

hydrochloric acid (i.e. hydrogen chloride) will exactly neutralize 40 grams of caustic soda.

Potassium iodide is a colourless solution. If chlorine gas is bubbled into it, then the solution turns black because the chlorine takes the place of the iodine and the uncombined iodine that is set free is black in colour. 35.5 grams of chlorine (atomic weight of chlorine) can take the place of 127 grams of iodine (atomic weight of iodine). 35.5 grams of chlorine are equivalent to 127 grams of iodine; 35.5 and 127 are the equivalent weights of chlorine and iodine respectively. Hydrogen also has an equivalent weight equal to its atomic weight (1). In 36.5 grams of hydrochloric acid there are 35.5 grams of chlorine in chemical combination with one gram of hydrogen. That is an equivalent weight of chlorine combined with an equivalent weight of hydrogen. In 63 grams of nitric acid, an equivalent weight of hydrogen (1 gm.) is combined with 62 grams of nitrate. The equivalent weight of the nitrate group, then, is 62.

In the cases mentioned above the equivalent and atomic weights are the same. This is because all the elements mentioned (and the nitrate group) have a valency of 1.

For an element with a valency of 2 its equivalent weight is only half its atomic weight. When a piece of the metal magnesium (valency 2) is dropped into a dilute solution of hydrochloric acid there is fizzing and frothing as hydrogen gas bubbles off, and the acid is converted into a solution of magnesium chloride, each molecule of which consists of one atom of magnesium and two of chlorine. One atomic weight of magnesium is combined with two equivalent weights of chlorine, so the equivalent weight of magnesium must be only half its atomic weight (i.e. the weight that would combine with one equivalent weight of chlorine). Also in this reaction one atomic weight of magnesium liberates two equivalent weights of hydrogen. This is further evidence that its equivalent weight equals atomic weight.

Exactly the same argument applies to the metal zinc which also has a valency of 2 and behaves similarly with dilute hydrochloric acid, forming zinc chloride.

Ferric iron has a valency of 3. When caustic soda is added to a solution of a ferric salt a brownish, rather jelly-like solid, ferric hydroxide forms. In the formation, one ferric iron atom has replaced three sodium atoms. One ferric iron atom is equivalent to three sodium atoms. Its equivalent weight equals atomic weight.

Equivalent weight = $\frac{\text{atomic weight}}{\text{valency}}$

Many chemicals in the laboratory are used in the form of solutions of various strengths. These strengths are usually expressed in terms of equivalent weights (in grams) per litre of solution.

If 1 litre of solution contains 1 equivalent weight (in grams) of dissolved substance it is called 1 normal or simply normal; if it has two equivalent weights then it is 2 normal and so on. The equivalent weight of hydrogen is one and that of chlorine 35.5. A normal solution of hydrochloric acid will contain 36.5 grams of hydrogen chloride in a litre of solution. The equivalent weight of an element or group is the number of grams of it that will combine with or take the place of

1 gram of hydrogen or 35.5 grams of chlorine.