

for quantitative calculations. Thus, the formation of carbon dioxide, by the action of oxygen on carbon, is expressed by the equation—



which not only tells us that one atom of carbon unites with two atoms of oxygen to form a molecule of carbon dioxide, but also that 12 parts by weight of carbon (atomic weight of carbon = 12) unite with 32 parts by weight of oxygen (atomic weight of oxygen = 16) to form 44 parts by weight of carbon dioxide. From these considerations it is easy to calculate the quantities of carbon and oxygen involved in the formation of a given quantity of carbon dioxide obtained from known quantities of carbon and oxygen.

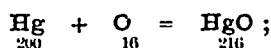
Ex. 1.—When carbon is burnt in oxygen gas it forms carbon dioxide, CO_2 . How much carbon dioxide by weight can be obtained by thus burning 15 grams of carbon?

Weight of CO_2 obtained from 12 grams of carbon	= 44	grams
" " 1 "	= $\frac{44}{12}$	"
" " 15 "	= $\frac{15 \times 44}{12}$	"
	= 55	"

Ex. 2. How much mercury is required to form 20 grams mercuric oxide?

For the sake of simplicity we shall use atomic instead of molecular equations.

Hence,



mercury required to form 216 grams of mercuric oxide = 200 grams

" " 1 "	= $\frac{200}{216}$	"
" " 20 "	= $\frac{20 \times 200}{216}$	"
	= 18.51	"

Exp.—What weight of oxygen can be obtained from 100 grams of potassium chlorate?



Weight of a molecule of potassium chlorate = $39.1 + 35.5 + 48 = 122.6$

Oxygen obtained from 122.6 grams $\text{KClO}_2 = 48$ grams

" " 1 "	= $\frac{48}{122.6}$	"
" " 100 "	= $\frac{100 \times 48}{122.6}$	"
	= 39.15	"

EXERCISE I

1. I want 100 lbs. of oxygen, how many pounds of potassium chlorate must I take?
2. I require 2 kilograms of oxygen, how much (1) mercuric oxide, (2) potassium chlorate, (3) manganese dioxide, shall I need?
3. On heating some potassium chlorate 298 grams of potassium chloride were left, how many grams of chlorate were heated, and how many grams of oxygen were formed?
4. What weight of hydrogen could I obtain from 70 grams of water by the action of sodium?
5. How much potassium chlorate will furnish sufficient oxygen to unite with the hydrogen evolved by the action of 200 grams of sodium upon water?

6. What weight of zinc must be added to dilute sulphuric acid to liberate 5 grams of hydrogen?

7. What weight of iron is required to prepare 35 grams of hydrogen from hydrochloric acid?

Relation of the Volume of Gases to Pressure.

In Art 22. Exp. 18.—We see that when a confined mass of gas is compressed, its volume diminishes with increased pressure, and conversely increases in volume as the pressure diminishes. Thus, if the pressure on a given mass of gas is doubled, the volume is reduced to one-half, if tripled, to one third, and so on.

Boyle's Law. The volume which a gas occupies is inversely proportional to the pressure to which it is subjected.

This law was enunciated independently by Boyle and Mariotte, and Dalton further showed that it was applicable to the case of a mixture of gases.

Ex. 4.—At a constant temperature a quantity of gas occupies 25 cubic feet under a pressure of 10 lbs.; what space will it occupy under a pressure of 24 lbs.?

Space occupied under a pressure of 10 lbs.	= 25	cubic feet.
" " 1 "	= 10×25	"
" " 24 "	= $\frac{10 \times 25}{24}$	"
	= $10\frac{5}{6}$	"

Standard Pressure.—The average weight of the atmosphere at the level of the sea, in the latitude of Paris, is that of a column of mercury 760 millimetres (30 inches) in height, and this is taken as the *Standard barometric pressure*.

Ex. 5.—A balloon containing 1200 cubic metres of hydrogen under a pressure of 770 millimetres of mercury ascends until the barometer stands at 530 millimetres; what volume would the gas in the balloon now occupy, supposing none to have escaped.

Space occupied under pressure of 770 mm.	= 1200	cubic metres.
" " 1 "	= 770×1200	"
" " 530 "	= $\frac{770 \times 1200}{530}$	"
	= 1743.4	"

EXERCISE II.

1. The height of the barometer is said to be, on a particular day, 740 mm; what is meant by this statement?
2. The standard pressure is 760 mm. of mercury; how many inches of mercury corresponds to this number?
3. 1000 c. c. of hydrogen are measured under a barometric pressure of 740 mm.; what will the volume become under the standard pressure of 760 mm.?
4. At a constant temperature a mass of air occupies 18 cubic feet under a pressure of 7.5 lbs., what space will it occupy under a pressure of 25 lbs.?
5. If, under the pressure of one atmosphere a certain quantity of hydrogen gas occupies 50 cubic inches, under what pressure would it occupy 30 cubic inches?

(To be Continued.)