

# AIR

## Introduction, Components and Composition of Air

### SYNOPSIS

Air is present all around us. All living things need air to breathe including human beings. Air is a mixture of mainly two gases, i.e., oxygen and nitrogen. Amongst these gases oxygen is heavier than nitrogen. Air is dense near the earth's surface. As we go up, it becomes thinner. It means that the oxygen gas is less as we go up. This is the reason why mountaineers take oxygen cylinders with them.

### Atmosphere

The envelope of air around earth is called atmosphere. It traps the heat from the sun to keep the earth warm. It also protects us from the harmful rays of the sun

### Composition of Air

Air is a mixture of gases. The two main contents of air are – nitrogen and oxygen. In addition to these, air also contains small quantities of carbon dioxide, water vapour and traces of other gases.

Nitrogen	= 78 %
Oxygen	= 21 %
Carbon dioxide	= 0.03 %
Other gases	= 0.97 %

The most important gas for all living creatures is oxygen which forms about 1/5 or 21 percent of air. Inert gases are also present in very less proportion (He, Ne, Ar, Kr, Xe, Rn)

### PROPERTIES OF AIR :

- \* Air is a colorless gaseous substance.
- \* Air occupies space .
- \* Air has weight and it exerts pressure in all directions.

### EXPERIMENT :

#### TO SHOW THAT AIR OCCUPIES SPACE :

1. Take a balloon and blow air by mouth .
2. Twist the mouth of balloon and tie with thread and press the balloon .
3. We can feel that air is present inside the balloon but we can't see with our naked eye, this shows that air occupies space .

#### TO SHOW THAT AIR HAS WEIGHT:

1. Make a hole in the middle twig of broom
2. Insert a thread into the hole of twig and suspend it freely
3. Blow the balloons with equal volume
4. Very simply tie two inflated balloons on the ends of a twig. The balloon should be balanced

5. Then pick a balloon and burst it and the other side goes down this demonstrates that air has weight

### **TO SHOW AIR EXERTS PRESSURE:**

#### **UPWARD DIRECTION:**

Fill roughly one-third of a cup with water. Then, cover the mouth of the cup completely with a flat, hard cardboard. Using your hand to keep it in place, turn the cup upside down. When you remove your hand, the cardboard stays in place. One would expect that due to gravity, the water will fall, and even the cardboard will. However, it does not, which means that something must be applying an upward force on the cardboard. This is nothing other than air pressure, which applies a force across the surface of the cardboard in an upward direction. Thus we can demonstrate that air exerts pressure, because otherwise, the water would have fallen.

#### **DOWNWARD DIRECTION:**

A glass vessel is taken and is half filled with water. A small piece of cork is dropped on water and it floats on it. A glass is inverted on the floating cork and is pushed over the floating piece of cork. The air in the glass exerts pressure downwards and pushes the cork down.

This shows that air exerts pressure in downward direction.

#### **SIDEWARD DIRECTION:**

A tin made of thin metal sheet is taken. The tin is heated with spirit lamp. It helps to push out air in the tin. After some time we observe the sides of tin pressed and it gets twisted. It means air exerts pressure on sides and due to this it gets twisted.

### **COMPONENTS OF AIR :**

1. The composition of air is not fixed, rather varies from place to place and also from season to season. In the lower layers, the composition of dry air is uniform.
2. Nitrogen and Oxygen are two main gases which account for about 99 per cent of the atmosphere.
3. Other gases present in the atmosphere include carbon dioxide, helium, ozone, argon and hydrogen.
4. Apart from the gases, the atmosphere also has varying quantities of dust particles and water vapour.

### **TO PROVE VARIOUS GASES PRESENT IN AIR**

Air contains carbon dioxide, nitrogen and oxygen. It can be proved by demonstrating experiments.

#### **OXYGEN:**

Invert a glass over a burning candle flame. After few seconds the flame goes off. It happens when oxygen gas was used up in burning.

#### **NITROGEN:**

When you put a burning candle on a table and invert a glass tumbler over it. After some time the flame goes off. It indicates that oxygen supply was cut and only nitrogen is present as it is non-supporter of burning. It puts off flame.

#### **CARBONDIOXIDE:**

Take lime water in a bowl and leave it undisturbed as it is exposed to air. After some time we observe a white colour layer formed on lime water. It is an indication

for presence of carbondioxide in air . The white layer is calcium carbonate which is formed when  $\text{CO}_2$  reacts with lime water  $[\text{Ca}(\text{OH})_2]$ .

### TO SHOW THAT AIR EXERTS PRESSURE :

Fill roughly one-third of a cup with water. Then, cover the mouth of the cup completely with a flat, hard cardboard. Using your hand to keep it in place, turn the cup upside down. When you remove your hand, the the cardboard stays in place.

One would expect that due to gravity, the water will fall, and even the cardboard will. However, it does not, which means that something must be applying an upward force on the cardboard. This is nothing other than air pressure, which applies a force across the surface of the cardboard in an upward direction.

Thus we can demonstrate that air exerts pressure, because otherwise, the water would have fallen.

### WATER VAPOUR :

Take few anhydrous copper sulphate crystals in a watch glass and leave it undisturbed . After sometimeits colour changes from colorless to blue it indicates that water vapour is present in air.

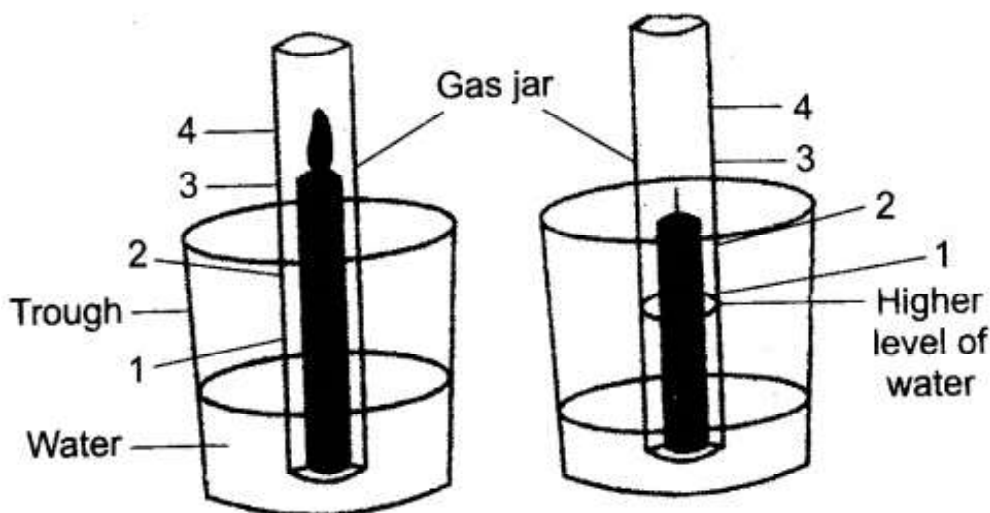
### EXPERIMENT :

To show that air contains nitrogen and oxygen in the ratio 4:1 by volume

Procedure: Take a glass container and fix a candle at its center. Put some quantity of water in the container. Place an empty, dry gas jar over it. Mark five marks above water surface on the jar at equal distances shown in the figure given below.

candle is lightened and is covered with the gas jar. After some time the candle is extinguished and the water level is raised in gas jar. The raised level in water is  $1/5$  of the volume of air in the gas jar.

This proves that one part of the air of the jar is a gas which



Experiment with a candle

supports combustion, i.e., oxygen. Hence,  $1/5$  by volume is oxygen in air

**C.D.F Points**

- Air occupies space and has mass.
- Air is a mixture of several gases like nitrogen, oxygen, carbon dioxide, inert gases and water vapour.
- The envelope of air around earth is called Atmosphere.
- The percentage of nitrogen in air by volume is 78%
- The percentage of oxygen in air by volume is 21%.
- Air contains oxygen and nitrogen in the ratio by volume is 1:4
- The percentage of  $\text{CO}_2$  in air by volume is 0.03%.
- He, Ne, Ar, Kr, Xe, Rn are called inert gases or noble gases.
- Air can be compressible.
- Air behaves as gases and it has neither definite volume nor definite shape
- Air exerts pressure in all directions.
- Carbon dioxide turns lime water to milky white.
- Oxygen is supporter of combustion.
- Nitrogen and Carbon dioxide are non supporter of combustion or burning
- Water vapour present in air changes the colour of anhydrous copper sulphate crystals from colourless to blue.

**CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ's)**

- Air is a:  
A) element                      B) mixture                      C) compound                      D) atom
- The earth is surrounded by envelope of air called  
A) atmosphere                      B) oxygen                      C) water vapour                      D) hydrosphere
- The percentage of oxygen in the clean dry air is about –  
(A) 21 per cent                      (B) 29 per cent  
(C) 71 per cent                      (D) 78 per cent
- Which of the following is not an inert gas?  
A) Helium                      B) Neon                      C) Oxygen                      D) Krypton
- Which is major part in air?  
A) Oxygen                      B) Nitrogen                      C) Carbon                      D) Neon
- Which gas turns lime water to milky white?  
A) oxygen                      B) nitrogen                      C) carbon dioxide                      D) water vapour
- Air occupies  
A) space                      B) oxygen                      C) nitrogen                      D) water vapour
- Combustion cannot take place without  
A) water                      B) carbon                      C) air                      D) zinc
- What is the ratio of oxygen and nitrogen in air by volume?  
A) 1:1                      B) 1:4                      C) 4:1                      D) 3:2
- The percentage of carbon dioxide in air by volume is :  
A) 21                      B) 78                      C) 0.1                      D) 0.03



13. The percentage amount of which of these gases in air is the least?  
A) oxygen                      B) carbon dioxide    C) nitrogen  
D) cannot say because it varies from place to place
14. Which of the following gas is not found in the atmosphere?  
A) Oxygen                      B) Hydrogen              C) Nitrogen                  D) Carbon dioxide
15. When we heat water ,we find bubbles coming from it . This shows that  
A)Water contains air                      B) Air contains water  
C) Water itself converts into bubbles  
D) water contains dissolved minerals.
16. Which of the following is necessary for a substance to burn ?  
A) Light                      B)Gasoline                  C)Hydrogen                  D) oxygen
17. When we breathe which of the following gas do we use ?  
A) Helium                      B)Carbondioxide    C) Hydrogen                  D)oxygen
18. Which of the following is not a constituent of atmosphere?  
A)Nitrogen                      B)Oxygen                  C) Aluminium                  D)Carbondioxide
19. Clothes dry faster when there is ..... water vapour in air  
A)less                      B)more                      C)either less or more    D)none
20. Hot air balloon rises up in the air because .....  
A)hot air is heavier than cold air.  
B) hot air is lighter than cold air .  
C)hot air does not play any role in rising the balloon.  
D)hot air contains water vapour which push up the balloon.

### JEE ADVANCED QUESTIONS

#### MULTIPLE CORRECT ANSWER TYPE

1. Air exerts .....pressure  
A) Upward                      B) Downward              C)sideward                  D)none of the above
2. which of the following statements are correct ?  
A)Air is essential for living things  
B)There is no place on land without air  
C)Air occupies space .                      D)We can see air
3. Which of the following are non supporters for combustion ?  
A) Oxygen                      B)Nitrogen                  C) Carbondioxide              D)Air
4. Inert gases among the following?  
A) Helium                      B) Neon                      C) Carbon                      D) Radon

#### STATEMENT TYPE :

- (A) Statement-1, is True, Statement - 2 is True; Statement - 2 is a correct explanation for Statement-1
- B) Statement - 1 is True, Statement is True; Statement - 2, is NOT a correct explanation for Statement 1
- C) Statement - 1 is True, Statement - 2, is False
- D) Statement - 1 is False, Statement - 2 is True

5. **Statement-I:** Carbon monoxide turns limewater to milky white .  
**Statement-II:** Chemical name of lime water is calcium hydroxide.
6. **Statement-I:** Anhydrous copper sulphate is used to identify water vapour in air  
**Statement-II:** It turns from colourless to blue by absorbing water.

**COMPREHENSION TYPE:****COMPREHENSION - I**

**A:** Air cover the earths surface upto 1000kms and it is considered as atmosphere.

7. The atmosphere consists mainly .....
- A) Oxygen and Nitrogen      B) Nitrogen and hydrogen  
 C) hydrogen and oxygen      D) none of the above.
8. The amount of water vapour in the air is called.....  
 A)Wind      B) Moisture      C) Respiration      D) Electrolysis .

**COMPREHENSION - II**

Air is mixture of several gases and it is homogenouswith different percentage composition.

9. Air contains a more quantity of :  
 A) Nitrogen      B) Hydrogen      C)Flourine      D) Chlorine
10. Oxygen is..... for combustion.  
 A) Flammable      B) Inflammable  
 C) supporter      D)Non - supporter

**INTEGER TYPE :**

11. Percentage of nitrogen in air is .....
12. Percentage of oxygen in air is .....
13. The number of parts by volume of nitogen in air is .....
14. The number of atoms present in carbondioxide is .....
15. The number of oxygen atoms present in limewater is.....

**MATRIX MATCH TYPE:**

16. **COLUMN-I (GASES)**      **COLUMN -II( %)**
- A)Nitrogen      i) 0.03  
 B)Oxygen      ii) 78  
 C) Carbondioxide      iii) 0.94  
 D) Inert gases      iv) 21
17. **COLUMN-I (GASES)**      **COLUMN -II**
- A) Nitrogen and oxygen are in ratio      i) supports burning  
 B) Carbondioxide      ii)  $\text{CaCO}_3$   
 C) Oxygen      iii) 4:1  
 D) Milky white substance      iv) extinguishes fire .

Key :

**CUQ's**

1-B,2-A, 3-A,4-C,5-B,6-C,7-A,8-C,9-B, 10-D

**JEE MAIN**

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

**JEE ADVANCED MULTIPLE**

1- ABC 2-ABC 3-BC , 4-ABD

STATEMENT :5-D, 6-A

**Comprehension - 1**

**7-A 8-B , 9-A , 10-C**

**INTEGER TYPE**

11-78, 12-21, 13-4, 14-3, 15-2

**Matching**

16-A-ii, B-iv, C-i, D-iii

17- A-iii, B-iv, C-i, D-ii

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