

Laws of Multiple and Definite Proportions and Conservation of Mass

Classwork:

1. Exactly twice as much oxygen are required to react with 1 gram of hydrogen to form hydrogen peroxide as compared to the amount needed to react with 1 gram of hydrogen to form water.

a) Does the data above support the law of multiple proportions or that of definite proportions? Justify your answer.

Multiple proportions as that law says that when two compounds are formed from the same two elements, the amounts of the second element needed to react with a set amount of the first can be expressed as a whole number ratio.

b) Both water and hydrogen peroxide are pure substances. Does the % by mass of hydrogen and oxygen in each vary with the size of the sample? Justify your answer.

No, since they are pure substances the relative amounts of hydrogen and oxygen must not vary regardless of the size of the sample. Being pure, they obey the law of definite composition.

2. A student purchases hydrogen peroxide from two different suppliers and then analyzed the % oxygen by mass in each. The data is below:

<u>Supplier</u>	<u>% by mass oxygen in sample</u>
A	90%
B	93%

a) Considering that the formula for hydrogen peroxide is H_2O_2 , how would you prove that neither of these samples is pure hydrogen peroxide?

The % by mass of O in hydrogen peroxide is around 94% which cannot vary according to the law of definite composition. These must either not be hydrogen peroxide or a mixture of hydrogen peroxide with something else.

b) What are materials called that are not pure?

Mixtures

c) Assuming the other substance present is water (H_2O), which sample contains a greater % of hydrogen peroxide? Justify your answer.

Water consists of just 89% by mass oxygen so... the sample with the higher % by mass of oxygen MUST contain the higher proportion of hydrogen peroxide.

3. Iron can form different oxides. Using the data below:

<u>Oxide of iron</u>	<u>% by mass iron</u>
A	77.73%
B	69.94%

a) Using calculations, demonstrate how this data supports the law of multiple proportions.

A: $77.73/22.7 = 3.405/1 \text{ Fe:O}$

B: $69.94/30.06 = 2.327/1 \text{ Fe:O}$

$3.405/2.327 = 1.5:1 \text{ or } 3:2$

Oxide "A" either has 3/2 more Fe or 2/3 the O

b) Both oxides consist of iron cations and oxide anions. Which oxide contains the iron ion with the higher + charge? Justify your answer.

Since oxide "A" has more Fe, more Fe ions must be present to neutralize the negative charge on the oxide ion. Therefore, if more Fe ions are required, they must have the lower charge.

c) How many oxide anions are present in a 48 gram sample of oxide B?

$1.26 \times 10^{24} \text{ ions}$