Learning, Teaching and Student Engagement

JAMES COOK UNIVERSITY AUSTRALIA

Cairns Singapore Townsville

Mathematics for Nursing and Midwifery

The module covers concepts such as:

- **Maths refresher**
- **Fractions, Percentage and Ratios**
- **Decimals and rounding**
- **Unit conversions**
- **Rate**

TheLearningCentre

UNLOCK YOUR POTENTIAL

Mathematics for Nursing and Midwifery

Contents

Introduction

Clinical nursing practice requires accurate numerical calculation and problem solving skills. Mastery of these skills is essential to ensure patient safety.

This workbook is designed to build student confidence and competence in foundational maths skills and their application to clinical calculations. You can work through modules at your own pace, attempt the practice questions and check answers. Follow links to external resources as needed.

Use this workbook to strengthen your understanding and progression through the Intellilearn modules. Refer also to the clinical calculation numeracy resources in your subject site.

1. Arithmetic of whole numbers

<u>Integers</u>

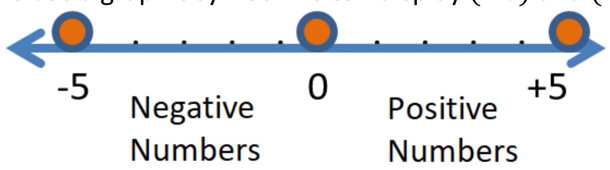
The most commonly used numbers in arithmetic are integers, which are positive and negative whole numbers including zero. Positive integers are 1, 2, 3, 4, 5 and so on.
The negative integers are -1, -2, -3, -4, -5 and so on.. Decimal fractions are not integers because they are 'parts of a whole', for instance, 0.6 is 6 tenths of a whole.

<u>Directed Numbers (negative and positive integers)</u>

Directed numbers are like arrows with a particular size and direction ($\xrightarrow{+}$ and $\xleftarrow{-}$). They have a magnitude (size) and a direction (positive or negative). The positive (+) and negative (-) symbols are used to signify their direction. Note that when using the calculator, we use the $(-)$ key rather than the subtraction key. Each negative number may also need to be surrounded by brackets ($e.g\ (-3)\ +\ (+3)\ =\ 0$) for your calculator to interpret it correctly.

When naming directed numbers, we use the terms *negative* and *positive* numbers. The terms *plus* and *minus* are avoided unless you are indicating that an operation is taking place (addition and subtraction).
$(-3)\ +\ (+3)\ =\ 0$ is read as '*negative 3 plus positive 3 equals zero'.* Generally, the positive (+) symbol isn't shown with positive numbers but can be assumed when a number has no sign (e.g 3 means +3).

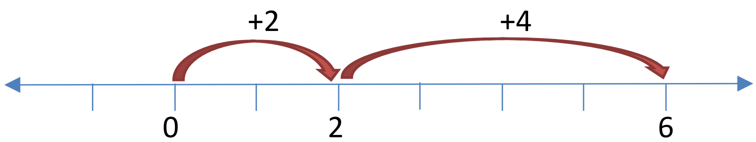
To use a graphic symbol we can display (-5) and $(+5)$ as:



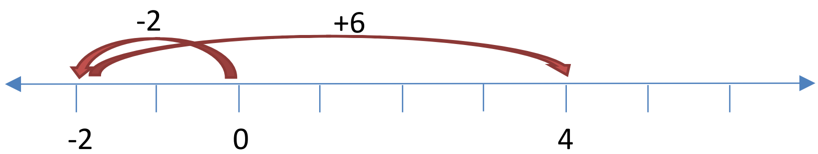
This graphic symbol is known as a number line and can be used to show how and why operations work.

Addition: To add a number we move to the right:

$2 + 4 = 6$



$(-2)\ +\ (+6)\ =$



In this example we added a positive number beginning at a negative number. Start at zero, move in a negative direction two places, then move in a positive direction six places. The answer is four.

Question 1a: Represent $-2\ +\ 3\ =$

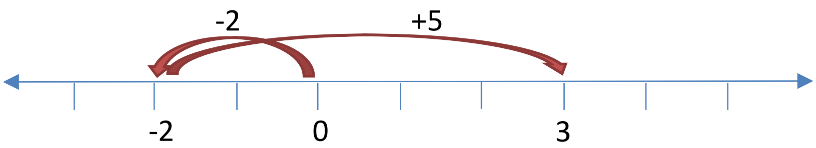
Subtraction: To subtract a positive number we move that number of places to the left.

For example, $3 - 4 = (-1)$
- Start at zero
- Move *three* spaces to the right (in a positive direction)
- Move *four* spaces to the left (in a negative direction)
- The answer is negative one

We can think about this as if we were on a lift. If we start at the ground floor and go up three floors, then down four floors, we would be one level below ground.

- **Note:** To subtract an integer means to add its' opposite. To subtract a negative number we move to the right rather than the left – in a positive direction.

For example: $(-2) - (-5) = 3$
"negative 2 minus negative 5" meaning $(-2) + 5$ (adding the opposite)

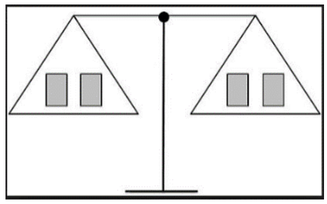


Question 1b: Your turn to represent $(+2) - (+5) =$

Two key points:

- Subtracting a negative number is the same as adding its opposite. $4 - (-3) = 4 + 3 = 7$
- Adding a negative number is the same as subtracting a positive number. $4 + (-2) = 4 - 2 = 2$

Question 2: Your Turn



a. Find the sum of 3, 6 & 4

b. Find the difference of 6 and 4

c. Find the product of (multiply) 7 & 3

d. Find the quotient of 20 and 4 (divide 20 by 4)

e. Find the factors of 24 (factors are whole numbers that divide exactly into another number)

f. Find the first five multiples of 7 (multiples are numbers that can be divided by another number – in this case 7 – without a remainder).

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Watch this short Khan Academy video for further explanation:
"Learn how to add and subtract negative numbers"
https://www.khanacademy.org/math/arithmetic/arith-review-negative-numbers/arith-review-sub-neg-intro/v/adding-and-subtracting-negative-number-examples

2. Naming fractions

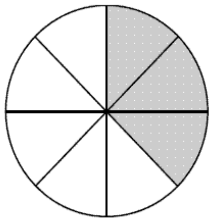
- Fractions are representations of "parts of a whole"
- A key concept is that division and fractions are linked. Even the division symbol (÷) is a fraction.

$$\frac{1}{2} \; is\ the\ same\ as\ 1\ divided\ by\ 2\ which\ is\ 0.5.$$

- A fraction is made up of two main parts: $\frac{3}{4} \;\; \rightarrow \;\; \frac{Numerator}{Denominator}$

The **denominator** represents how many parts of the whole there are, and the **numerator** indicates how many of the parts are of interest.

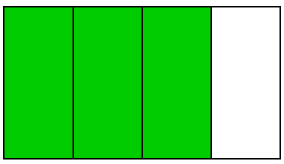
For instance, $\frac{5}{8}$ of a pie means that we have cut a pie into 8 **even** pieces and we are only interested in the five that are left on the plate.



- Fractions should always be displayed in their simplest form. For example, $\frac{6}{12}$ is written as $\frac{1}{2}$

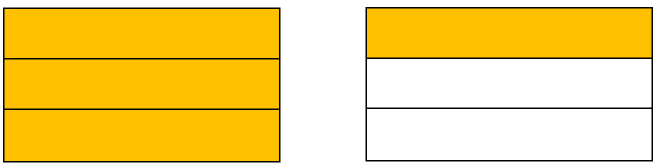
Strategies for converting fractions into their simplest form will be covered over the next sections.

- A **proper fraction** has a numerator smaller than the denominator, for example, $\frac{3}{4}$



This representation shows that we have four equal parts and have shaded three of them, therefore $\frac{3}{4}$

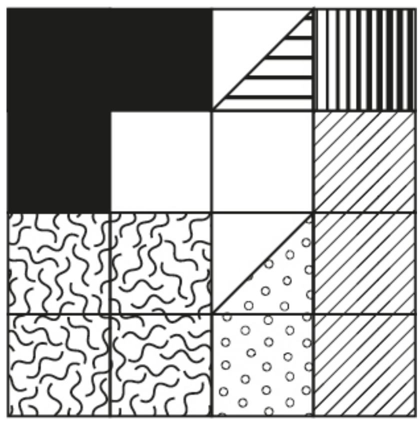
- An **improper fraction** has a numerator larger than the denominator, for example, $\frac{4}{3}$



Here we have two 'wholes' divided into three equal parts.

Three parts of '3 equal parts' makes a 'whole' plus one more part makes *'one whole and one third'* or *'four thirds'*

- Therefore, a **mixed fraction** has a whole number and a fraction, for example, $1\frac{1}{3}$



Question 3: Your Turn:

Name the fractions:

a) What fraction of the large square is black?

b) What fraction of the large square has vertical lines?

c) What fraction of the large square has diagonal lines?

d) What fraction of the large square has wavy lines?

Watch this short Khan Academy video for further explanation: **"Introduction to fractions"**
https://www.khanacademy.org/math/arithmetic/fractions/understanding_fractions/v/introduction-to-fractions

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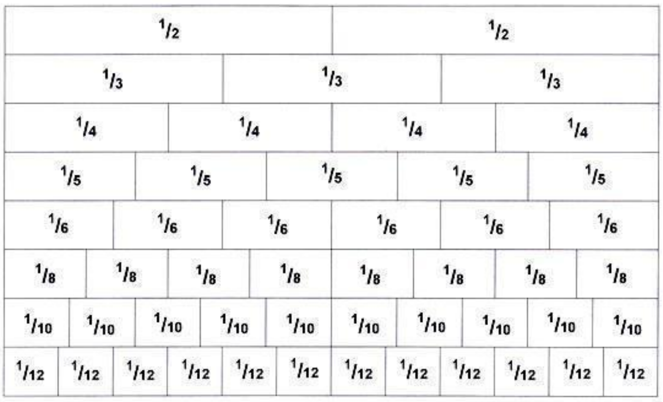
3. Equivalent fractions

Equivalence is a concept that is easy to understand when a fraction wall is used.



As you can see, each row has been split into different fractions: top row into 2 halves, bottom row 12 twelfths. An equivalent fraction splits the row at the same place. Therefore:

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{5}{10} = \frac{6}{12}$$

The more pieces I split the row into (denominator), the more pieces I will need (numerator).

To create an equivalent fraction mathematically, whatever I do to the numerator (multiply or divide), I must also do to the denominator and vice versa, whatever I do to the denominator I must do to the numerator. Take $\frac{2}{3}$ as an example, if I multiply the numerator by 4, then I must multiply the denominator by 4 to create an equivalent fraction:

$$\frac{2 \times 4}{3 \times 4} = \frac{8}{12}$$

Example problems: Use what you have understood about equivalent fractions to find the missing values in these fraction pairs.

1. $\frac{3}{5} = \frac{\quad}{20}$ Answer: The denominator was multiplied by 4. (20 ÷5 =4)

   So the numerator must by multiplied by 4. $\therefore \frac{3^{\times 4}}{5_{\times 4}} = \frac{12}{20}$

2. $\frac{27}{81} = \frac{9}{\quad}$ Answer: The numerator was divided by 3. (27 ÷9 =3)

   So the denominator must be divided by 3. $\therefore \frac{27^{\div 3}}{81_{\div 3}} = \frac{9}{27}$

Question 4: Your Turn:

a) $\frac{2}{3} = \frac{\quad}{9}$

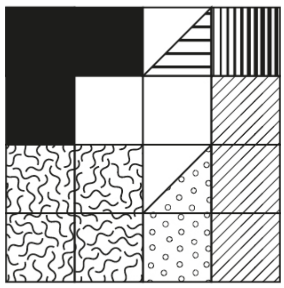
b) $\frac{5}{7} = \frac{45}{\quad}$

c) $\frac{9}{10} = \frac{\quad}{30}$

d) $\frac{\quad}{52} = \frac{4}{13}$

e) What fraction of the large square has dots?

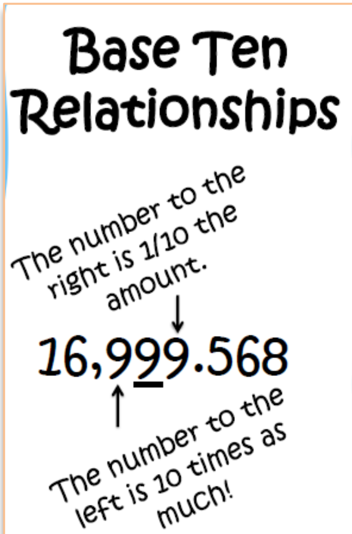
f) What fraction of the large square has horizontal lines?



Watch this short Khan Academy video for further explanation:
"Equivalent fractions"
https://www.khanacademy.org/math/arithmetic/fractions/Equivalent_fractions/v/equivalent-fractions

4. Working with decimals

Key Ideas:



The decimal separates whole numbers from parts of a whole.

For instance, 3.6; three is the whole number and 6 tenths of a whole.

Each digit in a number has a 'place value' (related to one).
The value depends on the position of the digit in that number.
Each position can be thought of as columns.
Each column is a power of ten.
For example, let's look at 56.39

Tens	Ones	Tenths	Hundredths
1x10	1	$\frac{1}{10}$	$\frac{1}{100}$
5	6 •	3	9

$5 \times 10^1 = 50$

$6 \times 1 = 6$

$3 \times \frac{1}{10} (3 \times 10^{-1}) = 0.3$

$9 \times \frac{1}{100} (9 \times 10^{-2}) = 0.09$

A **recurring decimal** is a decimal fraction where a digit repeats itself indefinitely.
For example, two thirds = 0.666666
Because the number repeats itself from the tenths position a dot can be written above the 6 as such $0.\dot{6}$
If the number was one sixth($\frac{1}{6}$), which as a decimal is 0.16666, then we signify as $0.1\dot{6}$
If the number contained a cluster of repeating digits, for example, five elevenths = 0.454545 we write $0.\dot{4}\dot{5}$
A terminating decimal is a number that terminates after a **finite** (not infinite) number of places, for example:

$\frac{2}{5} = \frac{4}{10}$ or 0.4; and $\frac{3}{16}$ = 0.1875 (terminating after 5)

Working with Decimals

What happens when we multiply or divide by ten, or powers of ten?

Patterns are identified when multiplying by ten. Often it is said that when multiplying by ten we move the decimal one place to the right. This is actually something we do in practice but it is actually the digits that move.

When we multiply by ten, all digits in the number become ten times larger and they move to the left.
What happens when we divide by 10? All the digits move to the right.
$963.32 \div 10 = 96.332$ all of the digits more one place to the right.
$963.32 \times 10 = 9633.2$ all of the digits move one place to the left.

Another key point when working with addition or subtraction of numbers is to line up the decimal points. A zero can be regarded as a place holder. For example, $65.32 + 74.634 =$ (see right)

$$\begin{array}{r} 65.320 \\ + \quad 74.634 \\ \hline 139.954 \end{array}$$

5. Rounding and estimating

Rounding numbers is a method of summarising a number to make calculations easier to solve. Rounding decreases the accuracy of a number. Rounding to a specified integer or decimal is important when answers need to be given to a particular degree of accuracy.

The Rules for Rounding:

1. Choose the last digit to keep.
2. If the digit to the right of the chosen digit is 5 or greater, increase the chosen digit by 1.
3. If the digit to the right of the chosen digit is less than 5, the chosen digit stays the same.
4. All digits to the right are now removed.
   For example, what is 7 divided by 9 rounded to 3 decimal places?
   So, $7 \div 9 = 0.777777777777777777777777777777777777$ …
   The chosen digit is the third seven (3 decimal places).
   The digit to the right of the chosen digit is 7, which is larger than 5, so we increase the 7 by 1, thereby changing this digit to an 8.
   $\therefore 7 \div 9 = 0.778$ to three decimal places.
5. The quotient in rule 4 above is called a **recurring decimal**. This can also be represented as $0.\dot{7}$. The dot above the 7 signifies that the digit repeats. If the number was 0.161616, it would have two dots to symbolise the two repeating digits: $0.\dot{1}\dot{6}$

Estimating is a very important ability which is often ignored. A leading cause of getting math problems wrong is because of entering the numbers into the calculator incorrectly. It helps to be able to estimate the answer to check if your calculations are correct.

Some simple methods of estimation:

- **Rounding:** $273.34 + 314.37 = ?$ If we round to the tens we get $270 + 310$ which is much easier and quicker. We now know that $273.34 + 314.37$ should equal approximately 580.
- **Compatible Numbers:** $527 \times 12 = ?$ If we increase 527 to 530 and decrease 12 to 10, we have $530 \times 10 = 5300$. A much easier calculation.
- **Cluster Estimation:** $357 + 342 + 370 + 327 = ?$ All four numbers are clustered around 350, some larger, some smaller. So we can estimate using $350 \times 4 = 1400$.

Example Problems:

1. Round the following to 2 decimal places:
   a. 22.6783 gives 22.68
   b. 34.6332 gives 34.63
   c. 29.9999 gives 30.00
2. Estimate the following:
   a. $22.5684 + 57.355 \approx 23 + 57 = 80$
   b. $357 \div 19 \approx 360 \div 20 = 18$
   c. $27 + 36 + 22 + 31 \approx= 30 \times 4 = 120$

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Watch this short Khan Academy videos for further explanation:

"Rounding decimals: to the nearest tenth"

https://www.khanacademy.org/math/pre-algebra/decimals-pre-alg/dec-rounding-estimation-pre-alg/v/rounding-decimals

Question 5: Your Turn:

A. Round the following to 3 decimal places:
   a. $34.5994 \approx$
   b. $56.6734 \approx$

B. Estimate the following:
   a. $34 \text{ x } 62 \approx$
   b. $35.9987 - 12.76 \approx$

6. Converting decimals into fractions

Decimals are an almost universal method of displaying data, particularly given that it is easier to enter decimals, rather than fractions, into computers. But fractions can be more accurate. For example, $\frac{1}{3}$ is not 0.33 it is $0.3\dot{3}$

The method used to convert decimals into fractions is based on the notion of place value. The place value of the last digit in the decimal determines the denominator: tenths, hundredths, thousandths, and so on…

Example problems:

1. 0.5 has 5 in the tenths column. Therefore, 0.5 is $\frac{5}{10} = \frac{1}{2}$ (simplified to an equivalent fraction).
2. 0.375 has the 5 in the thousandth column. Therefore, 0.375 is $\frac{375}{1000} = \frac{3}{8}$
3. 1.25 has 5 in the hundredths column and you have $1\frac{25}{100} = 1\frac{1}{4}$

The hardest part is converting to the lowest equivalent fraction. If you have a scientific calculator, you can use the fraction button. This button looks different on different calculators so read your manual if unsure.

If we take $\frac{375}{1000}$ from example 2 above:

Enter 375 then  followed by 1000 press = and answer shows as $\frac{3}{8}$.

NOTE: The calculator does not work for rounded decimals; especially thirds. For example, $0.333 \approx \frac{1}{3}$

The table below lists some commonly encountered fractions expressed in their decimal form:

Decimal	Fraction	Decimal	Fraction
0.125	$\frac{1}{8}$	**0.5**	$\frac{1}{2}$
0.25	$\frac{1}{4}$	**0.66667**	$\frac{2}{3}$
0.33333	$\frac{1}{3}$	**.75**	$\frac{3}{4}$
0.375	$\frac{3}{8}$	**0.2**	$\frac{1}{5}$

Question 6: Your Turn:

(No Calculator first, then check.)

a) 0.65 =

b) 2.666 =

c) 0.54 =

d) 3.14 =

e) What is 40 multiplied by 0.2 (use your knowledge of fractions to solve)

7. Converting fractions into decimals

Converting fractions into decimals is based on place value. For example, applying what you have understood about equivalent fractions, we can easily convert $\frac{2}{5}$ into a decimal. First we need to convert to a denominator that has a 10 base. Let's convert $\frac{2}{5}$ into tenths $\rightarrow \frac{2^{\times 2}}{5_{\times 2}} = \frac{4}{10}$ $\therefore$ we can say that two fifths is the same as four tenths: 0.4

Converting a fraction to decimal form is a simple procedure because we simply use the divide key on the calculator. Note: If you have a mixed number, convert it to an improper fraction before dividing it on your calculator.

Example problems:

1. $\frac{2}{3} = 2 \div 3 = 0.66666666666 \ldots \approx 0.67$
2. $\frac{3}{8} = 3 \div 8 = 0.375$
3. $\frac{17}{3} = 17 \div 3 = 5.6666666 \ldots \approx 5.67$
4. $3\frac{5}{9} = (27 + 5) \div 9 = 3.555555556 \ldots \approx 3.56$
5.

Question 7. Your Turn: (Round your answer to three decimal places where appropriate)

a) $\frac{17}{23} =$

b) $\frac{5}{72} =$

c) $56\frac{2}{3} =$

d) $\frac{29}{5} =$

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Watch this short Khan Academy video for further explanation:
"Converting fractions to decimals" (and vice versa)
https://www.khanacademy.org/math/pre-algebra/decimals-pre-alg/decimal-to-fraction-pre-alg/v/converting-fractions-to-decimals

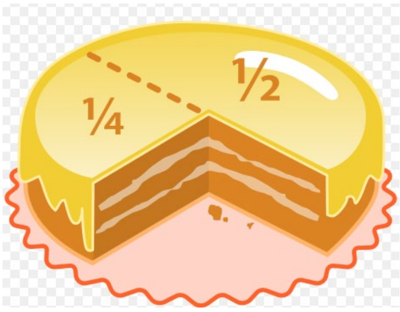
8. Fractions – addition, subtraction, multiplication and division

Adding and subtracting fractions draws on the concept of equivalent fractions. The golden rule is that you can only **add and subtract fractions** if they have the **same denominator**, for example, $\frac{1}{3}+\frac{1}{3}=\frac{2}{3}$.

However, if two fractions do ***not*** have the same denominator, we must use equivalent fractions to find a "common denominator" before they can be added together.

For instance, we cannot simply add $\frac{1}{4}+\frac{1}{2}$ because these fractions have different denominators (4 and 2). As such, arriving at an answer of $\frac{2}{6}$ (two sixths) would be incorrect. Before these fractions can be added together, they must both have the same denominator.

From the image at right, we can see that we have three quarters of a whole cake. So to work this abstractly, we need to decide on a common denominator, 4, which is the lowest common denominator. Now use the equivalent fractions concept to change $\frac{1}{2}$ *into* $\frac{2}{4}$ by multiplying both the numerator and denominator by two: $\frac{1}{2}\text{x}\frac{2}{2}=\frac{2}{4}$



Now that the denominators are the same, the addition can be carried out:

$$\frac{1}{4}+\frac{2}{4}=\frac{3}{4}$$

Let's try another:

$\frac{1}{3}+\frac{1}{2}$ We cannot simply add these fractions; again we need to find the lowest common denominator. The easiest way to do this is to multiply the denominators: $\frac{1}{3}$ *and* $\frac{1}{2}$ (2 x 3 = 6). Therefore, both fractions can have a denominator of 6, yet we need to change the numerator. The next step is to convert both fractions into sixths as an equivalent form. How many sixths is one third? $\frac{1}{3}=\frac{2}{6}$ $\left(\frac{1}{3}\times\frac{2}{2}=\frac{2}{6}\right)$ And how many sixths is one half? $\frac{1}{2}=\frac{3}{6}$ $\left(\frac{1}{2}\times\frac{3}{3}=\frac{3}{6}\right)$

Therefore: $\frac{1}{3}+\frac{1}{2}=\frac{2}{6}+\frac{3}{6}=\frac{5}{6}$

With practise, a pattern forms, as is illustrated in the next example:

$$\frac{1}{3}+\frac{2}{5}=\frac{1\times 5}{3\times 5}+\frac{2\times 3}{5\ \times 3}=\frac{5+6}{15}=\frac{11}{15}$$

In the example above, the lowest common denominator is found by multiplying 3 and 5, and then the numerators are multiplied by 5 and 3 respectively.

Question 8. Try the following problems to practice adding fractions:

a) $\frac{1}{3}+\frac{2}{5}=$

b) $\frac{3}{4}+\frac{2}{7}=$

c) $2\frac{2}{3}+1\frac{3}{4}=$

d) $2\frac{1}{6}+3\frac{7}{8}=$

Subtraction is a similar procedure:

$$\frac{2}{3}-\frac{1}{4}=\frac{(2\times4)-(1\times3)}{(3\times4)}$$

$$=\frac{8}{12}-\frac{3}{12}$$

$$=\frac{5}{12}$$

Question 9. Try the following problems to practice adding fractions:

e) $\frac{9}{12}-\frac{1}{3}=$

f) $\frac{1}{3}-\frac{1}{2}=$

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Watch this short Khan Academy video for further explanation: **"Adding and subtraction fractions"**
https://www.khanacademy.org/math/arithmetic/fractions/fractions-unlike-denom/v/adding-and-subtracting-fractions

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Compared to addition and subtraction, **multiplication and division of fractions** is easy, but sometimes a challenge to understand how and why the procedure works mathematically. For example, imagine I have $\frac{1}{2}$ of a pie and I want to share it between 2 people. Each person gets a quarter of the pie.

Mathematically, this example would be written as: $\frac{1}{2}\times\frac{1}{2}=\frac{1}{4}$.

Remember that fractions and division are related; in this way, multiplying by a half is the same as dividing by two.

So $\frac{1}{2}$ (two people to share) of $\frac{1}{2}$ (the amount of pie) is $\frac{1}{4}$ (the amount each person will get).

But what if the question was more challenging: $\frac{2}{3}\times\frac{7}{16}=$? This problem is not as easy as splitting pies.

A mathematical strategy to use is: "Multiply the numerators then multiply the denominators"

Therefore, $\frac{2}{3}\times\frac{7}{16}=\frac{(2\times7)}{(3\times16)}=\frac{14}{48}=\frac{7}{24}$

An alternative method you may recall from school is to simplify each term first. Remember, 'What we do to one side, we must do to the other.'

The first thing we do is look to see if there are any common multiples. For $\frac{2}{3}\times\frac{7}{16}=?$ we can see that 2 is a multiple of 16, which means that we can divide top and bottom by 2:

$$\frac{2^{\div2}}{3}\times\frac{7}{16_{\div2}}=\frac{1}{3}\times\frac{7}{8}=\frac{1\times7}{3\times8}=\frac{7}{24}$$

Division of fractions **seems odd, but it is a simple concept:**

You may recall the expression 'invert and multiply', which means we flip the divisor fraction (second term fraction). Hence, $\div\frac{1}{2}$ *is the same as* $\times\frac{2}{1}$

This 'flipped' fraction is referred to as the **reciprocal of the original fraction**.

Therefore, $\frac{2}{3}\div\frac{1}{2}$ is the same as $\frac{2}{3}\times\frac{2}{1}=\frac{(2\times2)}{(3\times1)}=\frac{4}{3}=1\frac{1}{3}$ Note: dividing by half doubled the answer.

Question 10. Use fractions to complete the following:

1. Find the reciprocal of $2\frac{2}{5}$

2. $\frac{2}{3} \times \frac{7}{13} =$

3. $1\frac{1}{6} \times \frac{2}{9} =$

4. $\frac{3}{7} \div \frac{2}{5} =$

5. $2\frac{2}{5} \div 3\frac{8}{9} =$

6. $\frac{(-25) \div (-5)}{4 - 2 \times 7} =$

7. $\frac{-7}{2} \div \frac{-4}{9} =$

8. If we multiply 8 and the reciprocal or 2, what do we get?

9. Which is the better score in a physiology test; 17 out of 20 or 22 out of 25?

10. What fraction of H_2O_2 is hydrogen?

11. A patient uses a glass that holds $\frac{1}{5}$ of a jug's volume. The patient drinks eight full glasses during the course of the day. What fraction of the second jug is left at the end of the day?

9. Percentage

The concept of percentage is an extension of the material we have already covered about fractions. To allow comparisons between fractions we need to use the same denominator. As such, all percentages use 100 as the denominator. The word percent or "per cent" means per 100. Therefore, 27% is $\frac{27}{100}$.

To use percentage in a calculation, the simple mathematical procedure is modelled below:

For example, 25% of 40 is $\frac{25}{100} \times 40 = 10$

Percentages are most commonly used to compare parts of an original. For instance, the phrase '30% off sale,' indicates that whatever the original price, the new price is 30% less. However, the question might be more complex, such as, "How much is left?" or "How much was the original?"

<u>Example problems:</u>

a. An advertisement at the chicken shop states that on Tuesday everything is 22% off. If chicken breasts are normally $9.99 per kilo. What is the new per kilo price?

Step 1: SIMPLE PERCENTAGE:

$$\frac{22}{100} \times 9.99 = 2.20$$

Step 2: DIFFERENCE: Since the price is cheaper by 22%, $2.20 is subtracted from the original: $9.99 - 2.20 = \$7.79$

b. A new dress is now $237 reduced from $410. What is the percentage difference? As you can see, the problem is in reverse, so we approach it in reverse.

Step 1: DIFFERENCE: Since it is a discount the difference between the two is the discount. Thus we need to subtract $237.00 from $410 to see what the discount was that we received. $410 – $237 $= \$173$

Step 2: SIMPLE PERCENTAGE: now we need to calculate what percentage of $410 was $173, and so we can use this equation: $\frac{x}{100} \times 410 = 173$

We can rearrange the problem in steps: $\frac{x}{100} \times 410^{\div 410} = 173^{\div 410}$ this step involved dividing 410 from both sides to get $\frac{x}{100} = \frac{173}{410}$ Next we work to get the x on its own, so we multiply both sides by 100. Now we have $x = \frac{173}{410} \times \frac{100}{1}$ Next we solve, so 0.42 multiplied by 100, $\therefore$ 0.42×100 and we get 42.

$\therefore$ The percentage difference was 42%.

Let's check: 42% of $410 is $173, $410 - $173 = $237, the cost of the dress was $237.00 ✓.

Question 11. Use percentages to calculate the following:

a) GST adds 10% to the price of most things. How much does a can of soft drink cost if it is 80c before GST?

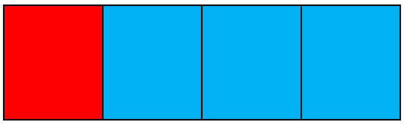
b) When John is exercising his heart rate rises to 180 bpm. His resting heart rate is 70 % of this. What is his resting heart rate?

c) Which of the following is the largest? $\frac{3}{5}$ or $\frac{16}{25}$ or 0.065 or 63%? (Convert to percentages)

10. Ratios

A ratio is a comparison of the size of one number to the size of another number. A ratio represents for every determined amount of one thing, how much there is of another thing. Ratios are useful because they are unit-less. That is, the relationship between two numbers remains the same regardless of the units in which they are measured.

Ratios use the symbol **:** to separate quantities being compared. For example, 1:3 means 1 unit to 3 units.



There is 1 red square to 3 blue squares

1:3

1 to 3

Ratios can be expressed as fractions but you can see from the above diagram that 1:3 is not the same as $\frac{1}{3}$. The fraction equivalent is $\frac{1}{4}$

Example:

A pancake recipe requires flour and milk to be mixed to a ratio of 1:3. This means one part flour to 3 parts milk. No matter what device is used to measure, the ratio must stay the same.

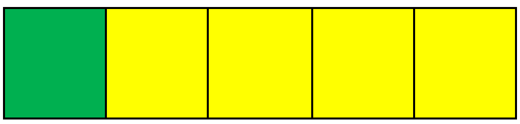
So if I add 200 mL of flour, I add 200 mL x 3 = 600 mL of milk

If I add 1 cup of flour, I add 3 cups of milk

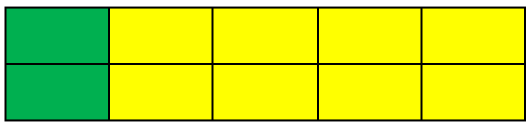
If I add 50 grams of flour, I add 150 grams of milk

Scaling ratios

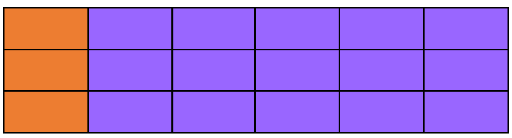
A ratio can be scaled up:



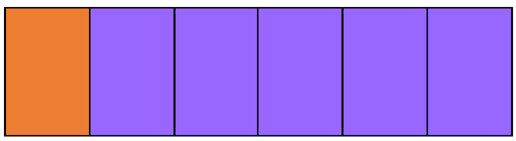
1:4 = 2:8



Or scaled down:



3:15 = 1:5



1:5 is the same as 2:10 is the same as 3:15 is the same as 4:20 and so on

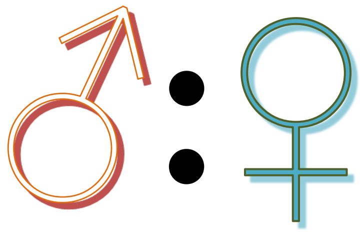
Scaling ratios is useful in the same way that simplifying fractions can be helpful, for example, in comparing values. For ratios the same process as simplifying fractions is applied – that is, scaling must be applied to both numbers.

For example, a first year physiology subject has 36 males and 48 females, whereas the clinical practice subject has 64 males and 80 females. You are asked to work out which cohort has the largest male to female ratio.

The male: female ratios can be expressed as:

36:48 – physiology subject

64:80 – clinical practice subject



Both numbers of the ratio 36:48 can be divided by 12 to leave the ratio 3:4
Both numbers of the ratio 64:80 can be divided by 16 to leave the ratio 4:5

These two ratios cannot be easily directly compared, but they can be rescaled to a common value of 20 for the females, against which the males can be compared if they are rescaled equivalently.

3 (x5):4 (x5) = 15:20 – physiology subject

4 (x4):5 (x4) = 16:20 – clinical practice subject

Comparing the ratios now shows that the clinical practice subject has a slightly higher ratio of males to females.

Question 12. Use ratios to complete the following:

a) For a 1:5 concentration of cordial drink, how much cordial concentrate do I have to add to water to make up a 600 mL jug?

b) Jane reads 25 pages in 30 minutes. How long does it take her to read 200 pages?

c) A pulse is measured as 17 beats over 15 seconds. What is the heart rate per minute?

d) Which of the following ratios is the odd one out? 9:27, 3:9, 8:28, 25:75

Ratios as percentages

Recall from the figures above, that the numbers in the ratio represents parts of a whole. To convert a ratio to percentage values, simply add the two parts of the ratio, to give the whole (total) and for each part, divide by the total. Then use the normal procedure to calculate the percentage by multiplying by 100.

Using the example from above, the table below calculates the percentage values of males and females for each subject from the ratios. Percentages allow for a quantified comparison.

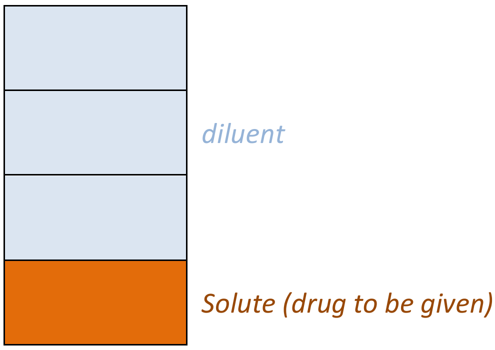
	Physiology 3:4	Clinical practice 4:5
Total	7	9
Male	$\frac{3}{7} \times 100 = 42.9\%$	$\frac{4}{9} \times 100 = 44.4\%$
Female	$\frac{4}{7} \times 100 = 57.1\%$	$\frac{5}{9} \times 100 = 55.6\%$

We are correct; there are more males than females (in percent) in the clinical practice subject.

Dilutions using the expression *solute in diluent*

Sometimes drug ratios are written in the form of *solute (usually drug to be given)* ***in*** *diluent (e.g. water or saline solution)*; for example **1 in 4.**

This means 1 part of every 4 of the final volume is solute and this is mixed with 3 parts of the diluent. When expressed in this way the total parts is 4. This relationship can be expressed as the fraction $\frac{1}{4}$



Question 13:

a) Write 2:3 in the form "2 in ?"

b) Write a solution of 1 in 8 in the form of a ratio.

c) How much concentrate do you need to make the following dilutions?

a) 500 mL of a 1 in 4 solution b) 600 mL of a 1:5 solution

d) Heparin, an anticoagulant, is available in a strength of 5000 units/mL. If 3000 units is required, what volume of heparin will be injected?

11. Units and unit conversion

Measurement is used every day to describe quantity. There are various types of measurements such as time, distance, speed, weight and so on. There are also various systems of units of measure, for example, the Metric system and the Imperial system. Within each system, for each base unit, other units are defined to reflect divisions or multiples of the base unit. This is helpful for us to have a range of unit terms that reflect different scale

Measurements consist of two parts – the number and the identifying unit.

Number → **50 kg** ← Identifying unit

In scientific measurements, units derived from the metric system are the preferred units. The metric system is a decimal system in which larger and smaller units are related by factors of 10.

Table 1: Common Prefixes of the Metric System

Prefix	Abbreviation	Relationship to Unit	Example
mega-	M	1 000 000 x Unit	2.4ML -Olympic sized swimming pool
kilo-	k	1000 x Unit	The average newborn baby weighs 3.5kg
-	-	Base unit	metre, gram, litre,
deci-	d	1/10 x Unit or 0.1 x Unit	2dm - roughly the length of a pencil
centi-	c	1/100 x Unit or 0.01 x Unit	A fingernail is about 1cm wide
milli-	m	1/1000 x Unit or 0.001 x Unit	A paperclip is about 1mm thick
micro-	µ	1/1 000 000 x Unit or 0.000001 x Unit	human hair can be up to 181 µm
nano-	n	1/1 000 000 000 x Unit or 0.000000001 x Unit	DNA is 5nm wide

Table 2: Common Metric Conversions

Unit	Larger Unit	Smaller Unit
1 metre	1 kilometre = 1000 metres	100 centimetres = 1 metre 1000 millimetres = 1 metre
1 gram	1 kilogram = 1000 grams	1000 milligrams = 1 gram 1 000 000 micrograms = 1 gram
1 litre	1 kilolitre = 1000 litres	1000 millilitres = 1 litre

Often we are required to convert a unit of measure; we may be travelling and need to convert measurements from imperial to metric (e.g. mile to kilometres), or we may need to convert units of different scale (e.g. millimetres to metres) for ease of comparison. In the fields of science and medicine, converting measurement can be a daily activity.

Easy conversion method for metric conversions…

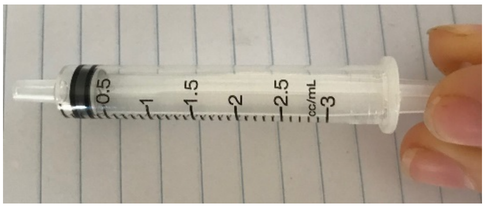
To convert from large units to smaller units MULITPLY by 1000

kg **x1000** **g** **x1000** **mg** **x1000** **microg**

To convert from small units to larger units DIVIDE by 1000

microg **÷ 1000** **mg** **÷ 1000** **g** **÷ 1000** **kg**

In more complex conversions it helps to apply a formula to convert units of measure. However, it is essential to understand the how and why of the formula, otherwise the activity becomes one we commit to memory without understanding what is really happening. It helps to get a 'feel' for measurement and have a common sense idea of what each unit 'looks like'. Most mistakes are made when procedures are carried out without understanding the context, scale or purpose of the conversion.



What does 1 mL look like?

Unit conversions are based on the **relationship** between different units of measure.

$1m = 100cm = 1000mm$ or we could say that $1mm = \frac{1}{10}cm = \frac{1}{1000}m$

Unit Conversion rules:

I. *Always write the unit of measure associated with every number.*

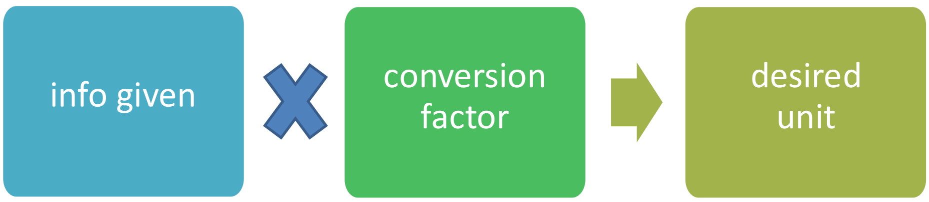
II. *Always include the units of measure in the calculations.*

The quantitative **relationship** between units is sometimes called the **conversion factor**.

For example, convert 58 mm into metres. From the relationship above we see 1000 mm = 1m

The quantity $\frac{1\ m}{1000\ mm}$ is called a **conversion factor;** it is a division/quotient; in this case it has metres on top and *mm* on the bottom

The graphic below shows the general approach to converting units using a conversion factor



$$\mathbf{58}\boldsymbol{mm} \times \frac{\mathbf{1}\boldsymbol{m}}{\mathbf{1000}\boldsymbol{mm}} = \mathbf{0.058}\boldsymbol{m}$$

Example problem:

Convert 125 milligrams (mg) to grams (g). There are 1000 mg in 1 gram so our conversion factor is $\frac{1\,g}{1000\,mg}$

The working is as follows: $125\,\cancel{mg} \times \frac{1\,g}{1000\,\cancel{mg}} = 0.125\,g$

Here we can cancel out the mg and are left with g which is the unit we were asked to convert to.

It is helpful to have a thinking process to follow when approaching problems. This one comes from the book, *Introductory Chemistry* (Tro, 2011, pp. 25-35).

There are four steps to the process: sort, strategise, solve and check.

1. **Sort:** First we sort out what given information is available.
2. **Strategise**: The second step is where a conversion factor is created from the known relationship between the units being converted. You may need to look at a conversion table and possibly use a combination of conversion factors.
3. **Solve**: This is the third step which simply means to solve the problem using the approach shown in the graphic above.
4. **Check**: The last step requires some logical thought; does the answer make sense?

Example problem: Convert 2 kilometres (km) into centimetres (cm).

1. **Sort**: we know there are 1000 metres in one km, and 100cm in one metre.
2. **Strategise**: So our conversion factors could be $\frac{1000m}{1km}\ and\ \frac{100cm}{1m}$
3. **Solve**: $2\,km \times \frac{1000\,m}{1km} \times \frac{100\,cm}{1m} = x\,cm$
   a. $2\,\cancel{km} \times \frac{1000\,\cancel{m}}{1\cancel{km}} \times \frac{100\,cm}{1\cancel{m}} = 2 \times 1000 \times 100\,cm\ \therefore 2\,km = 200{,}000\,cm$
4. **Check**: is there 200,000cm in a kilometre? Yes, that seems sensible.

Question 14. Create a conversion factor and convert the following:

Convert the following:

a) 285 cm into metres

b) 0.15g to milligrams

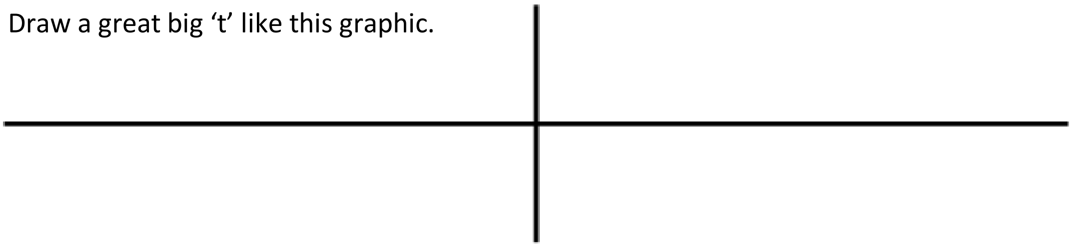
c) 200 micrograms to grams

Conversion Factors – how do I know what goes on the top and what goes on the bottom?:

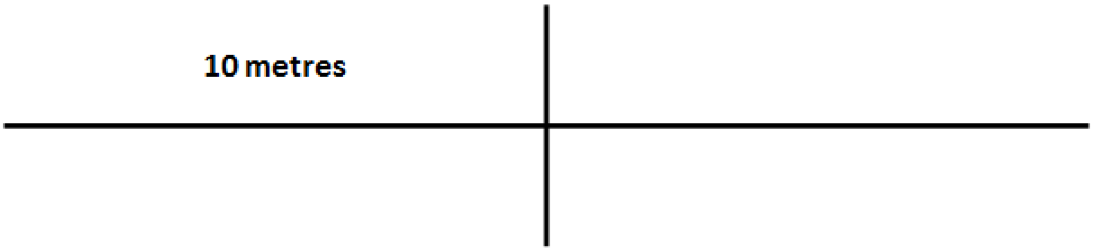
A graphic method may help

Example: convert 10m into centimetres.

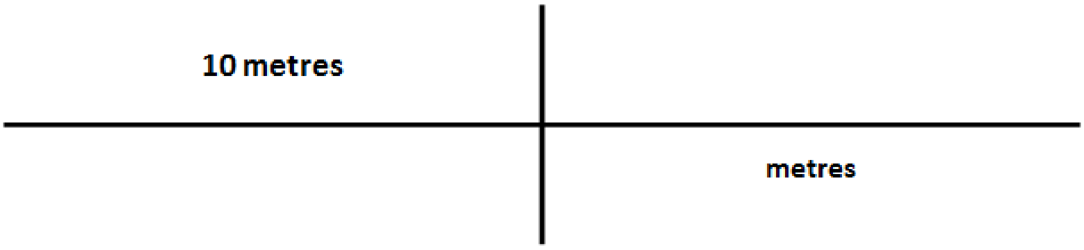
1. Draw a great big ‘t’ like this graphic.



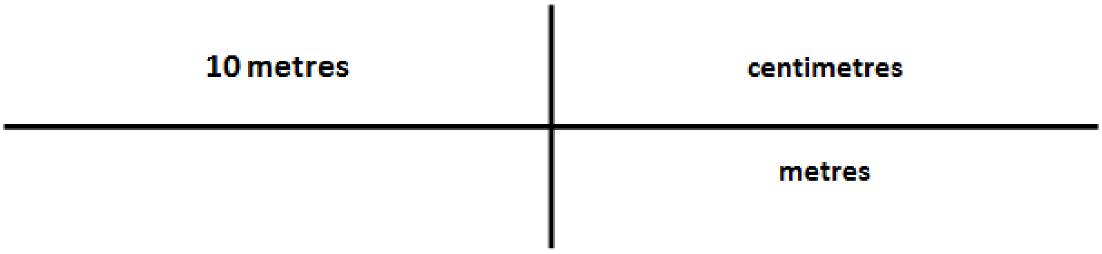
2. Put the number that you have to convert into the top left corner of this graphic.



3. Put the unit of that number (the unit you want to convert from) in the bottom right part of the graphic.



4. Write the unit you want to convert to in the top right part of the graphic.



5. Using the known relationship between the units (there are 100 centimetres in a metre) write the values in front of the units from step 3 and 4. The values on the top and bottom right are the conversion factor 100cm/1m

10 metres	100centimetres
	1metres

6. Once you have the graphic filled out, all you have left to do is multiply all the numbers on the top together, and divide this by the product of the numbers at the bottom. The unit of the answer will be 'centimetres' as the 'metres' cancel out:

$$\frac{10\cancel{m} \times 100cm}{1\cancel{m}} = 1000\ cm$$

More Examples:

a) Convert 0.15 g to kilograms and milligrams	b) Convert 5234 mL to litres
Because 1 kg = 1000 g, 0.15 g can be converted to kilograms as shown: $\mathbf{0.15\ g\ x\ \frac{1\ kg}{1000\ \cancel{g}} = 0.00015\ kg}$ **Also, because 1 g = 1000 mg, 0.15 g can be converted to milligrams as shown:** $\mathbf{0.15\ \cancel{g}\ x\ \frac{1000\ mg}{1\ \cancel{g}} = 150\ mg}$	Because 1 L = 1000 mL, 5234 mL can be converted to litres as shown: $\mathbf{5243\ \cancel{mL}\ x\ \frac{1\ L}{1000\ \cancel{mL}} = 5.234\ L}$

Question 15:

a. Convert 120 g to kilograms and milligrams.

b. Convert 4.264 L to kilolitres and millilitres

c. Convert 670 micrograms to grams.

d. How many millilitres are in a cubic metre?

e. How many inches in 38.10cm (2.54cm = 1 inch)

KHANACADEMY Watch this short Khan Academy video for further explanation:
"Unit conversion word problem: drug dosage"
https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-ratios-prop-topic/cc-6th-unit-conversion/v/unit-conversion-example-drug-dosage

12. Rate

A rate is a numerical comparison between two different kinds of quantities. A rate must have units, quantity per quantity. For instance, we can buy coffee at $9.80 for every kilogram. The two variables are money and kilograms. The term ‘per’ is a term used in exchange for the phrase ‘for every,’ so we buy coffee at $9.80 per kg. Other examples:

- Km per hour, km/hr
- Food prices: $ per weight
- Wages: $ per hour
-

When the rate is expressed ‘per hr’, ‘per g’, ‘per L’ we mean per 1 hr, 1 g or 1 L. This means, to calculate the value for more than 1 unit (hr, g, L etc), simply multiply the starting value by the number of hours, weight , volume etc.

Example Problem 1:

An intravenous line has been inserted in a patient. Fluid is being delivered at a rate of 42mL per hour (42mL/h). How much fluid will the patient receive in:

- 2 hours? $42\text{mL} \times 2\text{h} = 84\text{mL}$
- 8 hours? $42\text{mL} \times 8\text{h} = 336\text{mL}$
- 12 hours? $42\text{mL} \times 12\text{h} = 504\text{mL}$

A rate can be expressed mathematically as a fraction, e.g. 42 mL/hr can be written as $\frac{42\ mL}{1\ hr}$

For the example above, when the volume and time differ, it is expressed mathematically as $\frac{84\ mL}{2\ hr}$; $\frac{336\ mL}{3\ hr}$

A general expression of **rate** for this example is: $\frac{volume}{time} = infusion\ rate$

Example problem 2:

Yasmin is checking the IV fluid infusion on Mrs Cannon at the start of the shift. She sees from the fluid balance sheet that Mrs Cannon has received 320 mL over the past 4 hours. Mrs Cannon is to receive the full litre bag. How many hours would you expect it to take to infuse the full litre?

Step One: Gather the facts/information

How much fluid has Mrs Cannon received? **320 mL**

What is the rate at the fluid is being administered? That is, how much fluid has she received over what time? **320 mL in 4 hrs**

Step Two: Find a solution map; a formula to apply to solve the problem

1) $\frac{volume}{time} = infusion\ rate$
2) How to calculate the time taken: $\frac{total\ volume}{infusion\ rate} = time$

Step Three: Solve

1) Thus $\frac{320mL}{4\ hr} = 80$ ∴ the infusion rate is 80 mL/hr

2) If 320 mL has already been delivered, the remaining volume to be delivered is
   1000 mL – 320 mL = 680 mL

3) Thus $\frac{680\ mL}{80\ ml/hr} = 8\frac{1}{2}$

$$\therefore It\ will\ take\ a\ further\ 8.5\ hours\ to\ deliver\ the\ full\ 1L\ of\ fluid$$

Step Four: Check by working backwards

$80mL \times 8.5\ hr = 680$ ✓

Question 16: Your Turn

Use the steps above to solve the problem below. It is good practice to apply this way of working because it will help you to structure your mathematical thinking and reasoning in the future.

Sonia travels a distance of 156km and then turns right to travel a further 120km. The journey takes her six hours. What is the average speed of her journey?

Step One:

Step Two:

Step Three:

Step Four:

Watch this short Khan Academy video for further explanation: **"Introduction to rates"**
https://www.khanacademy.org/math/cc-sixth-grade-math/cc-6th-ratios-prop-topic/cc-6th-rates/v/introduction-to-rates

13. Nursing Examples

Calculating Intravenous Infusion rates and drops per minute (dpm)

Some information is required first:

- The total volume to be given, which is often written on the prescription in mLs.
- The time over which the volume is to be given, often in minutes
- The drop factor (determined by the administration set). This means how many drops per mL ($\frac{drops}{1\ mL}$), which are commonly 15, 20 or 60 drops/mL

$$\frac{total\ volume\ to\ be\ given\ (in\ mLs)}{time\ (in\ minutes)} \times \frac{drop\ factor}{1} = drops\ per\ minute$$

EXAMPLE PROBLEM:

If 1500mLs of 0.9% sodium chloride fluid is to be given over 10 hours, what is the infusion rate for delivery? If the IV administration set has a drop factor of 20, what will you set the drip rate at?

There are 2 parts to this question: 1) calculating the infusion rate (mL/hr), 2) calculating the drip rate (dpm).

Step One: Gather the facts/information

How much fluid is to be delivered? **1500 mL**
Over what time? **10 hrs**
What is the drop factor? **20 drops/mL**

Step Two: Find a solution map; a formula to apply to solve the problem

Part 1: $\frac{volume}{time} = infusion\ rate$

Part 2: $\frac{total\ volume\ to\ be\ given\ (in\ mLs)}{time\ (in\ minutes)} \times \frac{drop\ factor}{1} = drops\ per\ minute$

Step Three: Solve

Part 1: $\frac{1500\ mL}{10\ hr} = 150\frac{mL}{hr}$ ∴ the infusion rate is 150 mL/hr

Part 2: Note that the time given is in hours, but the formula for drops per minute requires time given in minutes.

Hours must be converted to minutes, using the relationship 1 hr = 60 minutes

$$10\ \cancel{hr} \times \frac{60\ min}{1\ \cancel{hr}} = 600\ min$$

The values can then be substituted into the equation:

$$\frac{1500\ \cancel{\text{mL}}}{600\ \text{min}} \times \frac{20\ drops}{1\ \cancel{mL}} = 50\ \frac{drops}{min} = 50\ \text{dpm}$$

$\therefore The\ drop\ rate\ on\ the\ IV\ administration\ set\ should\ be\ set\ to\ 50\ drops\ per\ minute$

Step Four: Check x3

1. Are both answers in the correct units for what is asked? Part 1 mL/hr; Part 2 dpm
2. Do both answers seem sensible? Is 150 mL/hr a reasonable rate? Yes, this rate may be ordered as rehydration therapy. Is 50 dpm reasonable? Yes, it is on the fast side, but reasonable.
3. Recheck the calculations $10 \times 60 = 600$; $\frac{1500}{600} \times 20 = 50$

Drug Dosage

Another example of calculations using proportional thinking is calculating the dosage of a drug to be given based on an individual's weight. This is a rate (or ratio) expressed as drug dose per kg.

Drug dosage is expressed as $\frac{drug\ dose}{1\ kg}$ and is multiplied by the patient's weight to give the total dose to be administered.

So the formula to calculate the dose to be administered is:

$$\frac{drug\ dose}{1\ kg} \times patient\ weight = dose\ to\ administer$$

Note that…
- *Drug dose is often expressed in a unit of mass (weight) such as microg, mg or g.*
- *Patient weight is expressed in kg.*

Additionally, **if the drug is in solution** (e.g. oral, IV, IM, SC) the correct dose to be administered, may need to be drawn from a stock solution. This is a medication solution that contains a ratio of drug (either as solute or solid) in a diluent (*refresh these concepts in section 10 Dilutions using the expression solute in diluent*).

Stock solution is expressed as $\frac{stock\ dose}{stock\ volume} = stock\ solution$

Note that…
- *stock dose is often expressed in a unit of mass (weight) such as microg, mg or g.*
- *stock volume is often expressed in mL*

Using proportional thinking:

$$\frac{stock\ dose}{stock\ volume} = \frac{dose\ to\ administer}{volume\ to\ administer}$$

We can reorganise this relationship using simple algebra. This gives a formula to calculate **the volume to be administered that will contain the correct dose**:

$$volume\ to\ administer\ = \frac{dose\ to\ administer}{stock\ dose} \times stock\ volume$$

EXAMPLE PROBLEM:

Mr Small weights 60kg. He has been ordered a drug with a dosage of 10 mg per kg. How much drug should be administered? If the drug is available in a stock solution of 250mg/5mL, what volume of drug solution should be administered?

There are two parts to this question: 1) the dose of drug to give (in mg); 2) the volume of the stock solution to give that will contain the required dose (in mL).

Step One: Gather the facts/information
What is the drug dosage? **10 mg/kg**
What is Mr Small's weight? **60 kg**
What is the stock solution? **250 mg/mL**

Step Two: Find a solution map; a formula to apply to solve the problem

Part 1: $\frac{drug\ dose}{1\ kg} \times patient\ weight = dose\ to\ administer$

Part 2: $\frac{dose\ to\ administer}{stock\ dose} \times stock\ volume = volume\ to\ administer$

Step Three: Solve

Part 1: $\frac{10\ \text{mg}}{1\cancel{\text{kg}}} \times 60\ \cancel{\text{kg}} = 600\ \text{mg}$ $\therefore$ *the dose to be administered is* $600\ mg$

Part 2 : $\frac{600\ \cancel{mg}}{250\ \cancel{mg}} \times \frac{5\ mL}{} = 12\ mL$ $\therefore$ *the volume to be administered that contains* $600\ mg$ *is* $12\ mL$

Step Four: Check x3

1. Are both answers in the correct units for what is asked? Part 1 mg; Part 2 mL
2. Do both answers seem sensible? Is 600 mg a reasonable dose? Yes, even though we don't know the actual drug, we can consider Mr Small's weight versus the dose/kg and this seems sensible. Is 12 mL reasonable? Yes, if 5 mls contains 250mg we would expect to give more than double to give 600 mg.
3. Recheck the calculations $10 \times 60 = 600$; $\frac{600}{250} \times 5 = 12$

Question 17: Your Turn

Apply your understanding of proportional thinking to solve the following:

a. A patient is prescribed 150mg of soluble aspirin. We only have 300mg tablets on hand. How many tablets should be given?

b. A solution contains fluoxetine 20mg/5mL. How many milligrams of fluoxetine are in 40mL of solution?

c. A stock has the strength of 5000units per mL. What volume must be drawn up into an injection to give 6500units?

d. An intravenous line has been inserted in a patient. The total volume to be given is 1200mL over 5hours at a drop factor of 15drops/mL. How many drops per minute will the patient receive?

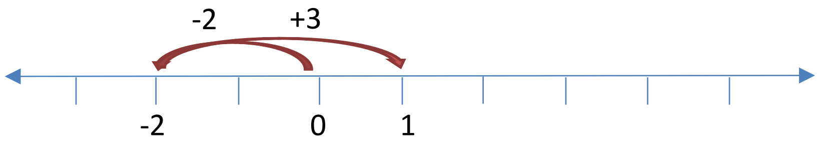
e. Penicillin syrup contains 200mg of penicillin in 5mL of water. If a patient requires 300mg of penicillin how much water will be required to make the syrup?

Answers

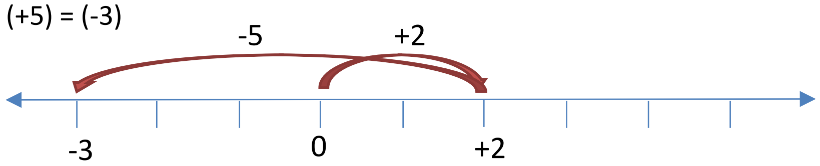
1. Arithmetic of Whole Numbers

Q1.

a. (-2) + 3 = 1



b. (+2) – (+5) = (-3)



Q2.

a. 13

b. 2

c. 21

d. 5

e. 1, 24, 2, 12, 3, 8, 4, 6

f. 7, 14, 21, 28, 35

2. Naming Fractions

Q3.

a. $\frac{3}{16}$

b. $\frac{1}{16}$

c. $\frac{3}{16}$

d. $\frac{4}{16} = \frac{1}{4}$

3. Equivalent Fractions

Q4.

a. $\frac{2}{3} = \frac{6}{9}$

b. $\frac{5}{7} = \frac{45}{63}$

c. $\frac{9}{10} = \frac{27}{30}$

d. $\frac{1}{52} = \frac{4}{13}$

e. $\frac{1\frac{1}{2}}{16} = \frac{3}{32}$
(You can’t have a fraction within a fraction)

f. $\frac{\frac{1}{2}}{16} = \frac{1}{32}$

5. Rounding and Estimating

Q5.

A. Round the following the 3 decimals

a. 34.599

b. 56.673

B. Estimate the following:

a. 30 x 60 = 1800

b. 36 – 13 = 23

6. Convert decimals into fractions

Q6.

a. $\frac{65}{100} = \frac{13}{20}$

b. $\frac{2666}{1000} = 2\frac{666}{1000} = 2\frac{333}{500}$

c. $\frac{54}{100} = \frac{27}{50}$

d. $\frac{314}{100} = 3\frac{14}{100} = 3\frac{7}{50}$

e. $40 \times \frac{2}{10} = \frac{40}{1} \times \frac{2}{10} = \frac{80}{10} = 8$

7. Converting fractions into decimals

Q7.

a. 0.739

b. 0.069

c. $(56 \times 3 + 2) \div 3 = 56.667$

d. 5.8

8. Fractions – addition, subtraction, multiplication and division

Q8.

a. $\frac{5}{15} + \frac{6}{15} = \frac{11}{15}$

b. $\frac{21}{28} + \frac{8}{28} = \frac{29}{28} = 1\frac{1}{28}$

c. $2\frac{8}{12} + 1\frac{9}{12} = 3\frac{17}{12} = 4\frac{5}{12}$

d. $2\frac{4}{24} + 3\frac{21}{24} = 5\frac{25}{24} = 6\frac{1}{24}$

Q9.

a. $\frac{9}{12} - \frac{4}{12} = \frac{5}{12}$

b. $\frac{2}{6} - \frac{3}{6} = -\frac{1}{6}$

Q10.

a. $\frac{12}{5} = \frac{5}{12}$

b. $\frac{7}{6} \times \frac{2}{9} = \frac{14}{54} = \frac{7}{27}$

c. $\frac{12}{5} \div \frac{35}{9} = \frac{12}{5} \times \frac{9}{35} = \frac{108}{175}$

d. $\frac{-7}{2} \times \frac{9}{-4} = \frac{-63}{-8} = 7\frac{7}{8}$
(A negative divided by a negative is a positive answer)

e. $\frac{14}{39}$

f. $\frac{3}{7} \times \frac{5}{2} = \frac{15}{14} = 1\frac{1}{14}$

g. $\frac{5}{4-14} = \frac{5}{-10} = -\frac{1}{2}$

h. $8 \times \frac{1}{2} = \frac{8}{2} = 4$

i. $\frac{17}{20} = \frac{68}{100} < \frac{22}{25} = \mathbf{\frac{88}{100}}$

j. $\frac{2}{4} = \frac{1}{2}$

k. $\frac{1}{5} \times 8 = \frac{8}{5}\ jugs\ per\ day$

$2\ jugs = \frac{10}{5}$

Remaining fraction = $\frac{10}{5} - \frac{8}{5} = \frac{2}{5}$

9. Percentage

Q11.

a. $\frac{10}{100} \times 80c = 8c$

$80c + 8c = 88c$

b. $\frac{70}{100} \times 180bpm = \frac{12600}{100} = 126bpm$

c. $\frac{3}{5} = \frac{60}{100} = 60\%$

$\frac{16}{25} = \frac{64}{100} = 64\%$

$0.065 = 6.5\%$

63%

64% is largest

10. Ratios

Q12.

a. $1\ cordial : 5\ water$
$6\ parts\ in\ total$
$1\ part = 600mL \div 6 = 100mL$
$Ratio = 100mL\ cordial :$
$500mL\ water$

b. $25\ pages : 30min$
$200\ pages :$
$240\ minutes\ or\ 4\ hours$

c. $17\ beats : 15\ sec$
$68\ beats : 60\ sec$

d. $1:3, 1:3, \mathbf{2:7}, 1:3$

Q13.

a. 3

b. 1:8

c. a. 100mL b. 100mL

d. $5000\ units : 1mL$
$1000\ units : \frac{1}{5}mL$
$3000\ units : \frac{3}{5}mL = 0.6mL$

11. Units and Unit Conversion

Q14.

a. $285cm \times \frac{1m}{100cm} = 2.85m$

b. $0.15g \times \frac{1000mg}{1g} = 150mg$

c. $200microgs \times \frac{1g}{1000\ microgs} = 0.2g$

Q15.

a. $120g \times \frac{1kg}{1000g} = 0.12kg$
$120g \times \frac{1000mg}{1g} = 120{,}000mg$

b. $4.264L \times \frac{1kL}{1000L} = 0.004264kL$
$4.264L \times \frac{1000mL}{1L} = 4264ml$

c. $670microg \times \frac{1g}{1000{,}000microg} = 0.00067g$

d. $1m \times \frac{100cm}{1m} = 100cm$

$1m^3 = 1m \times 1m \times 1m = 100cm \times 100cm \times 100cm = 1{,}000{,}000cm^3$

$1cm^3 = 1mL$

$1{,}000{,}000cm^3 = 1{,}000{,}000mL$

e. $38.10cm \times \frac{1\ inch}{2.54cm} = 15\ inches$

12. Rate

Q16.

Step One:

Distance first travelled = 156km

Distance after turn = 120km

Total distance = 156km + 120km = 276km

Time taken = 6hrs

Step Two:

$$Average\ speed\ = \frac{Change\ in\ distance}{time\ taken}$$

Step Three:

$$Average\ speed = \frac{276km}{6hrs} = 46km/h$$

Step Four:

$$46km/h \times 6hrs = 276km$$

13. Nursing Examples

Q17.

a. $tablets = \frac{150mg}{300mg} = \frac{1}{2}\ tablet$

b. $x\ mg\ fluoxetine = \frac{20mg}{5mL} \times \frac{40mL}{1} = \frac{800mg}{5} = 160mg$

c. $x\ mL\ of\ stock\ = \frac{6500\ units}{5000\ units} \times \frac{1mL}{1} = 1.3mL$

d. $Drops\ per\ minute\ = \frac{volume\ to\ be\ given\ (mL)}{time\ (minutes)} \times \frac{drop\ factor}{1}$

$1200\ mL\ per\ 5hrs$ (need this in minutes)

$5hrs \times \frac{60min}{1hr} = 300min$

$Therefore\ 1200mL\ per\ 300min$

Drop factor = 15 drops / mL

$Drops\ per\ minute = \frac{1200mL}{300min} \times \frac{15\ drops/mL}{1} = \frac{18000\ drops}{300min} = 60drops/min$

e. $x\ mL\ of\ water = \frac{300mg}{200mg} \times \frac{5mL}{1} = 7.5mL\ of\ water$