Air

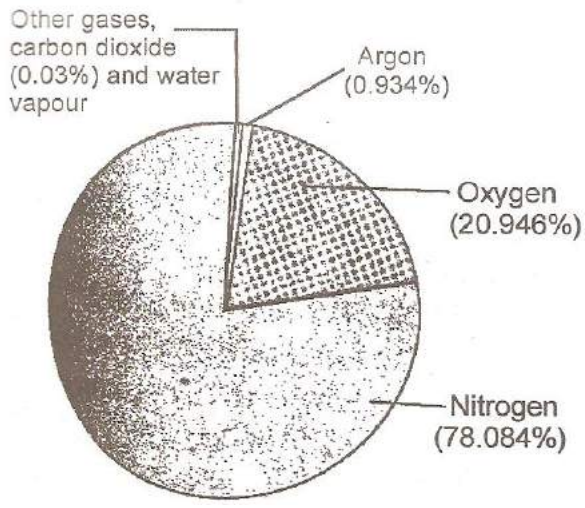
Air

Air is a mixture of several gases, water vapour and fine dust particles, a human being respires about 22,000 times everyday and takes in about 16 kg of air, Air contains mainly nitrogen, oxygen and smaller amounts of argon, carbon dioxide, water vapours and traces of helium, neon, krypton and xenon.

(a) Composition of Air:

Percentage composition of various constituents of air are as follows:-

Gas	Chemical formula	Proportion (% by volume)
Nitrogen	N_2	78.084
Oxygen	O_2	20.946
Carbon dioxide	CO_2	0.033
Argon	Ar	0.934
Neon	Ne	0.00018
Helium	He	0.0000052
krypton	Kr	0.0000014
Xenon	Xe	0.0000008
Methane	Ch_4	0.0000020
Hydrogen	H_2	0.0000005
Nitrous oxide	N_2O	0.0000005
Water vapour	H_2O	Variable
Dust particles	--	Variable
Other impurities	--	Variable



(b) Significance of Constituents of Air:

(i) Nitrogen: It is an important constituent of living organisms. It cannot be utilized by living organisms in elemental form. The elemental nitrogen is converted into its usable compounds like nitrate by nitrogen fixation processes.

(ii). Oxygen: Oxygen is extremely important for the survival of organisms as organisms respire in it. Requirement of oxygen is an essential condition for burning of a substance hence it plays an important role in combustion.

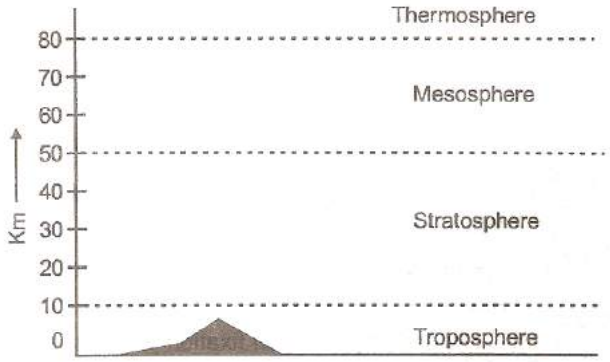
(iii) Carbon dioxide: It occurs in carbohydrates, fats, proteins, nucleic acids, enzymes and hormones, carbon dioxide molecules reflect back the heat radiations and help the earth not to radiate heat very rapidly at night. Carbon dioxide partially dissolves in water and helps in the formation of carbonate salts. These give taste to natural water. Carbon dioxide provides oxygen to the atmosphere by photosynthesis.

(iv) Water vapour: Water vapour rise high up into the atmosphere and get cooled to form clouds. These bring rain both on land and oceans. Snow is produced in cooler regions. The water vapour control the climatic conditions.
(v) Inert gases: Inert or noble gases are present in air in very small amount. These do not react with any substance but can be used in many ways.

Atmosphere

The transparent, thick and invisible envelope of air surrounding us is called atmosphere. It consist of a uniform mixture of permanent gases called dry air and varying amounts of other materials including organic and inorganic impurities such as smoke, pollen grains and dust particles.
The atmosphere is divided in various layer to facilitate the study of it.

(a) Layers of Atmosphere :
Atmosphere reaches a height of more than 120 km. These layers have been identified on the basis of change in temperature, chemical composition, air movements and density. Four layers are-



(i) Troposphere:

- The first layer of atmosphere is called troposphere which extends upto 10 km from the earth's crust.

- Clouds are present in the uppermost region.
- The temperature decreases as we move up.[For every 1 km height 6°C temperature drops].
- Water vapour content also decrease with height.

(ii) Stratosphere:
- It is second layer of the atmosphere.
- It lines between 10 to 50 km above the earth's surface.
- Air temperature mains constant (almost) upto a height of 25 km, then increases.
- Ozone layer is present in this layer. Ozone layer protects us from harmful U.V. radiations.

(iii)Mesosphere:
- It extends from 50 to 80 km.
- Temperature is lower than that of troposphere and stratosphere.
- In this region temperature falls with increase in altitude.

(iv) Thermosphere:
- It starts just above the mesosphere and extends 120 km and beyond.
- In this region the temperature generally increases with altitude. (Due to the absorption of intense solar radiations by limited amount of oxygen)
- It is also known as upper atmosphere or ionosphere.

(b) Significance of Atmospheric Study:
(i) Atmosphere plays an important role in formation of clouds, occurrence of rain and formation of snow.
(ii) Ozone layer of stratosphere protects us from harmful UV radiations.
(iii) Formation of winds occur in troposphere.

(iv) Weather Forecasting: By studying atmospheric conditions we can predict rain, snow, hurricanes etc. Thus, we can take appropriate measures to guard ourselves and our property against the damage caused by heavy rains, floods or drought. The prediction of weather by studying atmosphere conditions is called weather forecasting.

Atmospheric Pressure

(a) Behaviour of the Gases in the Atmosphere: The gases in the atmosphere constantly mix or diffuse into one anther.
(ii) Atmospheric gases can be compressed.
(iii) The heat energy of the sun, warms the atmospheric gases. This in turn, charges the temperature and density of the air, which further results in the formation of wind (moving air).
(iv) The molecules of the gases strike continuously on the sides of the vessel and in doing so exert a certain force on the walls of the vessel.

(b) Definition:
Pressure is the force (thrust) acting on a unit area of cross-section. e.g. if a force of 1 Newton acts perpendicularly on an area of 1 M^2, then the pressure is said to be one pascal (Pa).
Thus, the force (thrust) of the atmosphere on a unit cross-section area is called atmospheric pressure.
The atmospheric pressure changes with the change in altitude. It is because. On higher altitudes the weight of the air responsible for the pressure, decreases changes with the change in altitude. It is because, on higher altitude the weight of the air responsible for the pressure, decreases

(c) Units of Atmospheric Pressure:
The unit of pressure in SI system is pascal. However, it is too small unit. Thus, atmospheric pressure is measured in a bigger unit called kilopascal (kPa).
1 kilopascal (kPa) = 10^3 Pa = 1000 pa
a pascal is defined as the pressure exerted by a force of one newton (N) acting over an area of one square metre.

(d) Atmospheric pressure:
The pressure exerted by the atmosphere at sea level is called atmospheric pressure.
The magnitude of normal pressure is 1.03×10^5 pa.
The normal atmospheric pressure is also expressed in terms of vertical height of a pure mercury column. Its magnitude is 760 mm of Hg or 760 torr (1 mm is equal to 1 torr).
Atmospheric pressure is seldom higher than 775 mm and lower than 737 mm of mercury.

(e) Measurement of Atmospheric Pressure:
The atmospheric pressure is measured by an instrument called **barometer.** Commonly used barometer are as follows-

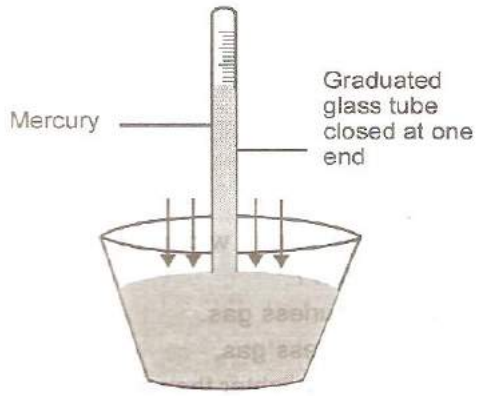
(i) Mercury barometer:
(A) Construction: An ordinary mercury barometer consists of a graduated glass tube of about 840 mm height, closed at the one end and open at the other. This tube is filled with mercury and then inverted in a trough full of mercury. The level of the mercury falls to a height of about 760 mm above its level in the trough (i.e. atmospheric pressure at the sea level is 760 mm of Hg).

(B) Working:
The atmospheric pressure is measured by observing the height of a column of mercury that its pressure exactly balances the pressure of atmosphere.

(C) Uses: Mercury barometer is used in school laboratories and in weather stations.

(D) Reasons for using mercury:
Mercury is ideal for a liquid barometer, because

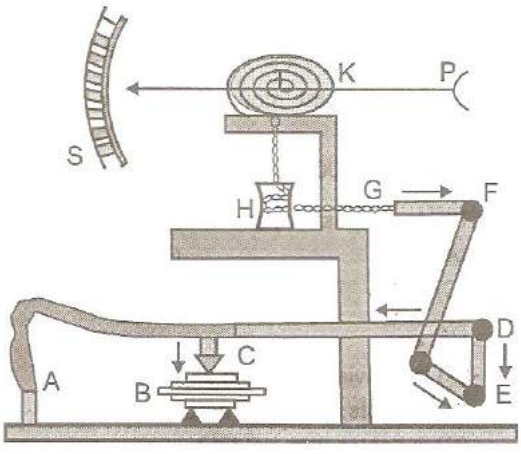
(i) It has a high density (13.6 g/cm^3), so it permits a short column.
(ii) It does not stick to the walls of the glass tube.
(iii) Mercury does not vaporize under vacuum conditions. Thus, we can record the correct atmosphere pressure.



Mercury barometer

(ii) Aneroid barometer:
This barometer does not contain any liquid and hence, is called aneroid barometer. It is very light in weight. It is portable and can be fixed at any place.

(A) Construction: It consists of a partially evacuated box 'B' made of corrugated iron sheet, which acts as a diaphragm. It is fixed at base of a circular wooden box. In the middle of the circular box, a central lever (C) is fixed which is connected to a flat spring A, and to the system of levers D,E and F.
The flat spring protects the diaphragm from collapsing, whereas, the system of levers helps in magnifying tiny movements of the central lever. The system of levers is further connected with a metallic chain (G), which passes over a pulley 'H'. A pointer (P) is attached to the pulley, which moves over a circular scale 'S'. a hair spring 'K' is attached to the pulley, which brings the pointer back to original position.



(B) Working: Suppose the atmospheric pressure increased pressure pushes the diaphragm downward, on account of which of the central lever moves down. This tiny movement of the central lever is magnified by the system of levers and hence, the metallic chain is pulled outward. The pull in the chain, in turn rotates the pulley and hence the pointer moves over the scale. However, due to the movement of the pulley the chain is pulled inward and the hair spring unwinds, due to which the pointer moves in the opposite direction.

(iii) Barograph: Barograph is a device which continuously records the atmospheric pressure on a mm graph paper fixed on a rotating drum. An link pen is attached to the pointer of an graph line on mm graph paper called barogram. The aneroid barometer is regularly checked against mercury barometer as the latter is more accurate.
(iv) Altimeter: It is a type of aneroid barometer that is calibrated to measure height.
Use: it is effectively used in aeroplanes to measure the height.

EXERCISE

1. Air is a/an
(A) element (B) compound
(C) mixture (D) none of these

2. The instrument used to measure atmospheric pressure is-
(A) electrometer (B) thermometer
(C) barometer (D) magnometer

3. Up higher in the mountains, water boils -
(A) at 100^{o}C (B) below 100^{o}C
(C) above 100^{o}C (D) above 200^{o}C

4. Photosynthesis by plant, releases -
(A) CO (B) CO_2
(C) N_2 (D) O_2

5. Hot air-
(A) is heavier than cold air
(B) weights the same as cold air
(C) is lighter than cold air
(D) None of the above

6. Dry air is free from -
(A) oxygen (B) water vapour
(C) hydrogen (D) sulphur dioxide

7. Density of liquid mercury is -
(A) 13.8 g/cm^3 (B) 13.6 g/cm^3
(C) 12.8 g/ cm^3 (D) 12.6 g/cm^3

8. Clouds are present in -
(A) troposphere (B) stratosphere
(C) mesosphere (D) themosphere

9. Which of the following layers is also known as ionosphere?
(A) Troposphere (B) Stratosphere
(C) Mesosphere (D) Themosphere

10. Which of the following component of air cannot be taken directly by plants?
(A) Oxygen (B) Nitrogen
(C) Carbon dioxide (D) None of these

11. The content of water vapour in air -
(A) varies
(B) does not vary
(C) is more as we go up from earth's surface
(D) None of the above

12. Components of air can be separated by which technique?
(A) Filteration
(B) Sublimation
(C) Fractional distillation
(D) By separating funnel

13. Which gas dissolves in water in a small amount and is a source of respiration for water animals?
(A) CO_2 (B) O_2
(C) N_2 (D) H_2

14. Which one of the following gases is not found free in air?
(A) Nitrogen (B) Oxygen
(C) Carbon dioxide (C) Hydrogen

15. Which of the following gases is heavier than air?
(A) Nitrogen (B) Oxygen
(C) Carbon monoxide (C) Hydrogen

16. In an experiment essential materials are test tube, glass tubes, lime water, ice cubes and shoot of hydrilla plant. In the experiment air is passed through lime water then lime water turns milky. It shows-
(A) the presence of carbon dioxide in air.
(B) the presence of water vapour in air.
(C) that green plants give out oxygen.
(D) that oxygen is lighter than air.

17. At higher altitudes, mountaineers find it difficult t breathe because-
(A) air is slightly heavier than oxygen
(B) oxygen is slightly heavier than air
(C) oxygen is slightly lighter than air
(D) both (A) and (C)

18. Global warming is caused when air has in excess:
(A) oxygen (B) water
(C) carbon-di-oxide (D) NO_2

19. Which statement is wrong for physical properties of oxygen?
(A) It is colourless gas.
(B) It is tasteless gas
(C) It is slightly lighter than air.
(D) It is odourless gas.

20. Which gas support to combustion?
(A) CO_2 (B) H_2
(C) O_2 (D) N_2

ANSWER – KEY

AIR

Q.	1	2	3	4	5	6	7	8	9	10
A.	C	C	B	D	C	B	B	A	D	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	C	B	D	B	A	B	C	C	C