethane and butane
- After polymerization Liquefied Petroleum Gas (LPG) is converted to get
 - Camphor
 - Polymers
 - Coal
 - None of these

Assertion & Reason Questions

DIRECTIONS : Each of these questions contains an Assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.

- If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
- If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
- If Assertion is correct but Reason is incorrect.
- If Assertion is incorrect but Reason is correct.

- Assertion :** Coal gas is a mixture of methane, hydrogen and carbon monoxide.

Reason : It is obtained when coal is burnt in excess of air.

- Assertion :** Anthracite is the purest form of coal.

Reason : It contains about 50% carbon.

3. **Assertion :** CNG and LPG are clean fuels.
Reason : They do not leave any residue on burning.
4. **Assertion :** Petroleum or crude oil pumped out of oil well is not pure.
Reason : Petroleum is refined to get various fraction which can be used for specific purposes.
5. **Assertion :** Petrol is more volatile than diesel oil.
Reason : Petrol condenses near the top of the column than diesel oil.
6. **Assertion :** Air and sunlight are inexhaustible natural resources.
Reason : Air and sunlight are present in unlimited quantity in nature.
7. **Assertion :** The main constituent of LPG is butane.
Reason : A small quantity of mercaptan is added to cooking gas cylinders supplied for domestic use.
8. **Assertion :** Sugar charcoal is prepared by dehydration of sugar.
Reason : Sulphuric acid is a dehydrating agent.
9. **Assertion :** Charcoal does not produce any smoke.
Reason : Charcoal contains only carbon.
10. **Assertion :** Bone charcoal cannot act as a reducing agent.
Reason : Since bone charcoal contains maximum percentage of calcium phosphate so it can not act as a reducing agent.
11. **Assertion :** Wood charcoal is used as one of the constituents of gun powder.
Reason : Wood charcoal is used as a deodorant and disinfectant.

Multiple Matching Questions

DIRECTIONS : Following question has Column-I and Column-II. Any given option in Column-I can have correct matching with one or more option given in Column-II. Match the entries in column-I with entries in column-II.

- | 1. Column-I | Column-II |
|----------------|----------------|
| (A) Peat | (p) 98% carbon |
| (B) Lignite | (q) 90% carbon |
| (C) Anthracite | (r) 70% carbon |
| (D) Lampblack | (s) 60% carbon |

- | 2. Column-I | Column-II |
|--------------|--|
| (A) Coal gas | (p) Aviation fuel |
| (B) Coke | (q) Jet fuel |
| (C) Petrol | (r) Obtained during the processing of coal to get coke |
| (D) Kerosene | (s) Used for manufacturing steels |
-
- | 3. Column-I | Column-II |
|--|-------------------|
| (A) Produce less pollutants on burning | (p) LPG |
| (B) Ethyl mercaptan is added to check its leakage | (q) Wood charcoal |
| (C) Used as a fuel in automobiles | (r) CNG |
| (D) Fuel obtained by burning wood in limited supply of air | (s) petrol |
-
- | 4. Column-I | Column-II |
|--------------------------------------|--------------|
| (A) Crude oil refining | (p) Petrol |
| (B) Domestic and jet engine fuel | (q) Coal gas |
| (C) Coal processing | (r) Kerosene |
| (D) Mixture of H_2 , CH_4 and CO | (s) Coal Tar |

Integer/Numerical Value Type Questions

DIRECTIONS (Qs. 1-6) : Following are integer/numerical value based questions. Each question, when worked out will result in an integer/numerical value.

- Number of exhaustible resources among the following is Air, Forests, coal, sunlight, petroleum
- How many products are obtained from destructive distillation of coal?
- How many among the following are fossil fuels? Coal, petroleum, Charcoal, Wood.
- The given reaction represents formation of producer gas:

$$2C + O_2 + 4N_2 \rightarrow xCO + 4N_2$$
 Here x is _____.
- How many of them are the main components of LPG.
 C_3H_8 , C_4H_{10} , C_3H_6 , CH_4 , C_2H_2 , C_2H_4 , C_5H_{12}
- How many types of charcoal are known?

SOLUTIONS

Brief Explanations of Selected Questions



Let's Revise Through FIB & T/F

1. False.
2. Ammonium, coal, coal
3. True
4. True
5. anthracite
6. hydrogen, methane, carbon monoxide
7. False : Anthracite contains 94-98% of carbon content.
8. adverse (bad)
9. 70
10. True
11. boiling point
12. False. 13. True
14. highest 15. True
16. True 17. True
18. organism 19. oil wells
20. True : Petra = rock, oleum = oil.
21. True
22. False.
23. False : The unrefined form of petroleum is called crude oil.
24. carbonisation
25. fractionating
26. unpleasant
27. False : Inhaling coal dust is harmful for humans.
28. CNG
29. methane
30. air pollution
31. True
32. True 33. False
34. True 35. True
36. carbon monoxide and nitrogen
37. slow 38. True
39. True 40. True
41. True : CNG is a cleaner and non-polluting fuel.
5. (d) Volatile and smoke producing constituents are removed during the coking of coal.
6. (d) Biogas can be produced from raw material such as agricultural waste, manure, sewage, plant material etc. All others are obtained by refining of petroleum which is a fossil fuel.
7. (c) water gas is a mixture of CO and H₂.
8. (d) 9. (b)
10. (a) Fractional distillation is used because the difference between the boiling point of different components is less.
11. (c) Kerosene is used as fuel in stoves, lamps and jet aircrafts.
12. (b) Coke can be used as a reducing agent in metallurgy.
13. (d) 14. (c)
15. (c) The process of heating coal to a high temperature in the absence of air is called destructive distillation of coal. It yields products such as coke, coal gas, etc.
16. (b) 17. (a)
18. (a) 19. (b)
20. (d) All statements are correct.
21. (a) Fossil fuels produce greenhouse gases like carbon dioxide which are responsible for global warming.

Assertion & Reason Questions

1. (a)
2. (a)
3. (c) PCRA suggests
 - (i) To drive at a constant and moderate speed.
 - (ii) Switch off the engine at traffic lights or at a place where you have to wait.
 - (iii) To ensure correct tyre pressure.
 - (iv) To ensure regular maintenance of the vehicle.
4. (b) 5. (a)

Passage/Case Based Questions

1. (d) 2. (b)

Very Short Answer Questions

1. Producer gas is a mixture of flammable gases (CO and H₂) and nonflammable gases (mainly N₂ and CO₂). But the main components of the mixture are carbon monoxide (CO) and nitrogen (N₂).
2. Water gas is a mixture of carbon monoxide and H₂.
3. The slow chemical process involved in the conversion of dead vegetation into coal is called carbonisation.

EXERCISE-1

Master Board

Multiple Choice Questions (MCQs)

1. (b) 2. (a)
3. (b)
4. (c) The world's first oil well was drilled in Pennsylvania, USA in 1859.

4. Coal was the primary source of energy in India in 2011.
5. Compressed natural gas or CNG is a non-polluting fuel.
6. Coal gas.
7. The first oil well was drilled at Pennsylvania, USA in 1859.
8. Petroleum Conservation Research Association.
9. Carbon dioxide is produced when coal burns in air.
$$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$$
10. Yes, It is obtained from fractional distillation of petroleum.
11. The fuel used in jet aeroplanes is unleaded kerosene (jet A) or a naphtha-kerosene blend (jet B).
12. Paraffin wax

Short Answer Questions

1. (a) Coal is a complex mixture of compounds of carbon, hydrogen and oxygen. Small amount of nitrogen and sulphur compounds are also present in coal.
(b) Coal is usually found in coal mines deep under the surface of the earth.
2. Five things that can help in preventing an energy crisis are:
 - (i) Hydroelectric power stations, though they produce only 12% of the total power in India, should be encouraged further.
 - (ii) Switch to renewable energy.
 - (iii) Install energy-efficient appliances in the home.
 - (iv) Save water and do not waste food.
 - (v) Rely less on fossil fuels.
3. When the gases are heated in a fractionating column they start rising up. As each gas reaches a height where the temperature of the furnace is just equal to or below the boiling point of the gas it condenses to form a liquid, for example, when steam rises in a column and the moment it touches a surface cooler than 100°C , it condenses to form water.
4. Euro I, Euro II, etc., are vehicular emission standards aimed at reducing atmospheric pollution. They ensure better and more efficient running of the vehicles without any wastage of the fuel. Indirectly they help in saving the fossil fuels.
5. The measures given by PCRA are
 - (i) Drive at a constant and moderate speed as far as possible.
 - (ii) Switch off the engine at traffic lights or at a place where you have to wait.
 - (iii) Ensure correct tyre pressure.
 - (iv) Ensure regular maintenance of the vehicle.

If we follow the tips given by PCRA then we can save more petrol or diesel.

6. Because it is obtained from the fractional distillation of petroleum which is a fossil fuel.
7. Because their formation is a very slow process and conditions for their formation cannot be created in the laboratory.
8. Petroleum is called black gold because of its important uses in all the industries and daily life.
9. Coal, Petroleum and Natural gas are called fossil fuels because they are formed from dead plants and animals deep buried under the rocks millions of year ago.
10. To meet the fuel requirement of our ever increasing population, we are overusing coal and petroleum on a large scale. It is apprehended that they may get exhausted in the near future. Similarly, trees in forests are being cut down recklessly for human settlement and establishment of industries. Though the forests are renewable natural resources, their regeneration requires a lot of time. The depletion of forests also results in the disappearance of wildlife.

Long Answer Questions

1. Few measures to manage and conserve our natural resources are :
 - (i) Reduce : Resources should be used sparingly and when absolutely necessary for e.g., save electricity by not wasting it.
 - (ii) Recycle : Recycling saves the natural resources so that their sustainability is maintained.
 - (iii) Control pollution : Some of the important steps to check environmental pollution are
 - (a) Identification of the sources and causes of pollution
 - (b) Estimation of capacity of environment to tolerate pollution.
 - (iv) Biodegradable waste should be converted to non-toxic and more efficient fuels which will decrease the pressure on the fossil fuels.
 - (v) Alternative sources of energy should be utilized.
2. Sunlight, wind and water are inexhaustible natural resources. They can be utilized as alternative sources of energy. They will reduce our dependence on coal and petroleum. Use of solar heaters and wind mills should be done. Sunlight can be used to produce electricity. Though water is inexhaustible source of energy the abnormal increase in human population has resulted in water crisis. Water should be conserved and various methods like water harvesting should be done for sustainability of water as a resource.

3.

S. No.	Natural Resources	Uses
1.	Coal	1. Cooking fuel 2. Used as a fuel in railway engines to produce steam
2.	Coke	1. Manufacture of steel 2. Extraction of metals
3.	Coal tar	1. Synthetic dyes and drugs 2. Sealing agent against leakage
4.	Coal Gas	1. Street light 2. Industrial fuel

HOTS Questions

- The process of separation of various fractions of petroleum by the process of fractional distillation is called refining of petroleum. The plant (place) where crude oil is precessed and refined into more useful petroleum products, is called a refinery.
- Coal mining, causes many adverse environmental impacts.
 - During mining of coal, a lot of methane, which is a dangerous 'greenhouse gas,' is released. It also interferes with groundwater and water table levels. Inhaling coal dust is harmful for humans.
 - Burning of coal, in addition greatly contributes to 'greenhouse gas' emissions, climate change and global warming.
 - Strip mining (removed of soil and rock) severely alters the landscape, which damages the environmental value of the surrounding land. Mountain top removal to extract coal is taken to be a large negative change to the environment.
- Water is a limitless resource because there are number of sources of water such as river, ponds, lake and ocean. 70 percent of the earth is covered by water, but only 1% is available for drinking purpose. Increased human population and unwise use of water have caused water scarcity.
- In a petroleum well crude oil is found above water. The two properties due to which it form layer above water are:
 - It is lighter than water.
 - it is insoluble in water.
- Solar energy, wind energy, tidal energy, ocean thermal energy and geothermal energy are some of the non-conventional sources of energy.
- Yes, all renewable resources are inexhaustible as they are present in unlimited quantity in nature and are not likely

to be exhausted by human activities, the resources can be used again and again. for example air sunlight etc.

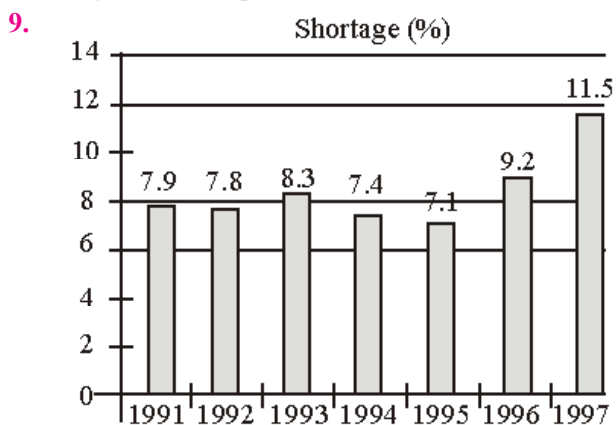
EXERCISE-2

NCERT Questions

Text-Book Exercise

- Advantages of using CNG and LPG as fuels are as follows
 - They can be easily transported in cylinders through pipe lines.
 - They are clean fuels and gives no ash particles after burning.
 - They can be used directly for burning in homes and factories.
 - They can give lot of heat energy when burnt.
 - Bitumen, a petroleum product is used for surfacing of roads.
 - About 300 million years ago the earth had dense forest in low lying wetland areas. Due to natural processes, like flooding, these forests got buried under the soil. As more soil deposited over them, they were compressed. Their temperature also rose as they sank deeper and under high pressure and temperature these dead plants got slowly converted into coal.
The process of conversion of dead vegetation into coal is called carbonisation.
 - coal, petroleum, natural gas
 - refining
 - CNG
 - (F) Fossil fuels are formed by natural process from the dead remains of living organisms.
 - (F) CNG is a cleaner fuel than petrol.
 - (T) Coke is an almost pure form of carbon.
 - (T) Coaltar is a mixture of about 200 substances.
 - (F) Kerosene is a constituents of petroleum hence it is a fossil fuel.
 - Fossil fuels require millions of year to form from the dead remains of living organisms at high temperature and pressure. They cannot be formed in laboratory. They are used at much faster rate than rate of their formation. Due to which fossil fuels are exhaustible in nature.
 - Characteristics of coke:**
 - It is tough, porous and black substance.
 - It is an almost pure form of carbon.
 - It burns much cleaner than coal.
- Uses:**
- It is used in manufacture of steel.
 - Used in extraction of many metals.

8. Petroleum was formed from organisms living in the sea. These dead organisms got settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum.



Exemplar Questions

- (d) Minerals, water and soil are natural resources whereas plastic is a man made substance.
- (c) Petroleum and minerals are non-renewable sources of energy which can get exhausted whereas sunlight is a renewable resource.
- (d) wild life and minerals
- (d) CNG is compressed natural gas which is made by compressing the natural gas. CNG is a petroleum product whereas other options provided are obtained from coal.
- (c) Exhaustible natural resources are limited and they get exhausted by human activities.
- (a) Fossil fuels are obtained millions of years ago remains of non-living materials. Get buried under the earth.
- (d) Coal is formed 300 million years ago when buried plants and trees get decomposed.
- (a) Coal
- (c) Characteristic smell of naphthalene makes the insects and moth run away from naphthalene stored under clothes etc.
- (b) Lubricating oil is obtained from crude petroleum.
- (c) Petroleum was formed from organisms living in the sea. As these organisms died, their bodies settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years, absence of air, high temperature and high pressure transformed the dead organisms into petroleum and natural gas.
- (d) Natural gas can be used for power generation hence statement (d) is wrong
- CNG stands for Compressed Natural Gas. It is considered to be a better fuel because it is less polluting.
- It is used for extraction of many metals and also for the manufacture of steel.
- Coal when processed in industry gives coke, coal tar and coal gas.
Coke is used in the manufacture of steel and in extraction of many metals.
Coal tar is used as starting material for manufacturing various substances such as synthetic dyes, drugs, explosives, perfumes, paints, etc.
Coal gas is used as fuel.
- Petroleum gas in liquid form (LPG) – used as fuel for home and industry.
 - Petrol – used as fuel for automobile and aviation.
 - Kerosene – used as fuel for stoves, lamps and for jet aircrafts.
 - Diesel – used as fuel for heavy motor vehicles, electric generators.
 - Lubricating oil – used for lubrication.
 - Praffin wax – used in ointments, candles, vaseline etc.
 - Bitumen – used in paints and road surfacing.
- Kerosene is used as fuel for stoves, lamps and jet aircrafts.

EXERCISE-3

Foundation Builder

Multiple Choice Questions (MCQs)

- (c)
- (a) Carbon monoxide (CO) is highly toxic and inflammable gas. It combines with blood haemoglobin to form carboxyhaemoglobin.
- (a)
- (c)
- (b)
- (b) Conc. H_2SO_4 dehydrates sugar to give sugar charcoal.
- (c) Since constituent hydrocarbons of LPG do not have any smell, ethyl mercaptan, a strong smelling agent is added to it to detect the leakage.

8. (c)
 9. (b) Butane can be easily compressed and liquefied to be filled into cylinders.
 10. (c) Anthracite has maximum percentage of carbon.
 11. (d)
 12. (d) Coal is called fossil fuel because they have been formed from fossilized remains of prehistoric organisms as long as millions and millions years ago.
 13. (b) Inexhaustible natural resources can be replenished continuously. For example wind, solar energy.
 14. (a) 15. (b)
 16. (b) A good fuel leaves a very small amount of residue after burning so statement I is correct. Petrol is a fuel made up of a mixture of volatile, flammable liquid hydrocarbons.

So, Statement II is correct.

Woods and coals are not ideal fuels as they release a lot of pollutants and residual material upon burning.

So, Statement III is incorrect.

Methane has a calorific value of 50 – 55 MJ / kg while those of wood and coal are 16 MJ /kg and 17 MJ / kg respectively.

Thus Statement IV is correct.

More than One Option Correct

1. (b, c, d)
 Coke is amorphous form of carbon means it does not have regular arrangement of carbon atoms.
 2. (b, c) 3. (b, c)
 Coal gas is obtained by destructive distillation of coal.
 4. (a, b, c)
 Synthetic dyes, drugs, perfumes all are made from coal tar.
 5. (a, b, d)
 Biogas is not a fossil fuel.
 6. (a, b, d)
 The unrefined form of petroleum is called crude oil.
 7. (a, b, c)
 8. (a, b, c, d)
 9. (a, b, c)
 10. (a, c)

Passage/Case Based Questions

1. (a) Petrol condenses near the top of the column since it is more volatile than other three.

2. (b) Their boiling points must be much higher than the temperature at the bottom of fractionating column hence they do not boil.
 3. (a) As the gas reaches a height where temperature is equal to or just below its boiling point, it will condense to form a liquid.
 4. (c) 5. (a) 6. (b)

Assertion & Reason Questions

1. (c) Coal gas is obtained by destructive distillation of coal.
 2. (c) Anthracite contains more than 90% carbon.
 3. (a)
 4. (b) Petroleum is refined by fractional distillation to get various useful fractions.
 5. (b)
 6. (a) Air and sunlight are not likely to be exhausted by human activities hence they are called inexhaustible natural resources.
 7. (b)
 8. (b) Sulphuric acid removes water from sugar and converts it to sugar charcoal.
 9. (a) Charcoal is produced on heating wood which removes all volatile impurities leaving behind the carbon. Since carbon is non volatile so it burns without smoke.
 10. (a) 11. (b)

Multiple Matching Questions

1. A → (s), B → (r), C → (q), D → (p)
 2. A → (r), B → (s), C → (p), D → (q)
 3. A → (p, q, r), B → (p), C → (r, s), D → (q)
 4. A → (p, r), B → (r), C → (q, s), D → (q)

Integer/Numerical Value Type Questions

1. (3) Petroleum, coal and forest are exhaustible resources.
 2. (4) Coke, coal tar, coal gas and ammonium compounds.
 3. (2) Petroleum and Coal.
 4. (2)
 5. (2) The main components of LPG are hydrocarbon containing three or four carbon atoms. The main components of LPG thus are propane (C₃H₈) and Butane (C₄H₁₀).
 6. (3) There are three types of charcoal
 (i) Wood charcoal
 (ii) Bone charcoal
 (iii) Sugar charcoal