Numerical Reasoning Test Tips, Tricks & Formulas 2024

How a numerical reasoning test works

Numerical tests differ from maths tests**.** Though both involve numbers and calculations, numerical tests are not trying to measure your school math proficiency. They do not expect you to memorize demanding algebra, trigonometry or probabilities formulas and theories, make composite computations and write out longhand answers. In numerical reasoning tests, we often come across candidates with great maths qualifications who demonstrate poor performance -and vice versa.

Numerical aptitude tests rely on basic mathematical concepts that can easily be reviewed and memorized such as the four operations (+, -, x, /) and certain related applied concepts such as percentages, averages and ratios. To succeed, you must master these basic concepts while drilling down into the complex questions of graphs and tables, number series and word problems and exercise by using appropriate exam techniques, lots of revisions and effective memory and analysis skills.

Numerical tests are designed to measure your ability to correctly **interpret numerical information** and use it to solve problems and make decisions. Modern tests base the information on real-life quantitative data you would find in the workplace and require that you perform the kinds of analysis with numbers you'd be expected to perform at your future work post.

Common characteristics of numerical tests include:

- **Multiple choice answers** - no long answers or showing/proving your working-out.
- **Use of calculators** (usually) **permitted** - no mental arithmetic required
- **Strict time limits** – typically around 1 minute
- **Example questions before you start the test** -untimed - not scored
- **No prior knowledge required** - no formulas to memorize (making cheat sheets useless)
- **Relevant to the workplace** - based on the kind of numerical information you would deal with in the job

Introductory tips

Don't try to read all the data and solve the entire question, nor understand the whole load of information presented in the prompt. Focus on the question, isolate and use only the relevant, useful data.

You must also sharpen your data interpretation skills. Since most numerical tests use some sort of graphs and tables to present information, you should get used to reading this type of data:

- Financial sections of daily newspapers and, of course, practice questions and sample tests are the best way to familiarize yourself with possible types of data presentation.
- Pay attention to units and scales. It is very common to find questions where the information is presented in millions when the question may refer to thousands.
- Pay attention for comments, asterisks, etc. They are easily missed but are often crucial to solve the questions.

Use the orientation test: After a few seconds of scanning the data, place your finger somewhere on the data area and explain that piece of data.

Know in advance if you're allowed to use a calculator and prepare accordingly.

If **no calculator is allowed,** improve your basic numeracy calculations, as they might make the difference between failure and success.

If you are allowed to use a calculator, know, and learn to skillfully use, your device. Using your calculator wisely can become a substantial time saver. For instance, people who are not accustomed to using the Memory keys of a calculator tend to write each result instead of leaving it on the calculator's screen or memory for the next calculation.

Top-level graduate and professional tests are at the top of the numerical-test tree. They measure the **advanced skill** of **numerical critical-reasoning** to reflect the demands of the jobs for which they are used to help recruit and the calibre of candidates who apply.

Numerical critical reasoning is the ability to analyse and manipulate numerical information in order to draw inferences, determine underlying relationships and make decisions. These high-level tests are expected to demonstrate abilities that exceed simply understanding numerical data and answering questions on it. Instead, you will need to work in a more complex way to arrive at the correct answers.

Practically this means that candidates are often required to go through several stages of calculations, i.e. perform multiple computations to reach an answer. Sometimes, these computations may even involve a degree of estimation or dealing with ambiguities, rehearsing situations that you will experience at work.

The basic reasons that people fail numerical reasoning tests do not relate to poor Math background but rather to their lack of familiarity with the test content and test taking practices, poor time management, silly arithmetic mistakes, or nerves and anxiety.

Analytical tips

- **Maintain maximum concentration** during the test session to perform at your best. This piece of advise applies to all aptitude tests. Nerves and anxiety must be minimised before they cause mistakes and a dip in performance.
  If you're feeling nervous, take long, slow breaths and focus on counting slowly down when exhaling. If distracted along this breathing countdown, repeat the process. This exercise reduces stress levels and enables your mind to concentrate on reasoning and collect the energy needed for the test.
- **Disregard the anxiety and do the task you have been trained for anyway.** Physical and mental symptoms of stress such as a racing heart, sweaty palms and a blowing mind are common stress-related sensations, making concentration and peak performance hard to achieve. Use the 'acceptance and commitment technique' to move past them. Acknowledge that these feelings are there, label and accept each of these stress related sensations, but commit on completing your task, focusing on your objectives and rehearsing your plans after you succeed the test. Ensuring that you are focused and calm is a prerequisite to employ the effective test-taking strategies and formulas that follow.
- **Read carefully and understand the questions.** Psychometric aptitude tests are deliberately structured to catch you out if you fail to read the question properly. Typical mistakes may include not recognizing the units, ignoring the applicability of a graph or table (e.g. dates), disregarding info in the table/graph legend, or making assumptions about the data implied meaning. It is often worth reading the question twice to check that you have understood it clearly before spending time solving it!
- **Bring your own calculator if you are allowed to.** In that way, you will be familiar with the functions and the locations of buttons instinctively, enabling you to save a few vital seconds over the other candidates. In that case, make sure you know useful features such as:

  - How to use the bracket function to deal with calculations involving multiple stages
  - How to enter values to multiple memories and recall them
  - Use of Powers, for example, when calculating compound interest over multiple years.

- If your psychometric test is online, you may be allowed to **use either your own calculator or the one on screen**. In this latter case, familiarize yourself promptly with the panel and the available keys of this tool. If allowed to use your own calculator, make sure your calculator has large buttons and a clear screen.

Don’t use the calculator on your mobile phone for example - which in most cases will be prohibited anyway, and the use of which may increase the chances of calculator entry mistakes.

- **Use rough paper for scratchwork.** Its sensible use will cut down mistakes and save you time. Practice to balance the extent to which you write down your work -not too long to save you time on each question; not too short to fail spotting mistakes. Avoid repeating identical computations – learn to transfer key-numerical information from one question to the next, to avoid repetitions.
- **Consider only the options available.** Typically numerical reasoning tests have limited (3-5) available options. In certain questions you can immediately discount some of the available options using deduction or common sense. In ratio questions particularly (e.g. what is the ratio of A:B:C:D) you might not have to calculate all of A, B, C and D. If you've calculated A and B and you can see that only one of the options available is your answer for A:B then click that one and move on! This is a good time-saving technique.
- **Use wise time allocation.** For numerical reasoning questions, if allowed by the test, check swiftly to see how many questions the table/graph applies to. It is common for one table/graph to apply to three or four questions, in which case it is worth investing time to read carefully its content before engaging with the first question. Then on each question, you can refer back to the data but at least you know where to search and what you are looking at.

Test Anxiety & Mental Overload: How to Overcome Panic

When most people encounter a numerical reasoning question, they are overloaded by visual, numerical and textual data. The typical reaction is panic. The thought is they must fully understand every detail at once.

This thought causes people to feel as if they are facing extremely ‘difficult’ or ‘complicated’ questions. However, in most cases that is simply not the case. So, calm down, remember to breath, and engage!

When solving a numerical reasoning question, address only what's relevant to the question. Don't try to attack an entire army of numbers and words at once. Rather, try to be strategic and take on one problem or variable at a time. Read on to learn how.

A few things worth noting before you start.

1) Time is everything: There is no complex math in numerical reasoning tests. The difficulty lies in the short (45-75 seconds) time available to solve each question. Most of the strategies you are expected to develop aim to help you shorten your solving time.

2) Estimation is key: Frequently, numerical reasoning tests are presented in multiple-choice. Therefore, estimation is key, and a calculation result close enough is sufficient for an answer!

3) Strengthening your mental muscles is a MUST: Contrary to the ‘you are mathematically gifted - or you are not’ notion, numerical reasoning tests depend remarkably on training and practice. You train, you get better - it's simple math.

The format of multiple-choice questions, combined with rigorous time constraints, gives an advantage to those who practice seriously.

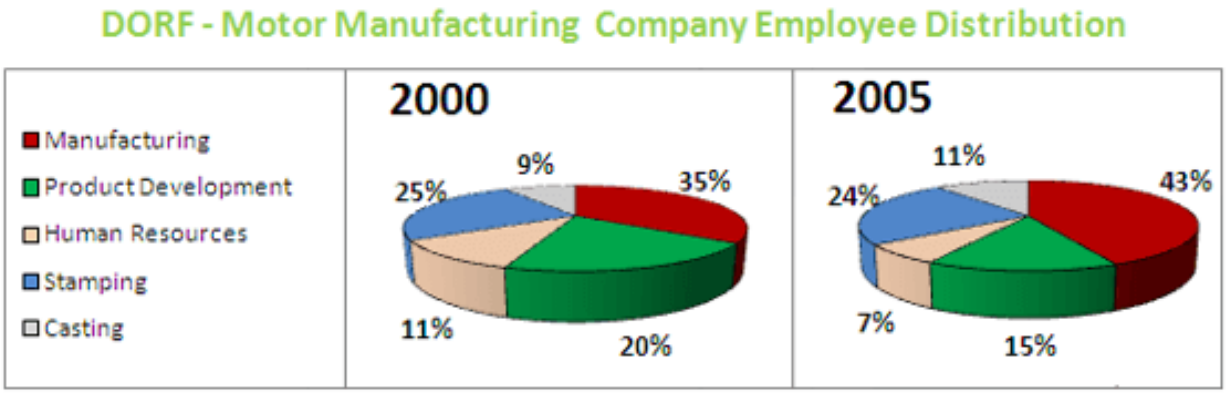
A Method to Tackle Numerical Reasoning Questions

The standard DOFE method to confront effectively most numerical reasoning questions consists of 4 stages:

1. **Detect** – what exactly is the question asking

2. **Observe** – separate the relevant from the irrelevant information
3. **Focus** – focus on the relevant information and perform the necessary calculations
4. **Eliminate and Solve** – use estimations and quick calculation methods to eliminate incorrect answers and solve the question

Let's take a look at an example:



In the year 2000, the Product Development department constituted 400 employees.

How many employees worked for the Stamping department in that year?

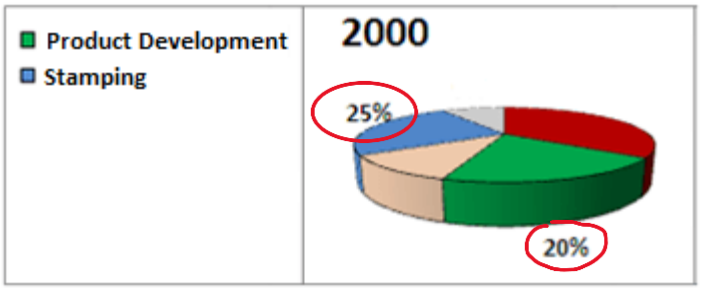
A. 400 B. 450 C. 500 D. 550

Let's break the solving process by implementing the 4 stages of 'DOFE':

The relevant information is:

- The data from the year 2000.
- The number of employees in the product development department
- The number of employees in the stamping department
- Mind that data to the rest of the departments and the 2005 graph are irrelevant.

Thus, the question turns to:



Far better, eh? Let's put the information we have on a table:

	Product Development	Stamping
Percentage of Employees	20%	25%
Number of Employees	400	?

Since the calculation is very straightforward, we will not eliminate and look for the solution:

Using ratios: (400/20) = (?/25) => ? = 20 x 25 = 500
The number of employees in the stamping department is: C **(500)**.

Let's try another example:

Post Offices Statistics (2010)					
	Post Offices (including mobile offices)	Mobile Offices	Letter Boxes	Post Office Boxes	Population (in millions)
Belgium	1,348	0	14,317	37,356	10.4
Czech Republic	13,871	10,470	24,006	40,844	10.2
Denmark	913	0	9,700	57,854	5.4
Germany	33,600	21,000	109,000	930,000	82.5
Estonia	545	0	3,623	11,919	1.3
Hungary	3,197	353	13,514	82,796	10.1

In Hungary, each person received 12 letters per month on average.

In Hungary, how many letters each month did people who don't own a post office box receive in total if no two post office boxes are owned by the same person, and those who own post office boxes always get their post delivered to their post office boxes?

A. 182,198,000 B. 121,037,832 C. 142,936,000 D. 120,206,448

Try using our 4 stages again: We're asked to find all the people in Hungary who DO NOT get mail by a post office box (POB), and multiply it by the number of letters.

The relevant information is:

- The total number of people in Hungary
- The number of people who DO get their mail by post office boxes
- The number of letters each person receives per month

Thus, the question turns to:

Post Offices Statistics (2010)		
	Post Office Boxes	Population (in millions)
Hungary	82,796	10.1

Number of letters per month: **12**. The content of the rest of the cells is irrelevant to the question.

Now let's break this whole lot of verbosity, intended to confuse you, to what it basically means:

... if no two post office boxes are owned by the same person, and those who own post office boxes always get their post delivered to their post office boxes?

No two post office boxes are owned by the same person:
- Number of people who own POBs = Number of POBs.

Those who own post office boxes always get their post delivered to their post office boxes:
- All mail received in POBs in Hungary = Number of POBs x Number of letters.

Now when we know all this, let's set a calculation plan:

[(All People in Hungary) - (People Who Have POBs)] x (Number of Letters per Month)

We have a complete drill to just plug numbers into, so let's do it: [10,100,000 – 82,796] x 12 = 120,206,448
Thus, the correct answer is **C (120,206,448**

Solving Techniques When You Can't Use a Calculator

In case you must face a test without a calculator, make sure that you are equipped with critical mathematical techniques. Read the following tips and experiment with them to embed them in your workstyle.

1) Multiplication by 5

When you need to multiply a number by 5, divide it first by 2 and then multiply by 10.

Example: 168 x 5 = ? ….(840)

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2) Use the Last Digit for Multiplication

Looking at the last digit of a multiplication can help you get to the correct answer without calculating.

Example: 123 x 429 = ?

A) 50,222 B) 52,767 C) 63,448 D) 55,409 (..3*..9=…7 ->C)

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3) Estimate among the available answers

Example: You put £1,500 in the bank at the beginning of 2010. How much will you have by 2020 if the interest rate is 5%, compounded annually?

A) £1,750.25 B) £2,225 C) £2,250 D) £2,443.30

(1,500*5%*10=750, 750+1500=2250 if no compounding occurred. We need an amount >2,250 => D)

4) Avoid Unnecessary Calculations to save precious time. For instance:

- **Ignore multiplication factors**

If you multiply and then divide by the same number, it can be ignored altogether.

Example: A family's ***monthly*** petrol expense in year 1 is £250. What will be the percentage change of their ***annual*** petrol expense in year 2 if their monthly expense is £180?

- **The '-1' percentage calculation**

If you're looking for a change in percentage, take the ratio values and subtract one.

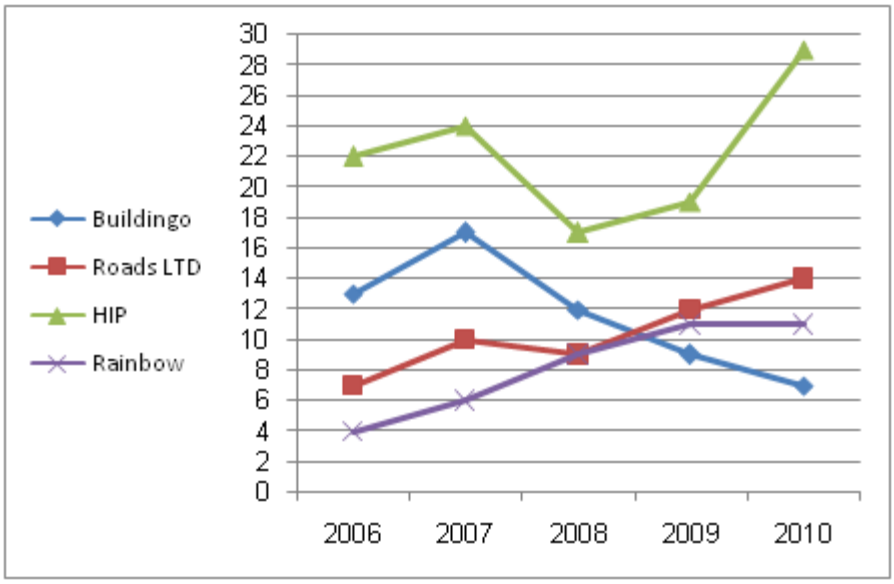
Example: Looking at the question in the previous example, we could have just written:

Change = (180/250)-1 = 0.72-1 = **-0.28**

- **Create a calculation template**

This might seem like a long process at first, but if you practice it perfectly, it will save you valuable calculation time. Create a framework in which you enter all your calculations, so eventually, you calculate only once.

Example: Government Construction Contracts (%)



In 2008, a total of 400 contracts were offered for £22,200 each. In 2009, contract value increased by 7%. In addition, there was a 25% decrease in the number of contracts.

How much more money than Buildingo did Roads do in 2009?

A. 192,543 B. 217,386 C. 321,654 D. 423,964 E. 213,786

The correct answer is **E** (213,786).

1. Create a template. Since the question asks, 'How much more …', it would look like:

Answer = $\mathbf{Income_{Roads} - Income_{Buildingo}}$

2. Break each part of the template into smaller parts:

Income = NC * PC => NC = TNC * Share(%)

Where: **TNC** = Total Number of Contracts **NC** = Number of company's Contracts **PC** = Price per Contract **Share** = Company's share of the contracts (from the graph)

So, the final template will look as follows: $\mathbf{(TNC * Share * PC)_{Roads} - (TNC * Share * PC)_{Buildingo}}$

3. Identify common multipliers to minimize the template

- We know that the price per contract PC is similar in all cases: PC = £22,200 x 1.07 = £23,754.
- We know that the total number of contracts TNC is 400 x 0.75 = 300.
- The only difference between Roads and Buildingo is their share:
  Buildingo has a share of 9%, Roads has a share of 12%.

4. Rearrange, plug in numbers and calculate once.

Now, after rearranging the numbers, our template will look like:

Answer = **(300 · 23,754) x (0.12 - 0.09) = 213,786**

Familiarize yourself with graphs and tables. It is important to swiftly digest and interpret data such as graphs, histograms and tables, often presented in numerical reasoning questions. Make it a second nature to check what the axes are and in what scale or units they are expressed, examine whether all numbers are given in the same or different units, and check what is an estimated projection of the recorded values. You can improve your data interpretation skills by reading figure-based news in magazines like The Economist or the Financial Times. You can also use the data in the pages of these publications to practice converting from one currency to another, a feature that commonly comes up in numerical tests.

Avoid Human error when performing calculations in your calculator, for example by summing a long list of numbers directly from the monitor screen or test paper instead of your rough working.

Check units and bases since a commonly used technique is to test candidates by presenting a table of numbers in different bases (thousands vs millions for example). A sloppy test taker will miss this and give the wrong answer, which is usually included in the options. Practice will help train in managing details.

Percentage increases and decreases constitute one of the most common areas of confusion and sources of mistakes in numerical reasoning questions. It is essential to understand whether you are being asked to work out a percentage change from A to B or from B to A. Below are some formulas which describe 4 common situations:

For percentage decreases we can use the formula:
A x (1 - percentage decrease expressed as a decimal) = B

For percentage increases we can use the formula:
A x (1 + percentage increase expressed as a decimal) = B

However, when calculating from B to A, we must rearrange these formulas.
For percentage decreases when we know the final result, but not the starting result:
B = A / (1 - percentage decrease expressed as a decimal)

And, similarly for percentage increases:
B = A / (1 + percentage increase expressed as a decimal)

Example: Sales this year were £200, which was a drop of 50% from the previous year. Calculate the sales last year?

Our unknown is A, the sales number for last year. Our end result is B, £200. The percentage decrease of 50% expressed as a decimal is 0.5. Putting these numbers into the formula: 200 = A / (1 - 0.5)
Rearranging to solve for A: 200 / 0.5 = A => 200 / 0.5 = 400

Two more examples: "In Year 2 sales were £1,000, which was an increase of 10% from sales of the previous year. What were the sales in Year 1?"

Essentially we need to solve the following problem: ***? x 110% = £1,000.***
So the calculation is ? = (£1,000 ÷ 1.1). So ***? = 909.091.***
Why is it not £1,000 x 0.9? Because that would be a decrease of 10% applied to £1,000, not an increase of 10% applied to an unknown number.

A similar question: "In Year 3 sales were £1,000. If in Year 4, sales decrease by 10%, what would be the sales in Year 4?"

Since this is a decrease of 10% from one number to another, we start with the reference number and multiply by (100 -10)% expressed as a decimal. So, in this second example, the correct working is ***£1,000 x 0.9 = £900.***

Remember: Emphasis should be placed in the wording of the question. Understand what the starting value is and what the end result involves.

NOTE: You will see in solutions a short-hand way of calculating percentage changes. Let's say we want to find the percentage change from 500 to 600. The long-hand way is to find the absolute difference (600 - 500 = 100) and then divide by the starting number. So we would have (100 ÷ 500) x 100 = 20%. This calculation actually simplifies down to 600 ÷ 500 = 1.2, which we know is a 20% increase.

Check out the Numerical Reasoning Test Formula Sheet that follows for more information on the formulas you will need to know.

Conduct follow-up checks. Having spent valuable time understanding a graph or table, consider spending an extra couple of seconds to check you answer by re-reading the question to make sure you have calculated what is being asked and that the answer you produced is sensible. Also, check whether your answer matches one of the multiple-choice options. Distractors are often generated from common mistakes.

Use a calculator which displays the last entry. With data interpretation questions it is inevitable that you will have to, at some point, add up (or subtract, or similar) a large list of entries from a table or graph. It is very easy in this type of calculator-entry work to miss out an entry or accidentally take an entry from an adjacent column. If you use a calculator which displays your previous /last calculation or entry, you can use this feature to make a background check of your previous entries.

Numerical Reasoning Tests Formulas - 2024 Guide

To succeed on any Numerical Reasoning Test you will need to have first mastered some basic maths skills. These skills typically involve Addition, Subtraction, Multiplication, Division, Averages, Percentages, and Ratios. Relevant advanced calculations, such as averages, percentages and ratios can become simpler with the use of specific formulas which are presented in the following short guide.

Averages

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

The formula to calculate this looks like this:

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

Or in a more mathematical form it would look like this: $\overline{X} = \frac{\sum x}{n}$

Where:

X_i = An item in the set; X_1, X_2, X_3 ... $\sum$ = Sum

N = The number of items in the set $\overline{X}$ = The average of set X

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.

The formula to calculate this looks like this:

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

and in mathematical form:

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

Where:

X_i = An item in the set; X_1, X_2, X_3 ... w_i = The weight of item i in the set $\sum$ = Sum

N = The amount of the items in the set $\bar{X}$ = The weighted average of set X

For example: the heights of students in a classroom were measured. There are 2 children at 1.20 m, 3 children at 1.25 m and 3 children at 1:30 m. What is the average height of a student in the classroom?

Solution:

$$\text{Weighted Average} = \frac{1.2 \times 2 + 1.25 \times 3 + 1.3 \times 3}{2 + 3 + 3} = 1.256 \text{ m}$$

Percentages & 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.

The formula to calculate this looks like this: **% = (fraction) x 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

The formula: % = (Value/Total) x 100

For example: if you own 20 company shares and the total number of shares is 400, this means you own: 20/400= 5% of the shares.

Percentage Increase/Decrease

The formulas:

% Increase: **New value = (1+ Increase) × (Original amount)**

% Decrease: **New value = (1 − Decrease) × (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? 91 − 0.15) × 30 = 0.85 × 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: $\frac{(\text{Original amount} - \text{New amount})}{\text{Original amount}} \times 100 = (1 - \frac{\text{New amount}}{\text{Original amount}}) \times 100$

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? (30-24/30) x 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?

$$\left|\frac{200-240}{(200+240)/2}\right| \times 100 = \left|\frac{-40}{440/2}\right| \times 100 = \left|\frac{-40}{220}\right| \times 100 = \mathbf{18.18\%}$$

Reversed Percentages:

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

% 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? $\frac{33}{1+0.2} = \frac{33}{1.2} = \mathbf{£27.5}$

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).

The formula looks like this: **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.

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

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?

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

Rate Formulas

A rate is a mathematical relationship between two quantities, which may involve different units. Rate problems usually entail three variables such as speed/distance/time or product/time/number of workers etc. You are given 2 variables and are expected to find the missing one according to the data given in question.

Speed: S = V × T where

S = distance **V**= velocity **T** = time

Work: W = P × T where

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 x 20 → 0.3/20 → 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 x 100) = 100 + 10 = £100

Return on Investment (ROI):

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.

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