19143: Perform calculations in a primary industry context

Level 2

Learner Guide

PrimaryITO
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Unit standard 19143 v3	Level 2	Credits 3
Perform calculations in a primary industry context		

14 July 2020 Version 1

Contents

Introduction

Learning outcome

To successfully complete this unit standard you will show that you are able to:

- apply area calculations to workplace examples
- apply volume calculations to workplace examples
- apply percentage calculations to workplace examples
- apply average calculations to workplace examples.

If you require the Learner Guide to be printed on coloured paper, contact Primary ITO on 0800 20 80 20 and talk to our Learning Support Team.

Glossary

You may find new words (highlighted in **bold black)** as you read through this Learner Guide. The meanings of these words are in the glossary at the back.

Symbols

You'll also see symbols which we've used to help you know what's going on, for example:

Alert: you must be aware of this.

Activity: a written activity for you to do.

Do this: a practical activity for you to do.

Search online: refer to online references for information on this topic.

Top tip: key information and useful tips.

Question: a question for you to think about.

Assessment

You will find a separate assessment booklet for this unit standard. You will need to work through the activities in the assessment.

Your Verifier will fill in the Verifier declaration once they are satisfied you have achieved the learning outcomes for the unit standard. Your Verifier may be your Supervisor or Workplace Trainer.

The Assessor will check all declarations and fill in the final sign-off once final competency is achieved. The Assessor may be your Training Adviser or a Workplace Assessor.

Measurements

The metric system

The metric system is a system of measuring. It has three main units:

- **m** stands for metre, and measures the size of an object
- **Kg** stands for kilogram, and measures the weight (mass) of an object
- **s** stands for seconds, and measures time.

The imperial system

The imperial system in New Zealand was replaced by the metric system in 1976, sometimes people will refer to the imperial system by using inches, feet, and yards when referring to the size of an object or space.

Metric length

When we measure how tall, long and wide something is, we are taking the metric length of that object.

H	Height (is how tall something is)
L	Length (how long something is)
W	Width (how wide something is)

See example below, the height, length and width of the bag of sugar is represented using the letters ‘H’, ‘L’ and ‘W’.

The most common measurements when measuring metric lengths are:

- Millimetres (mm)
- Centimetres (cm)
- Metres (m)
- Kilometres (km)

10 millimetres is equal to 1 centimetre .

100 centimetres is equal to 1 metre.

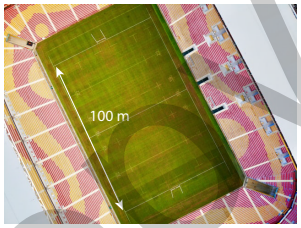
1000 metres is equal to 1 kilometre.

The lead of a pencil is about 1 mm wide.

The entire width of a marker is about 1 cm wide.

The length of a common guitar is 1 m long.

The length of a rugby pitch is 100 m, therefore 10 rugby pitches is equal to 1 km.



Measure the height, length and width of a bag of sugar.

Metric mass (weight)

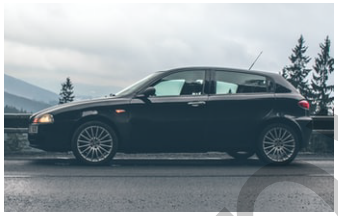
We measure mass by weighing an object. The most common measurements when measuring metric mass are:

- Grams (g)
- Kilograms (kg)
- Tonnes (t)

One paperclip weighs 1 g.

1 litre of milk weighs about 1 kg.

A small car weighs about 1 t.

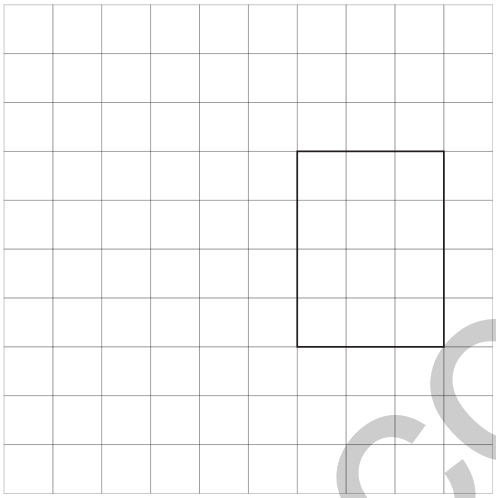


Activity: Converting grams to kilograms

If 1500g is equal to 1.5 kg, what is 1750 g in kg?

Area

Area measurements are used to determine how much space there is inside a 2-dimensional (2D) shape.

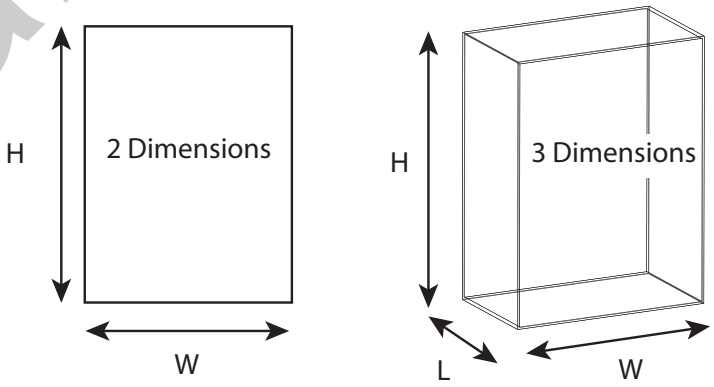


The amount of space inside the rectangle is the area.

Farming context

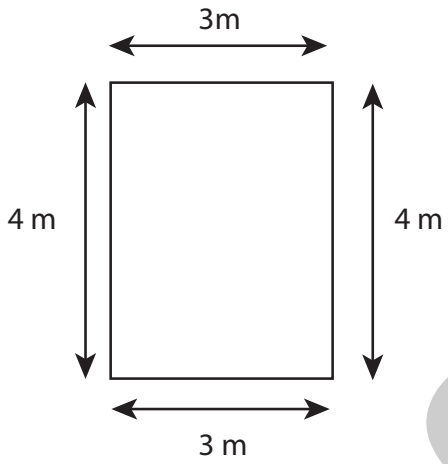
Calculating the area of a shape can be useful when working on a farm, for example, you may need to know how large a paddock is in order to calculate how many cows can graze in the paddock over a period of time.

Note the difference between 2-dimensional and 3-dimensional.



2-dimensional shape (left) and 3-dimensional shape (right).

The perimeter is the distance around the edge of a shape.



Insert caption for above diagram ...

Calculating the area

Understand how to calculate common shapes such as squares and rectangles.

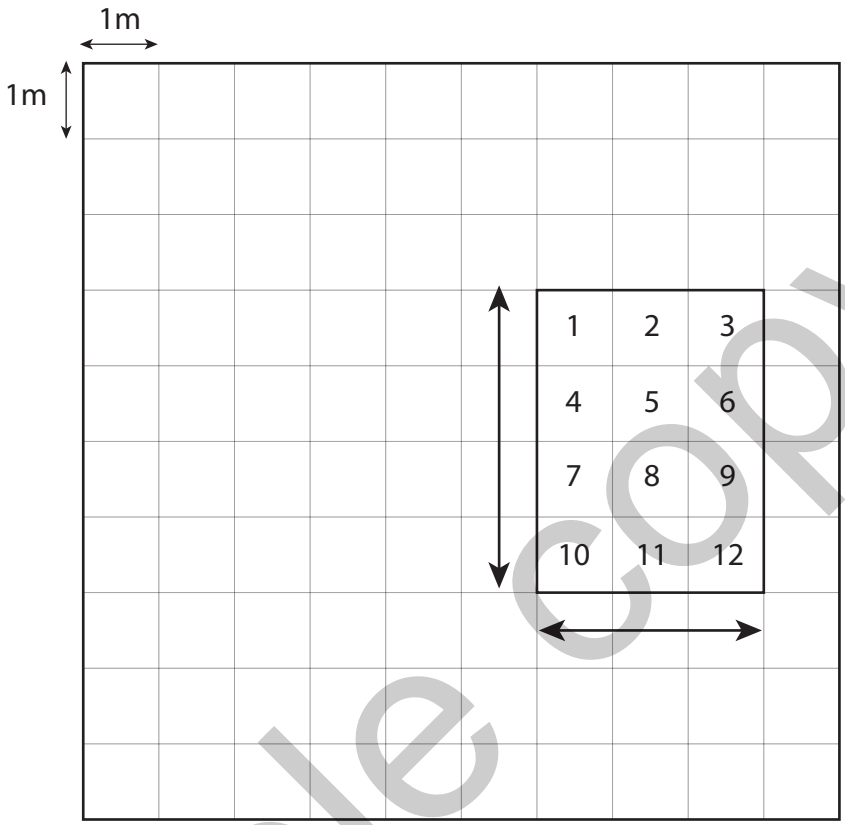
Grid method

When a shape is drawn on a scaled grid you can find the area by counting the amount of squares inside the shape.

In the example below, each grid square represents 1 m x 1 m, this means that each grid square is 1 metre 'squared' (1 m^2).

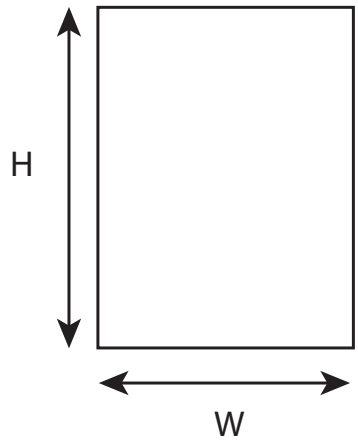
In mathematics the symbol ^{2} is used to abbreviate 'squared'.

There are 12 squares in the rectangle below, meaning that the area of the rectangle is 12 m².



Formula method

To find the area of a rectangle, multiply the height by the width.



Area = height x width

H = 8 m

W = 6 m

Area = 8 x 6 = 48 m^2

Hectares

A **hectare** is a unit of measurement, commonly used to measure the area of a paddock or a piece of land.

h is short for hectare e.g. 20 hectares is 20 h.

1 hectare is equal to 10,000 m^2.

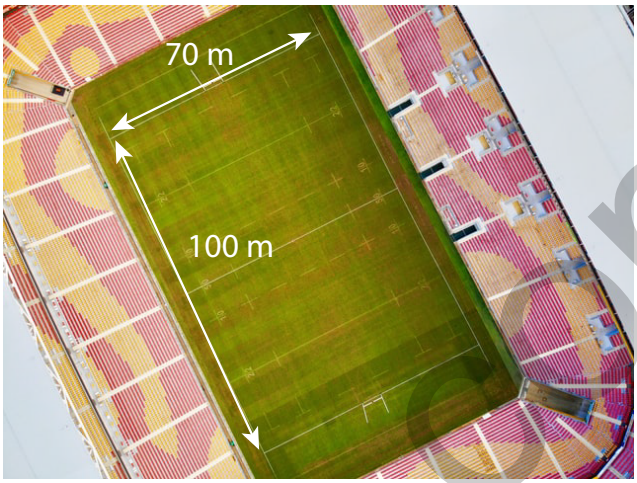
It is useful to know how to convert m^2 into hectares. For example, a paddock is 20,565 m^2. If we wanted to find out the size of that paddock in hectares we would divide 20,565 by 10,000.

20,565/10,000 = 2.06 hectares

The paddock is 2.06 hectares.

Activity: Calculating the area in metres

What is the area in m^2 of the rugby pitch below? Show your working out.



What is the area in hectares (h) of the same rugby pitch? Show your working out.

Volume

Volume measurements are used to determine how much space there is inside a 3-dimensional shape.

Farming context

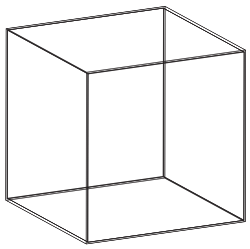
Calculating the volume of a shape can be useful when working on a farm, for example, you may need to know how large a trough is in order to calculate the amount of water it can hold.

In mathematics the symbol ^{3} is used to abbreviate 'cubed'.

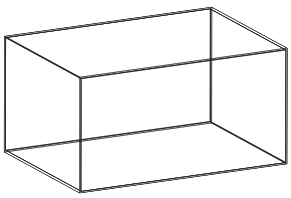
Calculating the volume

Understand how to calculate common shapes such as cubes, cuboids and cylinders.

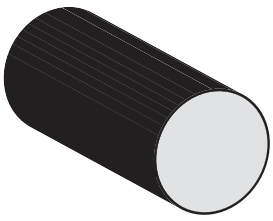
In a cube, the length, width and height are all equal.



A cuboid has unequal sides.

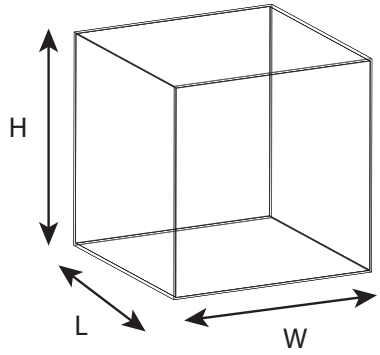


A cylinder is an extruded circle.



Formula method for the volume of cubes and cuboids

Volume of a cube or cuboid is calculated by measuring the height by the length by the width.



Volume = height x length x width

H = 1m

L = 1m

W = 1m

Volume = 1 x 1 x 1 = 1m³

Litres

A litre is a unit of measurement, used to measure the quantity of liquid.

L is short for Litres e.g. 20 Litres is 20L.

1 litre is equal to 1,000m³.

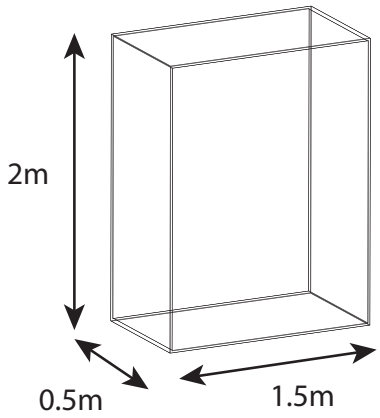
It is useful to know how to convert m³ into litres. Take for example, a tank that has a volume of 5 m³. If we wanted to find out how many litres of water that tank can hold, we would multiply 5 x 1000.

5 x 1000 = 5,000

The tank can hold 5,000 litres.

Activity: Calculating the volume of a cuboid

What is the volume in m^3 of the cuboid below? Show your working out.



How many Liters of water can the same cuboid hold when full?

A cube that is 1 metre on each side is also equal to 1,000 litres.

Formula method for the volume of cylinders

Pi

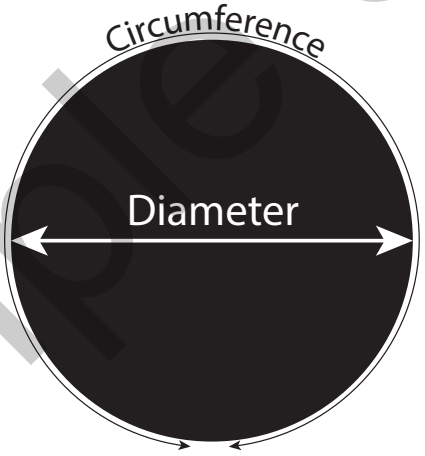
Before we explain how to find the volume of a cylinder, we must first understand what π is.

The symbol π is spelled ‘Pi’ and pronounced ‘pie’.

The definition of π is the circumference divided by the diameter.

Circumference/diameter = π = 3.14159

The circumference of a circle divided by the diameter of a circle is always π, no matter how large or small the circle is.

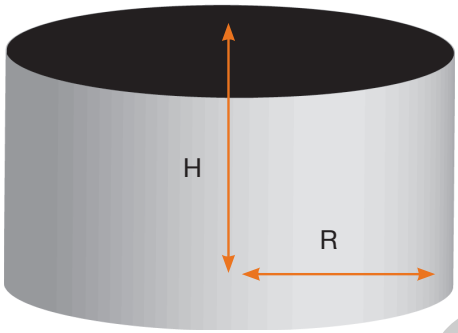


π is always approximately equal to 3.14159

Volume of a cylinder

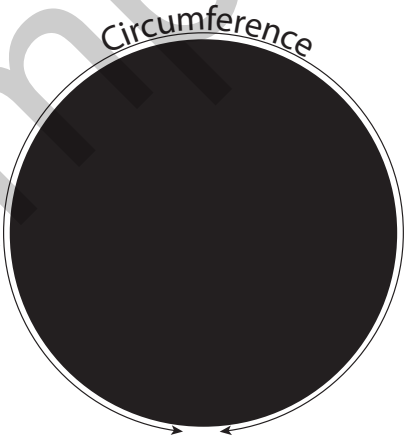
The volume of a cylinder is calculated by measuring ϖ multipied by radius² multiplied by height.

Volume of a cylinder = $\pi r^2 h$



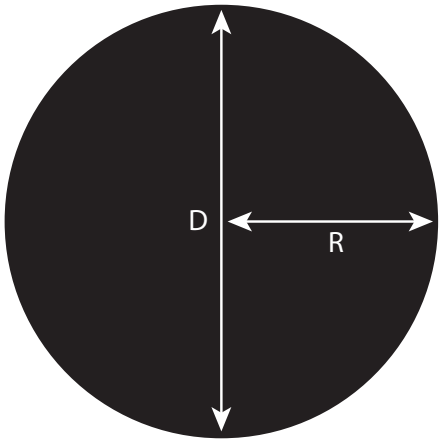
Circumference

The circumference is calculated by measuring the outside edge or rim of a circle.



Diameter and radius

The diameter is calculated by measuring one end of the circle to the other, making sure it passes through the centre point of the circle.

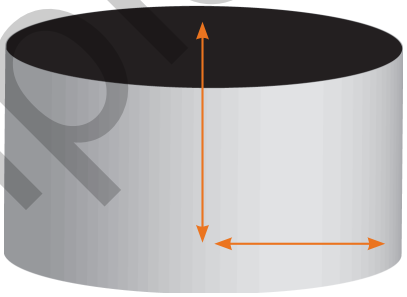


The radius is calculated either:

- dividing the diameter in half
- measuring a straight line from one edge of the circle to the centre point of the circle.

Measuring a cylinder example

In mathematics the symbol ^{3} is used when we are talking about the volume of a cylinder.



The dimensions of the cylinder above are:

H = 8 m

R = 4.5 m

Using the formula for measuring a cylinder Volume = $\varpi r^2 h$ we can calculate the volume as:

$$3.14159 \times 4.5^2 \times 8 = 508.9 \text{ m}^3$$

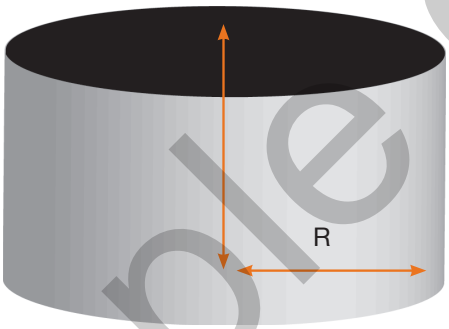
In this instance we would round our answer up to 509 m^3.

To convert this into litres we multiply 509 x 1000.

509 x 1000 = 509,000 L

Activity: Calculating the volume of a cylinder

What is the volume in m^3 of the cylinder below? Show your working out.



The dimensions of the cylinder are:

H = 20m

R = 11m

Percentages

Percent means out of 100, for instance, 1% means 1 out of 100.

Therefore, 50% means 50 out of 100 or 50/100.

When we write 50/100, we read it as ’50 out of 100’.

100% is 100/100, or exactly 1.

100% of any number is the original number, for example, if you got 100% in an exam that had 80 questions, that means you got 80 questions correct.

And 200% is 200/100, or exactly 2.

200% of any number is twice the original number. For example, 200% of 80 is 160.

Farming context

Calculating the percentage of a number can be useful when working on a farm, for example, you may need to estimate how much money you can make from your heifers if you intend to sell their calves for a certain amount of money.

Calving success is usually estimated as a percentage of the actual calves born and the calf survival to weaning.

Calculate the percentage of a number

In order to calculate the percentage of a number we divide the percentage by 100 then multiply by the number as in the example below.

For example, if we get 75% in an exam that has 80 questions, and we wanted to find out how many questions we got correct, we would work it out by doing the following:

75% = 75/100

75 ÷ 100 = 0.75

0.75 x 80 = 60

Therefore, you got 60 questions correct out of 80.

If you get 65 questions correct out of 80, how much percent of the questions did you get correct?

65/80 = 0.81

As a percent it is 81%.

0.81 x 100 = 81%

Search online: for the current purchase price of calves in New Zealand.

Activity: Calculating using percentages

If you have 65 heifers and it is estimated that 70% of them will have successfully given birth to healthy calves. How many calves will be born healthy?

Calculate the percentage as a loss or decline

In order to calculate the percentage as a decrease or difference between two numbers, divide the decrease by the original number and multiply the answer by 100.

% increase = increase ÷ original number x 100

For example, in 2018 the price of beef per kg in the butcher shop was $4.90, in 2020 the price was $5.20. By what percentage did the price of beef increase in 2020?

To answer this question we must first calculate the difference in $ between 2018 and 2020.

$4.90 - $5.20 = 0.30 cents (this is the increase)

0.30 ÷ 4.90 = 0.061

We then multiply the answer by 100 to get the percentage.

Answer = 0.061 x 100 = 6%

To multiply a number by 100, simply move the decimal place two places to the right.

The price of beef increased by 6% between 2018 and 2020. Calculate the mark-up as a percentage.

Mark-up is the amount of money that is added to the cost price of goods to cover overheads and profit.

Cost price is the price you pay for the goods.

For example, if you buy a cow for $1000 (cost price) and you sell it for $1500, then your mark-up is $500.

Mark-up = profit/cost x 100%

Profit = $1500 - $1000 = $500

$500/$1000 = 0.5

0.50 x 100 = 50%

To find the percentage, multiply by 100.

Search online: for the current price of beef per kg in New Zealand.

Activity: Calculating using percentages

If you sell 1kg of poultry for $2.15 and the retail cost per kg is $6.10.

What is your percentage mark-up in your 1kg of meat?

Averages

An average number is the sum of the numbers divided by how many numbers are being averaged.

For example, if we wanted to know the average of this group of numbers, 26, 20, 10, 24. We would first add them all together.

$$26 + 20 + 10 + 24 = 80$$

Then divide 80 (the sum of the numbers) by 4 (because there are 4 different numbers in the group).

$$80/4 = 20$$

The average is 20.

An ‘average’ number can sometimes be referred to as the ‘mean’ number.

Farming context

Calculating the average of a number can be useful when working on a farm. For example, you may need to know the average rainfall in November in your location in order to estimate the impact the rain will have on your crops the following year.

Calculating the missing number if you have the average number

Sometimes you may need to find the missing value from a group of numbers when you already know the average.

For example, Sione wants to increase his sales by 75% in 2021. He has one more year to meet this target.

In the last 5 years, his sales increased by 69%, 80%, 72%, 77% and 64%, by what percent must his sales increase by in order to meet his average target of 75%?

We take 75% as the average and we work backwards by multiplying 75 x 6 (as 6 is the amount of numbers in the group).

$$75 \times 6 = 450$$

$$450 - 69 - 80 - 72 - 77 - 64 = 88$$

Sione must increase his sales by 88% in the 6th year in order to hit his average target of 75%.

Activity: Finding the missing value using averages

How many kiwifruit were exported in 2016 if the overall average between 2007-2016 is 51 million?

Kiwifruit exported to international countries, 2007 - 2016	
Year	Amount in millions
2007	40
2008	40
2009	45
2010	47
2011	48
2012	52
2013	54
2014	55
2015	59
2016	?

Activity: Calculating the average

What is the average price of cauliflower between March – December 2019?

Cauliflower – monthly weighted average price ($/kg), March – December 2019	
Month in 2019	Weighted average price
March	4.58
April	4.03
May	3.45
June	3.76
July	2.71
August	3.43
September	3.91
October	3.94
November	4
December	3.95

Ratio

A ratio is how much there is in comparison to another.

For example, if there are 10 heifers and 2 bulls in a paddock, then the ratio of heifers to bulls is 10 heifers to 2 bulls.

Ratios can be shown in different ways. For example, 10 heifers to 2 bulls can be shown as:

- 10:2
- 10 to 2
- 10/2

Ratios can also be scaled up and down.

- 10:2 = 20:4 (scaled up)
- 10:2 = 5:1 (scaled down)

These are examples of 'part-to-part ratios' i.e. comparing one number to another.

Farming context

Calculating ratios can be useful when working on a farm. For example, you may need to know how much herbicide you need to mix with water, as the instructions will usually be in a ratio format.

Part to whole ratios

A ratio can also be compared to the whole lot in the ratio. That means, comparing one number to the combined sum of the other parts in the ratio.

For example, if there are 6 apples and 4 pears:

- the part-to part ratio = 6:4
- the part-to-whole ratio of apples to whole amount = 6:10.

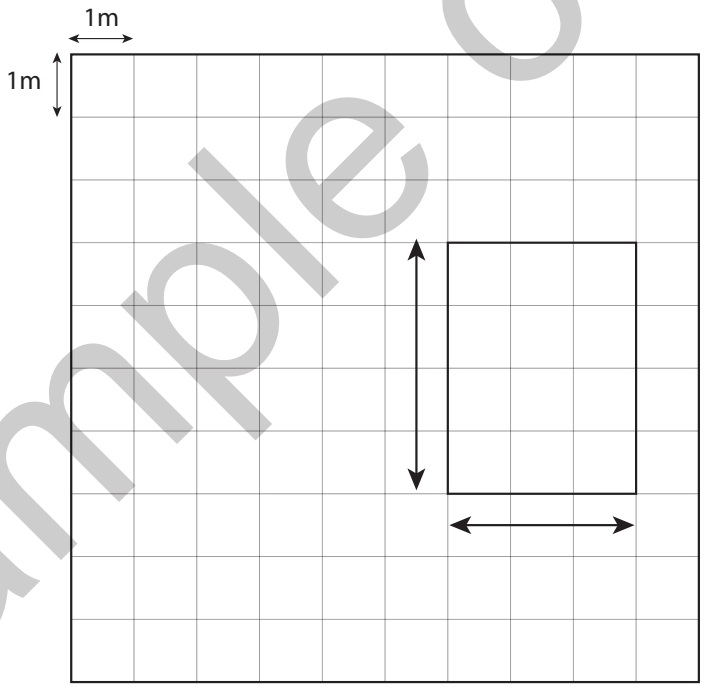
Ratios and measurement

In some instances, you may need to break down a ratio into a form of measurement.

For example, if you are required to mix cement, sand, and gravel together to make concrete, then you will need to know the amount in either weight or volume of each ingredient in order to get the ratio correct.

If the ratio of cement to sand to aggregate is 1:3:6 and if we wanted to know how much sand etc to measure, we would first find out how much ground we need to cover in cement, in cubic metres (m3).

Say we wanted to concrete the floor in the image below.



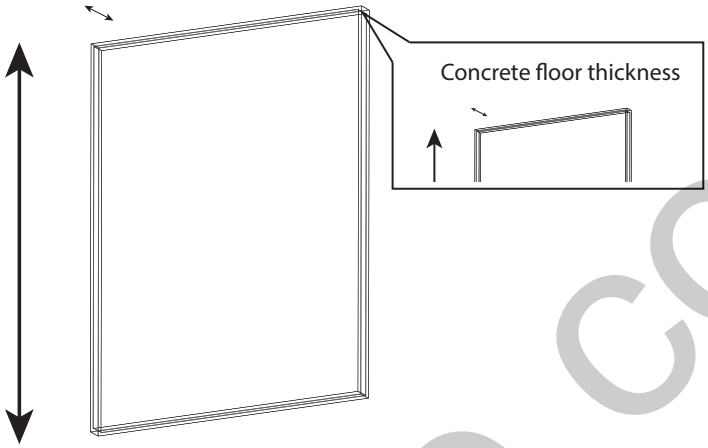
We can work out the area very easily:

$$4 \text{ m} \times 3 \text{ m} = 12 \text{ m}^2$$

However, we need to know the volume, therefore we need to know how thick the concrete floor needs to be. We will build the floor 175 mm thick.

In New Zealand, it is recommended that concrete floors are between 150mm - 200mm thick, depending on what the floor will be used for.

It can be easier to visualise the floor as a 3-dimensional object.



Firstly, we need to find the volume.

$4\ m \times 3\ m \times 0.175\ m = 2.1m^3$

The volume of concrete needed is $2.1m^3$.

Secondly, we would work out how much ground the entire ratio (whole part) needs to cover.

We want 1 + 3 + 6 = 10 (whole ratio part) to cover $2.1m^3$.

Thirdly, we work out how much 1 part concrete will cover.

$2.1m^3/10 = 0.21m^3$ (1 part)

Lastly, we multiply 1 part by the different ratio values to get $1.26m^3$.

$0.21m^3 : 0.63m^3 : 1.26m^3$

Converting m^3 into litres

If 1 m^3 is equal to 1000 litres, then simply multiply 1 m^3 x 1000.

$1\ m^3 \times 1000 = 1000\ L$

There are 1000 millilitres in a litre.

Converting m^3 into tonnes

If 1 m^3 is equal to 2.2 tonne, then simply multiply 1 m^3 x 2.2.

$1\ m^3 \times 2.2 = 2.2\ t$

You must know the amount of tonne per 1 m^3 in order to convert m^3 to tonne.

Activity: Calculating using ratios

If 100 litres of **two-stroke petrol** allows you to cover 1 hectare of land with a mix ratio 50:1 (50 litres petrol to 1 litre oil).

How much petrol in litres would you need to cover 60 hectares of land?

Glossary

Term	Definition
Area	A unit of measurement used to measure a piece of land or surface.
Average	A number expressing the central value of typical value of a group of numbers.
Hectare (ha)	A metric unit of square measurement equal to 10,000 square metres.
Herbicide	A substance that is toxic to plants. It is used to kill unwanted vegetation.
Two-stroke petrol	Is unleaded petrol mixed with two stroke oil. It is used to fuel machines with a 2 stroke engine and is commonly used in hand-held power tools like chainsaws.
Percentage	A proportion or part related to a whole value.
Volume	The amount of space a substance of object occupies.

More information

What	Where to go?
MathsNZ	www.mathsnz.com

Resource Feedback

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Please contact us via email **product@primaryito.ac.nz** if you have any suggestions that you feel would be useful.

Please remember to indicate the resource you are giving feedback on in your email, and please provide your contact details.

Thank you for taking the time to provide us with feedback.