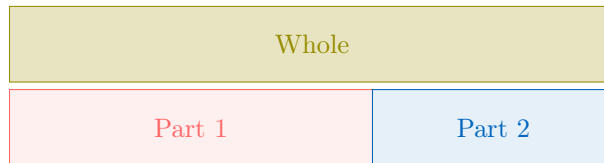# RATIOS

A DEFINITION

> **Definition Ratio**
>
> A **ratio** is a comparison of two quantities. The ratio 3 to 2 can be expressed as $3 : 2$ or $\frac{3}{2}$.

B PART-PART AND PART-WHOLE RATIOS

> **Definition Part-part Ratio**
>
> A **part-part ratio** compares two distinct parts of a whole.
>
> Part 1 : Part 2
>
> | Whole |
> | Part 1 | Part 2 |

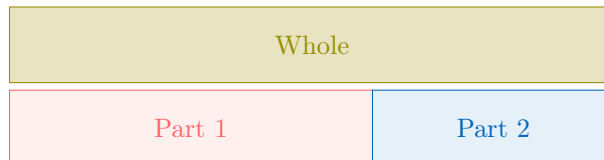**Ex:** For one bowl of fruit juice, there are 3 cherries and 2 apples.

The ratio of cherries to apples is $3 : 2$.

> **Definition Part-whole Ratio**
>
> A **Part-whole ratio** compares one part of a whole to the whole.
>
> Part 1 : Whole or Part 2 : Whole
>
> | Whole |
> | Part 1 | Part 2 |

Ex: If a juice is made with 1 lemon and 2 oranges, find the ratio of oranges to the total number of fruits.

Answer:

- The total number of fruits is $1 + 2 = 3$.

- The ratio of oranges to the total number of fruits is $\frac{2}{3}$.

C EQUAL RATIOS

Discover: Making Juice

- Let's make some fresh juice! For one glass of juice, we need 1 lemon and 2 oranges. The ratio of lemons to oranges is $1 : 2$.

- Now, if we want to make two glasses of juice, we need to double the ingredients.

- The ratio remains the same. The ratios are equal: $1 : 2 = 2 : 4$.

> **Definition Equal Ratios**
>
> Two ratios are **equal** if one can be expressed as a multiple of the other.

> **Method Using Fractions**
>
> To show that two ratios are equal, we can compare their related fractions. If the fractions are equal, then the ratios are equal.

Ex:

$$\text{As } \frac{1}{2} \; \overset{\times 2}{\underset{\times 2}{=}} \; \frac{2}{4}, \; 1 : 2 = 2 : 4$$

D PROPORTION

Discover: Imagine you're making a fruit juice mix. The recipe calls for 4 cups of orange juice and 2 cups of apple juice. This ratio of $4 : 2$ ensures the juice has the right flavor balance. But what if you want to make a larger batch? If you double the amount of orange juice, how much apple juice will you need to keep the same taste? Write your answer as a number of cups.

Answer: If you double the amount of orange juice from 4 cups to 8 cups, you also need to double the amount of apple juice from 2 cups to 4 cups to keep the same taste.
So, the new ratio is $8 : 4$, which is the same as the original ratio $4 : 2$.

> **Definition Proportion**
>
> A **proportion** states that two ratios are equal.

Ex: To make 1 chocolate cake, 4 eggs are needed. How many eggs are needed to make 2 cakes?

Answer: For 1 cake, it takes 4 eggs. Therefore, to maintain this proportion for 2 cakes, multiply both the number of cakes and the number of eggs by 2:

$$\frac{4}{1} \; \overset{\times 2}{\underset{\times 2}{=}} \; \frac{8}{2}$$

Thus, to make 2 chocolate cakes, you need 8 eggs.

E UNITARY METHOD

Discover: The unitary method is an approach used to solve problems involving proportions. The essence of this method is to determine the value of one unit of a quantity and then use that value to find the unknown quantity.

> **Method Unitary Method**
>
> 5 apples cost \$$10$. To calculate the cost of 8 apples, follow these steps:
>
> - **To the unit:** Find the cost of 1 apple by dividing the total cost by the initial number of apples 5:

$$\frac{10}{5} \overset{\div 5}{\underset{\div 5}{=}} \frac{2}{1}$$

So, 1 apple costs 2 dollars.

- **From the unit:** Find the cost of 8 apples by multiplying the unit ratio by the final number of apples 8:

$$\frac{2}{1} \overset{\times 8}{\underset{\times 8}{=}} \frac{16}{8}$$

So, 8 apples cost 16 dollars.

- $$\frac{10}{5} \overset{\div 5}{\underset{\div 5}{=}} \frac{2}{1} \overset{\times 8}{\underset{\times 8}{=}} \frac{16}{8}$$

F CROSS-MULTIPLICATION METHOD

Discover: Cross-multiplication is a method used to solve problems involving proportions. This method involves cross-multiplying across the quantities of a proportion to find the unknown quantity.

Method Cross-Multiplication in Table

5 apples cost \$10. To calculate the cost of 8 apples, follow these steps:

- **Step 1: Set up the Table**

Price	10	
Number of Apples	5	8

- **Step 2: Apply the Cross-Multiplication**

Price	10	$\frac{8 \times 10}{5} = 16$
Number of Apples	5	8

- So, 8 apples would cost 16 dollars.

Method Cross-Multiplication

5 apples cost \$10. To calculate the cost of 8 apples, follow these steps:

- **Step 1 : Set up the Proportion**
  Write the proportion where the cost of 5 apples is to 10 dollars as the cost of 8 apples is to x dollars:

$$\frac{10}{5} = \frac{x}{8}$$

- **Step 2: Solve for x**

$$\frac{10}{5} = \frac{x}{8}$$

$$5 \times x = 10 \times 8 \qquad \text{(cross mutiplication)}$$
$$x = 10 \times 8 \div 5 \quad \text{(dividing both sides by 5)}$$
$$x = 16$$

- So, 8 apples would cost 16 dollars.