Chapter 18: Behaviour of Gases

C18

1. Mention the features of gases.

a) Gases are highly compressible.
b) Gases exert pressure equally in all directions.
c) Gases mix evenly in all proportions without any mechanical aid.
d) Gases are least dense than other two states of matter.

2. What happens when a balloon with little air is tied to the mouth of a bottle with hot water? Why?

The balloon increases in size because temperature increases kinetic energy of gas molecules of balloon. This increases the random movement of gas molecules. Hence the volume increases gradually.

3. What is meant by absolute zero temperature?

The temperature -273^{o}C is called absolute zero or zero Kelvin.

4. State Charles's law.

"At constant pressure, the volume of a fixed mass of a gas is directly proportional to its absolute temperature (Kelvin)".

5. Write the mathematical form of Charles's law.

$V \propto T$ or $V = KT$

6. Derive Charles's law equation

If T_1 is initial temperature in Kelvin, V_1 is the initial volume in litres, T_2 is the final temperature and V_2 is the final volume then

According to Charles law

$V_1 = K T_1$ or $\frac{V_1}{T_1} = K$ .....(1)

Similarly $V_2 = KT_2$ or $\frac{V_2}{T_2} = K$ .....(2)

From equation (1) and (2) we get $\frac{V_1}{T_1} = \frac{V_2}{T_2} = K$

7. What happens to the volume when the temperature is doubled according to Charles's law?

If the temperature is doubled, the volume would also be doubled.

8. What happens to the volume when the temperature is reduced to one-half according to Charles's law?

If the temperature is reduced to one-half, the volume would also be reduced to one-half.

9. What is the relationship between volume and temperature of gases when pressure is kept constant?

Volume of a fixed mass of gas is directly proportional to its absolute temperature.

10. Give reason:

a) Soda bottles are often labelled "store in cool and dry place".

The carbon dioxide filled in soda bottles on exposure to heat, expands because the gas inside the bottle expands as temperature rises.

b) Balloons pops out during hot summer more frequently than in winter.

As the temperature increases in summer, the volume of the gas filled in balloon also increases which makes the balloons to pop out.

c) During winter football filled with air reduces to its original size when taken outdoors.

When football is taken out, its temperature decreases so the volume to gas filled also decreases.

11. Why are the air bubbles smaller in size in lower layers but grows bigger as they rise up when water is boiled?

Lower layers of water exert a lot of pressure on air bubbles. Hence they are smaller in size. But the pressure decreases as bubbles rise to the top. Hence they grow bigger.

12. State Boyle's law.

"At constant temperature, the volume of a given mass of dry gas is inversely proportional to its pressure".

13. Write the mathematical expression of Boyle's law.

If V is the volume of a certain mass of gas, under pressure P at constant temperature then according to Boyle's law,

$$V \alpha \frac{1}{P}$$

$$V = K \text{ x } \frac{1}{P}$$

$$PV = K$$

14. Give reason: When you exert pressure on air pillow, its size gets reduced.

The volume of air filled in the air pillow decreases as we increase the pressure.

15. How are pressure, volume and mass of a gas related?

The product of the volume and pressure of a given mass of dry gas is a constant.

16. If P_1 is the initial pressure, V_1 is the initial volume, P_2 is the final volume and V_2 is the final volume of a gas. Write the he relation between them.

According to Boyle's law

$P_1V_1 = P_2V_2$ = constant

17. Give reasons:

a) Deep sea fishes die when suddenly brought to surface.

The pressure at the bottom of the sea is more, but the pressure at the surface is less. So due to low pressure the fish dies.

b) Scuba diver's life is under threat when they suddenly come to the surface quickly.

As a diver goes deeper underwater, that pressure begins to increase. With the increase in pressure volume decreases, nitrogen gas begins absorbing into the diver's blood. When the diver begins his ascent, these gas molecules begin to expand back to their normal volume. With a slow ascent, or through the use of a depressurization chamber, those gasses can work their way back out of the bloodstream as they return to their normal volume.

c) Balloons pop when squeezed.

When a balloon is squeezed, the pressure increases. So it pops.

d) We feel uneasy pain in the ears during take off and landing of aeroplanes.

When the aeroplane takes off or lands, there is imbalance in pressure inside and outside of eardrum.

18. Mention some applications of Boyle's law in our daily life.

a) Deep sea fishes die when suddenly brought to surface due to low pressure.
b) Scuba diver's life is under threat when they suddenly come to surface quickly.
c) It is used in daily life situations like breathing, filling cheeks with air, filling air to vehicle tyres.
d) We feel pain in the ears when in an aeroplane during take off or landing.

19. What is meant by diffusion?

The random movement of gaseous molecules from the region of higher concentration to the region of lower concentration is known as diffusion.

20. Give reason:

a) Burning of kerosene does not produce much smell but when the burning ceases, it produces strong smell.

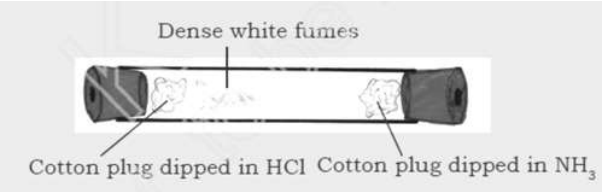
When kerosene is burnt, only few molecules diffuse with air after combustion. But when the burning ceases the unburnt hot vapours of kerosene enters into air and strong smell is got.

b) Smell of hot food reaches faster then that of cold food.

Smell of hot food reaches faster because rate of diffusion is faster. Cold food diffuses slowly.

21. Observe the experiment and answer the questions.

Take a glass tube. Keep a cotton plug dipped in concentrated hydrochloric acid at one end of the glass tube and cotton plug dipped in liquid ammonia at the other end.



a) What are the dense white fumes formed?

The dense white fumes are of ammonium chloride NH4Cl.

b) Why is the dense white fumes seen near the HCl end?

As HCl gas is denser than ammonia gas they diffuse slowly. Lighter ammonia vapours move with more velocity and both gases react and produce dense white fumes of NH4Cl near the HCl cotton plug end.

22. When does diffusion of gases takes place?

Diffusion of gases takes place when the gases do not react with one another.

23. What is rate of diffusion?

The rate of diffusion of a gas is the volume of gas diffusing per unit time.

24. State Graham's law of diffusion.

"The rate of diffusion of a gas is inversely proportional to the square root of its density".

25. Write the mathematical form of Graham's law of diffusion.

$$r \propto \frac{1}{\sqrt{d}} \text{ or } r = K\frac{1}{\sqrt{d}} \text{ or } k = r\sqrt{d}$$

26. Write the relationship between diffusion and mass.

$$r = K\frac{1}{\sqrt{d}} \text{ (at constant temperature)}$$

$$\text{But density} = \frac{\text{mass}(m)}{\text{volume}(v)}$$

$$\therefore r = \frac{K}{\sqrt{\frac{m}{v}}} \text{ or } r = k\sqrt{\frac{v}{m}}$$

27. What is the relationship between rate of diffusion and mass of gas?

Rate of diffusion is inversely proportional to mass of gas.

28. Name the gas responsible for Bhopal gas tragedy.

Methyl Isocyanate which is produced by the chemical combination of phosgene gas and methyl cyanide.

29. Give reason:

a) During the Bhopal gas tragedy, cockroaches, ants and mosquitoes survived.

Methyl Isocyanate is a gas denser than air. Hence it was unable diffuse in the crevices. So these animals survived.

b) When there is L.P.G leakage, one is advised to open all doors and windows.

When the doors and windows are opened the rate of diffusion of the LPG with air molecules is faster. Hence any damage by explosion can be prevented.

30. 2 litres of gas enclosed in a vessel at $2x10^5$ pa pressure and allowed to expand about 4 litres under constant temperature. What would be the final pressure?

31. If the product of pressure and volume of a gas is $15x10^5$ and if the pressure is $1.5x10^5$ pa. Find the volume in litres. (At constant temperature)

32. If the pressure of a gas is $2.5x10^5$ Pa and the volume of a gas is 6 litres then find the constant. (At constant temperature)

33. If the volume and the product of a gas are 5 and $15x10^5$ find the pressure of the gas. (At constant temperature)

34. The volume of the gas found to be at a pressure of 2500pa when the pressure was decreased by 500pa the gas occupied a volume of 2400 litres. Calculate the initial volume occupied by the gas before the change was done at constant temperature.

35. About 6 litres of oxygen gas is collected at 300K. If for a particular use, the volume has to be reduced to $\frac{1}{3}$ of its original volume, find the temperature to which the gas has to be cooled? [Pressure is kept constant]

36. A balloon has a volume of 2500ml on a day when the temperature is 30°C. If the temperature at night falls to 10°C, what will be the volume of the balloon if the pressure remains constant?

37. When 50 litres of oxygen at 20°C is compressed to 5 litres, what must the new temperature be to maintain constant pressure?

Fill in the blanks:

1. Under constant pressure degree rise in temperature, the volume of gas increases by $\frac{1}{273}$ of the original volume at 0^{o}C.
2. The SI unit of temperature is **Kelvin**.

3. The temperature **– 273^{o}C** is called absolute zero or zero Kelvin.
4. At constant pressure, the volume of a fixed mass of a gas is **directly proportional** to its **absolute temperature**.
5. The mathematical form of Charles's law is **V=KT**.
6. Charles's law equation is $\frac{V_2}{T_1} = \frac{V_2}{T_2}$.
7. At constant temperature, the volume of a given mass of dry gas is inversely proportional to it pressure is **Boyle's law**.
8. At constant temperature, the volume of a given mass of dry gas is inversely proportional to it **pressure**.
9. The mathematical form of Boyle's law is **PV = K**.
10. Product of the volume and pressure of a given mass of dry gas is a **constant**.
11. Boyle's law equation is **$P_1V_1 = P_2V_2$**.
12. The SI unit of pressure is **pascal**.
13. The random movement of gaseous molecules from the region of higher concentration to a region of lower concentration is known as **diffusion**.
14. Smell of hot food reaches faster because of **faster rate of diffusion**.
15. Diffusion takes place only when the gases **do not react with one another**.
16. Volume of gas diffusing per unit time is called **rate of diffusion**.
17. The rate of diffusion of a gas is inversely proportional to the square root of its density is **Graham's law of diffusion**.
18. The rate of diffusion of a gas is inversely proportional to **the square root of its density**.
19. The mathematical form of Graham's law of diffusion is $r = \frac{K}{\sqrt{d}}$.
20. The relationship between diffusion and mass is $r = K\sqrt{\frac{v}{m}}$.
21. Rate of diffusion is inversely proportional to **mass of the gas**.
22. Bhopal gas tragedy is due to **methyl Isocyanate**.

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