dioxide, MnO_2, copper oxide, CuO, ferric oxide, Fe_2O_3, lead oxide, PbO, zinc oxide, ZnO, magnesium oxide, MgO, sand, and powdered glass. Put these several mixtures into as many test-tubes, and into another test-tube put one gram of potassium chlorate alone. Imbed the tubes side by side in sand to about the same depth as they are filled within, apply a gradually increasing heat, and by means of glowing splints frequently plunged into the different tubes, observe the difference in the readiness with which the oxygen is evolved from the several mixtures. It will be seen that there is little difference among the first four tubes, and that the heat will probably not be sufficient to cause the oxygen to be evolved from the other five. After all the oxygen has been given off, about half-fill the first tube with water and gently heat till its contents are dissolved, filter through a piece of blotting paper, and gently dry on the hot sand the black substance remaining on the filter. It will be found to be manganese dioxide, and that it is in the same state after the experiment as at the commencement. The same is true of the next three oxides. These oxides may, however, undergo a temporary change. We know that MnO_2 is capable of taking up more oxygen and, combining with a molecule of water to form *manganic acid*, H_2MnO_4, and it is possible that when heated with potassium chlorate the manganese dioxide may absorb oxygen from this substance, and pass to the state of the higher oxide which is immediately decomposed, the oxygen being evolved and the manganese dioxide returning to its original state. The same applies to the next three oxides, all of which are known to be susceptible of higher oxidation. The zinc oxide and magnesium oxide, on the other hand, which do not form higher oxides, do not facilitate the decomposition of the chlorate.

40. Physical Properties of Oxygen.

Exp. 4.—Take the first bottle filled, which will contain a little air, but will suit well enough for this experiment. Observe the physical properties of the gas; it has neither color, taste, nor smell. Plunge a glowing splint of wood into it; the splint bursts into flame as in the preceding experiment. Hold the glowing splint at different heights *above* the mouth of the bottle; it will not burst into flame. Leave the bottle for a short time standing on the table with its mouth open; the glowing splint will show that the gas has not escaped. Turn the bottle mouth downwards, and hold the glowing splint *near* its mouth; it will burst into flame. Hold the bottle in this position for a short time; the splint will no longer burst into flame when plunged into the bottle. The gas has escaped. *Oxygen is, therefore, heavier than air.*

41. Combustion of Phosphorus in Oxygen.

Exp. 5.—Take a quart bottle of oxygen, and adjust the deflagrating spoon by holding it against the outside of the bottle, so that the little metallic cup may be about 5 centimetres (2 inches) from the bottom of the bottle, and put a little lime into it to absorb the moisture. Take a piece of phosphorus not larger than a small pea, dry it carefully with soft blotting paper, and place it on the lime in the cup. The phoshorus must not be touched with the fingers after it is dry, and it should be dried only when about to be used. Place the spoon in the bottle and touch the phosphorus with the end of a heated glass rod. The phosphorus burns brilliantly, and when the heat volatilizes it a flash of light fills the whole vessel, owing to the points of contact between the phosphorus and the oxygen being indefinitely increased, and the bottle is filled with dense white fumes. The phosphorus has combined with the oxygen, forming the white, snow-like substance called *Phosphorus Pentoxide*, P_2O_5. The molecule of phosphorus consists of *four* atoms, and the reaction is expressed as follows:—

$$\underset{\text{Phosphorus.}}{P_4} + \underset{\text{Oxygen.}}{5O_2} = \underset{\text{Phosphorus pentoxide.}}{2P_2O_5}$$

42. Acids.

Phosphoric Acid.—Pour a little water into the bottle and shake it up; the phosphorus pentoxide dissolves in the water. Taste a few drops of the solution; it is exceedingly sour. Pour into it some blue litmus solution; it will be immediately reddened. A substance possessing these characteristics is called an *acid*. The phosphorus pentoxide has combined with a molecule of water thus:—

$$\underset{\text{Phosphorus pentoxide.}}{P_2O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Metaphosphoric acid.}}{2HPO_3}$$

43. Combustion of Sulphur in Oxygen.

Exp. 6.—Wash the lime out of the cup of the deflagrating spoon, and dry it by holding it in the flame of the spirit-lamp. Place in it a piece of sulphur about as large as a pea. Heat the spoon in the flame until the sulphur melts and begins to burn with a pale-blue almost invisible flame, then place the spoon in a bottle of oxygen; the sulphur burns with a much brighter flame, emitting a beautiful violet-colored light. When the combustion is over, remove the spoon and observe, (1) the pungent suffocating smell of the gaseous combination of sulphur and oxygen which has been produced; (2) the seeming absence of anything in the bottle, the product of combustion being an invisible gas; (3) that a lighted paper plunged into the bottle will be immediately extinguished. The gas is called *Sulphur Dioxide*, SO_2, and the reaction is as follows:—

$$\underset{\text{Sulphur.}}{S_2} + \underset{\text{Oxygen.}}{2O_2} = \underset{\text{Sulphur dioxide.}}{2SO_2}$$

44. Sulphurous Acid.

Pour a little water into the bottle and shake it up. Observe that the hand is drawn into the bottle, showing that a vacuum has been produced. Taste a few drops of the water; it is sour. Pour a little of it into litmus solution in a test-tube; the solution is immediately reddened. This reddening of the vegetable blue coloring-matter is called the "*acid reaction.*" The gas has combined with a molecule of water to form *Sulphurous Acid*, H_2SO_3, thus:—

$$\underset{\text{Sulphur dioxide.}}{SO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sulphurous acid.}}{H_2SO_3}$$

45. Combustion of Carbon in Oxygen.

Exp. 7.—Cleanse the deflagrating spoon from sulphur, by holding it in the flame of the spirit-lamp till no smell of sulphur is perceived. Select a few splints of wood charcoal; place them upon the deflagrating spoon, and adjust it in a bottle of oxygen, as in the first experiment. The charcoal burns energetically in the gas, emitting much light and heat but little or no flame; observe that the product of combustion is an inodorous, invisible gas. Plunge a lighted taper into the bottle; the taper is extin-