

ANSWERS.

1. (a). The term "element" is applied to those constituents of matter which chemists have not been able to resolve into simpler bodies: in short, the term "element" is given to those substances out of which the earth, and all things thereon, are made, either by the simple bodies existing alone, or in combination with each other.

(b). That air is not an *element* can be shown by burning Phosphorus in a given volume; only a portion of it will be consumed. Thus, if a graduated jar be inverted and placed over water on which floats a capsule containing burning P., it will be found that about one-fifth part of the air will disappear, and its place will be filled by the water. The white fumes formed by the burning P. will be dissolved by the water. Now, were the air an element, it should be wholly consumed by the P, or else none of it should disappear; so we see that the remaining portion of the gas in the jar will not support combustion, as did the part which has united with the P, therefore, air is composed of at least two kinds of matter.

(c). A "mechanical mixture" is a mixture of two or more substances (each of which may be an element or a compound), in which each component retains its original properties, and which may be separated by mechanical means. A chemical compound differs from a mixture in that it has properties different from any of the component parts. In a mechanical mixture, the components may be present in any proportions, but in a chemical compound, the parts are present in definite proportions, and can only be separated from each other by a difficult chemical operation.

(d). That Nitrogen Monoxide is a chemical compound can be shown by filling two test tubes, one with air, the other with Nitrogen Monoxide, and passing into each a solution of Pyrogallate of Potash. From the vessel filled with air, the Oxygen will be absorbed, but not from that containing Nitrogen Monoxide. Or again, if Nitrogen Dioxide be passed into the vessel containing air, brown fumes N_2O_3 and N_2O_4 will be produced, showing that

the gas N_2O_2 has absorbed Oxygen from the air present; but if it be passed into a vessel of Nitrogen Monoxide, no change is produced, showing that the O of the N_2O is combined or locked up with the Nitrogen.

2. The best way of preparing Oxygen is to heat Potassic Chlorate, mixed with about one-third its weight of Manganese Dioxide, when all the Oxygen will be given off and Potassic Chloride and unchanged Manganese Dioxide will remain. The object of the Manganese Dioxide is to allow the Oxygen to come off at a lower temperature than the Potass. Chl. would require if heated alone. The equation is $KClO_3 = KCl + O_3$. Again, Oxygen may be prepared by heating Mercuric Oxide, HgO , when the O will be driven off and Mercury will condense in cooler parts of the tube. On a large scale O can be prepared by heating to a very high temperature, in an iron retort, Manganese Dioxide. In this case only one-third of the O is given off. The equation is $3 MnO_2 = Mn_3O_4 + O_2$.

The two gases Oxygen and Nitrogen Monoxide both rekindle a glowing taper, both support combustion vividly, but are distinguished by passing Nitrogen Dioxide into each. In the vessels containing Oxygen and air, brown fumes will be found, but in vessel containing Nitrogen Monoxide, no fumes will be found. Then vessels containing air and Oxygen can be distinguished by Pyrogallate of Potash as mentioned in question 1.

Atomic wt. of Potassium is 39.1, of Cl. 35.5, and O 16, therefore Potass. Ch., $KClO_3$, 122.6 parts yields 48 parts O; hence, 8 oz. will give 3.132 oz. of O, but each cubic foot of O weigh 592 grains, the vol. of $O = 3.132 \text{ oz.} \div 592 \text{ grains} = 2.54$ cubic feet.

3. (a). If a Nitrate as KNO_3 be heated with charcoal the Nitrogen is liberated in a free state. * Carbonic Acid is formed by the union of the Oxygen with a necessary quantity of Carbon, and the Carbonic Acid thus unites with the Potash. It is owing to the sudden liberation of Nitrogen from such mixtures that the explosive value of gunpowder is derived.

(b). When Nitric Acid acts on Copper,