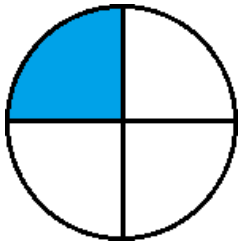
Percentages & Ratios

Percentages and fractions



How much of the figure on the left is coloured in? Your answer would correctly be ¼.

But what if the question was: What percentage of the figure on the left is coloured in?

Just as the answer can be expressed as a fraction, it can also be expressed as a percentage. The only difference is that to express it as a percentage, the denominator (the bottom number in the fraction) must be converted to 100.

So how much percent is 1/4?

To do this you:

Convert the denominator to 100.

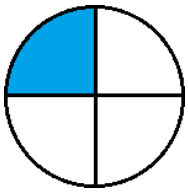
To do this, we need to multiply the numerator (the top number in the fraction) with the same factor. Figure out what factor multiplied by 4 makes 100. This is done by dividing 100 by 4 (rearranging the equation). In this case, $4 \times 25 = 100$, $(100 \div 4 = 25)$. So, the factor is 25.

1. Multiply your numerator by the factor. In this case it is $1 \times 25 = 25$
2. The product you just calculated is your percentage. We can now say that 25% of the circle is shaded.

Percentages and decimals

A decimal number is any number between 0 and 1. Referring to the circle once again, we can think of the whole circle as 1, and every piece is a number between 0 and 1. To get a percentage from this number, we simply **multiply** any decimal number by 100. Hence, 0.2 becomes 20%, 0.02 becomes 2%, and 0.73 becomes 73% etc. Similarly, if we have a percentage and want to express it as a decimal number, we **divide** the percentage by 100. For example, 55% becomes 0.55 (out of 1).

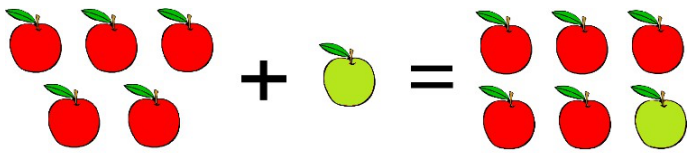
Coming back to our circle, we have now learnt that we can express this as:



1. $\frac{1}{4}$
2. 0.25
3. 25%

Can you have more than 100%?

Even though 100% is all of whatever it is you are measuring (for example 5 out of 5 apples), you can express things as more than 100%. This is especially true when using percent changes or comparisons, such as, if you have 5 apples out of a total of 5 - you have 100% of the apples. However, if you gain another apple, you will now have 120% of your **original** amount of apples.



100% of the apples 20% of the apples 120% of the apples

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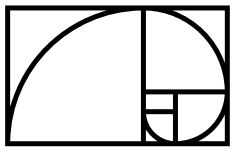
Ratios

Ratios are a simple but important concept in mathematics that help us compare two or more quantities. A ratio shows the relationship between amounts, i.e. how much of one thing there is in comparison to another. Ratios are used in everyday life, from cooking recipes to measuring ingredients. For example, a ratio of 1:4 in a salad dressing means there is 1 part of vinegar to 4 parts of oil.



In nursing, ratios are frequently applied in critical tasks such as IV fluid administration and medical dilutions. For instance, if a doctor prescribes an IV fluid to be administered at a ratio of 1:3, it means there is 1 part of medication or solution for every 3 parts of saline or water. Understanding how ratios work ensures that medications are prepared safely and accurately, which is essential for patient care.

Applied Examples

Worked examples:

Medical dosage calculation (ratio & percentage example)

Question 1a

A patient weighing 80 kg has been prescribed amoxicillin at a dosage of 30 mg per kg of body weight. Calculate the total dose in milligrams and determine how many tablets (rounded to the closest integer) are required if each tablet contains 500 mg of amoxicillin.

Step 1: *Determining the total dose*

Dosage per kg – 30 mg

Patient's weight – 80 kg

Total dose - 30 mg/kg x 80 kg = 2400 mg

Step 2: *Number of tablets needed*

Each tablet contains 500 mg amoxicillin

Total dose - 2400 mg

Tablets needed: $\frac{2400\ \text{mg}}{500\ \text{mg/tablet}} = 4.8\ \text{tablets}$

Since the question indicated to round to the closest integer, the answer is rounded up to administering **5 tablets for the patient.

Question 1b

Due to the patient's condition, the doctor adjusts the dose to 75% of the initially prescribed amount. Calculate the new dose and how many tablets (rounded to the closest integer) are required.

Step 1: *Application of percentage*

75% of 2400 mg = 2400 x $\frac{75}{100} = 1800$ mg

Tablets needed for 1800 mg: $\frac{1800 \text{ mg}}{500 \text{ mg/tablet}} = 3.6 \text{ tablets}$

Rounded up to **4 tablets**

IV Fluid Administration (ratio example)

Question 2
A patient is admitted to the emergency department with dehydration and requires an IV infusion of saline. The doctor prescribes 1 litre of saline to be administered over 6 hours. The IV drip set delivers 30 drops per millilitre. Calculate the drip rate in drops per minute.

Step 1: *Determining the ratio*

Total infusion time - **6 hours = 360 minutes** (remember to convert your units!)

The drip set delivers **30 drops for every 1 mL** of fluid.

*Key question now is – how many drops should be administered per minute?

Step 2: *Calculate the total drops*

Total volume to be infused: 1 litre = 1000 mL (important to make sure your units are the same!)

Drops per mL: 30 drops/mL

Total drops for the entire infusion: 1000 mL x 30 drops/mL = 30,000 drops.

Step 3: *Finding drops per minute*

Total infusion time: 360 minutes

Ratio of total drops to total minutes:

30,000 $drops$ / 360 $minutes$=83.33 $drops/min$

**Since it's not possible to have 1/3 of a drop, round the result to 83 drops per minute for practical application.

Medical Dilution (ratio example)

Question 3
You are asked to prepare a medication of amoxicillin that requires dilution. The prescribed dosage is 15 mg of the drug diluted in a ratio of 1:5 with saline (1 part drug to 5 parts saline). You are given a vial containing 20 mg of amoxicillin in 30 mL of solution. Calculate the total volume of saline and amoxicillin required for the patient.

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Step 1: *Determine how much **1 mg** of the drug is in the solution*
Volume per mg = 30 mL/20 mg = 1.5 mL per mg (mL/mg)

Step 2: *Calculate the volume of solution needed for **15 mg** of the drug*
15 mg x 1.5 mL/mg = 22.5 mL
Therefore, **22.5 mL** of the drug solution is required.

Step 3: Determine the volume of saline needed for a **1:5 ratio** (1 part drug to 5 parts saline):
Total parts = 1+ 5 =6 parts
If 22.5 mL is 1 part, multiply by 5 for the saline: 5 x 22.5 mL = 112.5 mL

Add **112.5 mL of saline** to **22.5 mL of the drug solution** to achieve the correct 1:5 dilution ratio for 15 mg of the drug which gives -

Final Answer: **total volume of 135 mL** to be prescribed to the patient.

Activity:

Question 1:

a) A patient weighs 50 kg and needs a dose of esomeprazole of 0.5 mg for every kilogram of their body weight. Given each tablet contains 5 mg of esomeprazole, how many tablets (rounded **up** to the closest integer) should you give to the patient?

b) The doctor adjusts the dose to 55% of the initially prescribed amount. Calculate the new dose and how many tablets (rounded **up** to the closest integer) are required.

Question 2:

A patient in the post-operative ward requires an IV infusion of 1.5 litres of glucose solution to be delivered over 8 hours. The IV drip set delivers 20 drops per millilitre. Calculate the drip rate in drops per minute (rounded **down** to the closest integer).

Question 3:

You are asked to prepare a solution of ceftriaxone that requires dilution. The prescribed dosage is 10 mg of the drug diluted in a ratio of 1:4 with saline (1 part drug to 4 parts saline). You are given a vial containing 25 mg of ceftriaxone in 50 mL of solution. Calculate the total volume of saline and ceftriaxone to be added.

Answers
Q1: a) 5 tablets, b) 13.75 mg, 3 tablets
Q2: 62 drops per minute
Q3: Total Volume = 100 mL (20 mL drug + 80 mL saline)

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