LAWS OF CHEMICAL COMBINATION

In order to understand the composition of a compound it is necessary to have a theory that accounts for quantitative relationships, These relationships are summarised in certain statements called laws of chemical combination

1. LAW OF CONSERVATION OF MASS:
(was given by Lavoisier in 1744)
The Law of conservation of mass states that mass can neither be created or destroyed in a chemical reaction

LIMITATION OF LAW OF CONSERVATION OF MASS:
The Law of conservation of mass fails for chemical reaction in which a large amount of heat is evolved or absorbed during the reaction.
According to Einstein's theory, mass & energy are interconvertible . The relation between two quantities is given by:

E=d(m)C^2

Q1. When 4.2g of sodium hydrogen carbonate (NaHCO3) is added to a solution of HCl weighing 10.0g. it is observed that 2.2g of CO2 is released into the atmosphere. The residue left behind is found to weigh 12.0g. Show that these observations are in agreement with the law of conservation of mass?

Q2. Lavoisier showed that when mercuric oxide was heated, it produced free mercury and oxygen.
Mercuric oxide -> Mercury + Oxygen
100 g 92.6 g X g
In an experiment 100 gm of mercuric oxide is heated then 92.6gm of mercury and X gm of oxygen are produced .Find the value of X?

Q3. X gm of potassium chlorate on decomposing produced 1.9 gm of oxygen and 2.9 gm of potassium chloride,Find the value of X?

2. LAW OF CONSTANT/DEFINITE PROPORTION:
(Was given by Joseph Proust in 1799)
This law states that chemical composition of a substance remains same whether it is prepared by any method or source.

Q4. 1.80 g of a certain metal burnt in oxygen gave 3.0 g of its oxide. 1.50 g of the same metal heated in steam gave 2.50 g of its oxide. Show that these results illustrate the law of constant proportion.

Q5. S02 gas was prepared by: (I) Burning sulphur in oxygen
(II) Reacting sodium sulphite with dilute H2S04 (III) Heating copper with concentrated H2S04 . It was found that in each case sulphur and oxygen combined in the ratio 1: 1. The data illustrate the law of :
(1) Conservation of mass
(2) Multiple proportion
(3) Definite proportion
(4) Reciprocal proportion

Q6. In an experiment 2.4 g of Fe on reduction with hydrogen gives 1.68 g of Fe. In another experiment 2.9 g of Fe0 gives 2.03 g of Fe on reduction with hydrogen.
Show that the above datas illustrate the law of constant proportion.

Condition under which law of constant proportion doesn't hold good

1. When a compound is obtained by using isotopes of combining elements. Thus, different isotopes of same element gives different mass ratios between the combining elements.

2. The law of constant composition doesn't hold good for non stoichiometric compounds. This is because, the non stoichiometric compounds don't have fixed composition.

3. Law of multiple proportion:

(Was given by Dalton in 1803)
According to law of Multiple proportion if two elements combine to form more than one compound than the different masses of one element which combine with a fixed mass of other element bear a simple ratio to one another.

Q7. Hydrogen peroxide and water contain 5.93% and 11.2% of hydrogen respectively.
Show that the data illustrate the law of multiple proportions.

Q8. Carbon combines with hydrogen in P, Q. R.
The % of hydrogen in P, Q. R are 25, 14.3, 7.7 respectively.
Which law of chemical combination is illustrated ?