

NATURAL SCIENCE.

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JULY EXAMINATIONS, 1883.

FIRST-CLASS TEACHERS—GRADE C.

Chemistry Paper, with answers

NOTE.—The answers are appended to the following questions rather to suggest a desirable form of answering than to convey information which, of course, any student interested in the subject could readily obtain for himself. The writer's experience tends to show that unless students are specially trained in the manner of answering, they will waste valuable time at examinations, inserting quantities of irrelevant matter and developing slovenly habits generally, to the just vexation of the examiners and the irrevocable loss of marks to the candidate.

1. Explain the full meaning of the following, merely as chemical symbols:—O, OH₂, 3Na₂CO₃.

1. O stands for one atom of oxygen. The weight represented by the symbol is always 16 units, that of the hydrogen atom being 1. OH₂ stands for one molecule of water, the molecule consisting of 1 atom of oxygen and 2 atoms of hydrogen. The symbol also indicates that 16 parts by weight of oxygen are combined with 2 parts by weight of hydrogen to form the molecule. 3Na₂CO₃ stands for 3 molecules of sodic carbonate, each molecule consisting of 2 atoms (46 parts by weight) of sodium; 1 atom (12 parts by weight) of carbon; and 3 atoms (48 parts by weight) of oxygen.

2. The chemical constitution of a gas being known, how can you calculate its specific weight?

Apply your method to find sp. wt. of the gases whose compositions are—CO₂, NH₃, C₂H₆O.

Can you mention any gases which form an apparent exception to the general rule?

2. By Avogadro's law, equal volumes of gases (under the same conditions) contain the same number of molecules. Therefore the weights of equal volumes are proportional to the weights of the molecules of the respective gases. The hydrogen molecule contains 2 atoms, and consequently 2 units of weight; so that if the chemical constitution of any other gas is known its sp. wt. can be obtained by dividing its molecular weight by 2.

CO₂ — molecular wt., 44; sp. wt., 22.

NH₃ — " 17; " 8.5.

C₂H₆O — " 74; " 37.

Common exceptions to the working of this principle are furnished by the vapour of sulphuric acid (H₂SO₄) and of ammonium chloride (NH₄Cl), the sp. wts. obtained being only about one-half of what we should expect. Nitrogen dioxide and tetroxide are also apparently anomalous.

3. The ultimate analysis of a substance composed of carbon, hydrogen, and oxygen, gives in one hundred parts—carbon, 40; hydrogen, 6.6; oxygen, 53.4, by weight, and the specific weight of its vapour is 30. Determine the formula of the substance.

3. Dividing each percentage by the atomic wt. of the corresponding element, we obtain the relative number of atoms of each in the compound:

$$C - \frac{40}{12} = 3.3$$

$$H - \frac{6.6}{1} = 6.6$$

$$O - \frac{53.4}{16} = 3.3$$

The simplest formula of the substance, therefore, is CH₂O; but as its sp. wt. is 30, its molecular weight must be 60. Therefore the true formula is C₂H₄O₂.

4. Describe the usual methods of obtaining the following substances, and in all cases