

## Using Ratios and Proportions

**Activity 1:** The tables below define a relation between two qualities. **Fill in the tables** and define the relation between the two qualities.

Kilometers	45				
Hours	1	2	3	4	5

Dirham	3.45				
Chocolate Bar	1	2	3	4	5

Apples					45
Days	1	2	3	4	5

Dirham	45				
Meters	0.1	0.2	0.3	0.4	0.5

From the first table we conclude that the ratio of Kilometers to hours is 45:1. In the third table the ratio of Apples to Days is 45 to 5.

**Definition 1:** A ratio is a comparison of two numbers.

The ratio  $a$  to  $b$  can be written as:  $a$  to  $b$ ,  $a : b$ ,  $a \div b$ ,  $\frac{a}{b}$

The ratio *six to eleven* can be written as:  $6$  to  $11$ ,  $6 : 11$ ,  $6 \div 11$ ,  $\frac{6}{11}$

**Example 1:** Hala has a bag with 3 DVDs, 4 marbles, 7 books, and 1 orange.

1) What is the ratio of books to marbles?

Expressed as a fraction, with the numerator equal to the first quantity and the denominator equal to the second, the answer would be  $\frac{7}{4}$ .

Two other ways of writing the ratio are 7 to 4, and 7:4.

2) What is the ratio of DVDs to the total number of items in the bag?

There are 3 DVDs, and  $3 + 4 + 7 + 1 = 15$  items total.

The answer can be expressed as  $\frac{3}{15}$ , 3 to 15, or 3:15.

**Rule 1:** Comparing ratios: To compare ratios, write them as fractions. The ratios are equal if they are equal when written as fractions.

**Remark:** Be careful! Order matters! A ratio of 1:7 is not the same as a ratio of 7:1. Two equal ratios form a proportion

**Definition 2:** A **proportion** is an equation that shows two equivalent ratios.

$$\frac{15}{25} = \frac{3}{5}$$

Every proportion has two **cross products**.

In the proportion  $\frac{20}{30} = \frac{2}{3}$ , the terms 20 and 3 are called the **extremes**, and 30 and 2 are called the **means**. The cross products are 20(3) and 30(2). The cross products are always equal in a proportion.

$$\frac{20}{30} = \frac{2}{3}$$

$$20(3) = 30(2)$$

*extremes*      *means*

$$60 = 60$$

**Theorem 1: Property of Proportions:** For any numbers  $a$  and  $c$  and any nonzero numbers  $b$  and  $d$ ,  $\frac{a}{b} = \frac{c}{d}$ , then  $ad = cb$ . Likewise, if  $ad = cb$ , then  $\frac{a}{b} = \frac{c}{d}$ .

When one of the four numbers in a proportion is unknown, cross products may be used to find the unknown number. This is called solving the proportion. Question marks or letters are frequently used in place of the unknown number.

**Property: Properties of Proportion:** Given a proportion these state the manipulations which you are allowed to do to the proportion and maintain equality:

- 1) If  $\frac{a}{b} = \frac{c}{d}$  then  $ad = cb$
- 2) If  $\frac{a}{b} = \frac{c}{d}$  then  $\frac{a}{c} = \frac{b}{d}$
- 3) If  $\frac{a}{b} = \frac{c}{d}$  then  $\frac{b}{a} = \frac{d}{c}$
- 4) If  $\frac{a}{b} = \frac{c}{d}$  then  $\frac{a+b}{b} = \frac{c+d}{d}$