nous, whether the gas allowed to mix with the coal gas in the long tube of the lamp be common air, carbon dioxide or pure nitrogen." Show that this fact is *not* in harmony with the received theory, accounting for the nature and structure of flame.

Ans.—The candle or gas flame consists of three parts: the area of non-combustion, of partial combustion, and of complete combustion. The luminous part of the flame lies in the region of partial combustion. The luminous power of the flame, according to the received theory, is due to the presence of particles of solid carbon in an intensely ignited condition in the flame. In the Bunsen burner it is said the gas draws up air with it through the holes at the bottom of the burner, and becomes so thoroughly mixed with the oxygen of the air, that complete combustion can take place at once throughout the entire flame. But carbon dioxide and pure nitrogen do not at all support combustion, as may be seen by bringing a burning candle into a vessel containing the gases. The non-luminosity of the flame of a Bunsen burner, when nitrogen or carbon dioxide are allowed to mix with the gas, cannot be owing to the complete combustion of the gas, seeing that nitrogen and carbon dioxide do not support combustion.

II. "At 26° C. the density of nitrogen tetroxide approaches 46. How should the formula for this compound be written to correspond to this density?"

Ans.—If at 26° C. the density of nitrogen tetroxide approaches to 46, its formula, to correspond to this density, must be written N_2O_4.

The molecule of all gases, simple or compound, occupies two volumes. If one volume of nitrogen tetroxide, representing the density, weighs 46, the molecule must weigh $46 \times 2 = 92$. But in the nitrogen tetroxide, the molecule weighing 92, the proportion of oxygen atoms to nitrogen atoms being as two to one, there must be two atoms of nitrogen, $14 \times 2 = 28$, united with four atoms of oxygen, $16 \times 4 = 64$, $28 + 64 = 92$.

III. "Required to prepare nitrogen monoxide from ammonium nitrate:

(i.) Write out the equation representing the reaction occurring in its preparation.

(ii.) Name the chief properties of the gas.

(iii.) State what precautions must be observed in preparing this gas when intended to be used for inhalation."

Ans.—(i.) $NH_4NO_3 = N_2O + 2H_2O$.

(ii.) *a.* Physical properties. Gas colourless, odourless, possessing slightly sweetish taste, condensible to a colourless liquid at $-99°$ C., and to a transparent solid at $-115°$; soluble in water, one volume of water at 0° dissolving 1.305 volumes of the gas.

b. Chemical properties. It supports combustion almost as readily as oxygen, relighting a glowing splint. Sulphur is extinguished unless burning brightly; burning brightly, it burns with a peculiar pink-edged flame. Phosphorus burns with almost as great brilliancy in this gas as in oxygen. The red fumes that make their appearance are due to the great heat which resolves a small portion of the nitrogen monoxide into nitrogen and nitrogen tetroxide.

$$4\,N_2O = 3\,N_2 + 2\,NO_2.$$

Its non-absorption by pyrogallate of potash and its non-forming of red fumes with nitric oxide, NO, distinguish it from oxygen.

iii. The gas must be passed through solution of iron sulphate, $FeSO_4$, to entirely free it from the presence of NO before it is used for inhalation.

IV. "As the result of certain experiment it was found that 50 litres, measured at 5° C., and 758^{mm} P., of a mixture of oxygen and ozone, containing 18 per cent. of the latter, when allowed to bubble through a solution of hydrogen dioxide, were just sufficient to completely decompose it. Calculate from these data the quantity of hydrogen dioxide present in the original solution."

Solution.—50 litres of oxygen and ozone at 5° C. and 758^{mm} P. become at 0° C. and 760^{mm} P.,

$$\frac{50}{1} \times \frac{273}{278} \times \frac{758}{760} = 48.97+$$

In 100 grammes of mixed gases there are 18 grammes of ozone and 82 grammes of oxygen.