



# JobTestPrep's Numerical Reasoning Formulas

Although taking a [numerical reasoning test](#) is not the same as taking a maths exam, in order to succeed on a numerical test you will need to have mastered some basic maths skills.

Numerical tests usually target the following mathematic skills:

1. Addition
2. Subtraction
3. Multiplication
4. Division
5. Averages
6. Percentages
7. Ratios

More advanced calculations, such as [averages, percentages and ratios](#) can become simpler with the use of specific formulas. Such is the case with algebraic questions that involve rate problems (work/ speed/ distance/ time) as well as financial-oriented problems.

In this PDF we offer a short guide to basic as well as advanced formulas that you are expected to be able to apply in your numerical test. We will focus on the following subjects:

1. [Averages](#)
2. [Percentages](#)
3. [Ratios](#)
4. [Rate formulas](#)
5. [Finance](#)

**Let's Get Started!**



## Averages

### Average

Definition: A calculated “central” value of a set of numbers.

$$\text{Average} = \frac{\text{Sum of items}}{\text{Number of items}}$$

$$\bar{X} = \frac{\sum x}{n}$$

### Weighted average

Definition: A calculated “central” value of a set of numbers, in which each value or set of values is assigned a different weight.

$$\text{Weighted average} = \frac{\text{Sum of observations} \times \text{weight}}{\text{Sum of weights}}$$

$$\bar{X}_w = \frac{\sum x * w_i}{\sum w_i}$$



## Percentages

### Percentages and fractions

Definition: A percentage is a part of a whole, where the whole is defined as 100. A fraction is a part of a whole, where the whole can be any number.

$$\% = (\text{fraction}) \times 100$$

- *Note that when dealing with percentages it is sometimes easier to convert them into decimals and use the decimals in percentages calculations. For example,  $50\% = 0.5$ ;  $120\% = 1.2$ ;  $11\% = 0.11$  etc.*

### Calculating a percentage

$$\% = \left( \frac{\text{Value}}{\text{Total}} \right) \times 100$$

*For example, if you own 20 company shares and the total number of shares is 400, this means you own:  $\left( \frac{20}{400} \right) \times 100 = 5\%$  of the shares.*

### Percentage Increase/Decrease

% Increase:

$$\text{New value} = (1 + \text{Increase}) \times (\text{Original amount})$$

% Decrease:

$$\text{New value} = (1 - \text{Decrease}) \times (\text{Original amount})$$

*For example, if a shirt cost £30 and a week later was offered at a 15% discount, how much does the shirt cost?  $(1 - 0.15) \times 30 = 0.85 \times 30 = £25.5$*



## Calculating Percentage Change

Definition: Percentage change refers to the relative percent change of an increase or decrease in the original amount.

% Increase:

$$\frac{(\text{New amount} - \text{Original amount})}{\text{Original amount}} \times 100 = \left( \frac{\text{New amount}}{\text{Original amount}} - 1 \right) \times 100$$

% Decrease:

$$\frac{(\text{Original amount} - \text{New amount})}{\text{Original amount}} \times 100 = \left( 1 - \frac{\text{New amount}}{\text{Original amount}} \right) \times 100$$

*For example, if a shirt cost £30 and a week later was offered for the price of £24, what was the discount on that shirt?  $\left( \frac{30-24}{30} \right) \times 100 = 20\%$*

**Note:** Percentage change is different from absolute change. While percentage change is calculated in relation to the original amount, absolute change is calculated as an absolute amount. In other words, it is not divided by the original amount.

## Calculating Percentage Difference

Definition: Percentage difference refers to the relative percentage change in a certain amount, when you are not able to determine which amount is the original one.

$$\left| \frac{\text{First amount} - \text{Second amount}}{(\text{First amount} + \text{Second amount})/2} \right| \times 100$$

*For example, "Molly's designs" gets 200 customers a week while "Best wear" gets 240 customers. What is the percentage difference in customers between the two stores?  $\left| \frac{200-240}{(200+240)/2} \right| \times 100 = \left| \frac{-40}{440/2} \right| \times 100 = \left| \frac{-40}{220} \right| \times 100 = 18.18\%$*



## Reversed Percentages

$$\underline{\% \text{ Increase}}: \text{Original amount} = \frac{\text{New amount}}{(1+\text{Increase})}$$

$$\underline{\% \text{ Decrease}}: \text{Original amount} = \frac{\text{New amount}}{(1-\text{Decrease})}$$

For example, if a shirt costs £33 after a 20% increase in price, how much did it cost prior to the price change?  $\frac{33}{1+0.2} = \frac{33}{1.2} = \text{£27.5}$

## Percentage Points

Definition: Percentage points refer to an increase or decrease of a percentage. This is an absolute term (in contrast to percentage change/difference).

Percentage points difference = New percent – Old percent

## Ratios

Definition: The relative size of two or more values. The values are usually separated by a colon sign.

**a:b** is a given ratio.

**N** is the total sum of items.

$$\text{The number of } \mathbf{a} \text{ items} = \left(\frac{\mathbf{a}}{\mathbf{a}+\mathbf{b}}\right) \times \mathbf{N}$$

For example, there are 70 red and blue marbles in a jar. The ratio of red to blue marbles is 3:4. How many red marbles are there?

$$\left(\frac{3}{3+4}\right) \times 70 = \frac{3}{7} \times 70 = 30 \text{ red marbles}$$



## Rate Formulas

What are rate problems?

A rate is a mathematical way of relating two quantities, which are usually measured in different units. Rate problems usually involve three variables such as speed/distance/time or product/time/number of workers etc. You are usually given 2 variables and are required to find the missing variable according to the data given in the question.

Speed:  $S = V \times T$       S=distance; V= velocity; T = time

Work:  $W = P \times T$       W= work; P = power; T = time

*For example, Jill drove across a 0.3 mile long bridge. The time it took her car to travel from one side to the other was 20 seconds. How fast was Jill driving?  $0.3 = V \times 20 \rightarrow V = \frac{0.3}{20} \rightarrow V = 0.015$  Miles per second (or 0.9 miles per minute).*

## Finance

Fixed and variable costs: Fixed costs are set expenses a company has which never change and variable costs are costs that vary depending on a company's production volume.

**Total cost = Fixed costs + Variable costs**

*For example, if the rent a pencil company pays for its offices is £100 per month, each pencil costs them £0.10 to make, and they make 100 pencils each month, what is the company's total monthly cost?  
Total cost =  $100 + (0.10 \times 100) = 100 + 10 = £110$*

Return on Investment: measures the profitability of an investment expressed as a percentage.

$$\text{ROI} = \frac{\text{Gain} - \text{Cost}}{\text{Cost}} \times 100$$



Profit margin: measures how much out of every dollar of sales a company actually keeps in earnings.

$$\text{Profit margin} = \frac{\text{Gross profit}}{\text{Total revenue}}$$