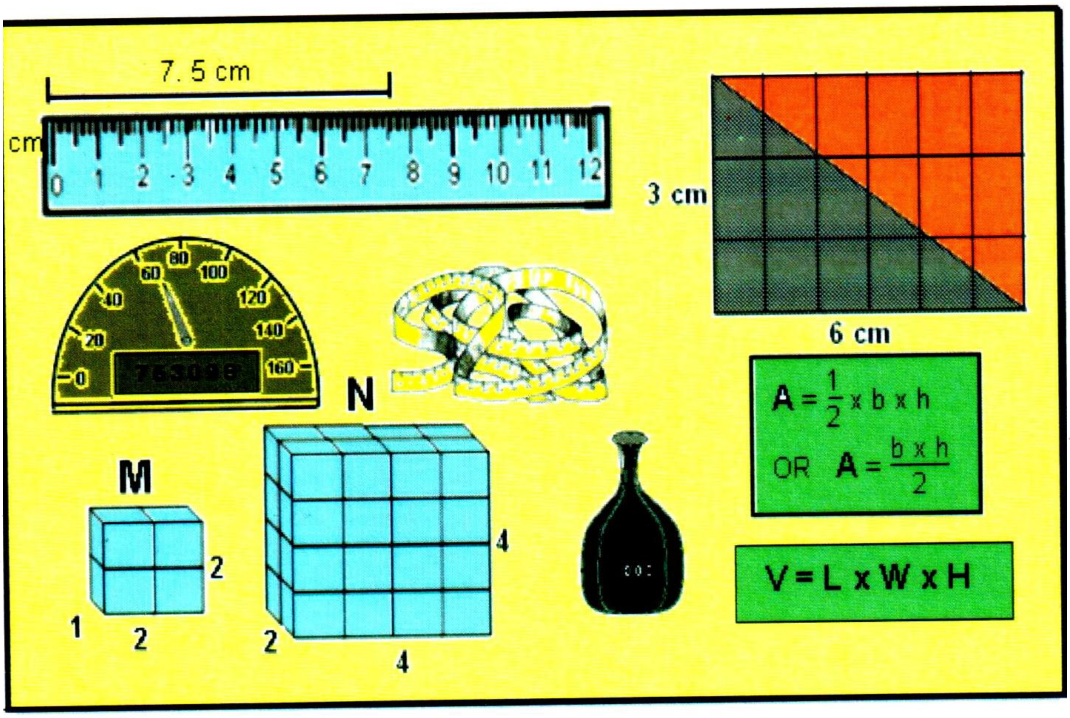
DEPARTMENT OF EDUCATION

# GRADE 7

# MATHEMATICS

# STRAND 3




# MEASUREMENTS (1)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PAPUA NEW GUINEA

# GRADE 7

# MATHEMATICS

# STRAND 3

# MEASUREMENTS (1)

| | |
|---|---|
| **SUB-STRAND 1:** | **LENGTH** |
| **SUB-STRAND 2:** | **AREA** |
| **SUB-STRAND 3:** | **VOLUME AND CAPACITY** |
| **SUB-STRAND 4:** | **DIRECTIONS** |

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We acknowledge the contributions of all Secondary and Upper Primary Teachers who in one way or another helped to develop this Course.

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**MR. DEMAS TONGOGO**
Principal- FODE

Written by: Luzviminda B. Fernandez
SCO-Mathematics Department

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## SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is part and parcel of the new reformed curriculum. The learning outcomes are student-centered with demonstrations and activities that can be assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution and Government Policies. It is developed in line with the National Education Plans and addresses an increase in the number of school leavers as a result of lack of access to secondary and higher educational institutions.

Flexible, Open and Distance Education curriculum is guided by the Department of Education‟s Mission which is fivefold:

- to facilitate and promote the integral development of every individual
- to develop and encourage an education system that satisfies the requirements of Papua New Guinea and its people
- to establish, preserve and improve standards of education throughout Papua New Guinea
- to make the benefits of such education available as widely as possible to all of the people
- to make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced through this course to provide alternative and comparable pathways for students and adults to complete their education through a one system, two pathways and same outcomes.

It is our vision that Papua New Guineans‟ harness all appropriate and affordable technologies to pursue this program.

I commend all the teachers, curriculum writers and instructional designers who have contributed towards the development of this course.

…………………………………………

**DR. UKE KOMBRA, PhD**
Acting Secretary for Education

# STRAND 3: MEASUREMENTS (1)

Dear Student,

This is the Third Strand of the Grade 7 Mathematics Course. It is based on the NDOE Upper Primary Mathematics Syllabus and Curriculum Framework for Grade 7.

**This Strand consists of four Sub-strands:**

**Sub-strand 1: Length**
**Sub-strand 2: Area**
**Sub-strand 3: Volume**
**Sub-strand 4: Estimation**

Sub-strand 1 – **Length** – You will estimate and measure distances using meter and kilometer measurements. You will measure the perimeter of regular and irregular polygons. You will also learn how to convert metric units of measurement from one unit to another. Lastly, you will investigate and measure the circumference of a circle.

Sub-strand 2 – **Area** – You will revise more about the meaning of area and area rules for triangles and rectangles. You will compare areas by estimation and learn how to work out the measurement of large areas. You will also investigate area rules of composite shapes and some special shapes like the parallelogram, the rhombus and the trapezium.

Sub-strand 3 – **Volume** – You will learn about the meaning of solid shapes and the two main families of solids, the prisms and the pyramid. You will investigate volumes of simple and compound prismatic solids. You will also learn to convert metric units of capacity and to work out problems on volume and capacity.

Sub-strand 4 – **Estimation** – You will learn to round off amounts and use a variety of estimation strategies and estimate sums of money.

You will find that each lesson has reading materials to study, worked examples to help you, and a Practice Exercise for you to complete. The answers to practice exercise are given at the end of each sub-strand.

All the lessons are written in simple language with comic characters to guide you and many worked examples to help you. The practice exercises are graded to help you to learn the process of working out problems.

We hope that you will find this strand both challenging and interesting.

All the best!

Mathematics Department
FODE

# STUDY GUIDE

**Follow the steps given below as you work through the Strand.**

Step 1: Start with SUB-STRAND 1 Lesson 1 and work through it.

Step 2: When you complete Lesson 1, do Practice Exercise 1.

Step 3: After you have completed Practice Exercise 1, check your work. The answers are given at the end of SUB-STRAND 1.

Step 4: Then, revise Lesson 1 and correct your mistakes, if any.

Step 5: When you have completed all these steps, tick the check-box for Lesson, on the Contents Page (page 3) like this:

$\boxed{\surd}$ Lesson 1: Measures of Length

Then go on to the next Lesson. Repeat the same process until you complete all of the lessons in Sub-strand 1.

> As you complete each lesson, tick the check-box for that lesson, on the Content Page 3, like this $\boxed{\surd}$.This helps you to check on your progress.

Step 6: Revise the Sub-strand using Sub-strand 1 Summary, then do Sub-strand test 1 in Assignment 3.

Then go on to the next Sub-strand. Repeat the same process until you complete all of the four Sub-strands in Strand 3.

<u>Assignment:</u> (Four Sub-strand Tests and a Strand Test)
When you have revised each Sub-strand using the Sub-strand Summary, do the Sub-strand Test in your Assignment. The Course book tells you when to do each Sub-strand Test.

When you have completed the four Sub-strand Tests, revise well and do the Strand Test. The Assignment tells you when to do the Strand Test.

> The Sub-strand Tests and the Strand Test in the Assignment will be marked by your Distance Teacher. The marks you score in each Assignment will count towards your final mark. If you score less than 50%, you will repeat that Assignment.

Remember, if you score less than 50% in three Assignments, your enrolment will be cancelled. So, work carefully and make sure that you pass all of the Assignments.

# SUB-STRAND 1

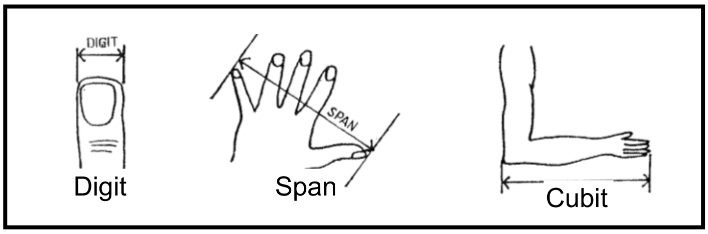
# LENGTH

# SUB-STRAND 1: LENGTH

## Introduction

You learnt in Grade 6 that in the past, people used many things as units of measurement. The Ancient Egyptians, for example, used different parts of their bodies to measure the length of objects.

Due to problems met using these units of measurement, a more common and easy system of measurement for everyone was introduced.




## The Metric System of Measurement

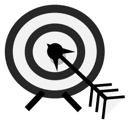
In the metric system the basic unit is the **metre**. The prefixes **kilo**, **centi** and **milli** are then added to give the other most common units as shown in the table below.

| Unit of Measurement | Symbol | Meaning |
|---|---|---|
| kilometre | ***km*** | 1000 m |
| metre | ***m*** | 1m |
| Centimtre | ***cm*** | $\frac{1}{100}$ m |
| millimetre | ***mm*** | $\frac{1}{1000}$ m |

In this Sub-strand, you will estimate and measure using metric units of lengths on maps and other sources, use appropriate units in calculations and investigate and measure the circumference of a circle.

# Lesson 1: Measures of Length

You learnt something about length in your Lower primary Mathematics.



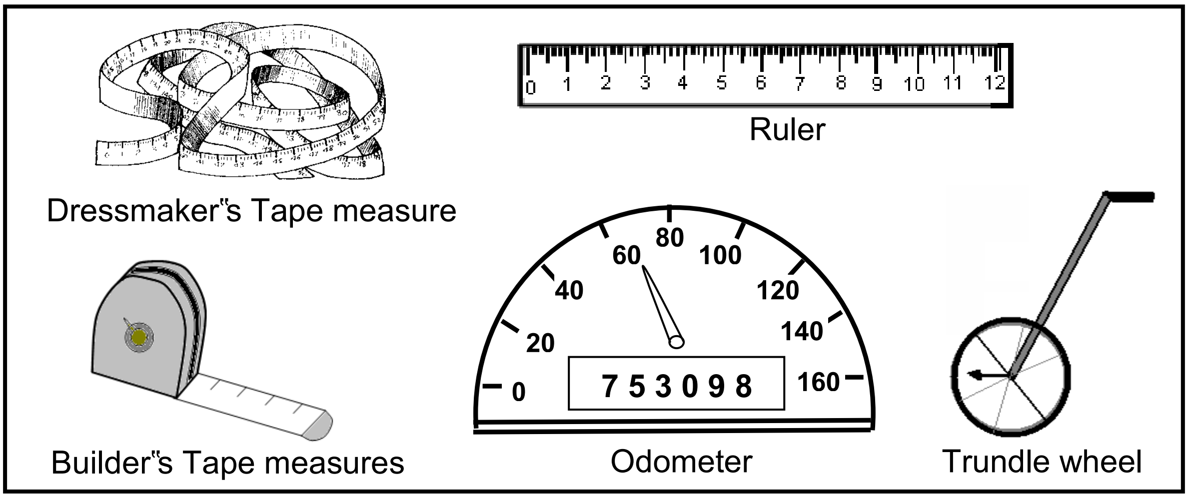
In this lesson, you will:
- identify instruments used to measure length
- identify units of measure
- use the appropriate metric units for a given length.

## Measuring Instruments

Mankind has devised instruments to help them measure quantities. To measure lengths and distances, we use a ruler, a meter stick, a tape measure and so on.

First you will learn to identify some of these measuring instruments and their uses.

Look at the diagram below.




Each instrument or tool is marked off in units suitable to the lengths it is likely to be used to measure.

1. The **Ruler** is a simple measuring instrument used to measure shorter lengths.

2. The **Tape Measure** is a simple measuring instrument for measuring lengths.
   - The **dress maker's tape measure** is used for body measurements like the arms and the waist. It is marked in **inches** and **centimetres.**
   - The **builder's tape measure** is used for longer lengths like the height of a classroom. It is marked in **centimetres** and **metres**.

3. The **odometer** on a car usually measures distances in tenths of a kilometre. The end digit (often in red) measures the tenths, so the remaining digits indicate the number of kilometers the car has traveled.

4. The **trundle wheel** measures longer distances like the length of a sports field. It is marked in **metres**.

To get the length of an object, we need to measure them. The most convenient instrument to use depends on the size of the object being measured.

Examples

What measuring instrument would we use for each of the following?

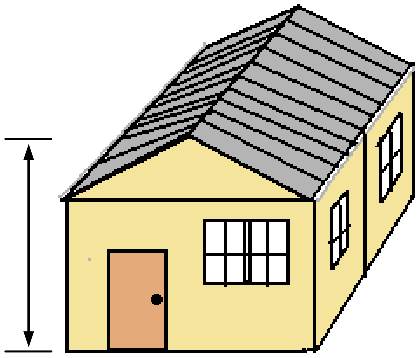
The length of the glue stick

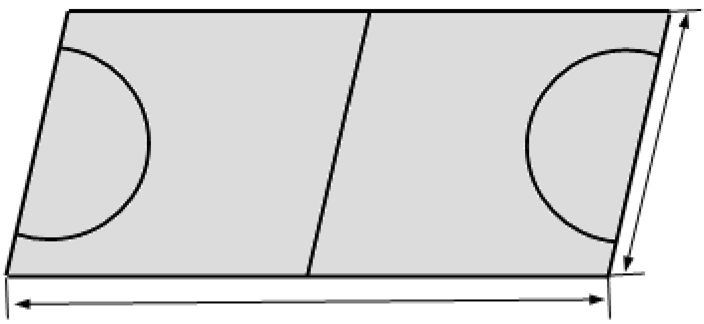
The width of a book


The size of a shoe

Since the objects above are with short lengths, we can use the **ruler** to measure them.

Now, for the lengths of the objects below, what measuring instrument would we use?


The height of a house


The length and width of a tennis court

For longer distances, we can use the **builder's tape measure, meter stick** or **trundle wheel.**

Now we will look at the different units of length.

**Units of Length**

The ***metre*** is the basic unit of length in the metric system. The metre is divided into ten equal parts called ***decimetres***. Each of these ten parts is divided into ten smaller parts called ***centimetres***. Each centimetre is divided further into ten smaller parts called ***millimetres.***

The prefixes **kilo, centi** and **milli** are then added to give the other most common units as shown in the table on the next page.

## UNITS OF LENGTH

| | | |
|---|---|---|
| 10 millimetres (mm) | = | 1 centimetre (cm) |
| 10 centimetres (cm) | = | 1 decimetre (dm) |
| 10 decimetres (dm) | = | 1 metre (m) |
| 10 metres (m) | = | 1 decametre (dam) |
| 10 decametres (dam) | = | 1 hectometre (hm) |
| 10 hectometres (hm) | = | 1 kilometre (km) |

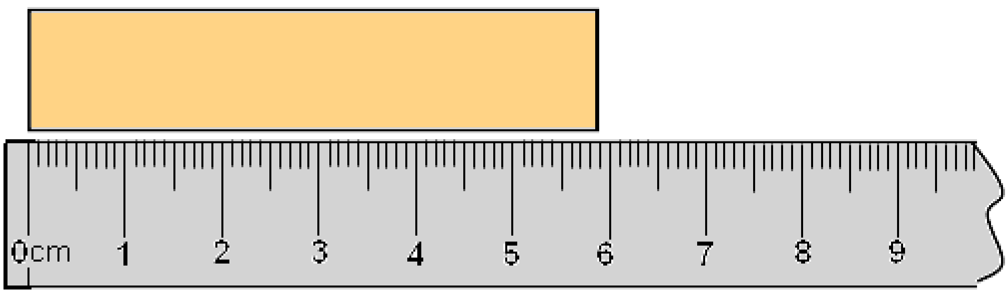
Decimetre, decametre and hectometre are rarely (not often) used. But they are still included in the table to help us see that the metric system is based on 10 and powers of 10.

| Unit | Symbol | Meaning | |
|---|---|---|---|
| kilometre | km | 1000 m | A kilometre is 1000 m. |
| metre | m | 1 m | A metre is 100 centimetres |
| centimetre | cm | $\frac{1}{100}$ m | A centimetre is one-hundredth of a metre. |
| millimetre | mm | $\frac{1}{1000}$ m | A millimeter is one-thousandth of a metre. |

When small lengths are being measured, like lines that can be drawn on this page, we usually give our answers in **centimetres** or **millimetres.** For longer lengths like the height of your classroom, we use **metres** and for very long lengths, like the distance from Port Moresby to Madang, we use **kilometres**.

### Measuring Length

The diagram below shows a ruler being used to measure the length of a rectangle.




What do you think is the length of the rectangle?

You are right when you say that the length is <u>about</u> 6 centimetres.

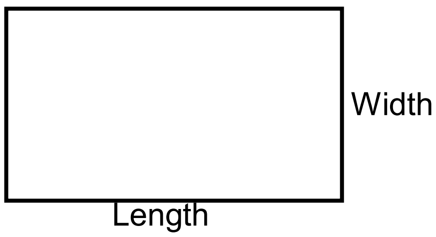
**No measurement can be given exactly. However, the smaller the divisions on the measuring instrument, the more precise the measurement can be.**

Now, get your ruler and measure the following lines and sides of the shapes below.

Write your answers to the nearest centimetres.

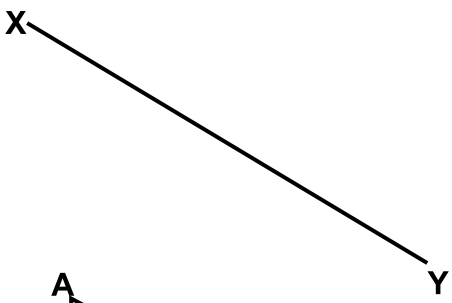
1. 


**Answer:** Length __________

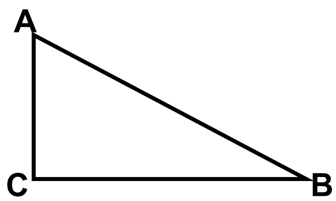
2. 


**Answer:** Length __________

Width __________

3. 


**Answer:** Line **XY** __________

4. 


**Answer:** AB__________

BC__________

AC__________

---

Compare your answers with the answers in the box.

Answers:

1. 7 cm
2. W = 3 cm, L = 5 cm
3. 6 cm
4. AB = 4 cm, BC = 4cm, AC = 2 cm

---

**NOW DO PRACTICE EXERCISE 1**

## Practice Exercises 1

1) What is the symbol for each of the following metric units in measuring length?

a) metre Answer:____________
b) centimetre Answer:____________
c) millimetre Answer:____________
d) kilometre Answer:____________

2) What units of length would you use for the following measurements?

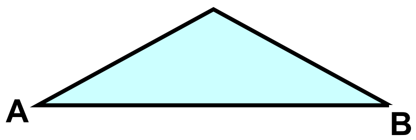
a) the length of your classroom Answer:____________
b) the measurement of your foot Answer:____________
c) the distance between Lae and Port Moresby Answer:____________
d) the width of an A4 paper Answer:____________
e) the height of a 2-storey house Answer:____________

3) Use your ruler to estimate the length of **AB** indicated in the following diagrams.

Write your answers to the nearest centimetres.

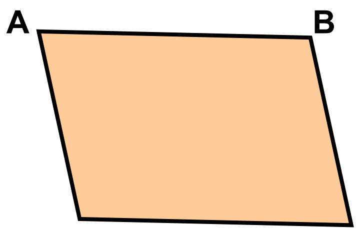
a) **A** ________________________________ **B** Answer:___________

b)



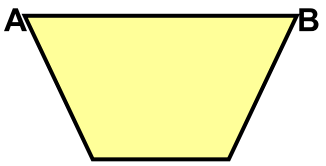

Answer: ___________

c)




Answer: ___________

d)

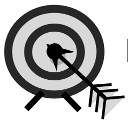



Answer: ___________

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 1**

# Lesson 2: Unit Conversion

You learnt to identify instruments used to measure length in lesson 1. You also learnt the units of measures for length.



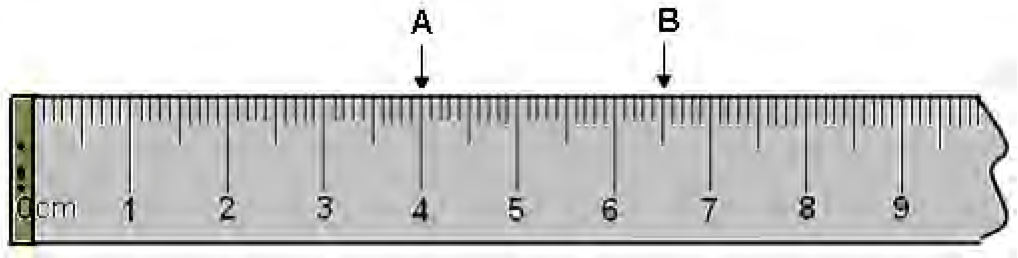
In this lesson, you will:

- read measurements using a ruler or tape measure.
- convert units of length from one unit to another.

## Reading Measurements

Study the worked examples below on reading measurements in centimetres and millimetres using rulers or tape measures.

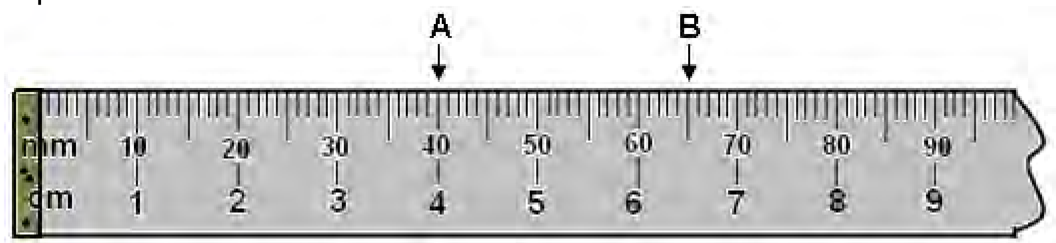
Example 1




How would you read the measurement indicated by point A and point B on the ruler to the nearest centimetre?

- To the nearest centimetre A would be 4 cm.
- To the nearest centimetre B would be 6.5 cm.

Example 2



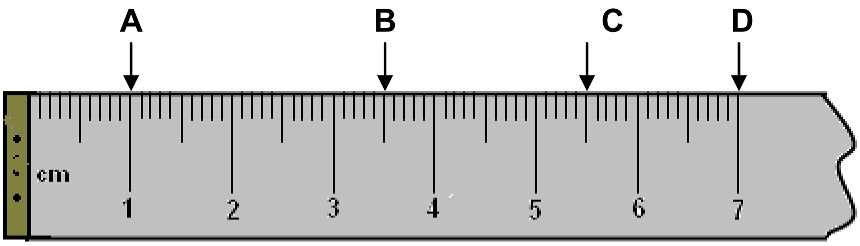

What would be the reading of point **A** and point **B** on the ruler to the nearest millimetre?

- To the nearest millimetre **A** would be 40 mm.
- To the nearest millimetre **B** would be 65 mm.

Measurement **A** = 40 mm is also the same as 4 cm.
Measurement **B** = 65 mm is also the same as 6.5 cm.

Example

Write down the length of each measurement indicated correct to the nearest centimetre and its equivalent to the nearest millimetre.




**Answer:** **A = ______cm ;** **A = ________ mm**

**Answer:** **B = ______cm ;** **B = _________mm**

**Answer:** **C = ______cm;** **C = _________mm**

**Answer:** **D = ______cm;** **D = _________mm**

| Answers: | |
|---|---|
| A = 1 cm | ; 10 mm |
| B = 3.5 cm | ; 35 mm |
| C = 5.5 cm | ; 55 mm |
| D = 7 cm | ; 70 mm |

**Unit Conversion**

To change one unit to another, you must know the metric units. You must also know which units are small and which are big.

Let us test your ability by answering these simple questions.

1. Which is smaller? centimetre or metre? **Answer:________**

2. Which is the largest? millimetre, metre, centimetre, kilometre **Answer :________**

3. Which is the smallest? millimetre, metre, centimetre, kilometer **Answer :________**

4. Arrange the units millimetre, metre, centimeter, kilometre from smallest to largest:

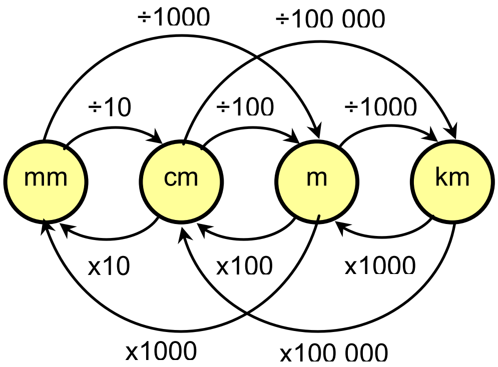
**Answer: __________, ___________, ___________, ___________**

Compare your answers to the one below.

Answers:
1. centimetre
2. kilometre
3. millimetre
4. millimetre, centimetre, metre, kilometre

| **These conversions are to be remembered:** | | |
|---|---|---|
| **1 kilometre (km)** | **=** | **1000 metres (m)** |
| **1 metre (m)** | **=** | **100 centimetres (cm)** |
| **1 centimetre (cm)** | **=** | **10 millimetres (mm)** |

Here is a chart you can follow to convert units from small to big unit and vice versa.




To use the chart, start at the unit to be converted and follow the directions along the arrows until you arrive at the desired unit.

- **To convert small units to large or big unit, you divide.**
- **To convert large or big units to small units, you multiply.**

Now look at the following examples.

**Conversion of small units to large or big units**

Example 1

Convert 50 000 centimetres into metres.

Solution: $50\ 000 \text{ cm} = \dfrac{50\ 000}{100}$

$= 500$

So, 50 000 cm = **500 m**

| cm to m is dividing by 100 |
|---|
| 100 cm = 1 m |

Example 2

Convert 763 metres into kilometres.

Solution: $763 \text{ m} = \dfrac{763}{1000}$

$= 0.763$

So, 763 m = **0.763 km**

| m to km is dividing by 1000 |
|---|
| 1000 m = 1 km |

Example 3

Convert 350 000 miliimetres to metres.

Solution: **Method 1**

Step 1: First change 350 000 mm into cm

$$350\ 000 \text{ mm} = \frac{350\ 000}{10}$$

$$= \mathbf{35\ 000\ cm}$$

| mm to cm is dividing by 10<br>Since, 10 mm = 1 cm |
|---|

Step 2: Now change 35 000 cm into m

$$35\ 000 \text{ cm} = \frac{35\ 000}{100}$$

$$= 350$$

| cm to cm is dividing by 100<br>Since, 100 cm = 1 m |
|---|

So, 350 000 mm = **350 m**

or by using **Method 2**

Step: Change 350 000 mm into m

$$350\ 000 \text{ mm} = \frac{350\ 000}{1000}$$

$$= 350$$

| mm to m is dividing by 1000<br>Since, 1000 mm = 1 m |
|---|

So, 350 000 mm = **350 m**

Now let us go to the next set of examples. This time we convert or change large or big units to small units.

**Conversion of large units to small units**

Example 1

Convert 5 metres to centimetres.

| m to cm is multiplying by 100<br>since, 1 m = 100 cm |
|---|

Solution: 5 m = 5 x 100

= 500

So, 5 m = **500 cm**

Example 2

Convert 1.2 kilometres to metres

Solution: 1.2 km = 1.2 x 1 000

= 1200 m

So, 1.2 km = **1200 m**

| km to cm is multiplying by 1000<br>Since, 1 km = 1000 m |
|---|

Example 3

Convert 2.45 m to mm

Solution: **Method 1**

Step 1 First change 2.45 m into cm

2.45 m = 2.45 x 100

= **245 cm**

| m to cm is multiplying by 100<br>Since, 1 m = 100 cm |
|---|

Step 2 Now change 245 cm into mm

245 cm = 245 x 10

= 2450

So, 2.45 m = **2450 mm**

| cm to mm is multiplying by 10<br>Since, 1cm = 10 mm |
|---|

OR by using **Method 2**

Solution:

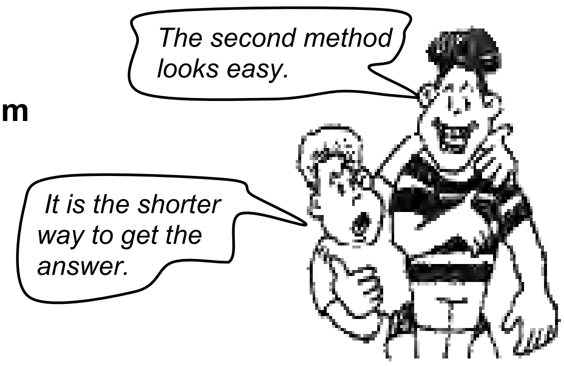
Change 2.45 m into mm

2.45 m = 2.45 x 1000

= 2450

So, 2.45 mm = **2450 mm**

| m to mm is multiplying by 1000<br>Since, 1 m = 1000 mm |
|---|




**NOW DO PRACTICE EXERCISE 2**

## Practice Exercises 2

1. Convert each of these measurements into the larger units indicated.

(a) 300 cm to m

Solution:

(b) 9000 cm to km

Solution:

(c) 65 mm to m

Solution:

(d) 200 000 mm to km

Solution:

2. Convert each of these measurements into smaller units as indicated.

(a) 5 cm to mm

Solution:

(b) 2.67 km to m

Solution:

(c) 2.9 m to mm

Solution:

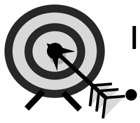
(d) 2.35 m to cm

Solution:

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 1.**

# Lesson 3: Estimating Length

You learnt to convert metric units of length from one unit to another in Lesson 2.



In this lesson, you will:

- estimate lengths and distances using different units
- measure the distance from home or town in kilometres using a map and its scale.

Now that you have had practice in measuring length, let‟s see how good you are at estimating various lengths before you measure them.


What can you say about these statements?

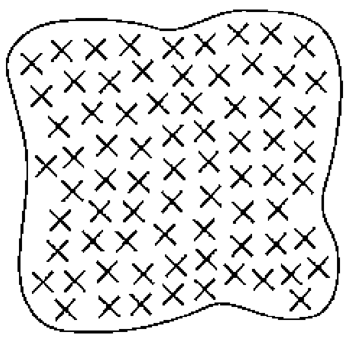
You are right when you say that they are not the actual or exact measurements. All these are called **estimates** or **approximates.**

**To estimate a measurement means to judge what it should be without actually measuring.**

There is no correct answer for your estimates. You should, however, try to be as close to the exact measurement as possible.

Example 1

Estimate the number of crosses. Write down your estimate.

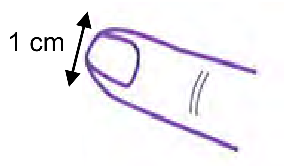


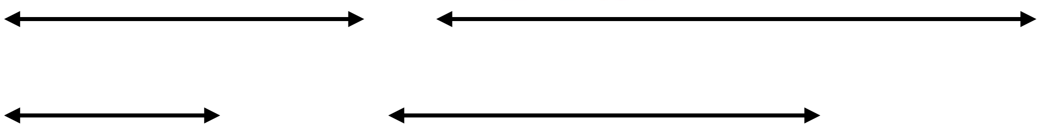
Now, count them. What is the difference between your estimate and your counting?

Are they close enough?

Example 2

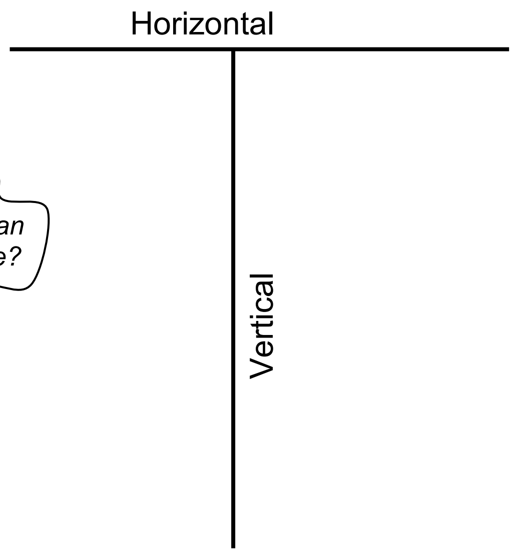
The width of your little finger is about 1 cm. Estimate the length of each line below and check by measuring using your ruler to see how close your estimate is.

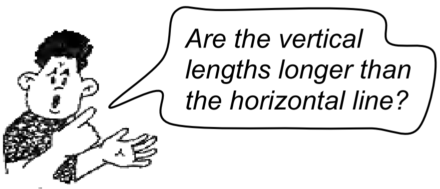


Example 3

Which is longer? Using ___ (1 cm), compare and find the actual measurement.




Now, try to practice more of estimation by completing the table below.

| | Your estimate | Correct measurement | Difference |
|---|---|---|---|
| The length of your arm | | | |
| Your friend‟s height | | | |
| The thickness of your pen | | | |
| The height of the door | | | |
| The thickness of a book | | | |
| The width of your desk | | | |

Again, the closer our estimate to the actual measurement is, the more correct our answer. This is not always easy so we need to practice more.

Now that you have an idea on how to estimate lengths, this time we will try to estimate and measure lengths using maps and scales.

What do we mean by scale?

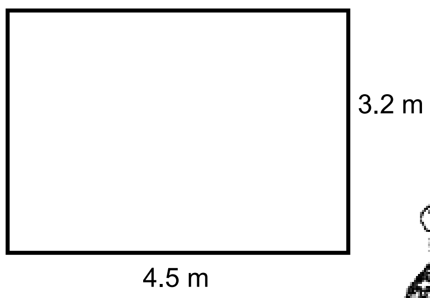
Think about this! Can you find a piece of paper big enough to draw a **real** house its **real size**? The answer is definitely NO.

We can only draw it on paper when we **reduce** the real size of the house to a smaller size.

| **The RATIO by which you reduce the size is called the SCALE.** |
|---|

Example 1

Look at the drawing below. It represents a room. The measurements tell you the real size of the room. The real length of the room is 4.5 metres.




Now, measure the length on the drawing.

How many centimetres is it?


We say:

1 cm on the drawing = 1 m in the actual room **OR**

1 cm (plan) = 1 m (real size)

If we want to write this as a scale, do we use the RATIO sign?


NO! We must compare **THE SAME THINGS** only.

Change 1 m to cm

1 m = 100cm

Therefore, we write: **SCALE 1:100** because 1m = 100 cm.

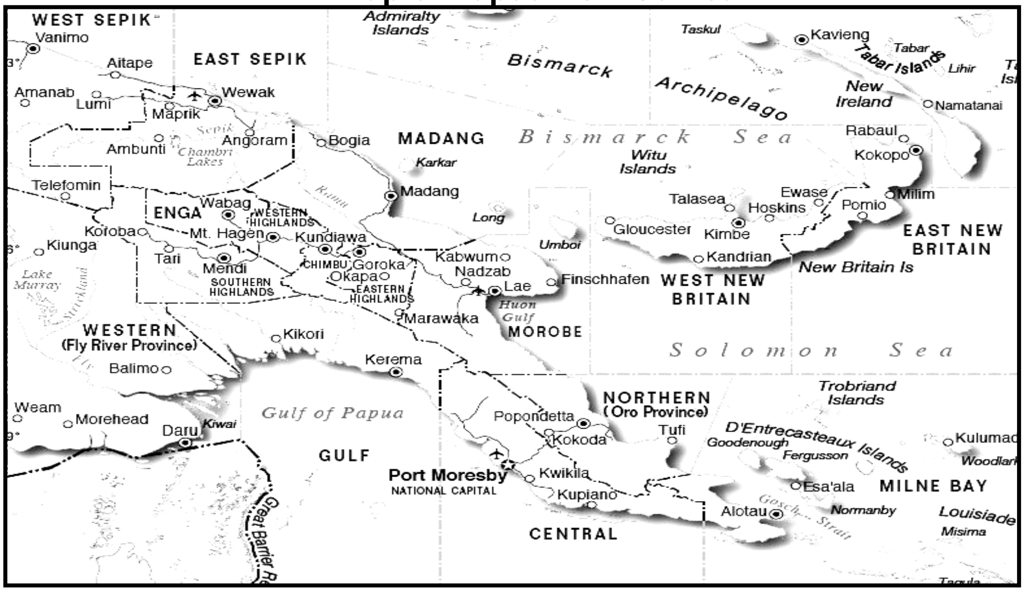
Example 2

Refer to the map below.

What does the **SCALE 1:5 000 000** mean?

Well, this means that 1 cm on the map is equal to 5 000 000 cm of the true size or we can say that everything on the map is 5 000 000 times smaller.

**Map of Papua New Guinea**




**SCALE: 1: 5 000 000**

So, a scale 1**:** 5 000 000 really means that 1 cm on the map represents 50 km on the actual land.

You must know that a map shows a big distance on land in a small space. In this case, 50 km is reduced and shown in 1 cm.

How is the 50 km actual distance taken?

In a map, the scale used is 1:5 000 000

That is,

1 cm on the map = 5 000 000 cm on the ground

$= 5\,000\,000 \times \frac{1}{100}$ m on the ground

$= 50\,000 \times \frac{1}{1000}$ km on the ground

So, 1 cm on the map = 50 km in actual size

If the distance between Wewak and Madang on the map is 3 cm, what is the actual distance between the two towns on the ground?

If 1 cm = 50 km, then <u>3 cm</u> on the map = 3 x 50 km = <u>150 km</u> on the ground.

Sometimes, the scale is given in different ways. Here is one such form.

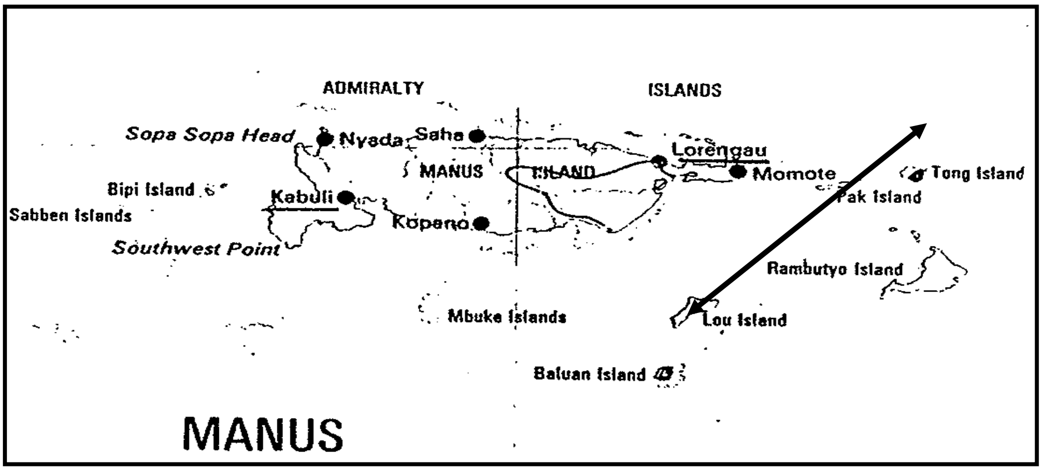
Example: 1 centimetre on the map = 25 kilometre on the ground

What is the scale, in ratio notation? To write ratios, we must convert either cm to km or km to cm so that the two measures are the same unit. So,

$$
\begin{aligned}
25 \text{ km} &= 25 \times 1000 \text{ m} \\
&= 25\,000 \times 100 \text{ cm} \\
&= 2\,500\,000 \text{ cm}
\end{aligned}
$$

We now have the scale **1: 2 500 000**

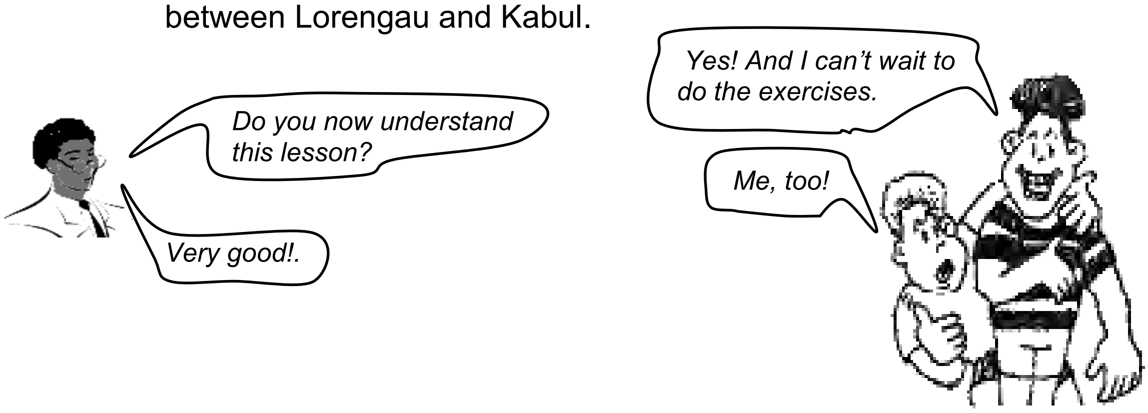
Look at the map of Manus Province shown below and answer the questions:




**SCALE: 1 cm on the map = 20 km on the ground**

On the map, the distance between Lorengau and Kabul is 3.5 cm. What is the distance between the two places on the ground?

Solution: If 1 cm = 20 km on the ground, then 3.5 x 20 = 70 km – the distance between Lorengau and Kabul.




**NOW DO PRACTICE EXERCISE 3**

## Practice Exercise 3

1. On a map, the scale used is 1: 200 000, what is the actual length?

**Answer:___________**

2. Here is a scale used on a map. "One centimetre on the map equals 10 km on the ground." Give the scale as a ratio.

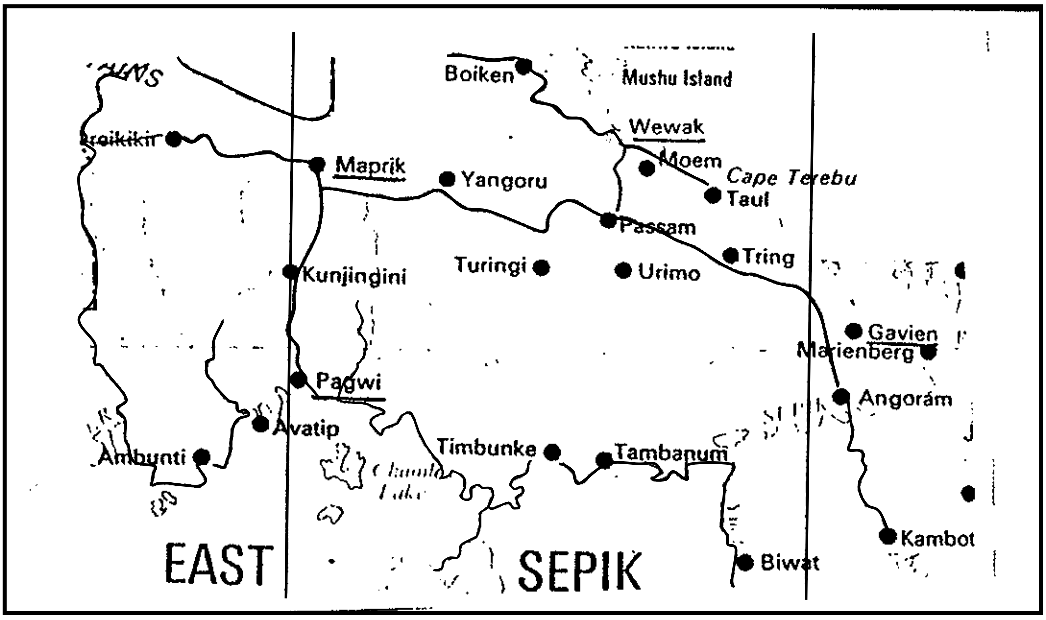
**Answer:___________**

3. A map of Papua New Guinea is drawn so that 25 km on land is shown by 5 cm on the map. What is the scale used, as a ratio?

**Answer:___________**

4. The distance between Town A and Town B on a map is 5.3 cm. The scale used is 1:3 000 000. What is the actual distance between the towns on the ground?

**Refer to the map of East Sepik Province below to answer Questions 5 and 6.**




**SCALE 1:2 000 000**

5. According to this scale, 1 cm on the map equals how many km on the ground?

**Answer:**___________

6. The distance on the map between Wewak and Maprik is 3 cm.

   What is the actual distance between them, on the ground?

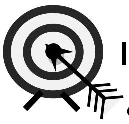
**Answer:**___________

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 1**

# Lesson 4: Perimeter

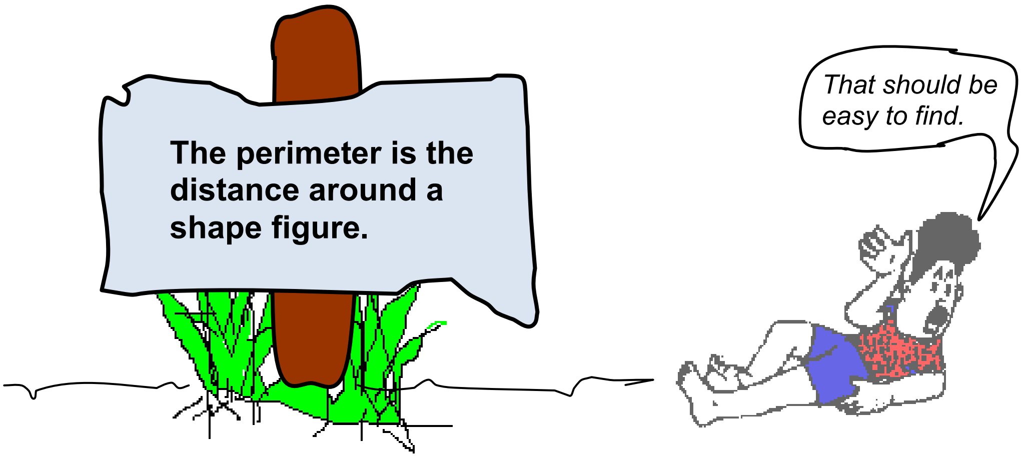
You learnt to estimate and measure lengths using metre and kilometre in Lesson 3.



In this lesson, you will:

- define perimeter
- develop and use formula to find perimeter of polygons
- solve everyday problems related to perimeter.

## Meaning of Perimeter



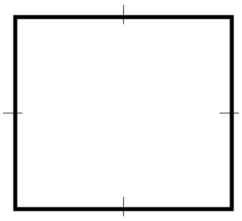

To find the *perimeter* of a shape, we add the length of all the sides together.

Perimeter is a length and the unit used is the same as the unit used on the sides of the shape. Example: mm, cm or km.

Let"s study the worked examples:

Example 1

The length of each side of the square is 2.5 cm. What is the perimeter?



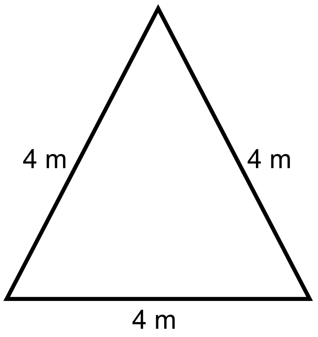
$P = S_1 + S_2 + S_3 + S_4$ or $P = 4S$ (since a square has four equal sides)

$P = 2.5 \times 4$ (equal sides)

$P = 10$ cm

Example 2

The perimeter of the triangle is given by: $P = S_1 + S_2 + S_3$

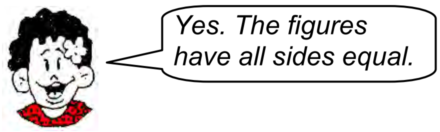


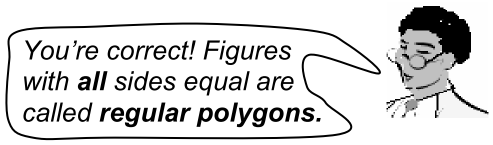

$P = S_1 + S_2 + S_3$

$P = 4\text{ m} + 4\text{ m} + 4\text{ m}$

**P = 12 m**

Do you recognize any property of the figures above?

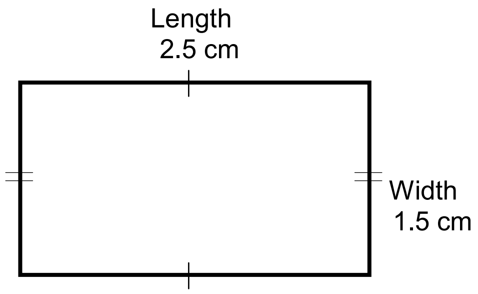


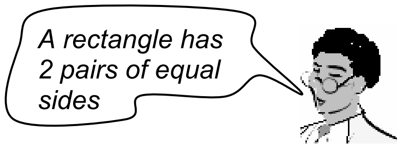




> To get the perimeter of **regular** polygons, multiply the length of one side by the number of equal sides. Example: P = 3s for a regular triangle and P = 4s for a square.

What about for a rectangle? How do we find its perimeter?

Look at the rectangle below.




If length is L and width is W, the perimeter would be …

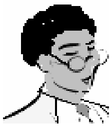
P = L + L + W + W OR P = 2L + 2W

P = 2.5 cm + 2.5 cm + 1.5 cm + 1.5 cm = 2(2.5) + 2(1.5)

P = 5 cm + 3 cm = 5 cm + 3 cm

**P = 8 cm** **P = 8 cm**

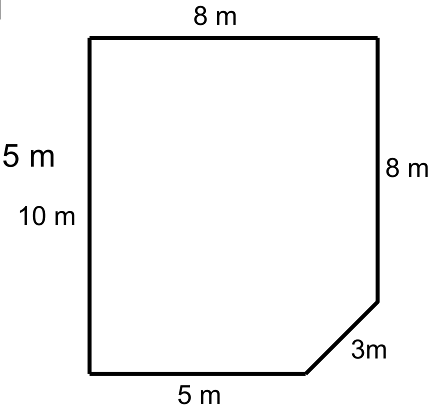
Sometimes the lengths of some sides might be the same. This can be indicated by putting *the* ***same mark*** ( + ) on equal sides.

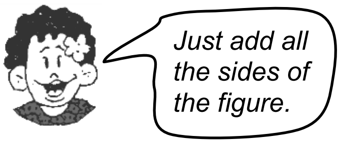


Now, let us get the perimeter of other shapes or figures with unequal sides. These figures are called **irregular polygons**.

Look at the worked examples:

Example 1

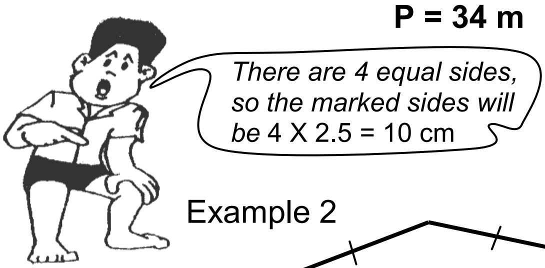


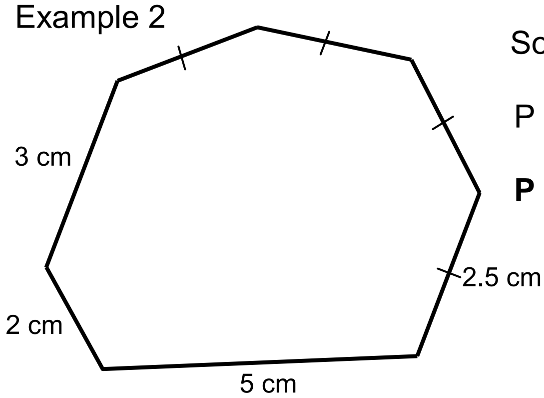

Solution:

P = 10 m + 8 m + 8 m + m 3 + 5 m

**P = 34 m**




Example 2



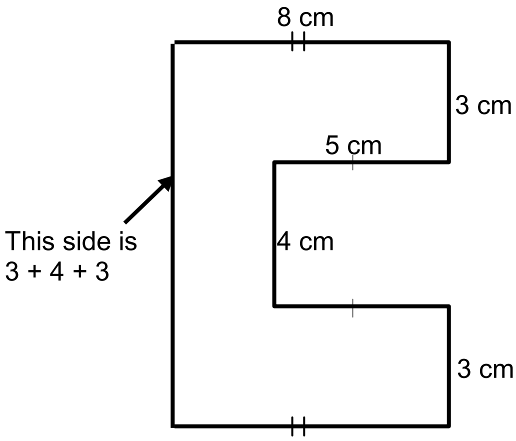

Solution:

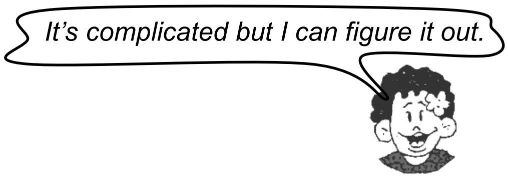
P = 3 cm+ 2 cm + 5 cm + 10 cm

**P = 20 cm**

Sometimes, we need to find the missing length of a side before we can find the perimeter. The marked sides are always equal in length.

Example 3




Solution:

P = 3 cm + 5 cm + 4 cm + 5 cm + 3 cm + 8 cm + 10 cm + 8 cm

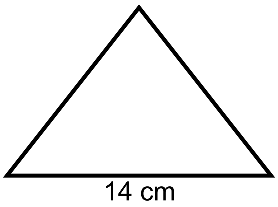
**P = 46 cm**

**NOW DO PRACTICE EXERCISE 4**

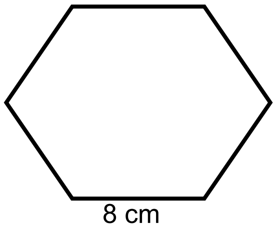
## Practice Excercise 4

1. Find the perimeter of each of the following shapes. Describe a shortcut method that could be used to find the perimeter of the shapes. “Regular” means that all the sides are of the same length.

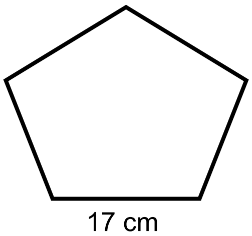
(a) equilateral Working out:



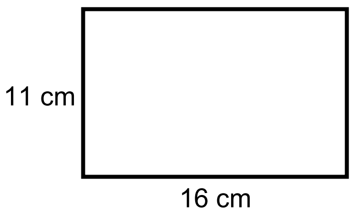

(b) regular hexagon Working out:



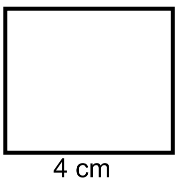

(c) regular pentagon Working out:




(d) rectangle Working out :

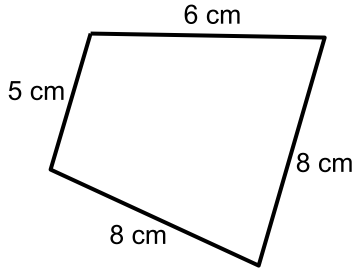



(e) square Working out:



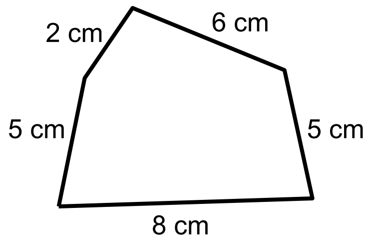
2. Find the perimeter of these shapes below.

(a)



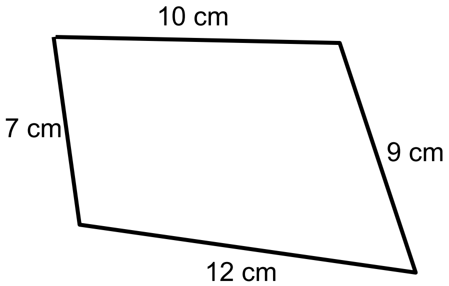

Answer: ___________

(b)



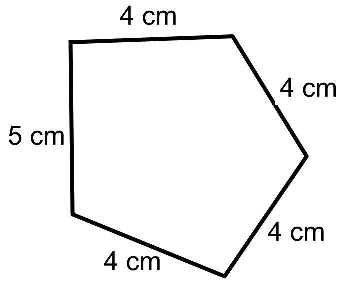

Answer: ___________

(c)



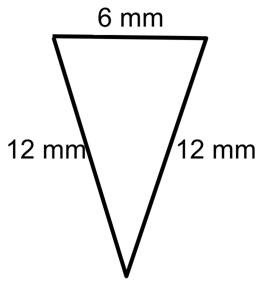

Answer: ___________

(d)



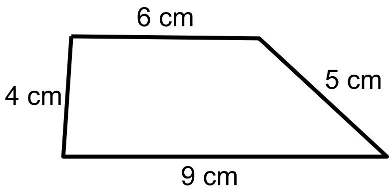

Answer: ___________

(e)




Answer: ___________

(f)




Answer: ___________

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**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 1.**

# Lesson 5: Circumference

In the previous lesson, you learned to measure the perimeter or distance around a polygon.

In this lesson, you will:

- define circumference
- find the circumference of a circle
- discover the value of $\pi$ (pi) by using the circumference and diameter of any circular object.

First we will revise what you‟ve learned in Grade 6 about circles.

Look at the figures.

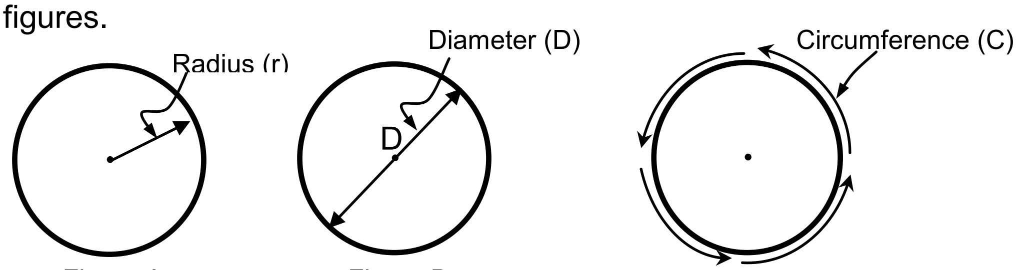
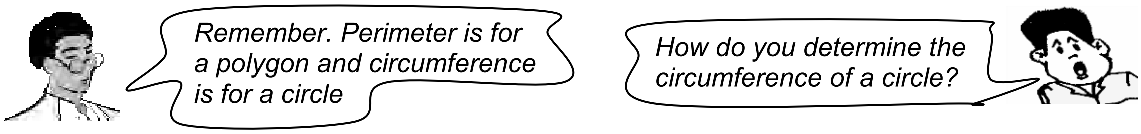



Figure A Figure B Figure C

Figure A shows the radius (r) or the distance between the centre of a circle and any point on its side.

Figure B illustrates the diameter (D) or the distance between two points on a circle which form a straight line passing through its centre.

Figure C illustrates the circumference (C) or the distance around a circle.




Here is an activity for you to do.

**Activity 1**

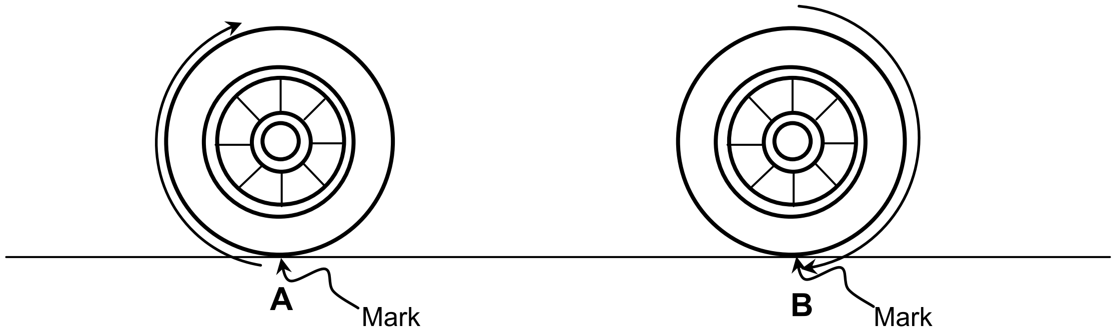
Step 1: Take any circular object (e.g., a wheel).

Step 2: Draw a straight line on a flat surface.

Step 3: Mark point A on the wheel and on the line.

Step 4: Place point A of the wheel over the point A of the line, then move the wheel on the line until the mark on the wheel touches the line again.

Step 5: Measure the distance from the first mark on the line to the second, This is the circumference of the wheel.




To get the formula for the circumference of a circle, do the following activity.

**Activity 2**

For this activity you will need:

string
some circular shapes or objects
a ruler
a calculator if any

Step 1: Get the circular object. Measure the circumference. To measure the circumference, wrap the string around the edge and then measure the string with your ruler.

Step 2: Measure the diameter with your ruler.

Step 3: Work out: circumference ÷ diameter using your calculator if any.

Step 4: Get two other circular objects and do the same activity. Fill the table below with your findings.

| Object | Circumference (C) | Diameter (D) | Circumference ÷ Diameter |
|---|---|---|---|
| 1 | 37.68 | 12 | 3.14 |
| 2 | | | |
| 3 | | | |

5. Get the average of all the entries in the last column.

The quotient obtained by dividing the circumference by the diameter is about 3.14. The exact value cannot be written down because it is a ***non-terminating*** (does not stop) and ***non-recurring*** (does not repeat) decimal. Because we cannot write an exact value, we use an approximation of 3.14 (correct to two decimal places or $\frac{22}{7}$ .

This is a constant (remains the same) used in determining the circumference and the area of a circle. This is represented by the Greek letter *pi* (pronounced „pie") and represented by the symbol $\pi$.

Therefore, if $\frac{\text{Circumference}}{\text{Diameter}}$ or $\frac{C}{D} = \pi$ or 3.14 or $\frac{22}{7}$

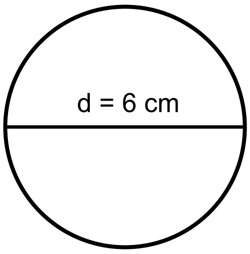
then, Circumference or $C = \pi D$ or $3.14 \times D$ or $\frac{22}{7} \times D$

This is the formula we use to find the circumference of a circle when we know the diameter.

Here are some examples

Example 1 Find the circumference of the circles below.

(a)

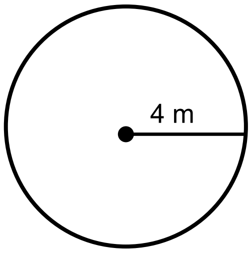



$C = \pi \times d$

$C = 3.14 \times 6$ cm or $\frac{22}{7} \times 6$ cm

C = 18.8 cm
(correct to 1 decimal place)

(b)




$C = \pi \times d$

$C = 3.14 \times 8$ m ($d = 2 \times 4$);
diameter is twice the radius!

C = 25. 1 m
(correct to 1 decimal place)

- **The Radius is a line segment from the centre of the circle to any point on the circle.**
- **The Diameter is a line segment connecting two points on the circle passing through the centre.**
- **To find the circumference, multiply the diameter by 3.14 or use the formula**

$$\boxed{C = \pi D}$$

- **To get the diameter, divide the circumference by π (3.14) or use the formula**

$$\boxed{D = \frac{C}{\pi}}$$

**NOW DO PRACTICE EXERCISE 5**

## Practice Exercise 5

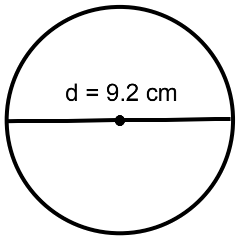
1. First, find the diameter and then use the formula to find the circumference in each of the following.

(a) radius = 2 cm (b) radius = 7 cm

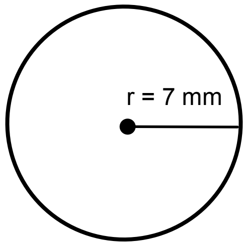
(c) radius = 15 cm (d) radius = 6.72 cm

2. Find the circumference of each circle.

(a)




(b)




**Answer:** ____________ **Answer:** ____________

3. A circular race track has a diameter of 100 m.

(a) What is the measure of one lap (to the nearest metre)?

**Answer:** ____________

(b) If Daniel runs four laps, has he run more or less than 1 km?

**Answer:** ____________

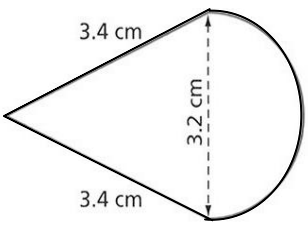
4. The radius of a round table is 92.8 cm. Give the distance around its edge in metres.

**Answer:** ____________

---

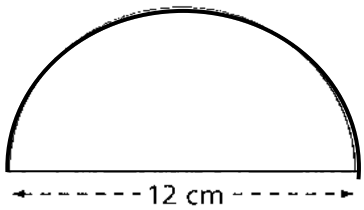
1. Find the circumference/perimeter of these figures.

(a)




**Answer:** ____________

(b)




**Answer:** ____________

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**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 1.**

## SUB-STRAND 1: SUMMARY


- The metre is the basic unit of length in the metric or standard international system which consist of the following

| | | |
|---|---|---|
| 10 millimetres (mm) | = | 1 centimetre (cm) |
| 10 centimetres ( cm) | = | 1 decimetre (dm) |
| 10 decimetres (dm) | = | 1 metre ( m) |
| 1000 metres (m) | = | 1 kilometre (km) |

- To change from a smaller unit to a larger unit, **divide**, by the appropriate multiple of 10.

- To change from a larger unit to a smaller unit, **multiply**, by the appropriate multiple of 10.

- To estimate a measurement means to approximate its measurement without actually measuring.

- Perimeter is the distance around a polygon. It can be determined by actual measurement or by computation when the necessary measures are given.

- The general formula for finding the perimeter of any polygon when all sides are congruent is :

**P = measure of each side x number of sides**

- If not, the formula to be applied is :

$$\mathbf{P = S_1 + S_2 + S_3 + S_4 + \ldots + S_n}$$

- The circumference of a circle is the distance around the edge of a circle.
- To find the circumference of a circle, we use the rule:

$\mathbf{C = \pi d}$ where $\pi = 3.14$ or $\frac{22}{7}$ and **d** is diameter of the circle

**REVISE LESSONS 1 – 6 THEN DO SUB-STRAND TEST 1 IN ASSIGNMENT 3.**

# ANSWERS TO PRACTICE EXERCISES 1- 6

## Practice Exercise 1

1. a) m b) cm c) mm d) km

2. (a) metres
   (b) centimetres
   (c) kilometres
   (d) centimetres
   (e) metres

3. (a) 7 cm

   (b) 4.7 cm

   (c) 3.5 cm

   (d) 3.6 cm

## Practice Exercise 2

1. (a) 3 m (b) 0.09 km

   (c) 0.065 m (d) 0.2 km

2. (a) 50 mm (b) 2670 m

   (c) 2900 mm (d) 235 cm

## Practice Exercise 3

1. 2 km
2. 1: 1 000 000
3. 1: 500 000
4. 159 km
5. 20 km
6. 60 km

## Practice Exercises 4

1. (a) 42 cm (b) 48 cm (c) 85 cm
   (d) 54 cm (e) 16 cm

2. (a) 27 cm (d) 21 cm
   (b) 26 cm (e) 30 cm
   (c) 38 cm (f) 24 cm

**Practice Exercise 5**

| | | | | |
|---|---|---|---|---|
| 1. | (a) | d = 4 cm ; | C = 12.56 cm | |
| | (b) | d = 14 cm ; | C = 43.96 cm | |
| | (c) | d = 30 cm ; | C = 94.2 cm | |
| | (d) | d = 13.44 cm ; | C = 42.20 cm | |
| 2. | (a) | C = 28.89 cm | (b) | C = 43.96 cm |
| 3. | (a) | 314 m | (b) | 1.256 km , YES |
| 4. | 5.827 m | | | |
| 5. | (a) | 11.82 cm | (b) | 18.84 cm |

---

**END OF SUB-STRAND 1**

# SUB-STRAND 2

# AREA

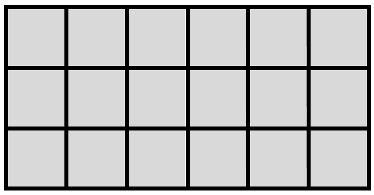
# SUB-STRAND 2: AREA

## Introduction

You learnt in Grade 6 that the area of a shape is the amount of space inside that shape. When we are measuring the area of a shape, we divide it into square units, and count how many there are inside the shape.

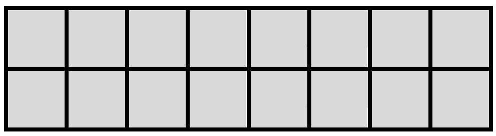
The diagram below will show you how the area of a shape is measured.

**A**



**Number of squares = 18**

**B**



**Number of squares = 16**

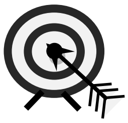
We say that the area of shape A is 18 square units, and the area of shape B is 16 square units. Obviously, area of shape A is larger than area of shape B. This is what we call comparison by estimation.

To get the area of a shape consistently we need a standard unit to measure the area.

In this Sub-strand you will compare areas by estimation and investigate area rules of quadrilaterals. You will learn more about measurement of area and the unit used for area in Lesson 6. You will learn how to work out the area of triangles and quadrilaterals in Lesson 7 to 11. You will also learn about the meaning of the base and the altitude or perpendicular height of different shapes. Lastly, you will learn to work out the area of composite shapes and solve some word problems on area.

# Lesson 6: Meaning of Area

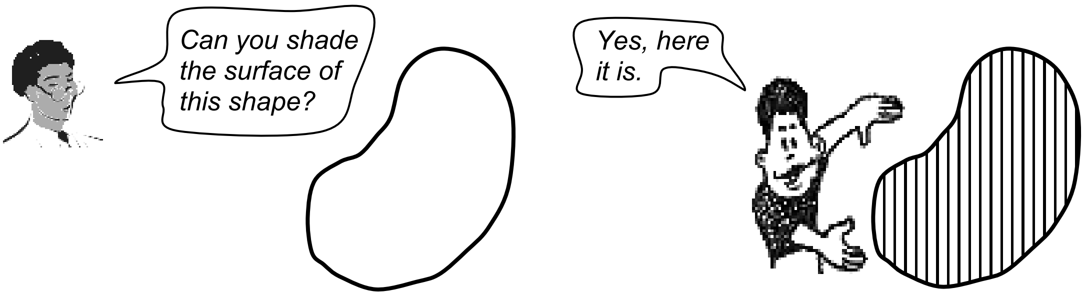
You learnt about length and the units of measures for length in the previous lessons. You also learnt to work out the distance around a shape.



In this lesson, you will:

- define area and identify the different units of area
- find the area of shapes by counting square units
- estimate, measure, and compare areas in square centimetres and square metres.

First, we will revise what we mean by **area**. Look at the shape below.

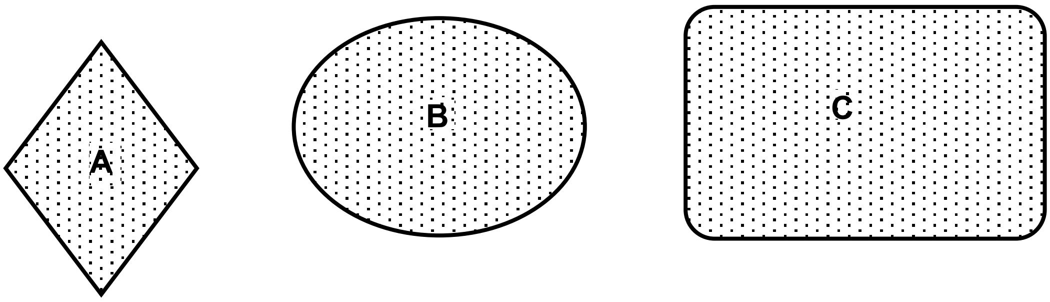



The shaded amount is called the **area** of the shape.

**REMEMBER:**

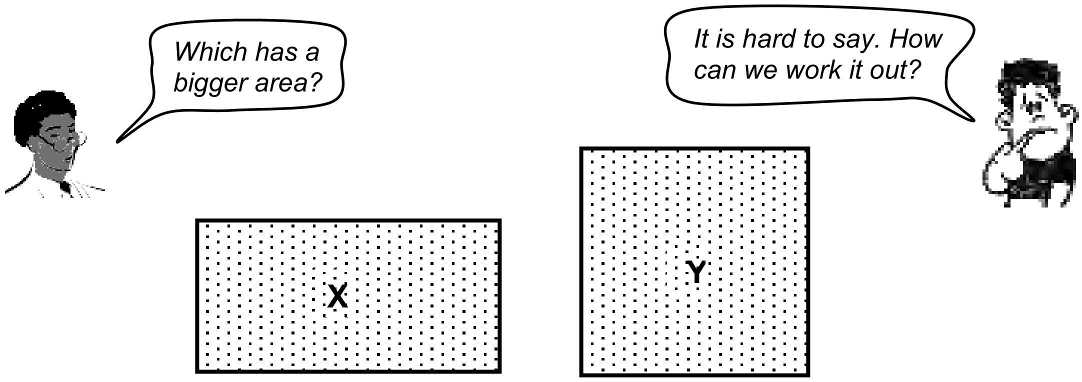
| |
|---|
| **The area of a shape is the amount of surface in that shape.** |

Look at the three shapes: **A, B,** and **C.**

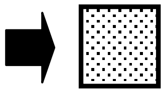



Shape C has the biggest area while Shape A has the smallest area.

Now look at these two shapes, **X** and **Y.**

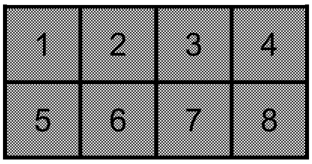



But you can use SQUARE UNITS to find out which shape has the bigger area.

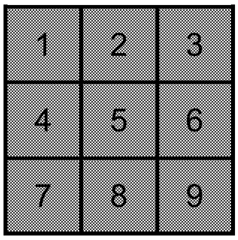


We measure areas by dividing the shapes into square units, and counting how many of these are inside the shapes.

Shape **X**




Shape **Y**



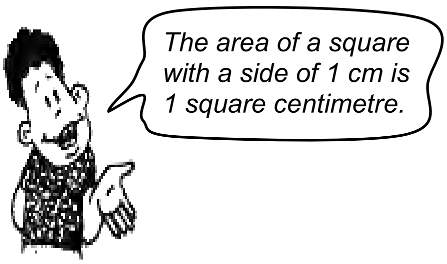

Number of squares = 8

Number of squares = 9

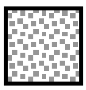
This means Shape **Y** has a bigger area than Shape **X**.

We say that the area of Shape **X** is 8 square units and the area of Shape **Y** is 9 square units.

Obviously, if we are to be consistent we need a standard unit of area. A convenient unit is the **square centimetre.**




1cm

1cm  1cm

1cm

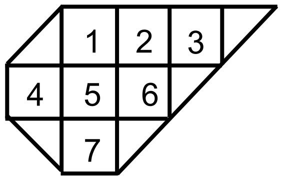
This can be written as

**1 cm$^2$**

A square centimetre is a **standard unit of area**. This means it is used all over the world.

Example 1

What is the area of this shape?



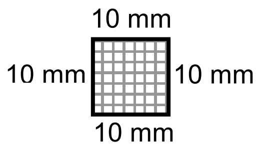

There are 7 whole square centimetres plus 5 half centimetres.

$$\text{So,} \quad \text{area} = 7 + \frac{5}{2}$$
$$= 7 + 2\frac{1}{2}$$
$$= 9\frac{1}{2}\ \text{cm}^2$$

Square centimeters are not the only units of area used.
Smaller areas could be measured in **square millimeters ($mm^2$)** while large areas could be measured in **square metres ($m^2$).**

Example 2

Each side of a square with a side of 1 centimetre is of course, 10 mm.

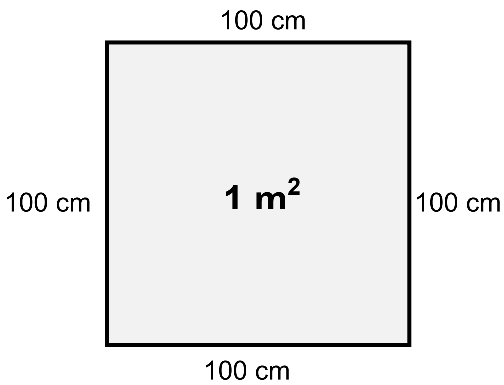



**$1\ cm^2 = 100\ mm^2$**

Therefore, we say that the area of the shape is **$100\ mm^2$.**

Example 3

A square that has sides of 1 metre (m) would measure 100 cm on each side.




**$1\ m^2 = 10\ 000\ cm^2$**

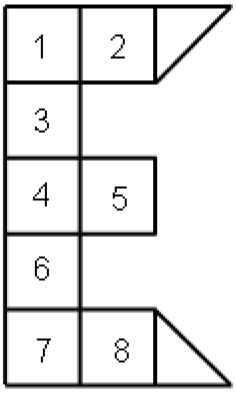
Therefore, we say that the shape of **$1\ m^2$** would be **$10\ 000\ cm^2$.**

**NOW DO PRACTICE EXERCISE 6**

## Practice Exercise 6

Work out the area of each of the shapes below. The first one is done for you.

1)

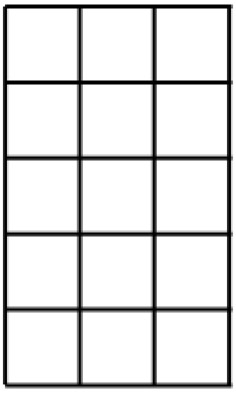



Area = $8 + \frac{2}{2}$

= 8 + 1

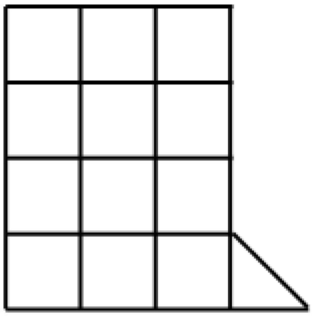
= <u>9 cm$^2$</u>

2)



Area = _____ cm$^2$

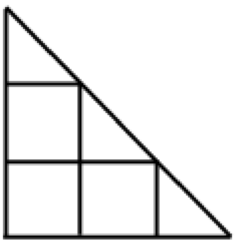
3)



Area = _____ + $\frac{\quad}{2}$

= _____ cm$^2$

4)

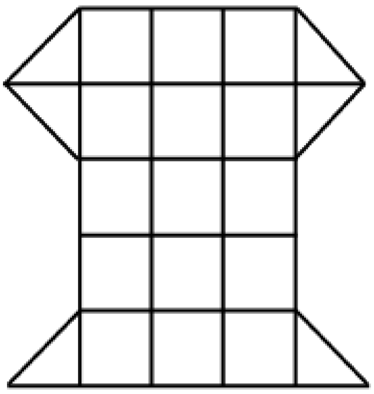


Area = ____ + ____

= ____ + ____

+ ____

5)

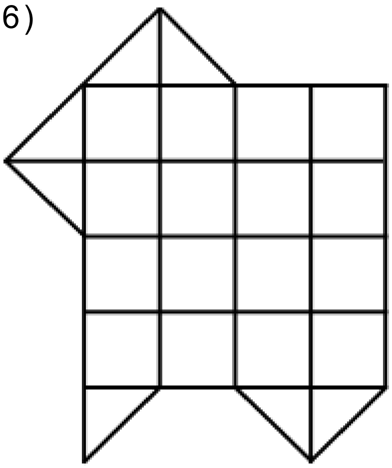


Area = ____ + ____

= ____ + ____

= ____ + ____

6)



Area = ____ + ____

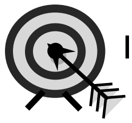
= ____ + ____

= ____

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 2**

## Lesson 7: Area of Rectangles and Squares

You learnt the meaning of area and the unit of measures of area in Lesson 6. You also learnt to find the area of a shape by counting square units as well as estimating, measuring and comparing area in square centimetres and square metres.

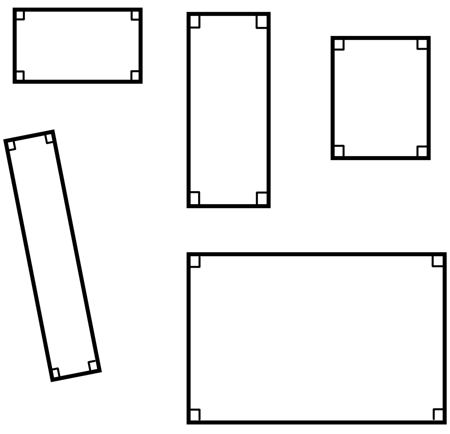


In this lesson, you will:

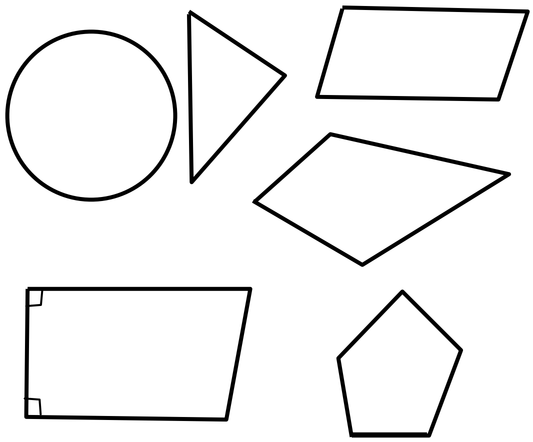
- learn the formula for finding the area of a rectangle and a square
- use and apply the formula in solving problems related to area.

A rectangle has four straight sides and all its interior angles are right angles ($90^\circ$), as in the example below.

These ARE rectangles:

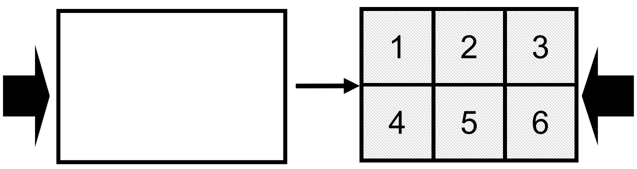


These ARE NOT rectangles:



Now you will learn to find the area of a rectangle.

Here is a rectangle

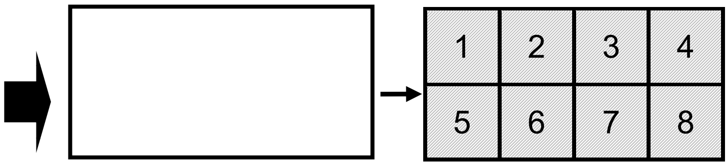



And here is the same rectangle but covered with square centimetres.

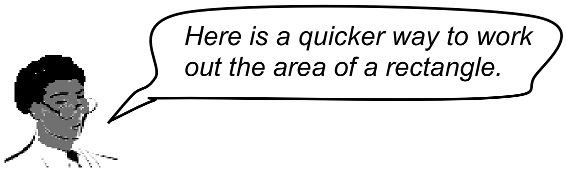
It takes 6 centimetre squares to cover the rectangle.

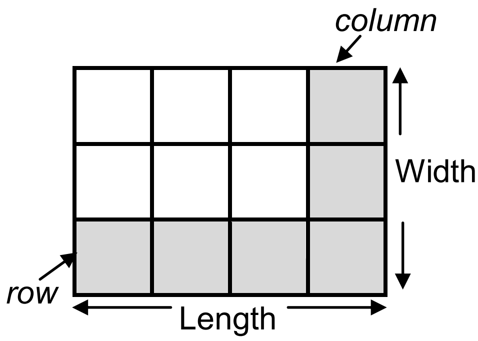
So, the area of the rectangle = **6 cm$^2$**

Here
Is another
rectangle




The area of
the rectangle
is 8 cm$^2$.




Width = 1+1+1
= 3

Length = 1+1+1+1
= 4

There are 4 cm$^2$ in one row.

There are 3 rows, therefore, AREA = 4 x 3
= <u>12 cm$^2$</u>

or

There are 3 cm$^2$ in one column.

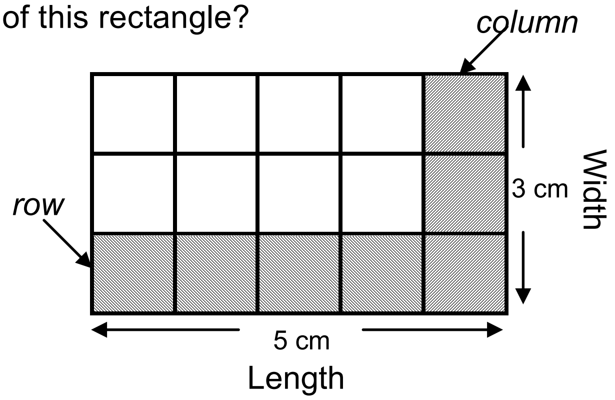
There are 4 columns, therefore, AREA = 3 x 4
= 12 cm$^2$

If we know the number of units in both the LENGTH and WIDTH of the rectangle, we can work out the AREA by simply using formula below.

| |
|---|
| **AREA OF A RECTANGLE = LENGTH x WIDTH** |
| **A = L x W** |

Example

What is the area of this rectangle?

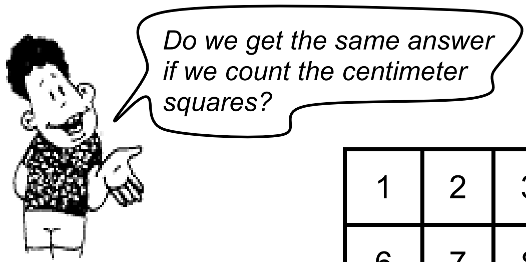


If we use the formula, we write it this way:

AREA = LENGTH x WIDTH

= 5 cm x 3 cm

= <u>15 cm²</u>





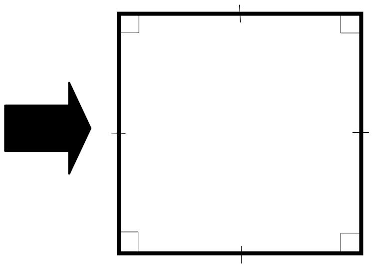
| | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 13 | 15 |

AREA = 15 $cm^2$

It is easier to use the formula, AREA .= LENGTH x WIDTH, it is quicker because we do not have to count all the squares. This will save time if the rectangle is a big rectangle.

Now you will learn to find the area of a square.

HERE IS A SQUARE



It has 4 straight sides.

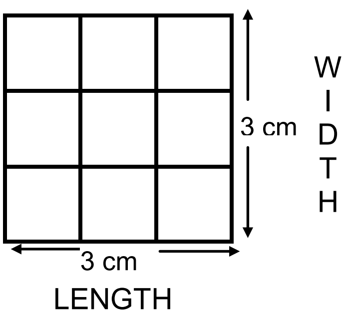
It has 4 right angles.

The 4 sides are equal in length

The shape is a RECTANGLE with all 4 sides equal and because it has 4 straight sides and all its angles are right angles. However, it is a special type of rectangle, with 4 equal sides. It is both equilateral and equiangular.

**A square is a rectangle with all four sides equal.**

We can work out the area of a square in the same way that we worked out the area of a rectangle, because a square is a rectangle.




AREA = LENGTH x WIDTH

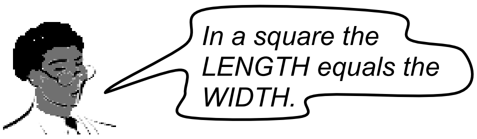
= 3 cm x 3 cm

= 9 $cm^2$

Check by counting the squares centimetres

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

AREA = <u>9 cm²</u>




So, if you know the length of any side in a square, you can work out its area, because the width is the same as the length.

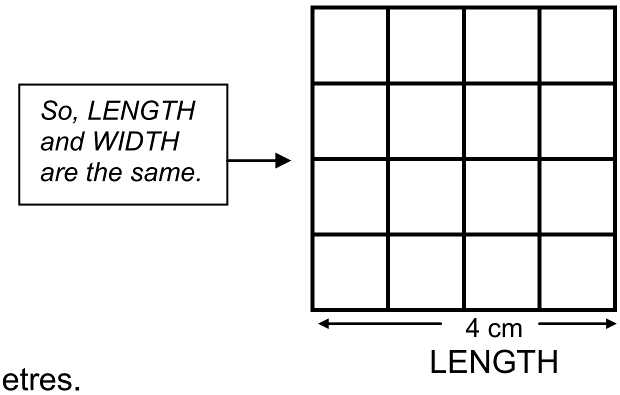
Since, the square has four equal sides, we can use this formula: $\boxed{A = s^2}$

**The area of a square is the square of a side.**

Example 1

What is the area of this square?

$$\begin{aligned} \text{AREA} &= s^2 \\ &= (4\text{ cm})^2 \\ &= \underline{4}\text{ cm} \times \underline{4}\text{ cm} \\ &= \underline{16\text{ cm}^2} \end{aligned}$$



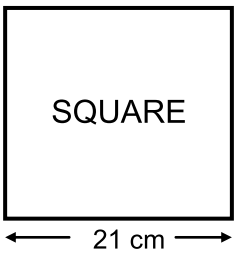

Check by counting the square centimetres.

There are 16 square centimetres.

Example 2

What is the area of the square shown in the diagram?

$$\begin{aligned} \text{AREA} &= s^2 \\ &= (21\text{ cm})^2 \\ &= \underline{21}\text{ cm} \times \underline{21}\text{ cm} \\ &= \underline{441\text{ cm}^2} \end{aligned}$$




WORKING

$$\begin{array}{r} 21 \\ \underline{\times\ 21} \\ 21 \\ \underline{42\ \ } \\ \underline{441} \end{array}$$

---

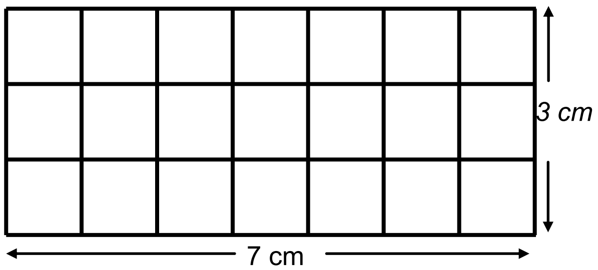
**NOW DO PRACTICE EXERCISE 7**

## Practice Exercise 7

1. Use the number sentence, AREA OF A RECTANGLE = LENGTH x WIDTH, to work out the area of each rectangle below.

   Check your answer by counting the centimetre squares.

(a)



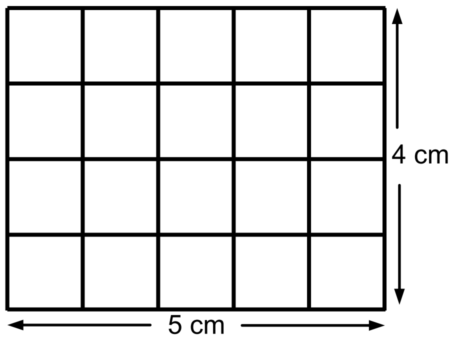

AREA = LENGTH x ___________

= _______cm x ______cm

= _______$cm^2$

Answer by counting the centimeter squares = _____$cm^2$

(b)




AREA = _________x __________

= _______cm x _______cm

= _______$cm^2$

Answer by counting the centimeter squares = _____$cm^2$

2. What is the area of this rectangle?

**NOTE: The diagram is not drawn to scale.**


AREA = __________ x __________

= __________ x __________

= __________

3. What is the area of a rectangle with a Length = 107 cm and a Width = 13 cm?

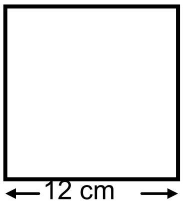
AREA = __________ x __________

= __________ x __________

= __________

4. Find the area of these squares:

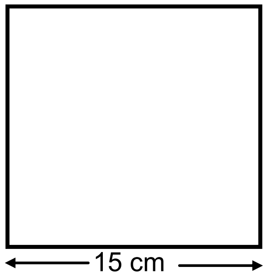
(a)




WORKING:

AREA = ___________

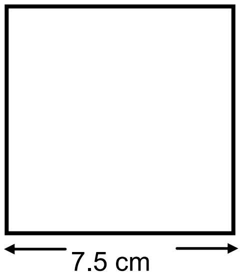
(b)




WORKING:

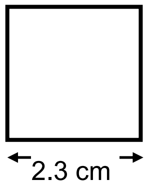
AREA = ___________

(c)




AREA = ___________

(d)




AREA = ___________

---

5. Problem Solving

a) The floor of a classroom measures 8 m by 10.6 m. Find its area.

b) A bed measures 190.5 cm by 88.82 cm. What is its area?

c) A square picture frame measures 265 mm on one side. What is its area?

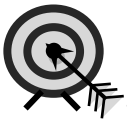
d) A square table measures 0.98 m on one side. What is its area? Give the equivalent in square centimetres.

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 8: Area of Triangles

You learnt to work out the area of a rectangle and a square in Lesson 7.



In this lesson, you will

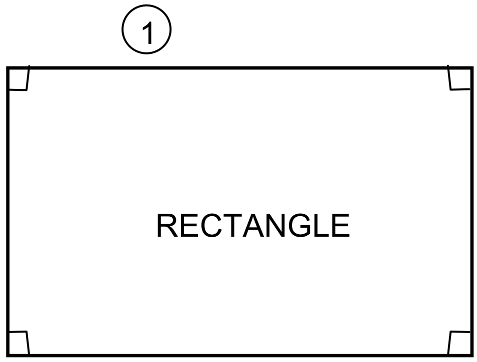
- learn the formula in finding the area of triangles
- use and apply the formula in solving problems related to the area of triangles.

First, you will learn to work out the area of a triangle.

**Activity 1**

You will need:

- ❖ A piece of paper
- ❖ Scissors

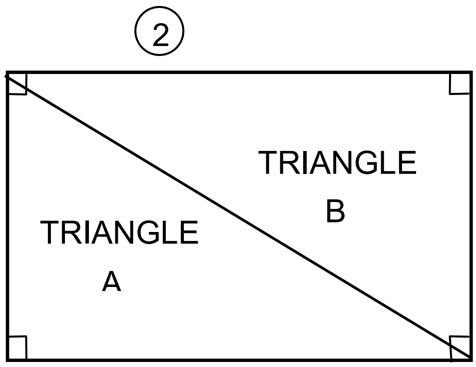



Here are the steps:

Step 1:

Place your paper over the rectangle shown on the right.

Trace the rectangle onto your paper.




Step 2:

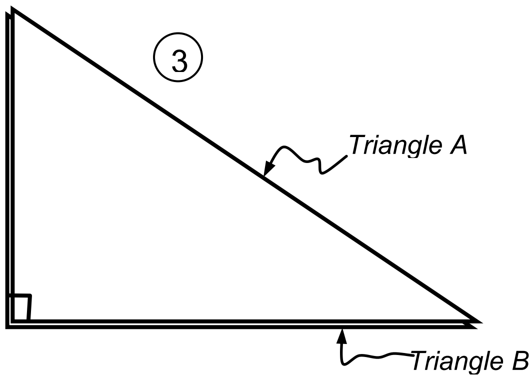
Draw a straight line joining two opposite corners of your rectangle as shown.

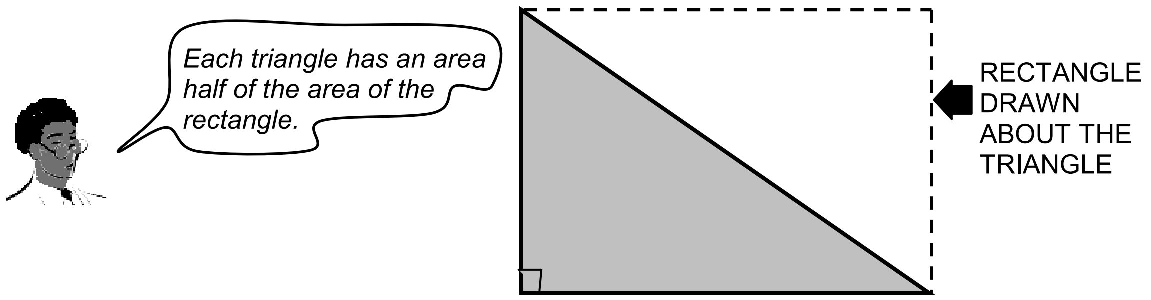
Cut your rectangle along the line to make 2 triangles, A and B.

Step 3:

Place triangle A and triangle B on top of each other so they fit exactly.

Do both triangles have the same area?



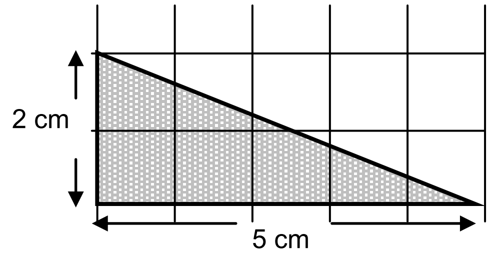

So, the area of a right angled triangle is half of the area of the rectangle which can be drawn about it.

You already know how to work out the area of a rectangle (See Lesson 7).

Now, you can work out the area of a right angled triangle. It will be **half of the area** of a rectangle drawn about it. This is true in all triangles.

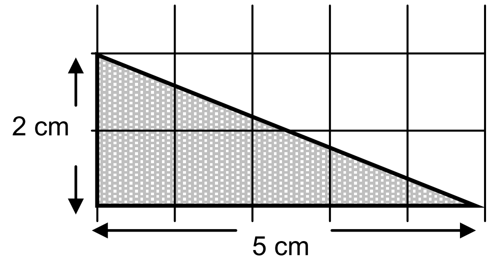
Example

What is the area of this triangle?




Step 1:

The triangle is a right triangle. It will have an area HALF of the area of rectangle drawn about it.
Draw the rectangle with dotted lines.



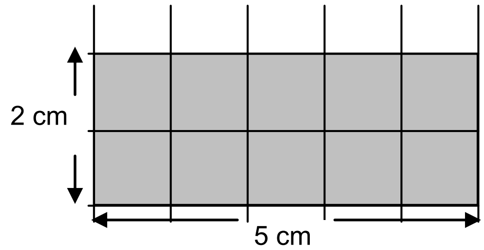

Step 2:

Work out the area of the rectangle.

The area of rectangle = Length x Width

= 5 cm x 2 cm

= 10 $cm^2$




***Check***:

*Count the number of centimetre squares.*

*There are 10 centimetre squares.)*

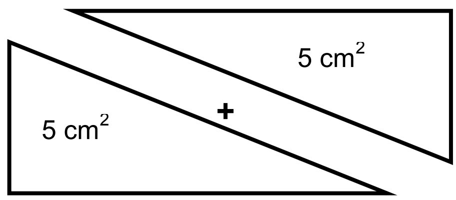
Step 3:

Work out the area of the triangle.

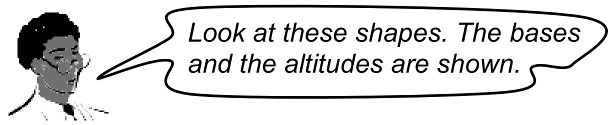
Area of triangle $= \frac{1}{2}$ Area of rectangle

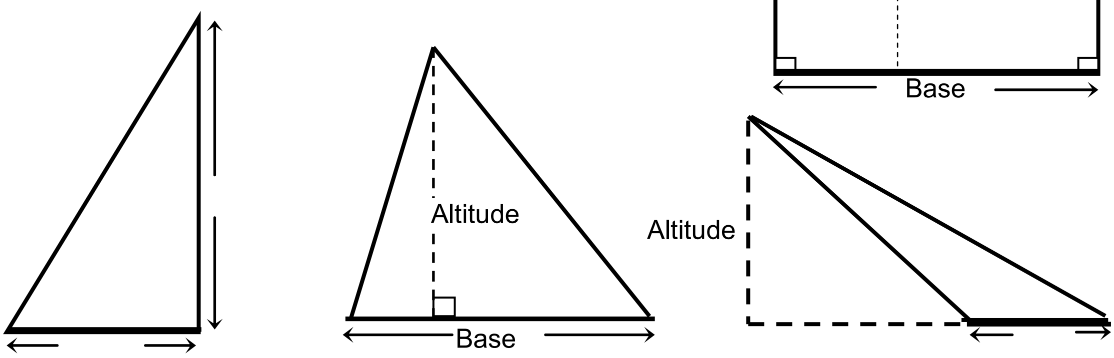
$= \frac{1}{2} \times 10$

$= 5\ cm^2$

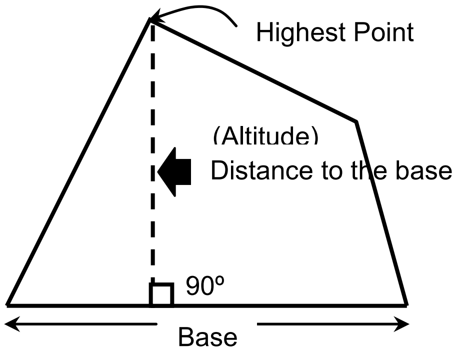


Now, practice finding the area of any triangle.




Look at the figure below:

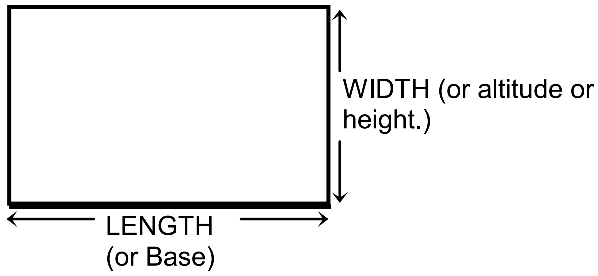



The highest point above the base is shown. The distance from the highest point to the base is the ALTITUDE or PERPENDICULAR HEIGHT.

If we draw the altitude or perpendicular height, it is a line that meets the base at $90^\circ$.

We know that the area of a rectangle = LENGTH x WIDTH.

Length is the base and width is the altitude or height.

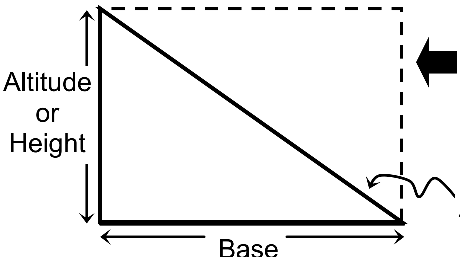



We say AREA OF RECTANGLE = BASE x PERPENDICULAR HEIGHT.

Also, the area of a triangle is HALF of the area of a rectangle formed about it.

So,

$$\boxed{\text{AREA OF A TRIANGLE} = \frac{1}{2} \times \text{BASE} \times \text{ALTITUDE or HEIGHT}}$$




Area of this rectangle = $\boxed{\text{Base x Altitude or Height}}$

Area of this triangle = $\boxed{\frac{1}{2} \text{ Base x Altitude or Height}}$

Below is the short way using symbol.

$$\boxed{\textbf{AREA OF TRIANGLE} = \frac{1}{2} \times b \times h \quad \text{or} \quad \frac{b \times h}{2}}$$

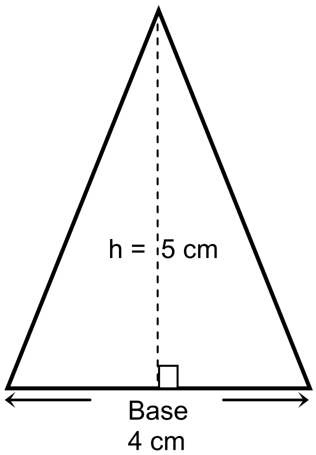
where: b = Base

h = Altitude or height

Here are some examples.

Example 1

Work out the area of the triangle shown below.




Use the sentence AREA OF A TRIANGLE = $\frac{1}{2}$ x b x h

$$\text{AREA} = \frac{1}{2} \times b \times h$$

$$= \frac{1}{2} \times 4 \text{ cm} \times 5 \text{ cm}$$

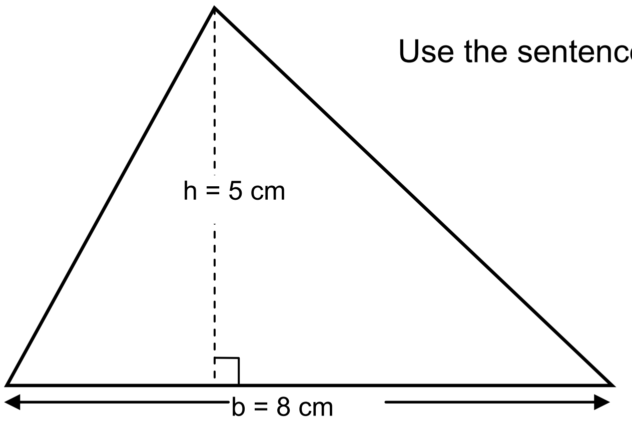
$$= \frac{1}{2} \times 20 \text{ cm}^2$$

$$= \underline{10 \text{ cm}^2}$$

So the triangle has an area of 10 $cm^2$.

Example 2

Work out the area of the triangle shown below.




Use the sentence AREA OF A TRIANGLE = $\frac{1}{2}$ x b x h

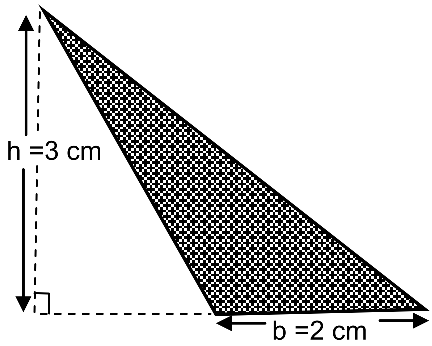
Area $= \frac{1}{2} \times 8 \text{ cm} \times 5 \text{ cm}$

$= \frac{1}{2} \times 40 \text{ cm}^2$

$= 20 \text{ cm}^2$

So the triangle has an area of 20 $\text{cm}^2$.

Example 3



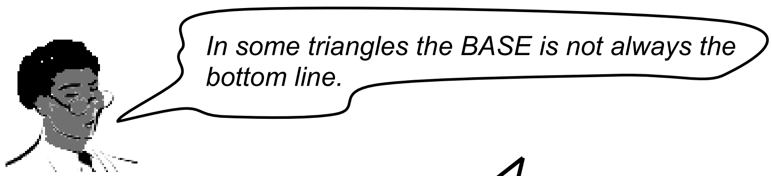

AREA OF A TRIANGLE = $\frac{1}{2}$ x b x h

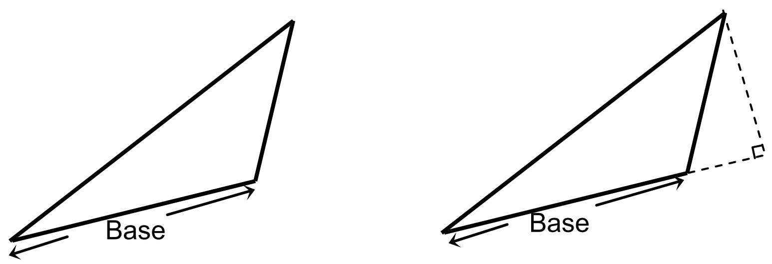
Area $= \frac{1}{2} \times 2 \text{ cm} \times 3 \text{ cm}$

$= \frac{1}{2} \times 6 \text{ cm}^2$

$= 3 \text{ cm}^2$

So, the area of the triangle is 3 $\text{cm}^2$



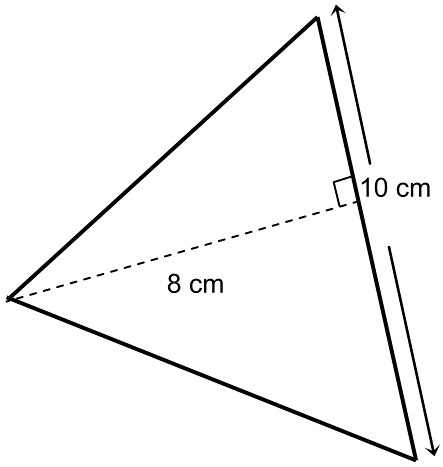




In page 55, you learnt how to draw the perpendicular height of a triangle.

Example 4

Work out the areas of the triangles shown below.

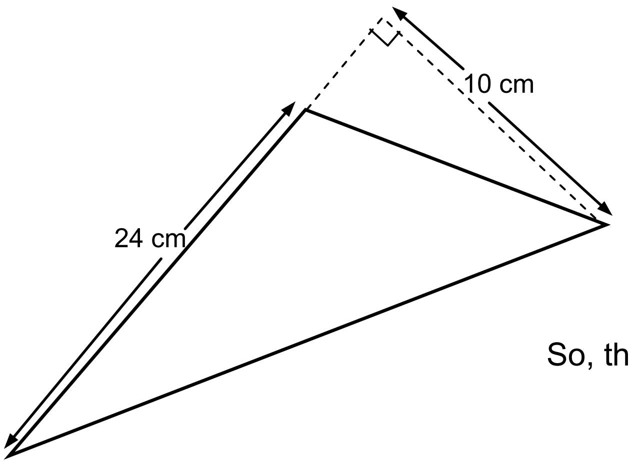
a)




$$\text{AREA} = \frac{1}{2} \times b \times h$$
$$= \frac{1}{2} \times 10 \text{ cm} \times 8 \text{ cm}$$
$$= \frac{1}{2} \times 80 \text{ cm}^2$$
$$= 40 \text{ cm}^2$$

So, the area of the triangle is 40 $cm^2$.

b)




$$\text{AREA} = \frac{1}{2} \times b \times h$$
$$= \frac{1}{2} \times 24 \text{ cm} \times 10 \text{ cm}$$
$$= \frac{1}{2} \times 240 \text{ cm}^2$$
$$= 120 \text{ cm}^2$$

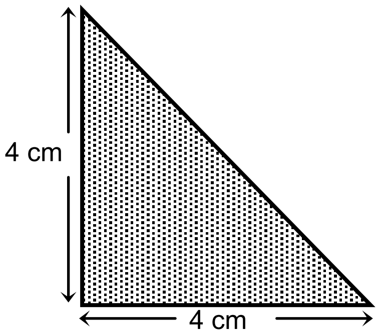
So, the area of the triangle is 120 $cm^2$.

**NOW DO PRACTICE EXERCISE 8**

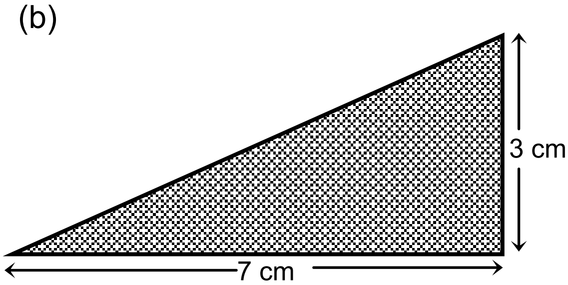
## Practice Exercise 8

1) Complete the rectangle about each triangle below. Work out the area of the triangles.

(a)




(b)




Area of Rectangle = Length x ______

= ____________

Area of Triangle = $\frac{1}{2}$ Rectangle Area

= $\frac{1}{2}$ x __________

= ____________

Area of Rectangle = _______ x ______

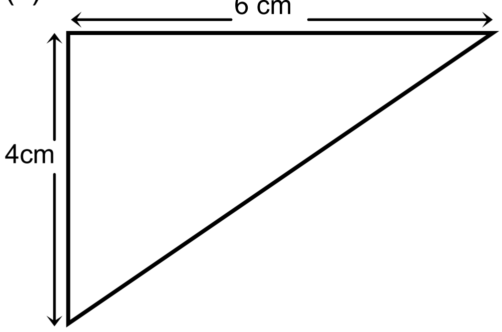
= ____________

Area of Triangle = $\frac{1}{2}$ Rectangle Area

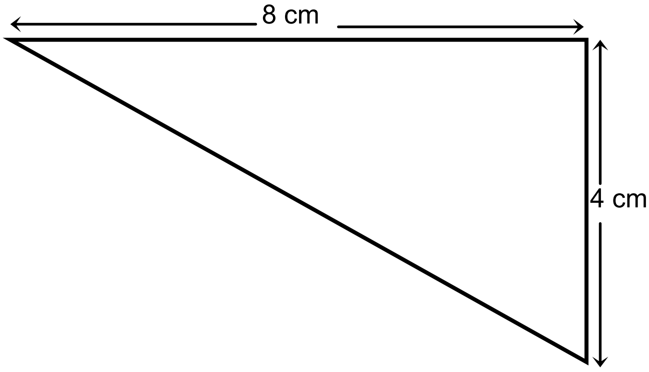
= ______ x ______

= ____________

(c)




(d)




Area of ________ = Length x ______

= ____________

Area of Triangle = $\frac{1}{2}$ ____________

= ________ x ________

= ____________

Area of ________ = _____ x _____

= ____________

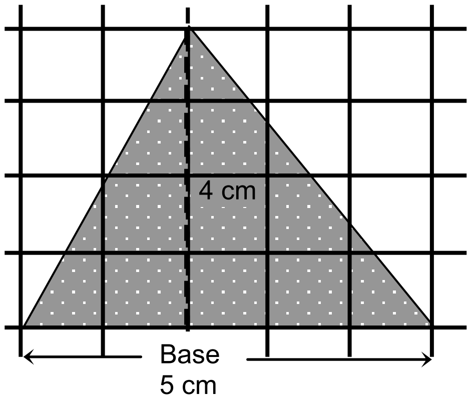
Area of Triangle = ____________

= ______ x ______

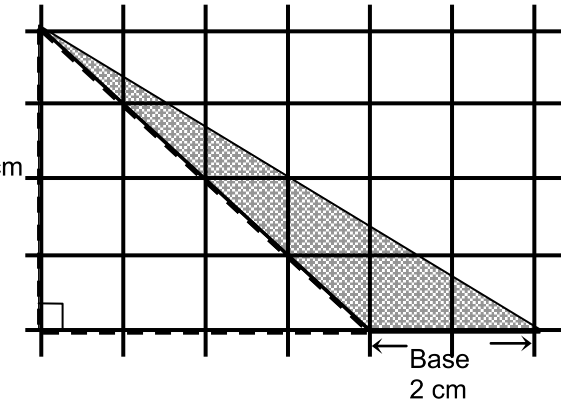
= ____________

2) Use the number sentence AREA OF A TRIANGLE = $\frac{1}{2}$ x b x h to work out the area of these triangles.

(a)




(b)




AREA OF TRIANGLE = $\frac{1}{2}$ x b x h

= $\frac{1}{2}$ x ___x _____

= $\frac{1}{2}$ x _______

= ___________cm$^2$

AREA OF TRIANGLE = $\frac{1}{2}$ x b x h

=_____ x _____ x _____

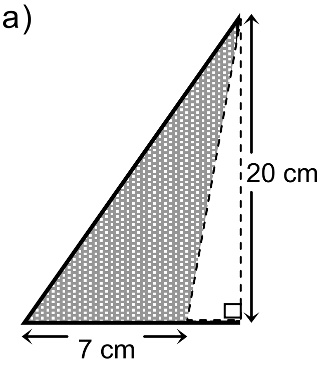
= ______ x ______

= ____________

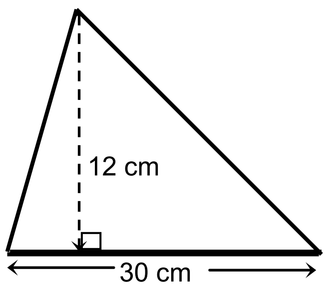
---

3) Use the formula AREA OF A TRIANGLE = $\frac{1}{2}$ x b x h to work out the area of the triangles in the diagrams below.

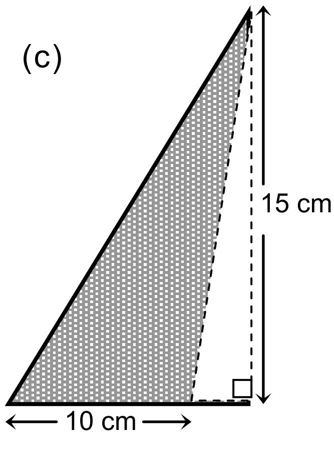
(a)




b)




(c)




AREA = $\frac{1}{2}$ x b x h

= ___________

= ___________

= ___________

AREA = ____________

= _____________

= _____________

= _____________

AREA = ___________

= ____________

= ____________

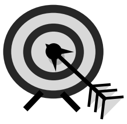
= ____________

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3.**

# Lesson 9: Area of Parallelograms

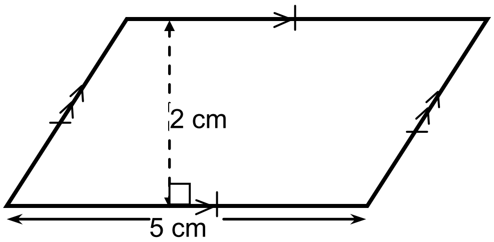
You learnt about parallelogram in Lessons 10 and 11 of Strand 2.



In this lesson, you will:

- develop the formula in finding the area of parallelograms
- use and apply the formula in solving problems related to area of parallelograms.

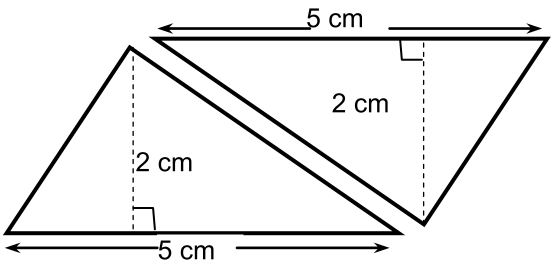
Below is a parallelogram.




In a parallelogram the pairs of **opposite sides are equal.**

This is different from rectangles and squares because the angles are not 90 degree or right angles.

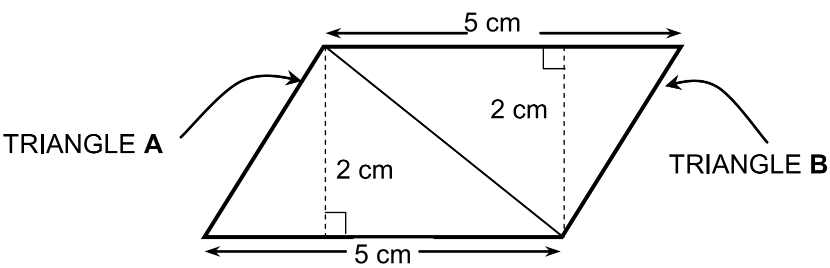
The figure is split into two and placed as shown,




The base is 5 cm, so the base of both triangles in split shapes = 5 cm.

The altitude or height (H) is 2 cm, so the altitude or height of both triangles in the split shapes = 2 cm.

To work out the area of parallelogram, work out the area of each part of the composite (compound or combined) shape:



**AREA OF TRIANGLE A**

Area = $\frac{1}{2}$ x b x h

= $\frac{1}{2}$ x 5 x 2

= $\underline{5\ cm^2}$

**AREA OF TRIANGLE B**

Area = $\frac{1}{2}$ x b x h

= $\frac{1}{2}$ x 5 x 2

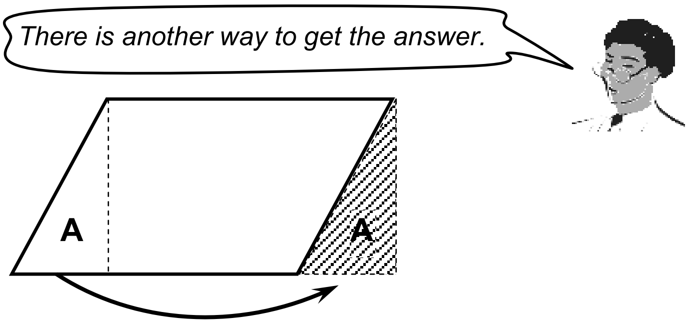
= $\underline{5\ cm^2}$

Now add the areas of the parts to get the area of the whole shape.

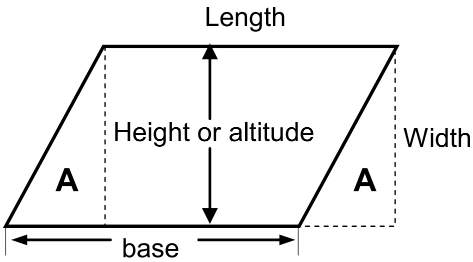
Area of Composite Shape = Area of Triangle **A** + Area of Triangle **B**

= 5 + 5

= $\underline{10\ cm^2}$



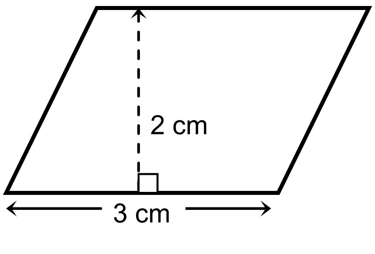

If part A of the parallelogram in the figure is cut and placed as shown below,




the base of the parallelogram is equal to the length of a rectangle, while the perpendicular height or altitude of a parallelogram is equal to the width of a rectangle.

If the Area of a Rectangle = Length x Width (L x W), then, the Area of a Parallelogram = Base x Height (b x h).

Instead of adding $\frac{1}{2}$ (b x h) and $\frac{1}{2}$ (b x h) we can just work out b x h.




b x h = 3 x 2

= $\underline{6\ cm^2}$

We can find the area of a parallelogram if we multiply the base by the height or altitude.

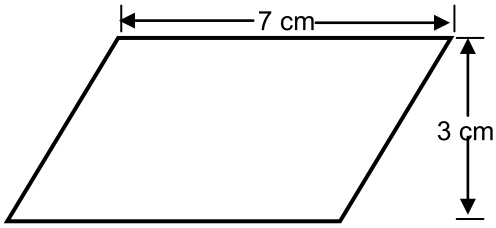
**AREA OF PARALLELOGRAM = base x altitude**

**A = b x h**

Now look at the examples below.

Example 1

Identify the base and the altitude, and work out the area of the parallelogram below:




Base = 7 cm

Altitude = 3 cm

Area = base x altitude

= 7 cm x 3 cm

= 21 $cm^2$

So, the area of the parallelogram is 21 $cm^2$.

Example 2

A rug in the shape of a parallelogram has a base of 344 cm and an altitude of 305 cm. Can it cover an area of 1365 square centimetres?

To be able to answer the problem, we have to work out the area of the rug.

Area of the rug = base x altitude

Area = 344 cm x 305 cm

= 104 920 $cm^2$

The area of the rug is 104 920 $cm^2$.

The area of the rug is more than the area to be covered which is 1365 $cm^2$, Therefore the answer is YES.

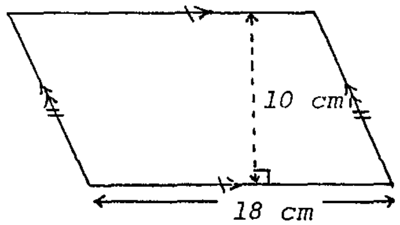
---

**NOW DO PRACTICE EXERCISE 9**

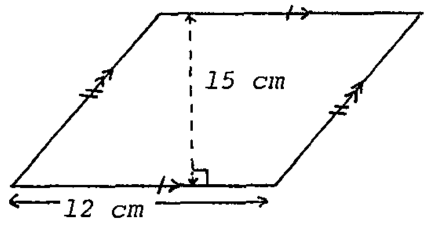
## Practice Exercise 9

1) Work out the area of these parallelograms.

(a)




(b)




AREA = b x h
= ____ x ____
= ____$cm^2$

AREA = ____ x ____
= ____ x ____
= ______

(**Note**: The figures are not drawn to scale)

2) Solve the following problems.

a) A picture frame in the shape of a parallelogram has a base of 18 cm. Its altitude is 12 cm. What is its area?

b) A plastic grid sheet in the shape of parallelogram has a base of 43 cm and an altitude of 25 cm. What is its area?

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 2.**

# Lesson 10: Area of Rhombus

In Lesson 9, you learnt how to work out the area of a parallelogram.

In this lesson, you will:

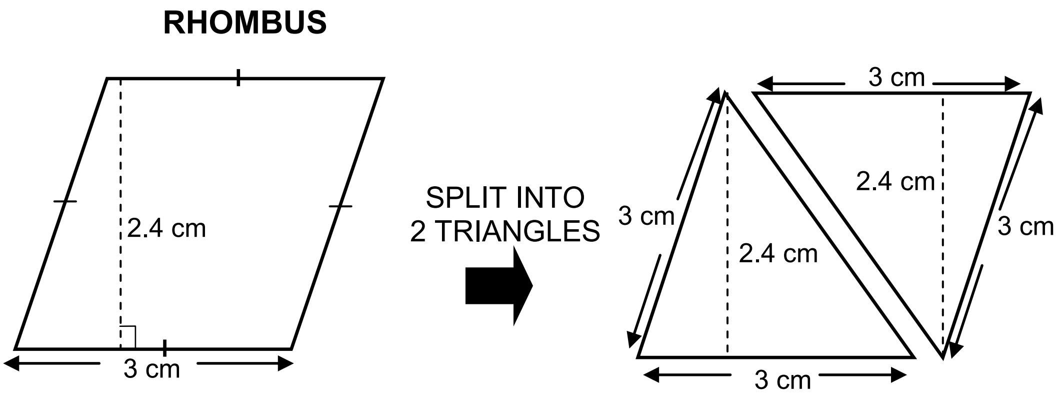
- develop the formula for finding the area of a rhombus
- use and apply the formula in solving problems related to the area of a rhombus.

You learnt the meaning of a rhombus in Strand 2, Lesson 11.

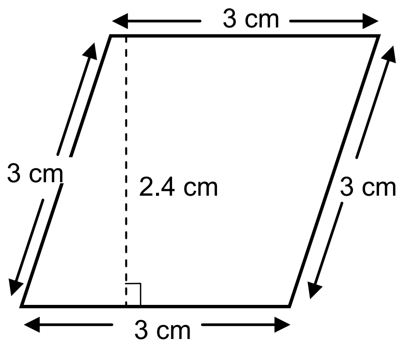
**A rhombus is a special type of parallelogram with all its sides equal and whose angles are oblique. Its opposite sides are congruent.**

Now you will learn to work out the area of a rhombus.

Look at the diagram below.




We can work out its area the same way as a parallelogram.




Base = 3 cm
Perpendicular height or altitude = 2.4 cm

We can use the sentence, **Area of Parallelogram = b x h**, to work out the area of a rhombus, which is a special type of parallelogram.

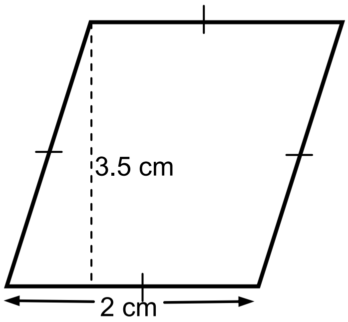
So, Area of a Rhombus = b x h
= 3 cm x 2.4 cm
= 7. 2 $cm^2$

**REMEMBER:**

**Do not get confused and use the length of the side instead of the perpendicular height. The side is not the perpendicular height**.

Example 1

What is the area of a rhombus with a side of 2 cm and a perpendicular height of 3.5 cm?




WORKING OUT:

A = b x h

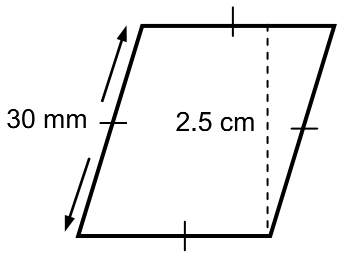
A = 2 cm x 3.5 cm

A = 7 $cm^2$

Example 2

What is the area of a rhombus with a side of 30 mm and a perpendicular height of 2.5 cm?

WORKING OUT:




Change the units of the base from mm to cm to make the units the same.

30 mm ÷ 10 = 3 cm

A = b x h

A = 3 cm x 2.5 cm

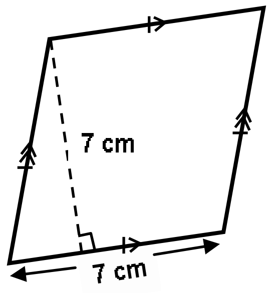
A = 7.5 $cm^2$

**NOW DO PRACTICE EXERCISE 10**

## Practice Exercise 10

1) Work out the area of each rhombus below.

(a)

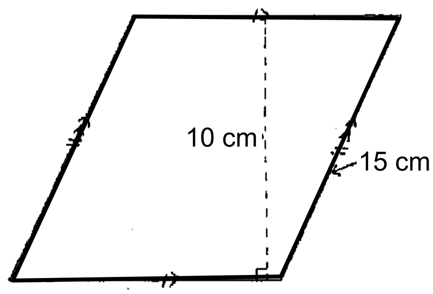



AREA = b x h

= ____ x ____

= ____ ___

(b)




AREA = ____ x ____

= ____ x ____

= ____ ___

2) Andrew‟s garden at home is in the shape of a rhombus whose side is 870 cm. Its altitude is 620 cm. What is the area of Andrew‟s garden?

3) Find the area of a rhombus with a base of 90 mm and a height of 14 cm. Express the answer in square centimetres.

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 2.**

# Lesson 11: Area of Trapeziums

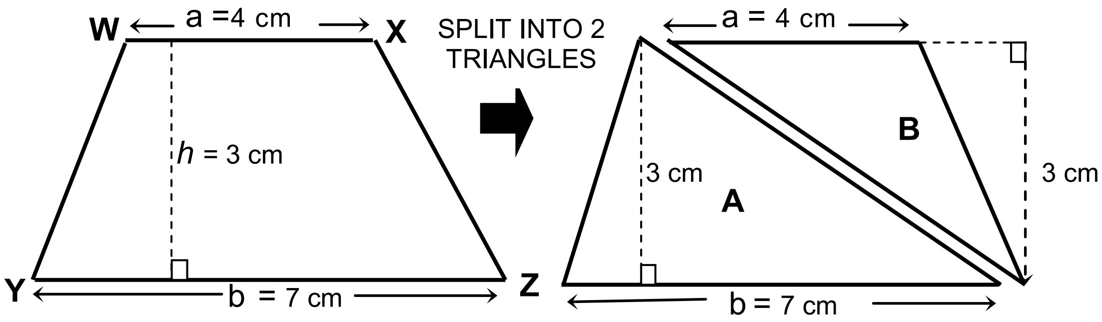
In Lesson 10, you learnt to work out the area of a rhombus.

In this lesson, you will:

- develop the formula for finding the area of a trapezium
- use and apply the formula in solving problems related to the area of a trapezium.

The other special shape we will look at is the **trapezium** or **trapezoid**.

**A trapezium (UK) or trapezoid(US) is a quadrilateral with only one pair of opposite sides parallel. The opposite sides are NOT equal.**




Above is the trapezoid **WXYZ** with bases **a = WX** and **b = YZ** and altitude **h.**

We have split the trapezoid into 2 triangles, Triangle **A** and Triangle **B**, with the same altitude (h) which is 3 cm.

Therefore the area of the trapezi equals the area of the two triangles. Equivalently, we write it as follows:

Area of Trapezoid = Area of Triangle **A** + Area of Triangle **B**

$$\text{Area of Trapezoid} = \left(\frac{1}{2} \text{ x b x h}\right) + \left(\frac{1}{2} \text{ x a x h}\right)$$

We can also say that,

The area of trapezoid equals one-half the sum of its two bases multiplied by its height or altitude. This can be written in the number sentence:

$$\boxed{\mathbf{A = \frac{1}{2}\,(\,a + b\,)\,h}}$$

Computing for the area of the trapezoid WXYZ,

$$
\begin{aligned}
A &= \frac{1}{2}(a + b)\,h \\
&= \frac{1}{2}(4\text{ cm} + 7\text{ cm})\,(3\text{ cm}) \\
&= \frac{1}{2}(11\text{ cm})\,(3\text{ cm}) \\
&= \frac{1}{2}(33\text{ cm}^2)
\end{aligned}
$$

Answer = 16.5 $\text{cm}^2$

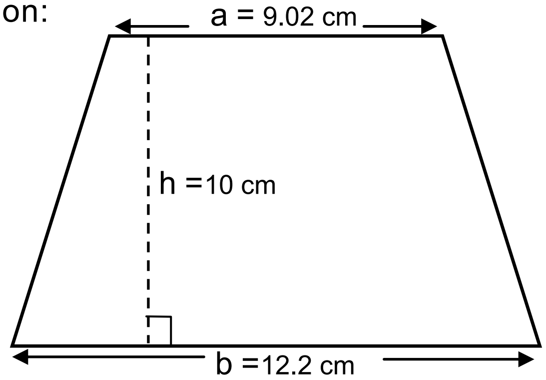
Example 1

Find the area of a trapezoid with the following dimensions:

a = 9.02 cm, b = 12.2 cm and h = 10 cm.

The trapezoid looks like the diagram below;

Solution:




> **Note:**
> **Always draw a diagram of the problem if there is none in the question.**

WORKING OUT:

$$
\begin{aligned}
A &= \frac{1}{2}(a + b)\,h \\
&= \frac{1}{2}(9.02\text{ cm} + 12.2\text{ cm})(10\text{ cm}) \\
&= \frac{1}{2}(21.22\text{ cm})(10\text{ cm}) \\
&= \frac{1}{2}(212.2\text{ cm}^2) \\
&= 106.1\text{ cm}^2
\end{aligned}
$$

So, the area of the trapezoid is 106.1 $\text{cm}^2$.

Example 2

A trapezium has the following dimensions:
a = 8.5 cm, b = 10.3 cm and h = 110 mm. Find its area.

Working out:

Change the units of the height to centimetres to make the units the same.

h = 110 mm ÷ 10 = **11 cm**

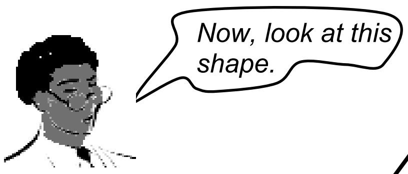
$$A = \frac{1}{2}(b_1 + b_2)\ h$$

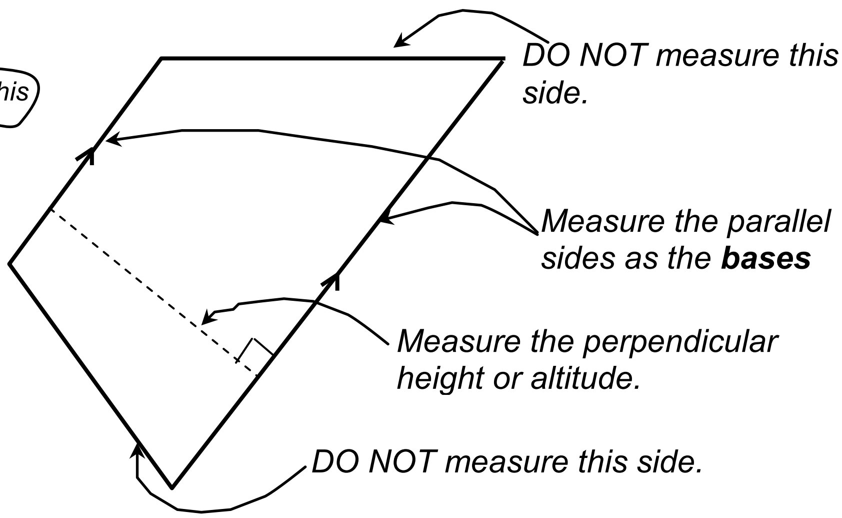
$$A = \frac{1}{2}(8.5 + 10.3)\ 11$$

$$A = \frac{1}{2}(18.8)\ 11$$

$$A = \frac{1}{2}(206.8\ \text{cm}^2)$$

$$A = 103.\ 4\ \text{cm}^2$$



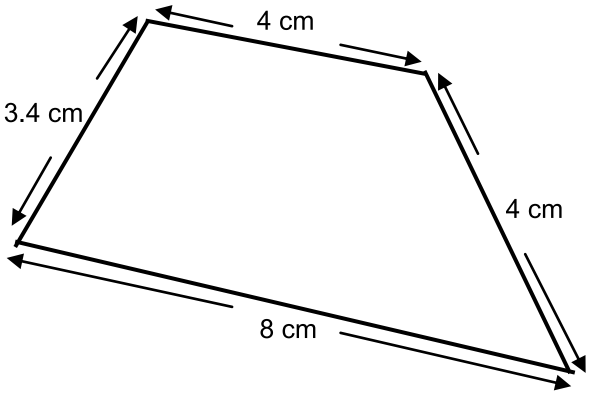

- If no measurements are given, be sure to make the RIGHT MEASUREMENT when you work out the area.
- If all measurements are given, be sure to use the RIGHT MEASUREMENT when you work out the area.

---

**NOW DO PRACTICE EXERCISE 11**

## Practice Exercise 11

1. Work out the area of the trapezium. Use your ruler if necessary.




We can split it into two ________ A and B.

Area OF A: Area OF B:

Area = __________ Area = __________

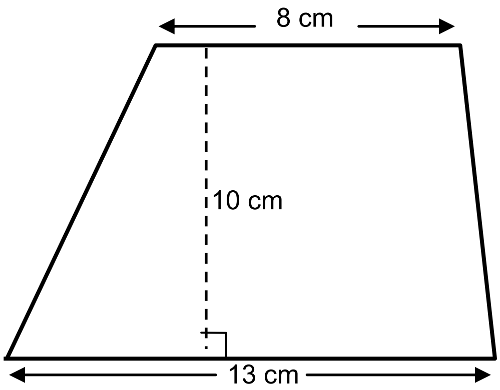
= __________ = __________

= __________ = __________

So, area of trapezoid = _______ + _______

= __________

2. Work out the area of the trapezium below.



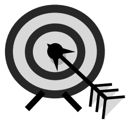

**Answer:**________________

3. A trapezium has the following dimensions: a = 10 cm, b = 8.4 cm and h = 150 mm. Draw the trapezium and find the area.

**Answer:**________________

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 2.**

# Lesson 12: Areas of Composite Shapes

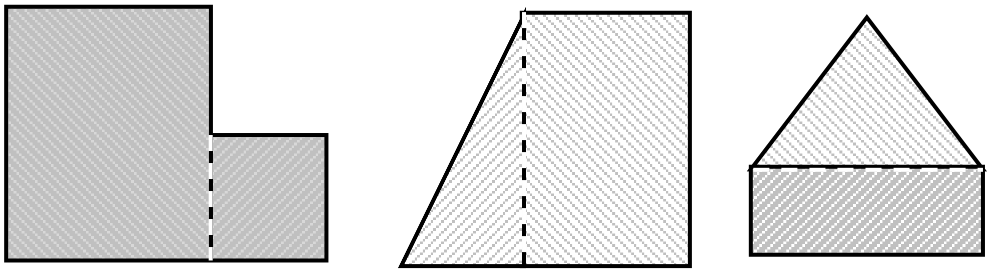


You learnt to work out for the area of a trapezium in Lesson 11.

In this lesson, you will:

- find the areas of composite shapes
- revise lessons on areas of rectangles, squares and triangles.

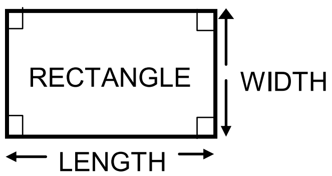
First, you will learn what composite shapes are.



We call these shapes **COMPOSITE** shapes. We can divide them into simple shapes. The parts used to make these shapes are RECTANGLE, SQUARE and TRIANGLE. You already know how to find the area of these parts.

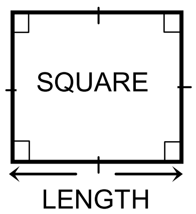
**Remember:**

***Lesson 7***



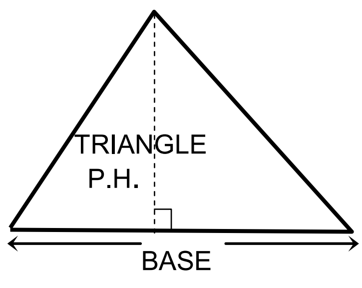

Area = L x W

***Lesson 7***

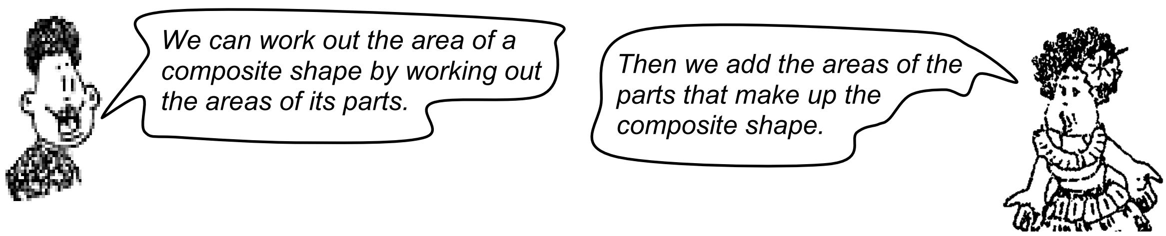



Area = $S^2$

***Lesson 8***

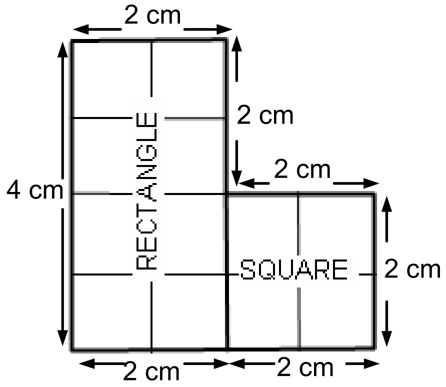



Area $= \frac{1}{2}$ b x h



Example 1

Find the area of this composite shape:




Step 1: The composite shape is made up of

Area of RECTANGLE + Area of SQUARE

Step 2: Find the areas of the parts:

Area of rectangle = 8 $cm^2$

Area of square = 4 $cm^2$

Step 3: Add the areas of the parts:

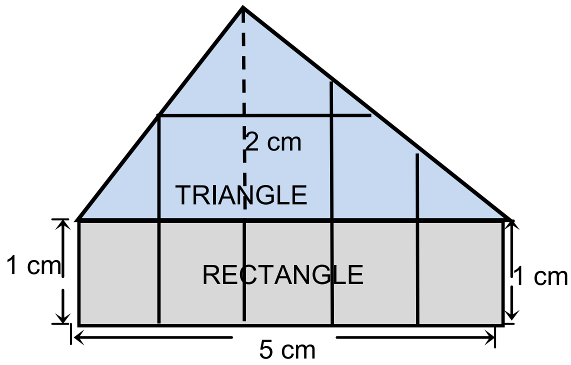
Area of composite shape = 8 + 4

= <u>12 $cm^2$</u>

Example 2

SQUARE

Find the area of this composite shape below.




Step1: The composite shape is made up of a RECTANGLE **+** TRIANGLE.

Step 2: Find the areas of the parts:

Area of rectangle = <u>5 $cm^2$</u>

Area of triangle $= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 5 \times 2$

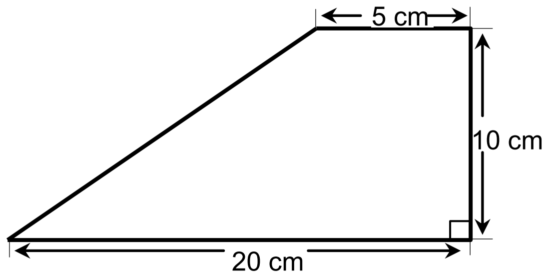
= <u>5 $cm^2$</u>

Step 3: Add the areas of the parts:

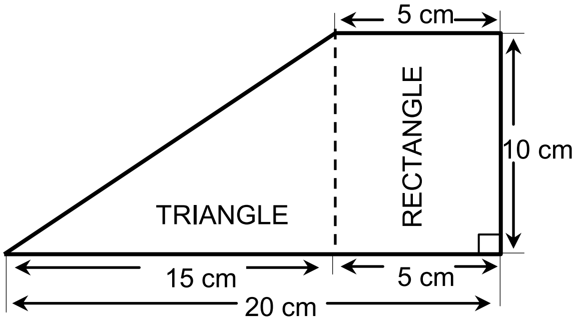
Area of composite shape = <u>5</u> + <u>5</u>

= **10 $cm^2$**

Now look at this composite shape.



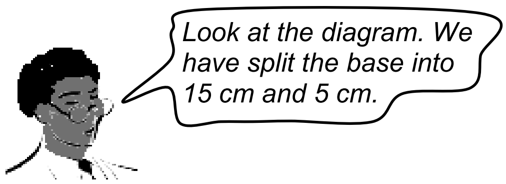

The area of this shape can be found by dividing it into two parts.





We can work out the area of a triangle using Area = $\frac{1}{2}$ x b x h.

We can work out the area of a rectangle using Area = Length x Width.




The top of the RECTANGLE is 5 cm.

So, the bottom of the rectangle is 5 cm.

This means the BASE OFTHE TRIANGLE is 20 cm – 5 cm = 15 cm.

What is the perpendicular height of the triangle?

One side of the rectangle is 10 cm.

So, the opposite side of the rectangle is also 10 cm, which gives us the perpendicular height of the triangle, shown as a dotted line.

Now, work out the areas of the triangle and the rectangle.

Area of triangle = $\frac{1}{2}$ x b x h

= $\frac{1}{2}$ x 15 cm x 10 cm

= 75 $cm^2$

Area of rectangle = Length x Width

= 5 cm x 10 cm

= 50 $cm^2$

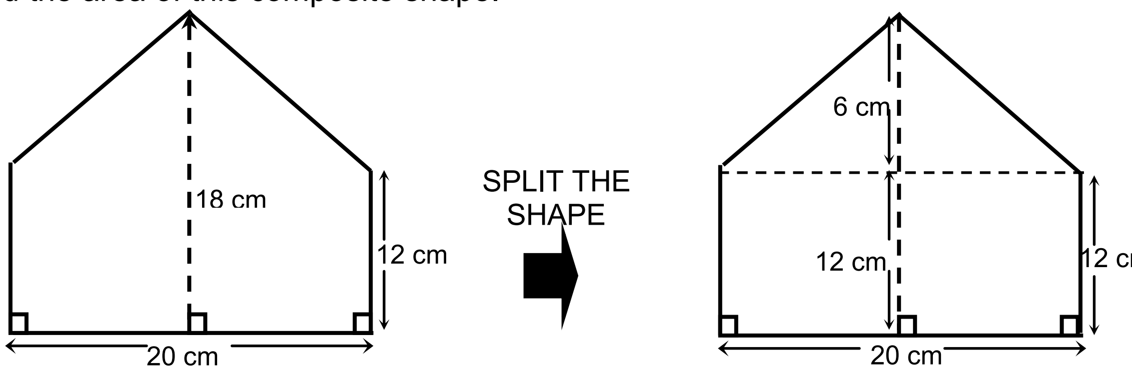
Next, add the areas to get the area of the composite shape.

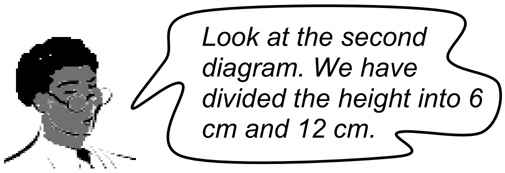
Area of Composite Shape = 75 $cm^2$ + 50 $cm^2$

=125 $cm^2$.

Example 3

Find the area of this composite shape.




When we split the composite shape, we get a TRIANGLE and a RECTANGLE.

The perpendicular height of the composite shape is 18 cm. But the perpendicular height of the rectangle is 12 cm,

So, the perpendicular height of the triangle is 18 cm – 12 cm = 6 cm.

What is the BASE of the triangle?

The base of the rectangle is 20 cm.

So the side of the rectangle opposite the base is also 20 cm (dotted line **……..**).

This is the same as the base of the triangle, so base = 20 cm.

Now work out the areas of each part.

*Area of triangle* = $\frac{1}{2}$ x b x h

= $\frac{1}{2}$ x 20 cm x 6 cm

= $60\ cm^2$.

*Area of rectangle* = Length x Width

= 20 cm x 12 cm

= $240\ cm^2$

Next, add the areas of the triangle and rectangle to find the area of the composite Shape

Area of Composite Shape = $60\ cm^2 + 240\ cm^2$

= $300\ cm^2$.

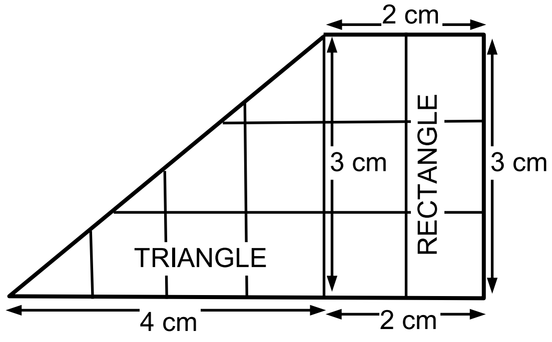
---

**NOW DO PRACTICE EXERCISE 12**

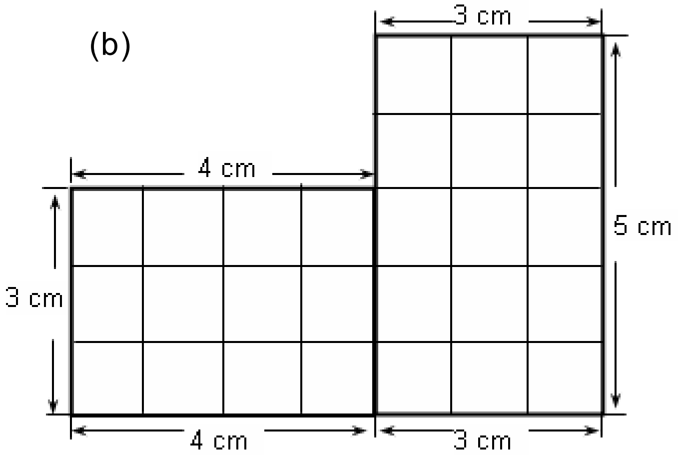
## Practice Exercise 12

1. Find the areas of the composite shapes below.

(a)




(b)




COMPOSITE SHAPE = TRIANGLE +_____

Area of triangle = $\frac{1}{2}$ x ___ x ____

= ____x _____ x ____

= ________ cm$^2$

Area of ________ = ___ x ____

= ___ cm$^2$

So, AREA OF COMPOSITE SHAPE

= ____ + ____

= _________ cm$^2$

COMPOSITE SHAPE = _____+ ____

Area of <u>Rectangle A</u> = ___x ____

= _____

Area of ________ = ___ x ____

= __________

So, AREA OF COMPOSITE SHAPE

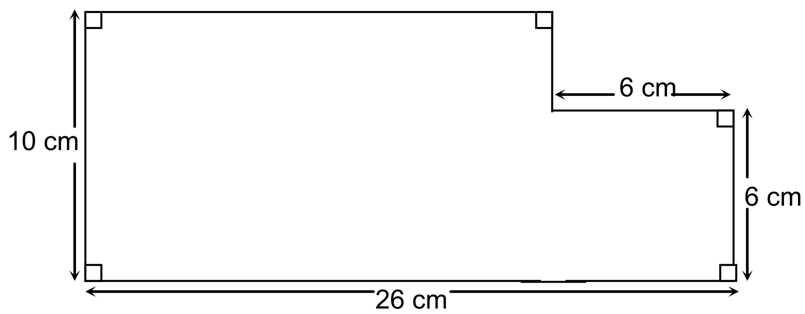
= ___ x ____

= __________

---

2. Work out the areas of these composite shapes. Split each shape first.

(a)




We can split the shape into a ____________ and a ____________.

AREA OF THE FIRST SHAPE:

Area = __________

= __________

= __________

AREA 0F THE SECOND SHAPE:

Area = __________

= __________

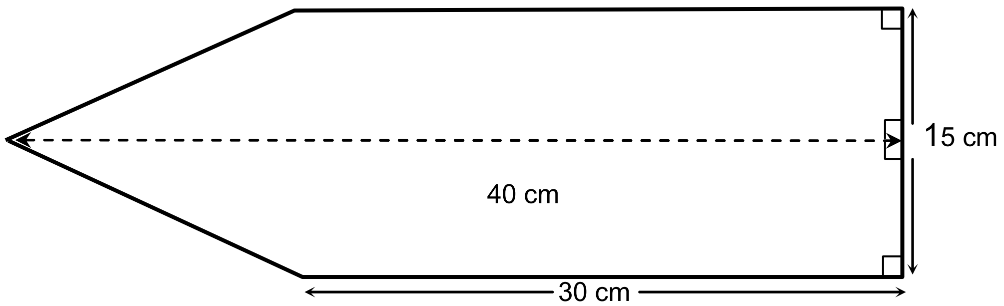
= __________

Note: Remember to split the base when you split the shape.

*Area of composite shape* = ___________+ ___________

= ___________

(b)




We can split the shape into a ____________ and a ____________.

AREA OF THE FIRST SHAPE:

Area = ___________

= ___________

= ___________

AREA 0F THE SECOND SHAPE:

Area = ___________

= ___________

= ___________

(Note: The perpendicular height has been shown as a dotted line: _ _ _ _ _ _.
Remember to split the perpendicular height when you split the shape.)

*Area of composite shape* = ___________+ ___________

= ___________

**Note that the shapes are not drawn to scale.**

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 2.**

## SUB-STRAND 2: SUMMARY


- The area of a shape is the amount of space inside that shape.
- We measure area by dividing it into square units, and counting how many there are inside the figure.
- The area of a rectangle is found by multiplying its length by its width.

  Formula: $\boxed{A = L \times W}$

- The area of a square is the square of a side.

  Formula: $\boxed{A = s^2}$

- The area of a triangle is half the product of its base and its altitude or height.

  Formula: $\boxed{A = \frac{1}{2} \times b \times h \quad \text{or} \quad A = \frac{b \times h}{2}}$

- The area of a parallelogram is equal to the product of its base and its height .

  Formula: $\boxed{A = b \times h}$

- The area of trapeziums is equal to one–half the sum of its two bases multiplied by its height.

  Formula: $\boxed{A = \frac{1}{2}(a + b)h}$

- The area of a rhombus can be found by using the formula for finding the area of a parallelogram.

- To find the area of composite shapes, divide the composite shape into small rectangles, squares or triangles then add all the areas together.

**REVISE LESSONS 6-12 THEN DO SUB-STRAND TEST 2 IN ASSIGNMENT 2.**

# ANSWERS TO PRACTICE EXERCISE 6 - 12

---

**Practice exercise 6**

2) 15 $cm^2$

3) $12\frac{1}{2}$ $cm^2$

4) $4\frac{1}{2}$ $cm^2$

5) 18 $cm^2$

6) $19\frac{1}{2}$ $cm^2$

---

**Practice exercise 7**

1) (a) 21 $cm^2$ (b) 20 $cm^2$

2) 201.42 $cm^2$

3) 1391 $cm^2$

4) (a) 144 $cm^2$ (b) 225 $cm^2$
(c) 56.25 $cm^2$ (d) 5.29 $cm^2$

5) (a) 84.8 $cm^2$ (b) 16920.21 $cm^2$
(c) 70 225 $cm^2$ (d) 9604 $cm^2$

---

**Practice exercise 8**

1) (a) 8 $cm^2$ (b) 10.5 $cm^2$
(c) 12 $cm^2$ (d) 16 $cm^2$

2) (a) 10 $cm^2$ (b) 4 $cm^2$

3) (a) 70 $cm^2$ (b) 180 $cm^2$ c. 75 $cm^2$

---

**Practice exercise 9**

1) (a) 180 $cm^2$
(b) 180 $cm^2$

2) (a) 216 $cm^2$
(b) 1075 $cm^2$

**Practice exercise 10**

1) (a) 49 $cm^2$ (b) 150 $cm^2$

2) 539 400 $cm^2$

3) 126 $cm^2$

---

**Practice exercise 11**

1) 21 $cm^2$

2) 105 $cm^2$

3) 138 $cm^2$

---

**Practice exercise 12**

1) (a) 12 $cm^2$
   (b) 27 $cm^2$

2) (a) 236 $cm^2$
   (b) 525 $cm^2$

---

**END OF SUB-STRAND 2**

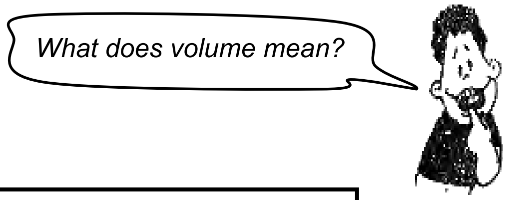
# SUB-STRAND 3

# VOLUME AND CAPACITY

# SUB-STRAND 3: VOLUME AND CAPACITY

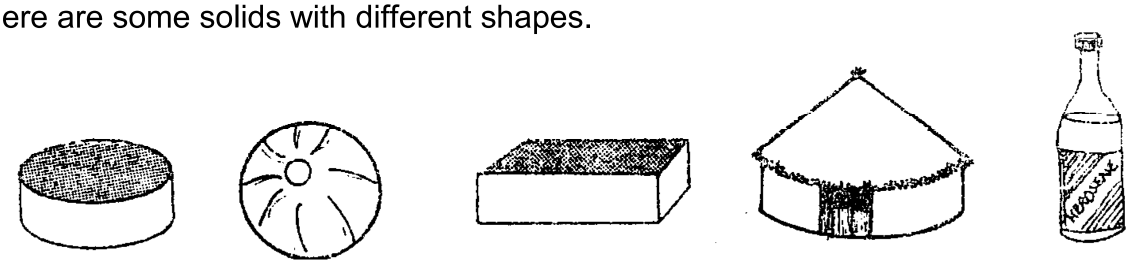
## Introduction

You learnt how to measure the areas of different plane shapes in the previous sub-strand. In this sub-strand, you will learn the volume of different solid shapes.




**VOLUME – is the amount of space an object occupies.**

Here are some solids with different shapes.



In this Sub-strand you will study volumes of simple and compound prisms, use rules to determine volumes of different solid shapes and investigate capacity and the relationship between capacity and volume.

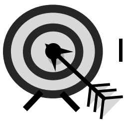
You will learn the meaning of volume, the standard unit used for measuring volume and how to work out the volume of rectangular prisms.

You will also learn how to work out the volume of some shapes which can be split into rectangular prisms. Then you will learn the meaning of capacity and the standard unit for measuring capacity.

Lastly, you will learn to work out problems on volume and capacity.

# Lesson 13: Measuring 3D Space (Volume)

You learnt about finding the area of different solid shapes in Strand 2 Sub-strand 3.



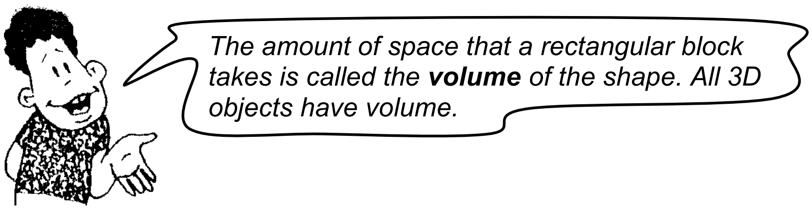
In this lesson, you will:

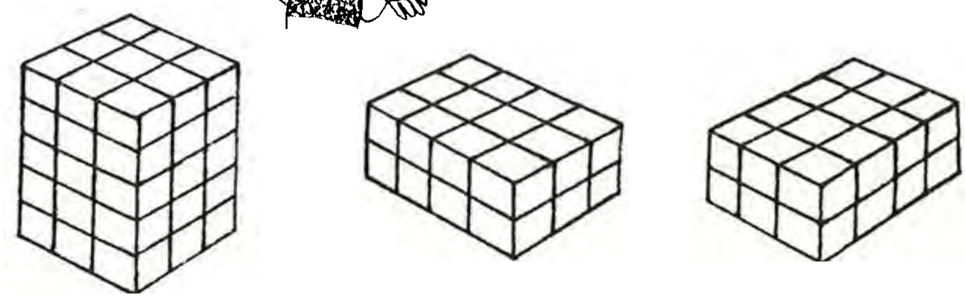
- define volume
- measure volume of simple solid shapes.

---

We know that solids have **thickness**, as well as **length** and **breadth**. They are also 3 dimensional (3D) and that they may be full or empty inside.

Now, you will learn the meaning of volume and the standard unit used for measuring volume.



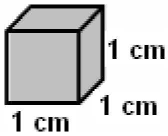
**Volume refers to the amount of space a solid shape can occupy.**

While the area refers to the *surface* of an object, volume refers to the *thickness* of a solid shape.

If we measure the volume of an object, we need appropriate units. To measure area we used **square units**. To measure volume we use **cubic units**.

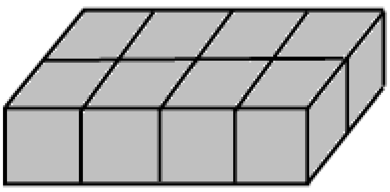
Example

If this is one cubic unit



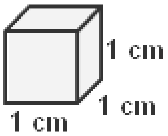

= **$\underline{1\text{ cm}^3}$**

then the volume of this solid is 8 cubic units.

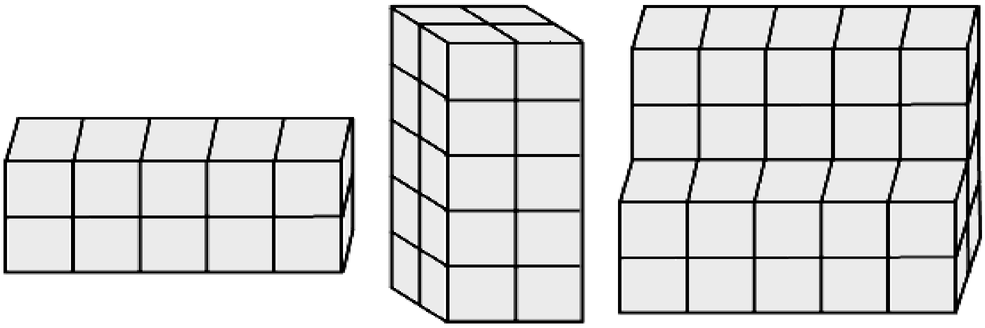


= **$\underline{8\text{ cm}^3}$**

We can find the volume by counting the number of cubic units that the figure occupies.

Using the 

, find the number of cubes in each rectangular block below.



a) Two rows of 5 cubes

Cubes = 10 cubes or
V = 10cm$^3$

b) 4 cubes in each 5 rows
cubes = 4 x 5 rows of
cubes or 20 cubes
V = 20cm$^3$

c) Back section has 5 x 4
rows of cubes or 20 cubes
V = 20cm$^3$
Front section has 2 x 5
rows of cubes or 10 cubes
= 10 cm$^3$
So, 20 + 10 = 30 cubes
V = 30 cm$^3$

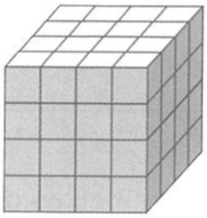
---

**NOW DO PRACTICE EXERCISE 13**

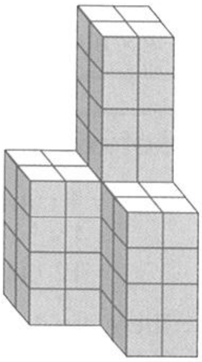
## Practice Exercise 13

Count the number of cubes to find the volume of each shape. Each cube is in cubic centimetres.

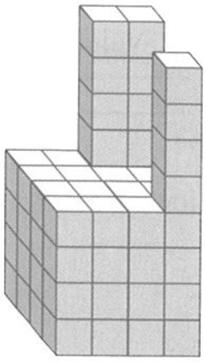
(a)



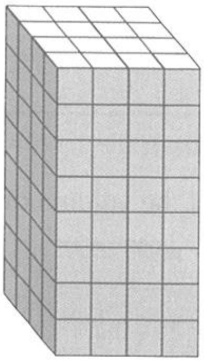
(b)



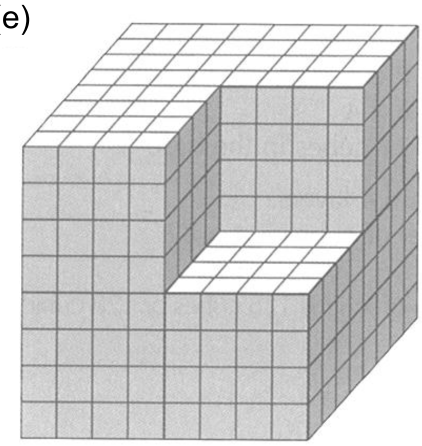
(c)



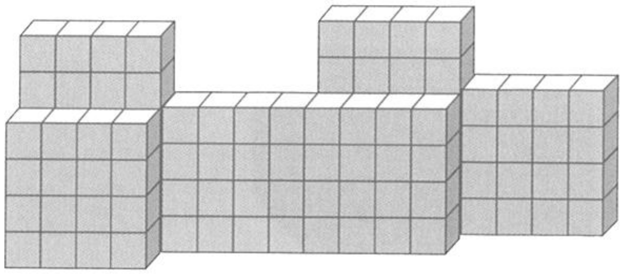
(d)



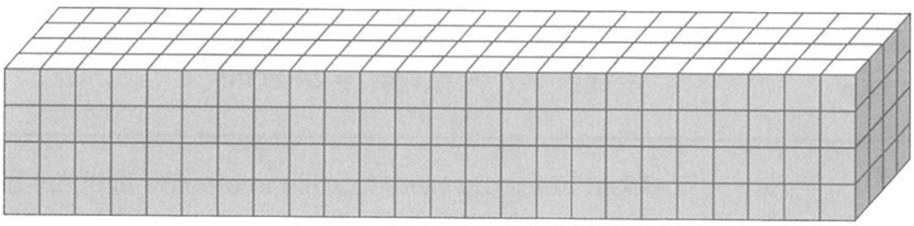
(e)



(f)



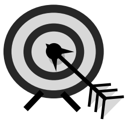
(g)



**CORRECT YOUR WORK ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 14: Volume of Rectangular Prism

In Lesson 13, you learnt the meaning of volume and how to find the volume of simple solids by counting cubes.



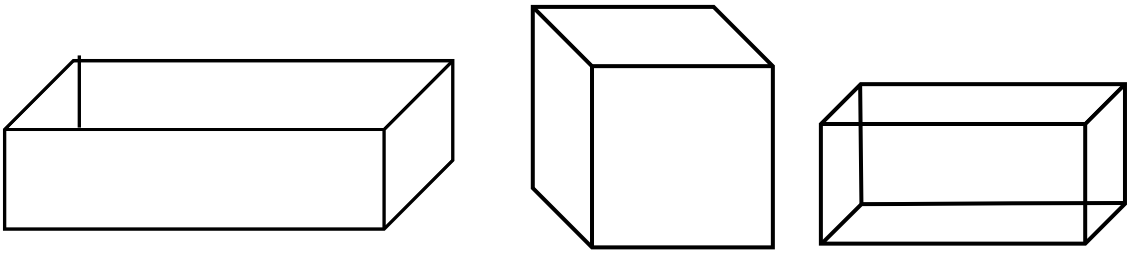
In this lesson, you will:

- define rectangular prisms
- find the volume of rectangular prisms.

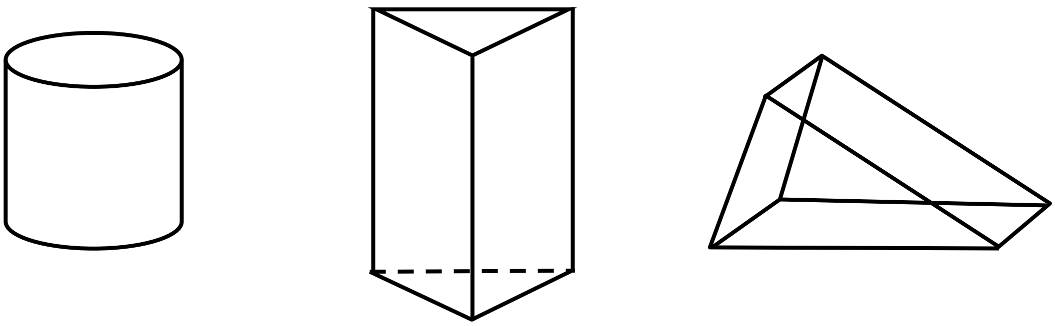
In Strand 2 Lesson 14, you learnt the meaning of a rectangular prism.

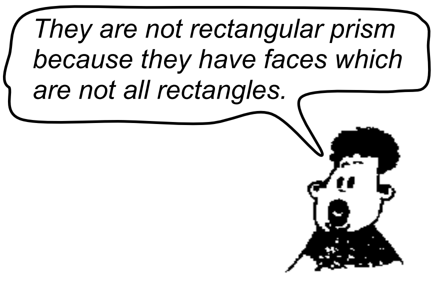
**A rectangular prism is a solid shape whose six faces are all rectangles.**

Here are examples of rectangular prisms.



These are not rectangular prisms. Why?





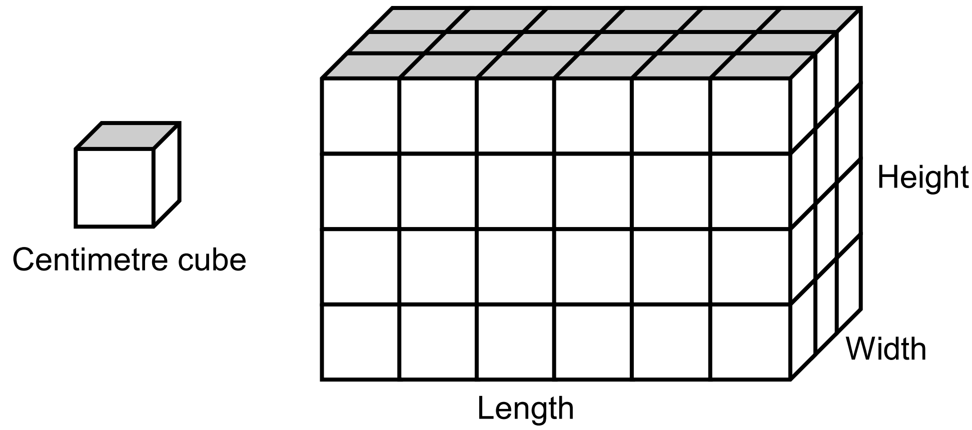

Now go to the next page.

**Volume of a Rectangular Prism**

In lesson 13, you learnt how to find the volume of solids by counting centimetre cubes.

In this lesson, you will learn how to work out the volume of a rectangular prism by using a rule.

We see that the rectangular prism has a length, a width and a height.



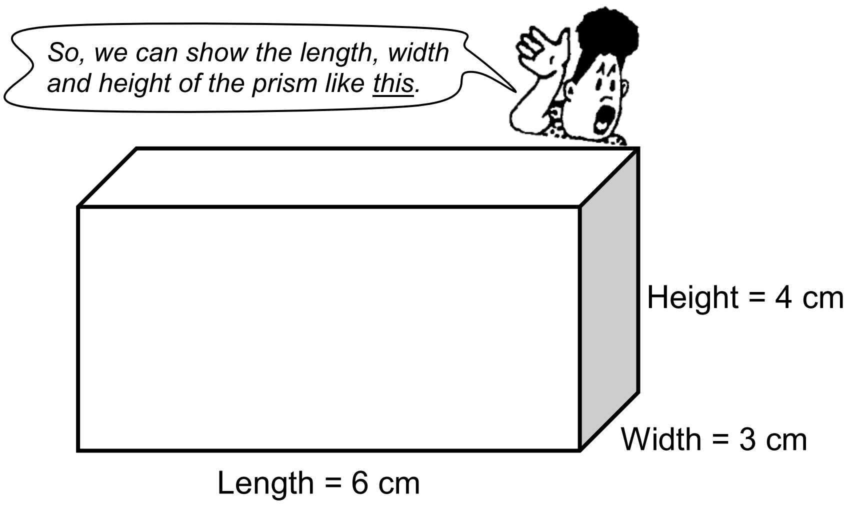

**Prism X**

Using these dimensions, we will know that

The length of the prism is 6 cm, because each cube has a length of 1 cm.

The width of the prism is 3 cm, because each cube has a width of 1 cm.

The height of the prism is 4 cm, because each cube has a height of 1 cm




Length of prism = 6 cm

Width of prism = 3 cm

Height of prism = 4 cm

You learnt how to find the volume of the rectangular prism by counting the cubes in each line, the number of lines and the number of layers.

Volume of prism =(No. of Cubes in 1 Line) x (No. of lines) x (No. of layers)

Volume of prism = 6 x 3 x 4

We also know this

Length of prism = 6 cm

Width of prism = 3 cm

Height of prism = 4 cm

Volume = **Length x Width x Height.**

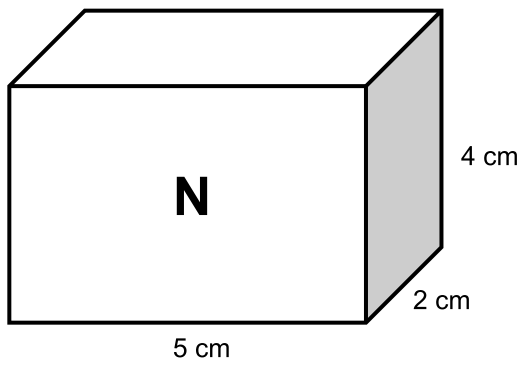
= 6 cm x 3 cm x 4 cm

= 72 $cm^3$

| |
|---|
| **Volume of Rectangular Prism = Length x Width x Height** |
| **or simply V = L x W x H** |

Example 1

Look at the rectangular prism **N**.
Find the volume of the prism.




Length = 5 cm

Width = 2 cm

Height = 4 cm

Volume = Length x Width x Height

= 5 cm x 2 cm x 4 cm

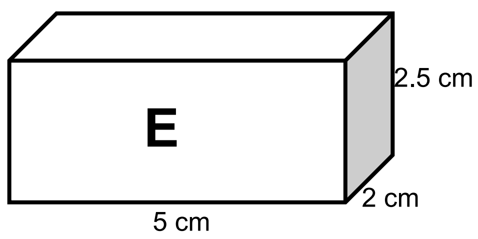
= 10 x 4 $cm^3$ ← (cm x cm x cm)

= 40 $cm^3$

Example 2

Look at the rectangular prism **E**.

Find the volume of the rectangular prism **E**.




Length = 5 cm, Width = 2 cm, Height = 2.5 cm

Volume = L x W x H

= 5 x 2 x 2.5 $cm^3$

= 10 x 2.5 $cm^3$

= 25 $cm^3$

Example 3

A rectangular box is 20 cm long, 7.5 cm wide and 8 cm high.

What is the volume of the box?

Length = 20 cm
Width = 7.5 cm
Height = 8 cm

So, Volume = Length x Width x Height
= 20 cm x 7.5 cm x 8 cm
= 150 x 8 $cm^3$
= 1200 $cm^3$

**We do not always need a diagram. If length, width and height are known, then the volume can be found by using the formula**

**Volume = Length x Width x Height.**

Example 4

A block of wood in the shape of a rectangular prism is 10 cm long, 8.5 cm wide and 5.4 cm high. Find its volume.

Length = 10 cm
Width = 8.5 cm
Height = 5.4 cm

So, Volume = Length x Width x Height
= 10 cm x 8.5 cm x 5.4 cm
= 85 x 5.4 $cm^3$
= 459 $cm^3$

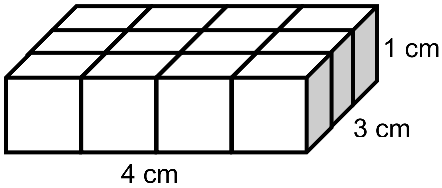
---

**NOW DO PRACTICE EXERCISE 14**

## Practice Exercise 14

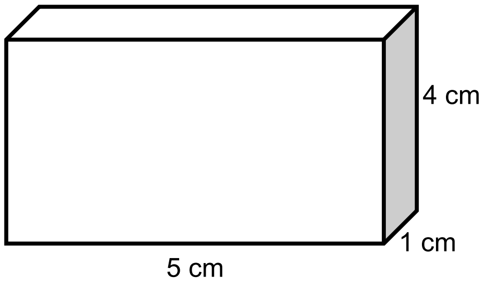
1. Find the volume of these rectangular prisms.

(a) Length of prism = 4 cm
Width of prism = 3 cm
Height of prism = 1 cm



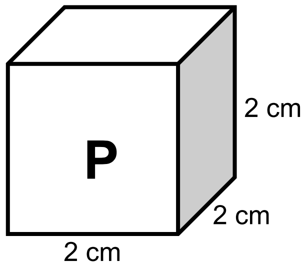

Volume = ______ x ______ x ______
= 4 cm x ______cm x ______ cm
= _______x 1 $cm^3$
= _______ $cm^3$

(b) Length = 5 cm
Width = 1 cm
Height = 4 cm




Volume = ______ x ______ x ______
= 5 cm x ______ cm x ______cm
= 5 x 4 ______
= ______$cm^3$

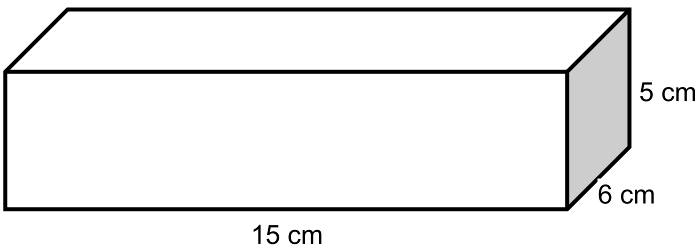
2. A cube P has a side of 2 cm. Fill in the blank spaces.




The Length of cube P = ______ cm
The Width of Cube P = ______ cm
The Height of Cube P = ______ cm

So, the volume of Cube P = ______cm x _____cm x _____cm
= _______$cm^3$

3. Find the volume of the rectangular solid shown by filling in the blank spaces.




Length = _______ cm
Width = _______ cm
Height = _______ cm

Volume = Length x _______ x _______
= ______x _______ x _______
= _______ x _______ $cm^3$
= _______ $cm^3$

4. A rectangular box has a length, 12 cm; width, 7.5 cm, and height 7 cm. Find its volume.

Answer: ___________

---

5. Find the volume of the following rectangular prisms described:

(a) Rectangular Prism R

Length = 24.5 cm

Width = 10 cm

Height = 5 cm

Answer:___________

(b) Rectangular Prism S

Length = 18 cm

Width = 12.5 cm

Height = 8.4 cm

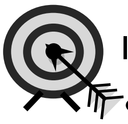
Answer:___________

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 15: Volume of Compound Prismatic Solids

You learnt how to find the volume of a rectangular prism in the previous lesson.



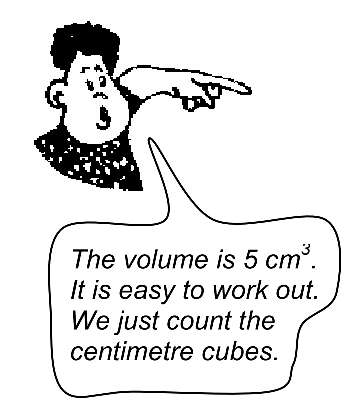
In this lesson, you will:

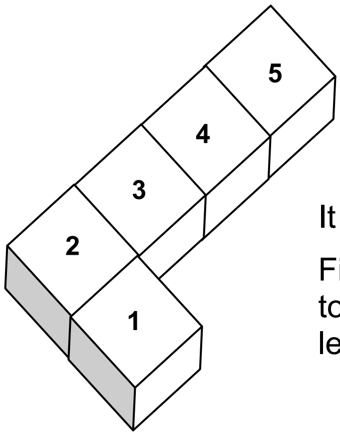
- define compound prismatic solids
- find the volume of compound prismatic solids.

First, you will learn the meaning of compound prismatics solids.

**Compound prismatic solids are solids which can be split or divided into rectangular prisms.**

Look at this shape.



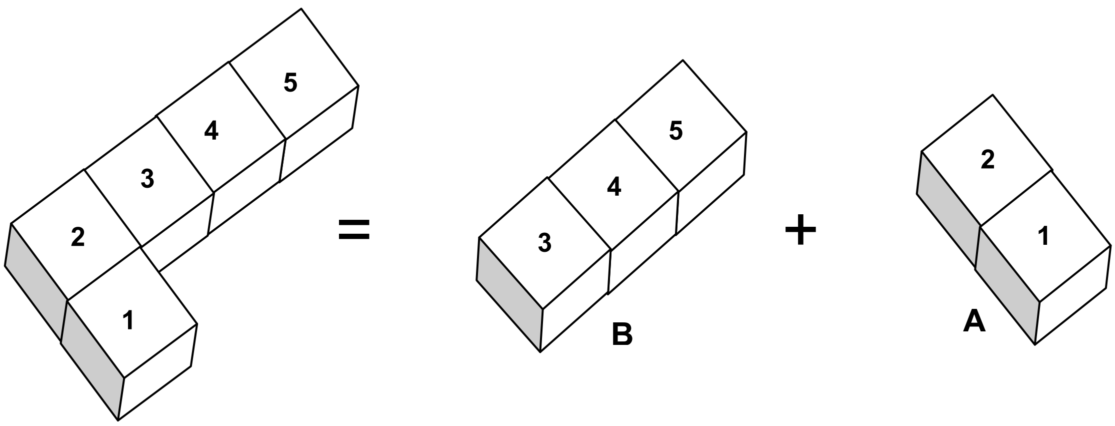




It is not a rectangular prism.

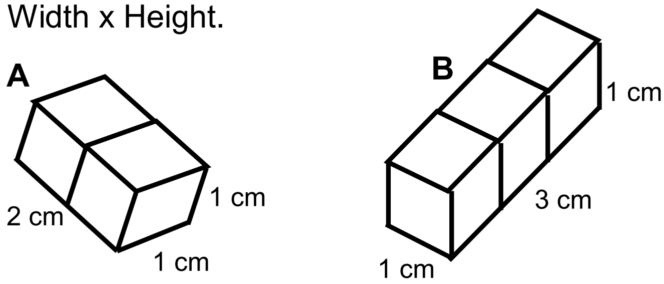
Five centimetre cubes are placed together to form a solid like the letter L.

Here is another way to work out the volume.

We will split or divide this solid shape into two rectangular prism.



Now, to find the volumes of rectangular prisms **A** and **B**, we will use the formula Volume = Length x Width x Height.




VOLUME of Prism A
V = length x width x height
V = 2 cm x 1 cm x 1 cm
V = 2 $cm^3$

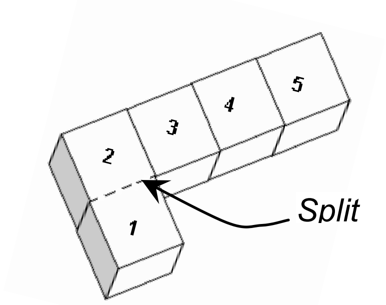
VOLUME of Prism B
V = length x width x height
V = 3 cm x 1 cm x 1 cm
V = 3 $cm^3$

Add the volume of prism **A** and the volume of prism **B** to get the volume of the entire **L** shaped prism.

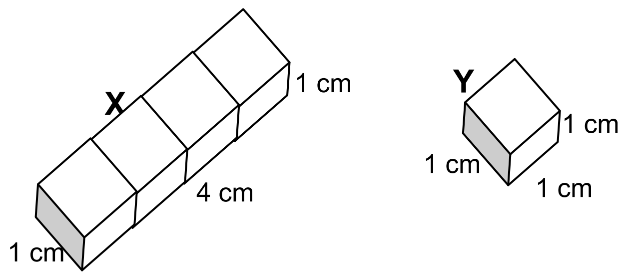
Volume of Prism **A** + Volume of Prism **B** = 2 $cm^3$ + 3 $cm^3$
= 5 $cm^3$

There is also another way of splitting the same **L** shaped block.

Split along the dotted line…. between block 2 and 1.




Then we get two prisms , which we call **X** and **Y**.




We can find the volume of prism **X** and prism **Y**.

Volume = length x width x height
= 4 cm x 1 cm x 1 cm
= 4 $cm^3$

Volume = length x width x height
= 1 cm x 1 cm x 1 cm
= 1 $cm^3$

So, volume of the **L** shape = Volume of Prism **X** + Volume of Prism **Y**

= 4 $cm^3$ + 1 $cm^3$

= 5 $cm^3$

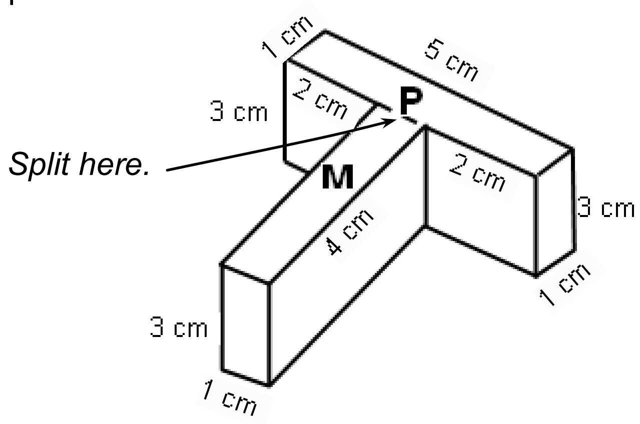
We find the volume of the **L** shape in three ways.

1. By counting centimetre cubes, volume = 5 $cm^3$
2. By splitting into parts **A** and **B**, volume = 5 $cm^3$.
3. By splitting into parts **X** and **Y**, volume = 5 $cm^3$.

**Note:** It is not always possible to count the centimetre cubes. So, we split the shape into rectangular prisms and calculate.

Example 1

Find the volume of theT-shaped metal block .




.

This shape is **not** a rectangular prism.

We can split or divide this shape into two rectangular prisms which have the following measurements:

| Rectangular Prism **P** | Rectangular Prism **M** |
|---|---|
| Length = 5 cm | Length = 4 cm |
| Width = 1 cm | Width = 1 cm |
| Height = 3 cm | Height = 3 cm |

For Rectangular Prism **P**

Volume = L x W x H

Volume = 5 cm x 1 cm x 3 cm

= 15 $cm^3$

For Rectangular Prism **M**

Volume = L x W x H

Volume = 4 cm x 1 cm x 3 cm

= 12 $cm^3$

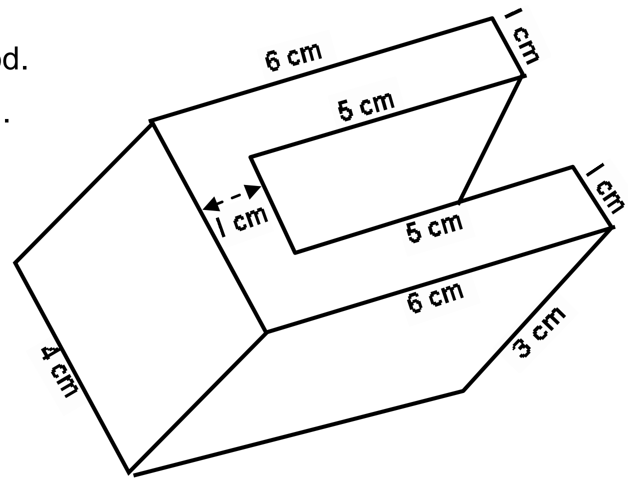
So, volume of **T** shaped metal block = 15 $cm^3$ + 12 $cm^3$

= 27 $cm^3$

Example 2

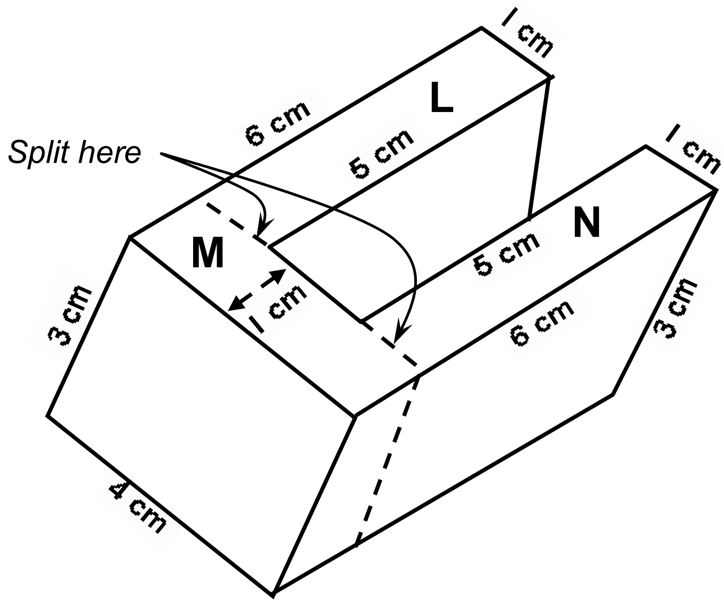
Find the volume of the block of wood.

This solid is not a rectangular prism.




We can split or divide this solid shape into 3 parts which are rectangular prisms.

We can split it into 3 parts, **L**, **M** and **N**.




(i) For Rectangular Prism **L**

L = 5 cm, W = 1 cm, H = 3 cm

So, Volume = 5 x 1 x 3 $cm^3$

= 15 $cm^3$

(ii) For Rectangular Prism **M**

L = 4 cm. W = 1 cm, H = 3 cm

So, Volume = 4 x 1 x 3 $cm^3$

= 12 $cm^3$

(iii) For Rectangular Prism **N**

L = 5 cm, W = 1 cm, H = 3 cm

So, Volume = 5 x 1 x 3 $cm^3$

= 15 $cm^3$

So, the Total Volume of the block of wood = 15 $cm^3$ + 12 $cm^3$ + 15 $cm^3$ = 42 $cm^3$

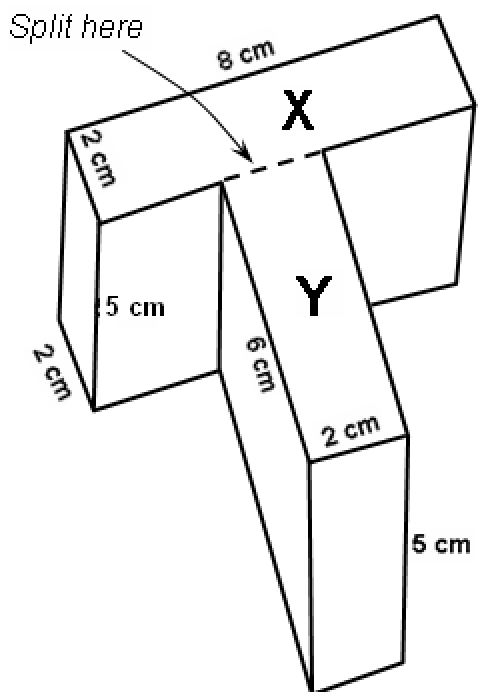
---

**NOW DO PRACTICE EXERCISE 15**

## Practice Exercise15

1. Look at the **T**-shaped block shown in the diagram. It can be divided along the dotted line or split into two parts, **X** and **Y**.

Fill in the blank spaces. (*This is a scale drawing; use the measurements shown)*




(a) <u>For Part **X**</u>

Length = _____cm

Width = _____cm

Height = _____cm

Volume = _____x ____ x _____ cm$^3$

= _____cm$^3$

(b) <u>For Part **Y**</u>

Length = _____cm

Width = _____cm

Height = _____cm

Volume = _____x ____ x _____cm

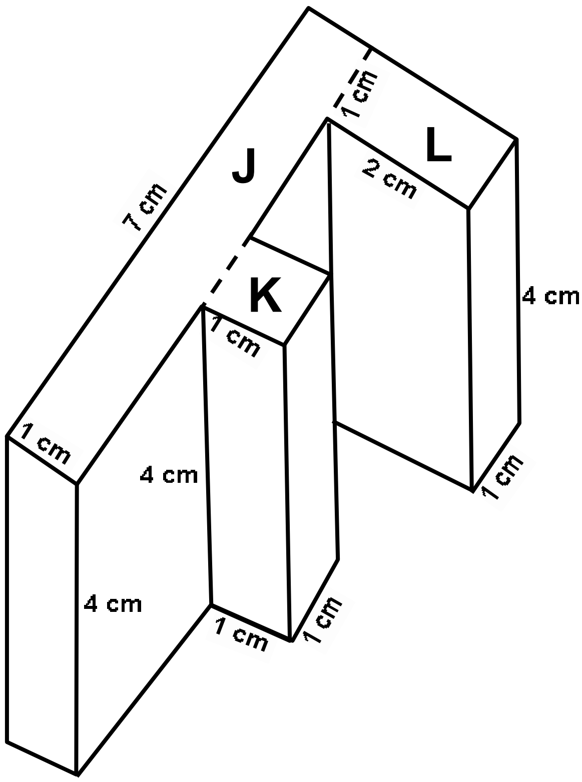
= _____cm$^3$

(c) Volume of **T** shaped block = _______ + _______cm$^3$

= _________ cm$^3$

2. A wooden block is in the shape of the letter **F**.

It can be split or divided into 3 parts J, K and L along the dotted lines.




(a) Find the volume of Part **J.**

Length = _____

Width = _____

Height = _____

So, Volume = _____x ____ x _____

= _____x ____ x _____

= _____x ______

= ______cm$^3$

(b) Find the volume of Part **K.**

Length = _____

Width = _____

Height = _____

So, Volume = ________x ________ x _______

= ________x ________ x _______

= ________x ________

= ________cm$^3$

(c) Find the volume of Part **L**

Length = _____cm, Width = _____cm, Height = _____cm

So, Volume = ________x_________ x ________

= ________x_________ x ________

= ________x_________

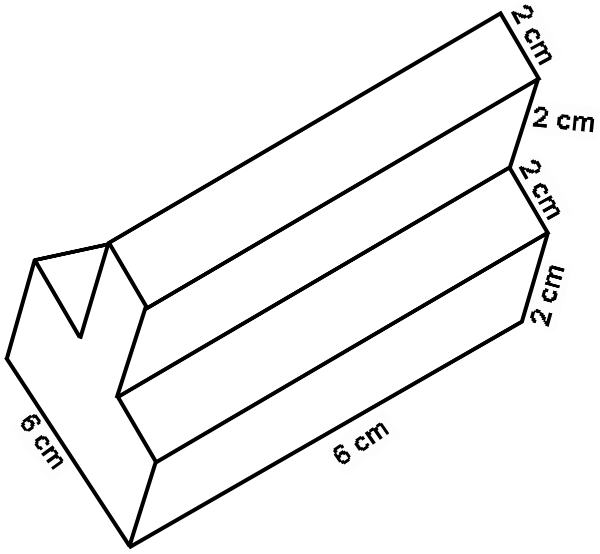
= ______cm$^3$

(d) What is the volume of the **F** shaped block?

Volume = ______ cm$^3$ +_______ cm$^3$ + _______ cm$^3$

= ________ cm$^3$

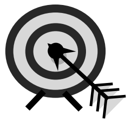
3. The solid shown below is formed by joining rectangular prisms together. Find the volume of the solid.




**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 16: Capacity

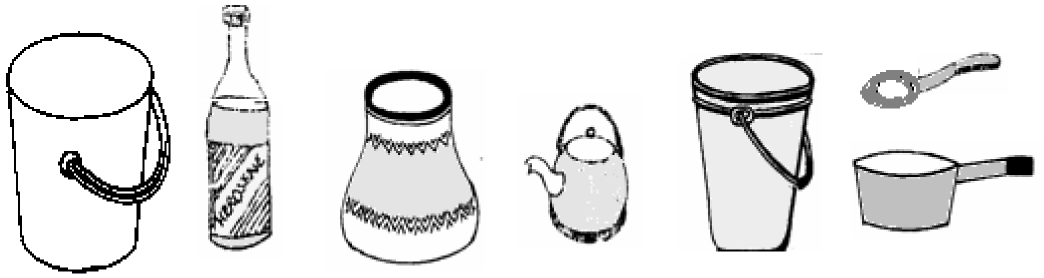
In the previous lessons, you learnt about volume of solids.



In this lesson, you will:

- identify the basic unit for capacity
- convert metric units of capacity.

Look at the different containers below. Which container can hold a greater amount of liquid?



When we measure the amount of a liquid that a container can hold, we are measuring its **capacity**. We can only compare which container holds more liquid if we know the capacity of the container in units.

We say that an amount of a liquid is so many cupfuls or spoonfuls. For the volume of solids, we need some standard unit. For example, medicine is usually measured in millilitres while milk can be bought in 1 litre cartons.

Here are the units for measuring capacity in the Metric System.

**Measures of Capacity**

10 millilitres (mL) = 1 centilitre (cL)
10 centilitres (cL) = 1 decilitre (dL)
10 decilitres (dL) = 1 litre (L)
10 litres (L) = 1 decalitre (daL)
10 decalitres (daL) = 1 hectolitre (hL)
10 hectolitres (hL) = 1 kilolitre (kL)

**The basic unit in the metric system for measuring capacity is the litre (L).**
**This means that: 1000 millilitres (mL) = 1 litre (L)**
**1000 litres (L) = 1 kilolitre (kL)**

Using the table of units above, we can easily convert a unit to an equivalent smaller or larger unit. It would be helpful if we bear in mind the different units in the following order.

**kilo - hecto - deca - L - deci - cent - milli**

Example 1

How many milliltres are there in 5 L?

Solution: From litres count how many steps there are until you reach millilitres.

There are 3 steps going to the right, hence, we multiply 5 by 1000.

Thus, 5 L = 5 x 1000 = 5000 millilitres.

> Remember that multiplying by a power of 10 simply means moving the decimal point 1, 2, or 3 places to the right.

We have 5 L ⟶ 5000. ⟶ 5000 mL

5 L = 5000 mL

Example 2 How many litres are there in 20 000 mL?

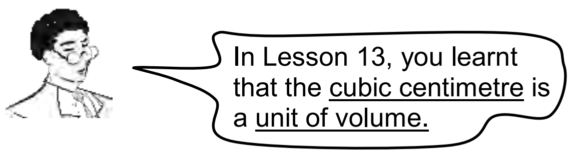
Solution: From millilitres count how many steps there are until you reach litres.

There are 3 steps going to the left , hence, we divide 20 000 by 1000.

Thus , 20 000 mL = 20 000 ÷ 1000 = 20 L

> Remember that dividing by a power of 10 simply means moving the decimal point 1, 2, or 3 places to the left.

We have 20 000 mL ⟶ 20.000 ⟶ 20 L

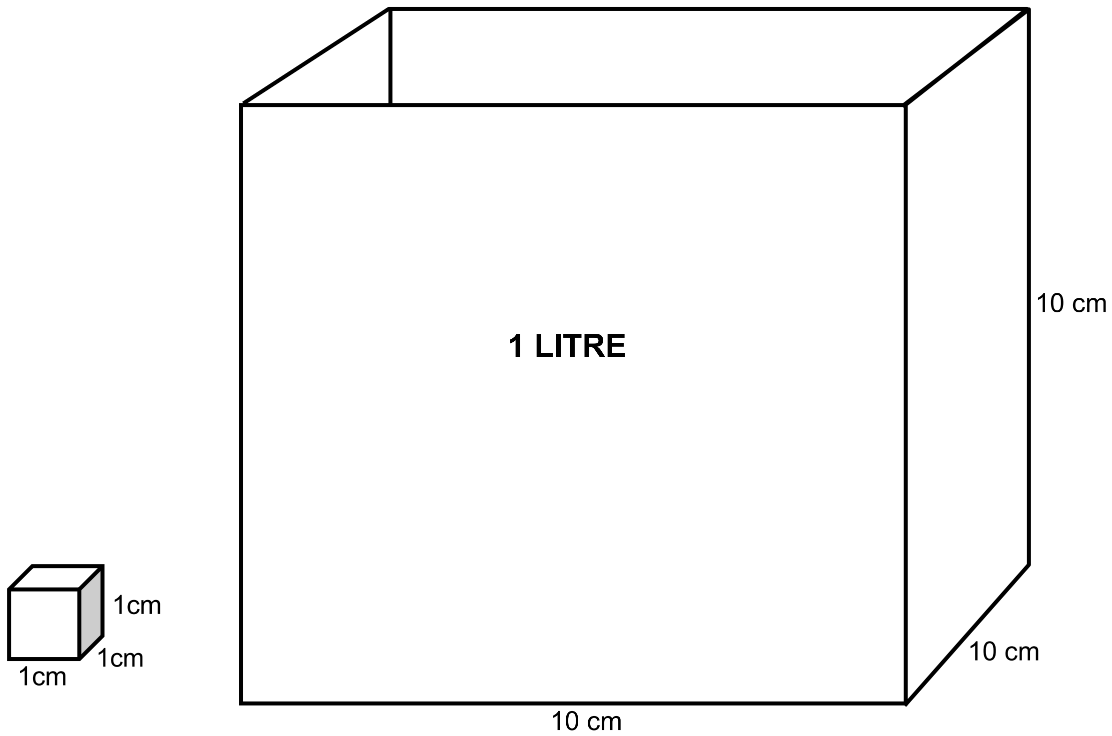



Earlier you learnt about measuring capacity using millilitres (mL) and litres (L).

Capacity is linked to volume.

> **Volume is the amount of space occupied or taken by a 3-D object generally measured in cubic millimetres ($mm^3$), cubic centimetres ($cm^3$) and cubic metres ($m^3$).**
>
> **Capacity is the amount or volume of liquid that an open container can hold or the space available in the container.**

Below are two prisms showing the comparison of a litre and a cubic centimeter.




**Small Prism**

Volume = l x w x h

V = 1 cm x 1 cm x 1 cm

V = 1 $cm^3$

**Large Prism**

Volume = l x w x h

V = 10 cm x 10 cm x 10 cm

V = 1000 $cm^3$

A solid that has a volume of 1000 $cm^3$ has a capacity of 1 litre or 1000 millilitre.

**So, 1000 $cm^3$ = 1 litre or every 1 $cm^3$ = 1 ml**
**This also means 1 $m^3$ = 1 kL**

If the volume of the small prism is 1 $cm^3$, then you would need 1000 centimetre cubes to fill the 1 litre box.

You will find it useful to change LITRES to CUBIC CENTIMETRES or MILLILITRES, etc.

Example 1 Fill in the blank .

(a) 5 L = _______$cm^3$

Answer: __5000 $cm^3$_

WORKING

1 litre = 1000 $cm^3$
So, 5 L = 5 x 1000 $cm^3$
= 5000 $cm^3$

(b) 2.5 L = _______mL

Answer: __2500 mL_

WORKING

1 litre = 1000 mL
So, 2.5 L = 2.5 x 1000 mL
= 2.500 mL

WORKING

(c) $\frac{1}{2}$ L = ________mL

1 litre = 1000 mL

So, $\frac{1}{2}$ L = $\frac{1}{2}$ x 1000 mL

= 500 mL

Answer: 500 $cm^3$

Example 2 Fill in the blank.

WORKING

(a) 4000 mL = ________L

1000 mL = 1 L

So, 4000 mL = $\frac{4000}{1000}$ L

= 4 L

Answer: 4 L

WORKING

(b) 5000 $cm^3$ = _________L

1000 $cm^3$ = 1 L

So, 4000 mL = $\frac{5000}{1000}$ L

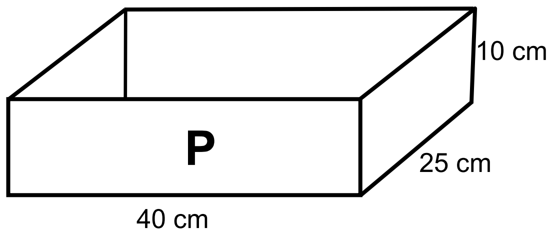
= 5 L

Answer: 5 L

Example 3

**P** is an open prism.

Find its capacity in litres.




Length = 40 cm

Width = 25 cm

Height = 10 cm

Volume = Length x Width x Height

V = 40 x 25 x 10 $cm^3$

So, Capacity = 40 x 25 x 10 $cm^3$

= 10 000 $cm^3$

Now, change 10 000 $cm^3$ to litres.

Capacity in litres = 10 000 ÷ 1000 L

= 10 L

Answer: 10 L

**NOW DO PRACTICE EXERCISE 16**

## Practice Exercise 16

1. Fill in the blanks and complete the working out. The first one has been done for you.

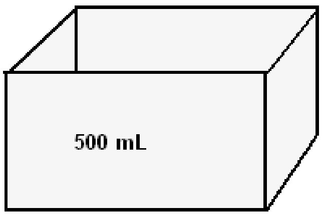
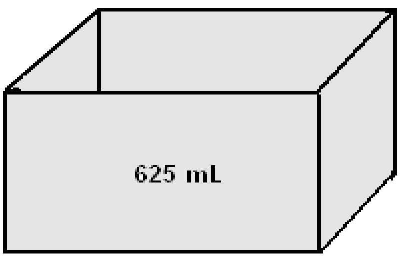
| | WORKING |
|---|---|
| (a) 0.3 L = 0.3 x 1000 $cm^3$<br>= <u>300</u> $cm^3$ | 0.3 x 1000<br>= 300 |
| (b) 5 L = 5 x ___________mL<br>= ___________mL | |
| (c) $\frac{1}{2}$ L = ___________ x ___________ $cm^3$<br>= ___________ $cm^3$ | |
| (d) 0.6 L = ___________ x __________ $cm^3$<br>= ___________ $cm^3$ | |

2. Change the following into litres. The first one has been done for you.

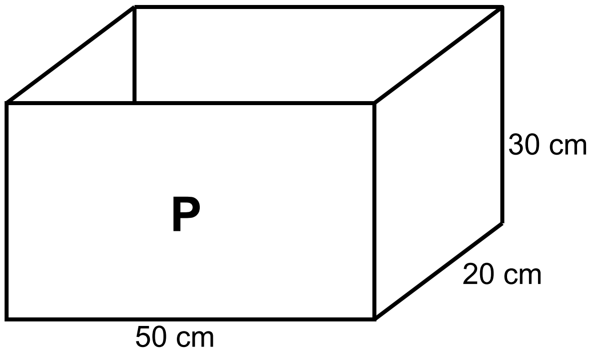
| | WORKING |
|---|---|
| (a) 1750 mL = <u>1.75</u> L | 1750 mL = 1750÷ 1000L<br>= $\frac{1750}{1000}$ L<br>= <u>1.75</u> L |
| (b) 2000 mL = ___________L | |

| | | WORKING |
|---|---|---|
| (c) | 1600 mL = __________L | |
| (d) | 750 $cm^3$ = __________ L | |

3. Here are some containers marked in mL.
   Find the capacity of each in litres.

| | | WORKING |
|---|---|---|
| a) |  | 350 mL = $\frac{350}{1000}$ L<br>= 0.35 L |
| (b) |  | |
| (c) |  | |
| (d) |  | |

4. **P** is an open prism.
The length , width and height of the prism are marked.




Fill in the blank spaces for prism **P**.

Length = _______ cm
Width = _______ cm
Height = _______ cm

So , Volume = _______ x _______ x ________ $cm^3$
= _______ x _______ $cm^3$
= _______ $cm^3$

So, capacity = ________ $cm^3$
Capacity in litres = ________ ÷ ________
= ________ L

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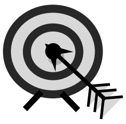
**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 17: Volume of Displacement

You learnt to measure volume and capacity in the previous lessons.



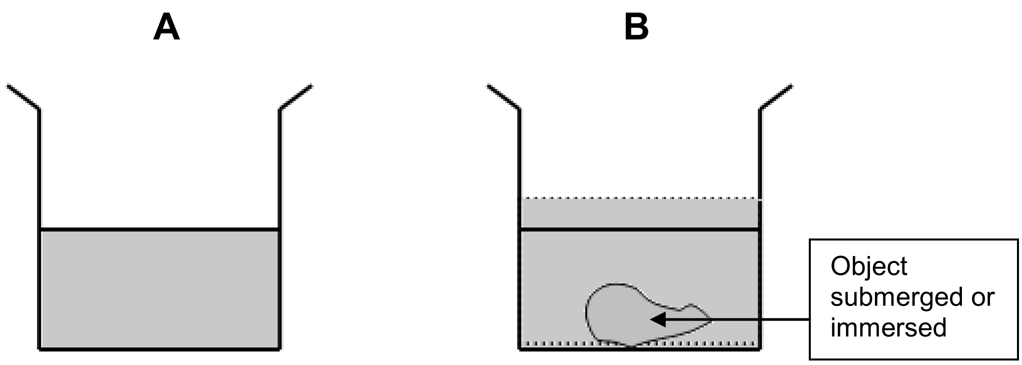
In this lesson, you will:

- determine the volume of solids by finding the volume of liquid displaced in a container.

To understand what displacement is all about, look at the examples below.

Example 1

Take the capacity reading of A and B and find the difference in the capacity.




500 mL of liquid 800 mL of liquid

Find the difference in the capacity.

| Steps: | Solution: |
|---|---|
| 1. Take the capacity of **A** (liquid only) | 500 mL (original) |
| 2. Take the measurement of **B** (with object in) | 800 mL (displacement) |
| 3. Find the difference | 800 mL – 500 mL = 300 mL |

The difference created by the displacement is 300 mL.

**The volume of displacement is the difference between the second volume and the original volume of liquid caused by an object completely submerged or immersed in liquid.**

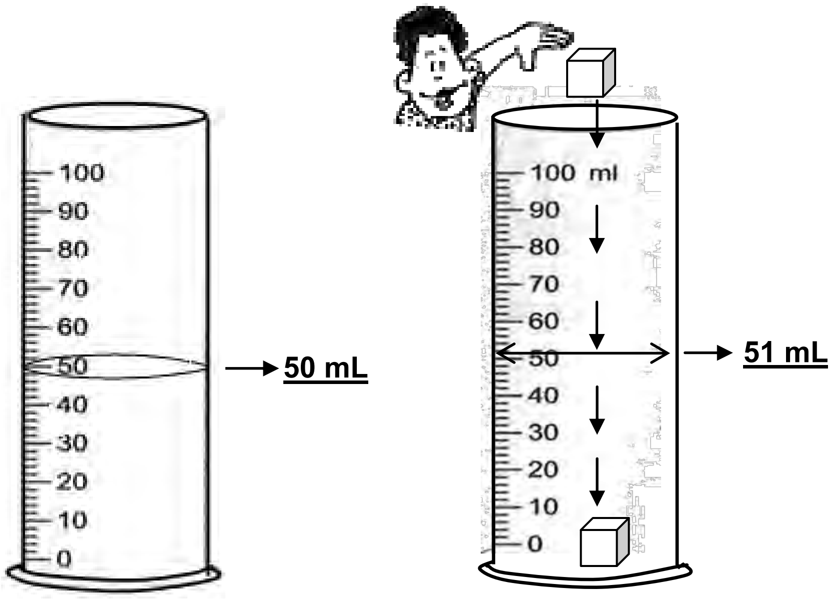
**Volume of Displacement = Volume A – Volume B**

For this second example, we will submerge an object of a <u>known volume</u> and compare its volume to the measure of displacement.

Try to perform this simple experiment on the next page:

Example 2

1. Fill in a measuring cylinder to the 50 mL mark. Place a 1 cm cube in the cylinder and note the water level afterwards. If your cube does not submerge (go under water) carefully use a pen or a compass to push it just under the water level.




**Measuring Cylinder** **Measuring Cylinder**

*Note the new water level. Has the water level changed?*

*Oh yes! The water level has risen by **1 mL.***

The 1 cm cube has a volume of 1 $cm^3$. When it is dropped into the cylinder the water level has risen by 1 mL which is the volume of displacement.

2. Add two more cubes to the cylinder. What do you notice about the water level now?

   **When objects of <u>known volume</u> are submerged in the water, their volume measures also the displacement.** It means, an object with a volume of 5 $cm^3$ will give a displacement of 5 mL.

| **REMEMBER:** |
|---|
| **1 mL = 1 $cm^3$** |
| **1 L = 1000 $cm^3$** |

*When you have 10 cubes in the cylinder, the water level will rise by how many mL?*

*The answer is 10 mL!*

Example 3

If a 10 cm block is immersed in a large measuring jug filled with water to the 1 litre mark, what is the volume of displacement?

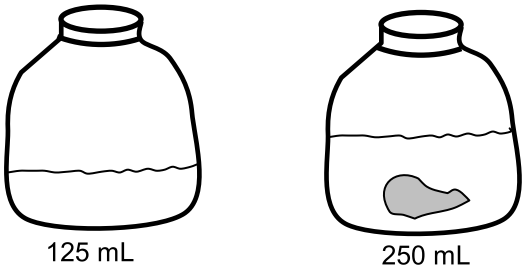
Solution: Volume of block = 10 cm x 10 cm x 10 cm = 1000 $cm^3$

**So, the volume of displacement is 1 Litre. 1000 $cm^3$ = 1 L**

What is the new water level? The new water level will be 2 litres.

Example 4

What is the volume of the solid immersed in the jar?




Volume displaced = Volume of the object

250 mL – 125 mL = 125 mL

125 mL = 125 $cm^3$

**Volume of object is 125 $cm^3$.**

**Displacement is the process of finding the volume of solids especially those with an irregular shape by putting the solid into a calibrated (adjusted) measure of liquid and noting the liquid rise in the scale of the measure, which is the same as the volume of the**

**NOW DO PRACTICE EXERCISE 17**

## Practice Exercises 17

1. A drum is filled with 1000 L of water. A block of wood 60 cm long, 50 cm wide and 30 cm high was immersed in the drum. What is the volume of displacement?

Answer:__________

2. Mother bought an aquarium and filled it with 10 L of water. She put in stones with a volume of 250 $cm^3$. What is the new level of water of the aquarium?

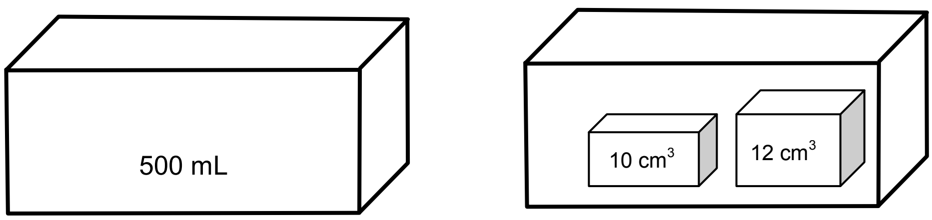
Answer:__________

**Refer to the diagram to answer Question 3.**


3. What is the volume of displacement?

Answer:__________

**Refer to the diagram to answer Question 4.**



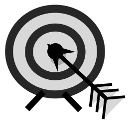

4. Find the new water content, (in mL) of the rectangular solid.

Answer:__________

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 18: Problems on Capacity

You learnt to work out the volume of solids by finding the volume of liquid displaced in a container.



In this lesson, you will:

- estimate the capacity of a container given its measurement in length units
- solve problems involving volume and capacity.

---

In this lesson we will learn how to work out more problems on volume and capacity.

**Remember:**
**Volume – is the space occupied or taken up by an object.**
**Capacity – is the volume of liquids or space that an open container can hold.**

Follow the steps and the working of these examples carefully.

Example 1

A can of oil has a capacity of 2 L.

How many mL of oil does it contain when $\frac{1}{4}$ full?

Step 1: (Find the capacity in L)

Capacity when full = 2L


So, when $\frac{1}{4}$ full $= \frac{1}{4}$ of 2 L

$= \frac{1}{4} \times 2$ L

$= \frac{1}{2}$ L

WORKING

$\frac{1}{\cancel{4}_{2}} \times \cancel{2}^{1}$

$= \frac{1}{2}$

Step 2: (Change $\frac{1}{2}$ L to mL)

1 L = 1000 mL

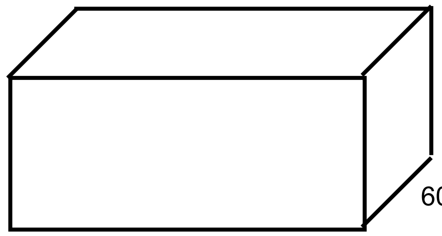
So, $\frac{1}{2}$ L $= \frac{1}{2} \times 1000$ mL

= 500 mL

Answer: **500 ml**

Example 2

A water tub has a cuboid shape.




Its length = 100 cm
Width = 60 cm
Height = 50 cm

(a) Find its capacity in litres.

Step 1: (Find the capacity in $cm^3$)

Length = 100 cm
Width = 60 cm
Height = 50 cm

Capacity = Volume = Length x Width x Height

= 100 x 60 x 50 $cm^3$
= <u>300 000 $cm^3$</u>

Step 2: (Change $cm^3$ to L)

1000 $cm^3$ = 1 L

So, 300 000 $cm^3$ = $\frac{300\,000}{1000}$ L

= 300 L

Answer: **300 L**

(b) How many litres of water does it hold when $\frac{2}{3}$ full?

When full it contains 300 L.

So, when $\frac{2}{3}$ full, it contains $\frac{2}{3}$ x 300 L = **200 L**

WORKING

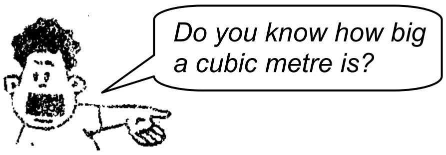
$$\begin{array}{r} 100 \\ \underline{\times \;\; 60} \\ 6000 \\ \underline{\times \;\; 50} \\ \underline{300\,000} \end{array}$$

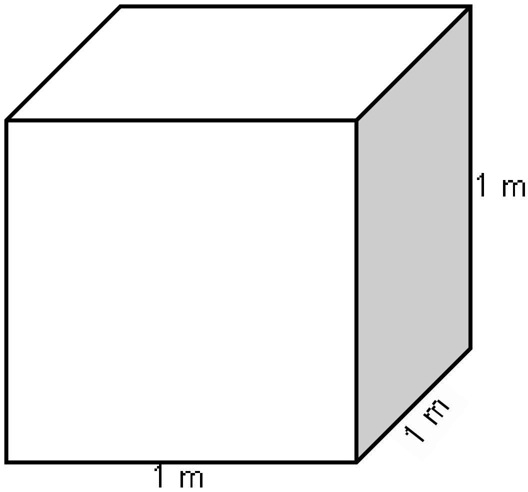
$$\frac{300\,000}{1000}$$

$$\frac{2}{\cancel{3}_{1}} \times \cancel{300}^{100} = 200$$

Here is a cube with side length of 1 metre. Its volume is 1 cubic metre.

The short form for cubic metre is **m³.**



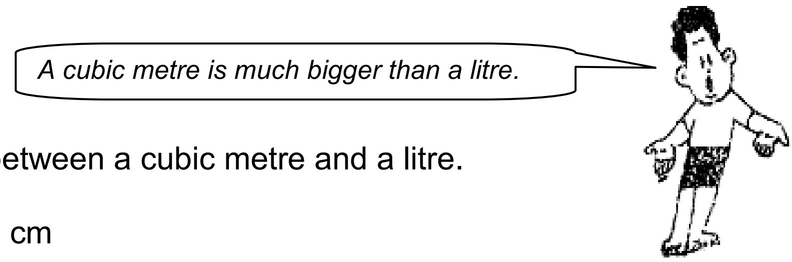

Do this activity and you will know.

**Activity** You will need: 1. a ruler (20cm)
2. a long piece of string.

Measure 5 lengths, each 20 cm long, on the string.

The length you have measured is 20 x 5 cm = 100 cm = 1 m.

A cube having sides 1 m long has a volume of 1 cubic metre.




Here is the relationship between a cubic metre and a litre.

$$1 \text{ m} = 100 \text{ cm}$$

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

$$= 1\,000\,000 \text{ cm}^3$$

$$1 \text{ litre} = 1000 \text{ cm}^3$$

$$\text{So, } 1 \text{ m}^3 = \frac{1\,000\,000}{1000} \text{ L}$$

$$= \underline{1000 \text{ L}}$$

**1 Cubic metre = 1000 Litres**
**$1 \text{ m}^3$ = 1000 L**

Example 1

A water tank is 3 m long by 2 m wide and 1 m high.

What is its volume?

Length = 3 m

Width = 2 m

Height = 1 m

Volume = length x width x height

= 3 x 2 x 1 $m^3$

= 6 x 1 $m^3$

Answer: **Volume = 6 $m^3$**

Example 2

An oil tank is in the shape of a cube of side 2 m.

(a) How many litres of oil does it hold when full?

Length of cube = 2 m

So, volume = 2 x 2 x 2 $m^3$

= 8 $m^3$

1 $m^3$ = 1000 L

So, 8 $m^3$ = 8 x 1000

= 8000 L

Answer: **8000 litres**

(b) How many litres does it hold when $\frac{3}{4}$ full?

Full tank = 8000 litres

So, $\frac{3}{4}$ tank = $\frac{3}{4}$ x 8000 litres

= 6000 litres

Answer: **6000 litres**

WORKING

$$\frac{3}{\cancel{4}_{1}} \times \cancel{8000}^{2000}$$

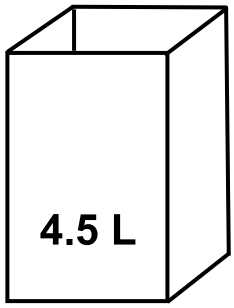
= 6000

**NOW DO PRACTICE EXERCISE 18**

## Practice Exercise 18

(1) A container has a capacity of 4.5 L.

How many litres of water does it contain when $\frac{1}{3}$ full?




Capacity = __________L

So $\frac{1}{3}$ capacity = $\frac{1}{3}$ x __________L

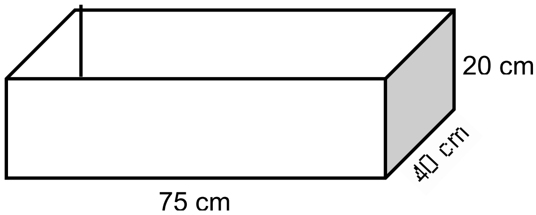
= __________L

= __________L **Answer**

---

(2) A basin is 75 cm long, 40 cm wide and 20 cm high.

(a) What is its volume in $cm^3$?




Length = __________cm

Width = __________cm

Height = __________cm

So, Volume = __________ x __________ x __________

= __________ x __________

= __________$cm^3$ **Answer**

(b) What is its capacity in litres?

Volume = __________ $cm^3$

1000 $cm^3$ = __________L

So, __________ $cm^3$ = __________x $\frac{1}{1000}$ L

= __________L

Capacity = __________ **Answer**

(3) A water tank in the shape of a rectangular prism has length of 60 cm; width, 50 cm and height = 45 cm.

(a) Find its volume in $cm^3$.

Length = ________cm

Width = ________cm

Height = ________cm

Volume = ________x ________ x ________ $cm^3$

= ________x ________ $cm^3$

= ________ $cm^3$

Volume = _________ $cm^3$ **Answer**

(b) How many litres of water does it hold when $\frac{1}{3}$ full?

Volume = ________ $cm^3$

So, capacity when full = _________ $cm^3$

(Change $cm^3$ to litres.)

1000 $cm^3$ = _________L

So, ______ $cm^3$ = _________ x $\frac{1}{1000}$ L

= _________ L

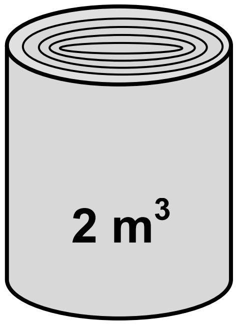
When full it contains _________ L

So, when $\frac{1}{3}$ full, it contains $\frac{1}{3}$ x __________L

= __________L

When $\frac{1}{3}$ full it contains __________L. **Answer**

4. An oil drum has a capacity of 2 $m^3$.




(a) What is its capacity in litres?

1 $m^3$ = _________ L

So, 2 $m^3$ = 2 x _________ L

= __________ L **Answer**

(b) How many litres of oil will it contain when $\frac{3}{4}$ full?

When full, it contains __________ L

So, when $\frac{3}{4}$ full, it contains __________ x _________ L

= __________ L **Answer**

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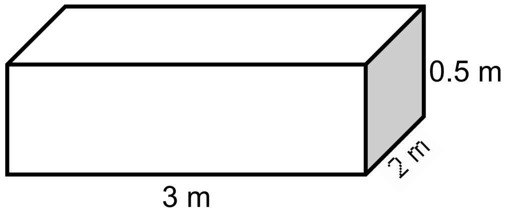
5. A rectangular water tub is 3 m long, 2 m wide and 0.5 m high.




(a) What is its volume?

Length = _________ m

Width = _________ m

Height = _________ m

So, Volume = _________ x _________ x _________ $m^3$

= _________ x _________ $m^3$

= _________ $m^3$ **Answer**

(b) How many litres will it contain when $\frac{1}{5}$ full?

When full, it contains __________ $m^3$

When $\frac{1}{5}$ full, it contains $\frac{1}{5}$ x __________ $m^3$

= __________ $m^3$

1 $m^3$ = 1000 L

So, _________ $m^3$ = _________x _________L = __________L

= __________L **Answer**

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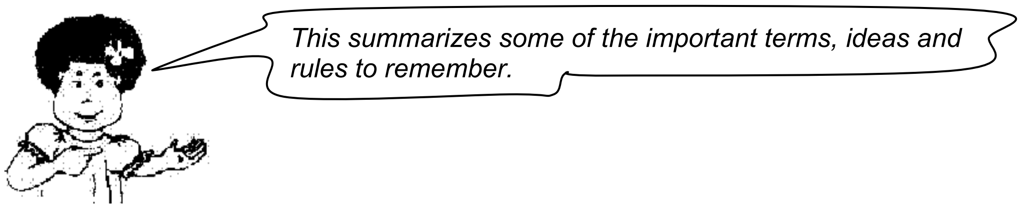
**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

## SUB-STRAND SUMMARY




- The amount of space inside a three dimensional shape is called volume.
- Units of Volume

  Cubic millimetre ($mm^3$)

  Cubic centimetre ($cm^3$)

  Cubic metre ($m^3$)
- The volume of a rectangular prism is **Volume = Length x Width x Height** or

**V = L x W x H**

- The volume of a composite solid shape can be found by counting the number of centimetre cubes the shape contains or by splitting the shape into rectangular prisms and calculating the volume.
- Capacity is the amount of liquid or space an open container can hold.
- Units of capacity

  Millilitre(mL), litre (L) and kilolitre (kL)
- Displacement is the process of finding the volume of solids, especially those with an irregular shape, by putting the solid into a calibrated (adjusted) measure of liquid and noting the liquid rise in the scale of the measure, which is the same as the volume of the solid.

**REVISE LESSONS 13 – 18 THEN DO SUB-STRAND TEST 3 IN ASSIGNMENT 3.**

# ANSWERS TO PRACTICE EXERCISES 13- 18

## Practice Exercise 13

(a) 64 cubes (b) 64 cubes (c) 76 cubes
(d) 128 cubes (e) 496 cubes (f) 112 cubes
(g) 384 cubes

## Practice Exercise 14

1. (a) 12 $cm^3$ (b) 20 $cm^3$
2. 8 $cm^3$
3. 450 $cm^3$
4. 630 $cm^3$
5. (a) 1225 $cm^3$ (b) 1890 $cm^3$

## Practice Exercise 15

1. (a) 80 $cm^3$ (b) 60 $cm^3$ (c) 140 $cm^3$
2. (a) 28 $cm^3$ (b) 4 $cm^3$ (c) 8 $cm^3$
   (d) 40 $cm^3$
3. 96 $cm^3$

## Practice Exercise 16

1. (b) 5000 ml
   (c) 500 $cm^3$
   (d) 600 $cm^3$
2. (b) 2 L
   (c) 1.6 L
   (d) .75 L
3. (b) .5 L
   (c) .15 L
   (d) .625 L
4. 30 L

**Practice Exercise 17**

1. 90 L
2. 10.25 L
3. 450 ml
4. 478 mL

---

**Practice Exercise 18**

1. 1.5 L
2. (a) 60 000 $cm^3$ (b) 60 L
3. (a) 135 000 $cm^3$ (b) 45 L
4. (a) 2000 L (b) 1 500 L
5. (a) 3 $m^3$ (b) 600 L

---

**END OF SUB-STRAND 3**

# SUB STRAND 4

# ESTIMATION

# SUB-STRAND 4: ESTIMATION

## Introduction

When doing a calculation we can make a rough check of the answer by finding an estimate. The estimate is the closest value we give before the actual answer. If the answer we obtain differs by a large amount from the estimate then we know an error has been made and the calculation can be checked.

To make an estimate we usually need to round off the numbers in the question.

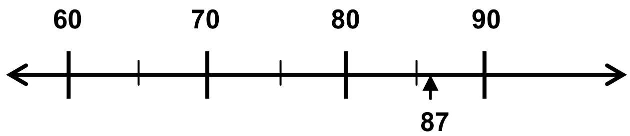
**Rounding off a number means giving an estimated value of the number to the nearest tens, hundreds and thousands and so on.**

Rounded numbers are useful when an exact number is not necessary. For example if we are asked how many people attended the school cultural show, we are not expected to give the exact number of people. We say "about 2000" if we think the number of people who attended is closer to 2000 than 1000 or 3000, or we may say "about 1500".

Let us use the number line to show how rounding off numbers will be done.

Example 1:

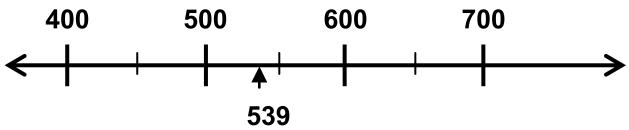
To round off 87 to the nearest ten, you must decide whether it is closer to 80 or 90.




Since it is closer to 90, then the rounded value of 87 is 90. Does the number line help you?

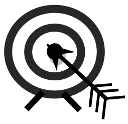
Example 2:

Round off 539 to the nearest hundred. Look at the number line to decide your answer.




In this Sub-strand, you will round off amounts, use a variety of estimation strategies and estimate sums of money.

# Lesson 19: Rounding Off

In this lesson, you will:

- define rounding off
- list the basic steps of rounding off whole number
- round off whole numbers to the indicated place value using the steps.

First you will learn what rounding off means.

**Rounding off a number means giving an estimated value of the number to the nearest tens, hundreds, thousands, and so on.**

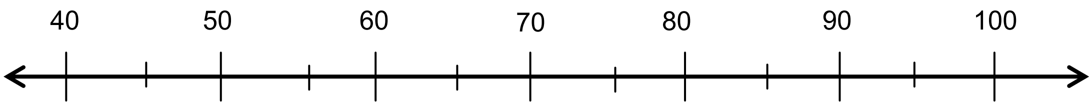
It is easy to round off numbers using the number line.

Look at the following examples.

Example 1

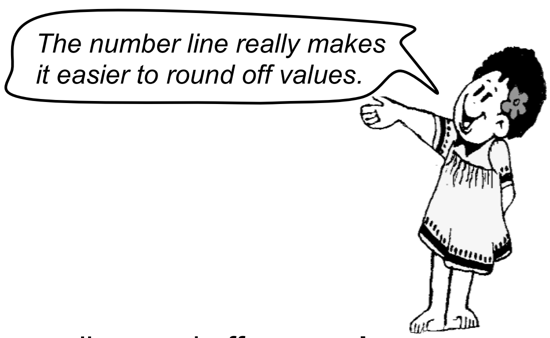
Round off each of these numbers to the **nearest ten**.

(a) 53
(b) 79
(c) 86
(d) 44
(e) 97




Decide which number on the number line is closer to the given number.

(a) 53 is rounded off to 50
(b) 79 is rounded off to 80
(c) 86 is rounded off to 90
(d) 44 is rounded off to 40
(e) 97 is rounded off to 100




Example 2

To round off numbers which are **halfway** we usually round off **upwards**.

65 becomes 70 when rounded to the nearest ten.
650 becomes 700 when rounded to the nearest hundred.
1500 becomes 2000 when rounded to the nearest thousand.

We will try another method of rounding numbers since drawing number lines consume more time. Without using the number line we can round off numbers by simply looking at the next digit to the right of the given <u>place value.</u>

Let us have a look at the following examples:


Example 1

(a) Round off 7600 to the nearest thousand.

given place value(thousand)

7 | 6 0 0 Step 1 Put **an imaginary line <u>behind</u>** the last required place

Step 2 Look at the next digit after the line

8 0 0 0 If the number is less than 5 (<5) i.e. 0, 1, 2, 3, 4, just copy and retain the number

If the number is equal to or greater than 5 ($\geq 5$) i.e. 5, 6, 7, 8, 9, then add 1 to the number

Step 3 Since 6 > 5, add 1 to the digit in the given place value (7 + 1) and drop all digits to the right and replace them with zeros.

7600 rounded off to the nearest thousand is 8000.

7600 is approximately 8000. In symbols, $7000 \approx 8000$

(b) Round off 7200 to the nearest thousand.

given place value (thousand)

7 | 2 0 0 Step 1 Put **an imaginary line <u>behind</u>** the last required place

Step 2 Look at the next digit after the line

7 0 0 0 Step 3 Since 2 < 5, we retain and copy the digit 7 in the given place value. Then we drop all digits to the right of the given place value and replace them with zeros. Do not forget also to copy the digit to the left of the given place value.

7200 rounded off to the nearest thousand is 7000.

7200 is approximately 7000 or $7200 \approx 7000$.

(c) Round off 7500 to the nearest thousand.

Given place value (thousand)

7 ⁝ 5 0 0 Step 1: Put **an imaginary line <u>behind</u>** the last required place

Step 2: Look at the next digit after the line

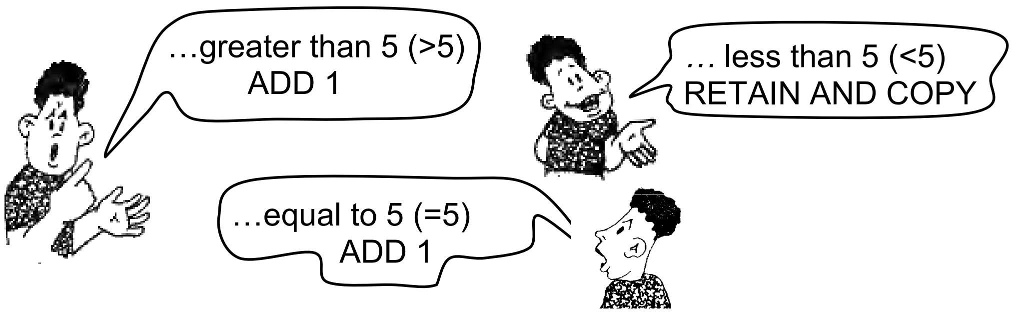
8 0 0 0 Step 3: Since 5 = 5, then add 1 to the digits in the given place value. Drop all digits to the right then replace them with zeros. Do not forget also to copy the digit to the left of the given place value.

7500 rounded off to the nearest thousand is 8000.

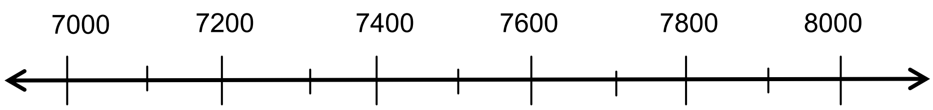
7500 is approximately 8000 or 7500 $\approx$ 8000.

From the examples, you will notice that the next digit ***to the right*** of the given place value is either **less than 5** (< 5), **greater than 5** (> 5) or **equal to 5** (= 5).

In summary, we say that in rounding off numbers if the next digit to the right of the given place value is:




You can always check your answer by using the number line. Decide which is closer to the number.




(a) 7600 is closer to 8000, so 7600 $\approx$ 8000.

(b) 7200 is closer to 7000, so 7200 $\approx$ 7000.

(c) 7500 is halfway, so 7500 $\approx$ 8000.

Example 2

Round off to the nearest hundred.

hundreds place
next digit after the imaginary line

| | | |
|---|---|---|
| 6 **7** ¦ 8 9 | If **5 or more**; ROUND UP | 6 **8** 0 0 |
| 2 4 **2** ¦ 5 0 | | 2 4 **3** 0 0 |
| 4 3 **2** ¦ 3 0 | **less than 5**; RETAIN AND COPY | 4 3 **2** 0 0 |
| 7 1 9 1 **4** ¦ 1 8 | | 7 1 9 1 **4** 0 0 |

Example 3

The attendance at the PTA meeting during the school year was 382, 215, 187 and 241.

Estimate the total attendance for the year to the nearest hundred.

Solution: 382 = **400**; 215 = **200**; 187 = **200** ; 150 = **200**
400 + 200 + 200 + 200 = **<u>1000</u>**

Example 4

Round off each number to the nearest hundred. Find the estimate and exact answer.

| | | Estimate | Exact Answer |
|---|---|---|---|
| (a) | 236 + 314 = | 200 + 300 = 500 | 550 |
| (b) | 841 – 682 = | 800 – 700= 100 | 159 |
| (c) | 350 x 450 = | 400 x 500 = 200 000 | 157 500 |

**NOW DO PRACTICE EXERCISE 19**

# Practice Exercise 19

1. Round off to the nearest ten, hundred and thousand. an example has been done for you.

| | **Ten** | **Hundred** | **Thousand** |
|---|---|---|---|
| Example: 3728 | 3730 | 3700 | 4000 |
| 1) 6459 | | | |
| 2) 72 811 | | | |
| 3) 7406 | | | |
| 4) 695 989 | | | |
| 5) 5555 | | | |

2. Round off each number to the indicated place value.

(a) 8 074 952

Ten ____________
Hundred ____________
Thousand ____________
Ten thousand ____________
Hundred thousand ____________

(b) 92 341 702

Hundred ____________
Thousand ____________
Ten Thousand ____________
Hundred Thousand ____________
Million ____________

3. Estimate each answer by rounding off each number to the nearest ten. Then compare this to the exact answer.

| | Estimate | Exact Answer |
|---|---|---|
| Example: 37 + 52 | 40 + 50 = 90 | 37 + 52 = 92 |
| 1. 18 + 23 + 42 | | |
| 2. 118 ÷ 38 | | |
| 3. 37 x 32 | | |
| 4. 987 – 778 | | |
| 5. 94 + 152 + 35 + 653 | | |

4. Problem Solving

Mr. Asi and his wife received the following orders for eggs in one week: 56, 75, 89, 17, 24, 92, 63.

(a) Estimate the number of eggs ordered from the couple to the nearest ten.

(b) The car‟s odometer shows 6329 before the trip. At the end of the trip, it reads 6721.

Estimate the distance traveled to the nearest hundred.

(c) Give a quick estimate of the average of the following addends to the nearest hundred: 852, 675 and 943 hamburgers.

---

5. Joven works part time by boring holes on buttons made of coconut shell. He keeps track of his output as follows: 116, 220, 105, 89 and 127.

Estimate Joven‟s total output to the nearest hundred.

---

6. A large mining company made a profit last year of K 37 868 472.

What would be the best approximation of this figure in millions?

---

7. A mobile company launched a new phone in the market at the beginning of April. At the end of April 5348 mobile phones had been sold.

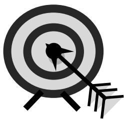
(a) How many phones were sold to the nearest ten?
(b) Round off the numbers of phones sold to the nearest thousand?

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4**

# Lesson 20: Rounding Off Decimals

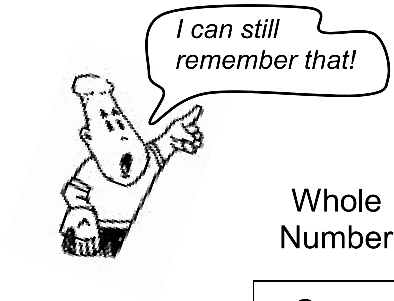
You learnt the meaning of "Rounding off" and the basic steps of rounding off numbers in Lesson 19.



In this lesson, you will:

- round off decimals to the given place value.

Since we already know how to round off whole numbers, we should be able to round off decimals easily. But before we do the rounding of decimals, let us have a short recall of the place value of decimals.




**Place Value Chart**

Let us show 5.357 on a Place Value chart:

Whole Number | Decimal Point | Decimal Numbers

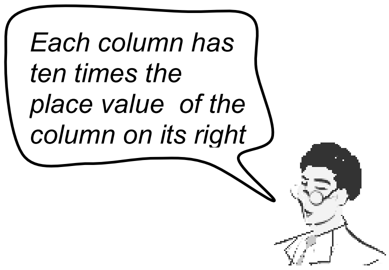
| Ones | | tenths | hundredths | thousandths |
|---|---|---|---|---|
| 5 | • | 3 | 5 | 7 |

The 5 has the value 5 ones

The 3 has the value $\frac{3}{10}$.

The 5 has the value $\frac{5}{100}$.

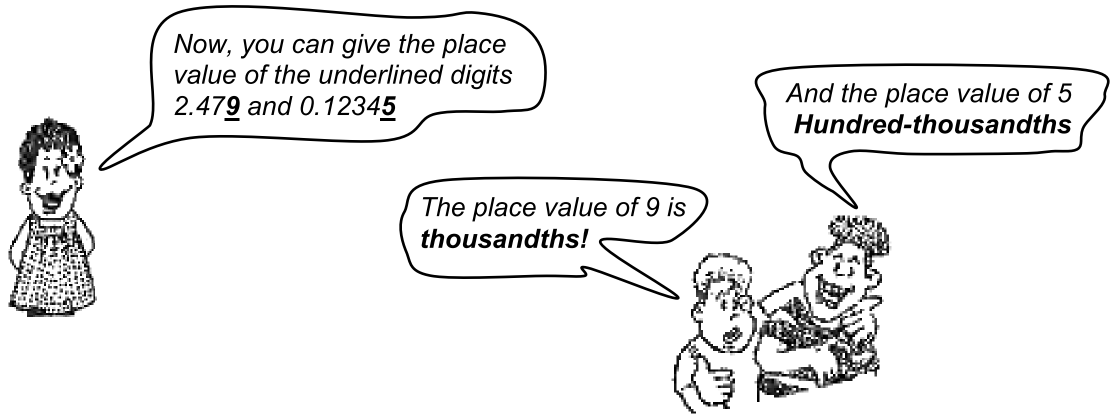
The 7 has the value $\frac{7}{1000}$.




Using the place value cards, 5.357 can also be shown as: | 5 | .3 | 5 | 7 |

Separating the cards, we have: | 5 | | .3 | | .05 | | .007 |

This also means the same as | 5 | | $\frac{3}{10}$ | | $\frac{5}{100}$ | | $\frac{7}{1000}$ |



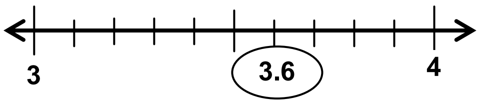

**Rounding off Decimals**

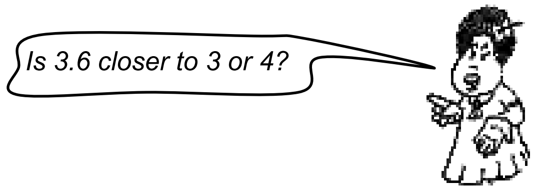
We will again use the number line in rounding off decimals.

Study the following examples:

Example 1

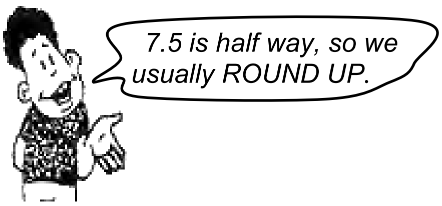
Round off 3.6 to the nearest **whole number**. Look at the number line.



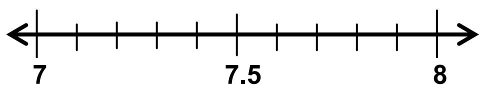




Then, the rounded value of 3.6 to the nearest whole number is 4.

Example 2



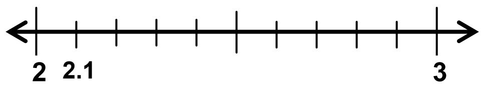

Round off 7.5 to the nearest whole number.




Therefore, 7.5 is rounded up to 8.

Example 3

Round off 2.1 to the nearest whole number.




2.1 closer to 2. Then the rounded value is 2.

Now we will apply the basic method of rounding off.

**Basic Method of Rounding Off Decimals**

Example 1

Round off 6.842 to 1 decimal place.

Step 1: Put a dividing line behind the last required place.

6. 4 8 2

Step 2: Look at the next digit after the line.

If it is 0, 1, 2, 3 or 4 i.e less than 5, then do nothing.

If it is 5, 6, 7, 8, or 9 i.e. equal to or greater than 5, then add 1 to the place BEFORE the line.

Step 3: Since 8 > 5, add 1 to 4.

Remove the places after the imaginary line.

If they are units, tens, hundreds or larger places, then replace them with zero.

**The answer is 6.482 $\approx$ 6.5 to one decimal place.**

Example 2

Round off 532.4922 to the nearest ten.

Step 1: 53 2.4922 (3 is the tens place, so draw line after 3)

Step 2: The digit after the line is 2.
2 is less than 5, so do nothing.

Step 3: The decimal places after the tens place disappear and the units place becomes zero.

**The answer is 532.4922 $\approx$ 530 to the nearest ten.**

Example 3

Round off 1.2351 to the nearest hundredth.

Step 1: 1. 2 3 5 1 ( Dividing line is after 3 in the hundredth place)

Step 2: The digit after the line is 5.
5 is in the group of 5, 6, 7, 8, 9 or halfway so add 1 to 3.

Step 3: Remove or drop all the digits after the imaginary line since it is in decimal.

**The answer is 1.2351 $\approx$ 1.24 to the nearest hundredth.**

Example 4

Round off 63.57982 to the nearest thousandth.

Step 1: 63.579 | 82 (Dividing line is after 9 in the thousandth place.)

Step 2: The digit after the line is 8.
8 is in the group of 56789, so add 1 to 9.

Step 3: In this step, we will use the "carry" method.

63.579 ~~82~~ 1 plus 9 is 0 and carry
The "carry" adds 1 to 7 in the hundredth place
63.580 to give 8.

**The answer is 63.57982 ≈ 63.580 to the nearest thousandth.**

The zero after 8 must be written because thousandth is the place value being asked for.

Example 5 Round 0.396 to the nearest hundredth.

Step 1: 0.39 | 6 (Dividing line is after 9 in the hundredths place.)

Step 2: The digit after the line is 6.
6 is in the group of 56789, so add 1 to 9.

Step 3: In this step, we will use the "carry" method.

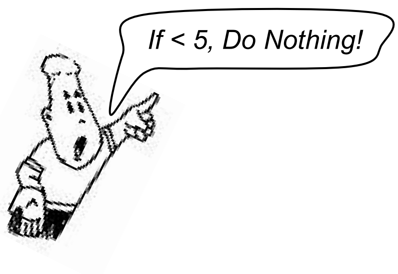
0.3 9 ~~6~~ 1 plus 9 is 10.

0. 3 9 Write 0 and carry 1 to 3 again.
0. 40 So 1 + 3 = 4

**The answer is 0.396 ≈ 0.40 to the nearest hundredth.**

The zero must be written after 4 because hundredths is the place value being asked for.

To summarize rounding off decimals, study the given examples below:




1. Round off 1.**6**93 to the nearest tenth.

9 > 5 so, add 1 to 6

1.693 ≈ **1.7**

2. Round off 87.3**2**1 to the nearest hundredth.

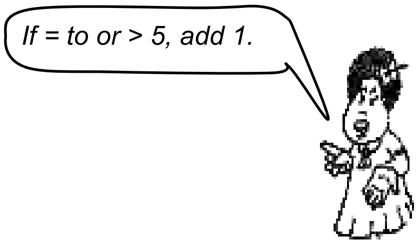
1 < 5 so, Do Nothing to 2

87.321 ≈ **87.32**

3. Round off 217.34058 to the nearest thousandth.

5 = 5 so, add 1 to 0.

217.34058 $\approx$ **217.341**




4. Round off 293.25 to the nearest tens.

3 < 5 so, do Nothing to 9

293.25 $\approx$ **290**

5. Round off 642.5 to the nearest whole number.

5 = 5 so, add 1 to 3

642.5 $\approx$ **643**

To **round off decimals**, we first identify the given place value where we will round off, then we look at the digit to the right of the given place value.

- **If it is equal to or greater than 5, we add 1 to the digit in the given place value and drop all the digits after it.**
- **If it is less than 5, we do nothing but only copy and retain the digit in the given place value. We just drop all the digits to its right.**

---

**NOW DO PRACTICE EXERCISE 20**

## Practice Exercises 20

1. Write the place value of the underlined digit.

| | Place Value | | Place Value |
|---|---|---|---|
| a. $0.17\underline{8}$ | | f. $37.12\underline{3}45$ | |
| b. $23.\underline{0}866$ | | g. $\underline{1}00.100$ | |
| c. $139.00000\underline{1}$ | | h. $0.10\underline{0}$ | |
| d. $\underline{6}.69$ | | i. $\underline{1}234.56$ | |
| e. $1009.\underline{2}$ | | j. $3000.1814\underline{7}$ | |

2. Round off each number as indicated:

| | Tenth | Hundredth | Thousandth | Ten-Thousandth |
|---|---|---|---|---|
| a. 0.5064089 | | | | |
| b. 0. 0009235 | | | | |
| c. 9.2055055 | | | | |
| d. 78.010987 | | | | |
| e. 63. 456789 | | | | |

3. Round off each number as indicated.

a. 8. 249075

nearest whole number ___________
tenth ___________
hundredth ___________
thousandth ___________
ten-thousandth ___________

b. 1250.635892

nearest ten ___________
nearest hundred ___________
nearest whole number ___________
nearest hundredth ___________
nearest 100-thousandth ___________

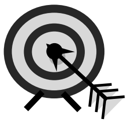
c. 7249.0505055

nearest ten ___________
nearest hundred ___________
nearest thousand ___________
nearest whole number ___________
nearest tenth ___________
nearest hundredth ___________
nearest thousandth ___________
nearest ten-thousandth ___________
nearest 100-thousandth ___________
nearest millionth ___________

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4**

# Lesson 21: Rounding Off Measurements of Length

You learnt to round off decimals to the nearest given number of place.

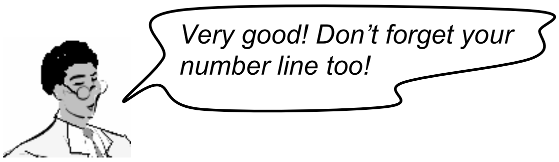


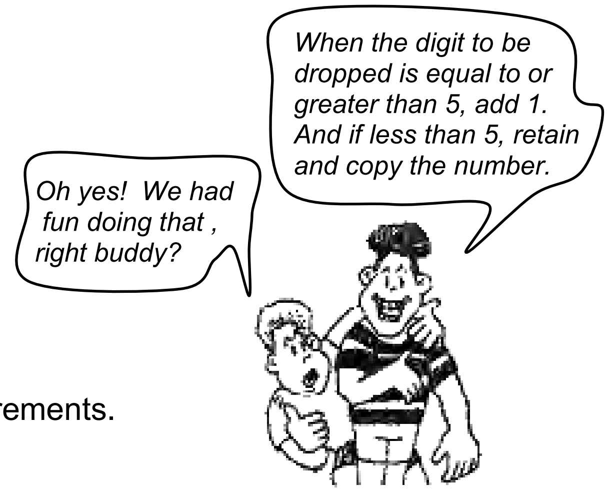
In this lesson, you will:

- round off measurements of length to the nearest 1 cm, 1 m and 1 km as appropriate.

In rounding length measurements we apply the same rules in rounding whole numbers and decimals. We just have to see which place value and unit of measurement we need to round the measurements.

Do you still remember the rules?

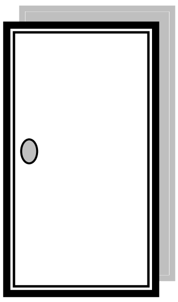


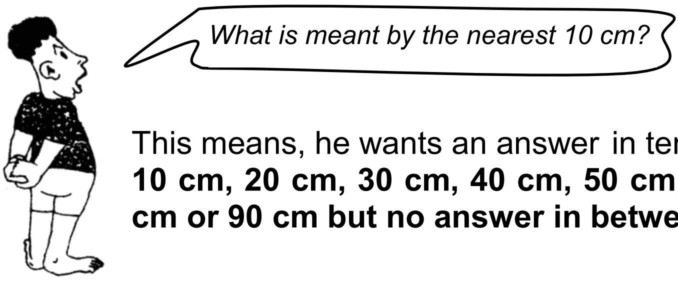




Now you are going to round length measurements.

Example 1

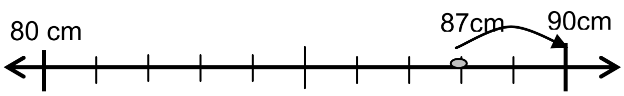
Miko was measuring the width of a door and found it to be exactly 87 cm. He decided to make answer to the nearest 10 cm so he could purchase the material. What would the answer be?






This means, he wants an answer in tens only, that is **10 cm, 20 cm, 30 cm, 40 cm, 50 cm, 60 cm, 70 cm, 80 cm or 90 cm but no answer in between.**

So looking back to your **number line, 87cm is between 80 and 90.**

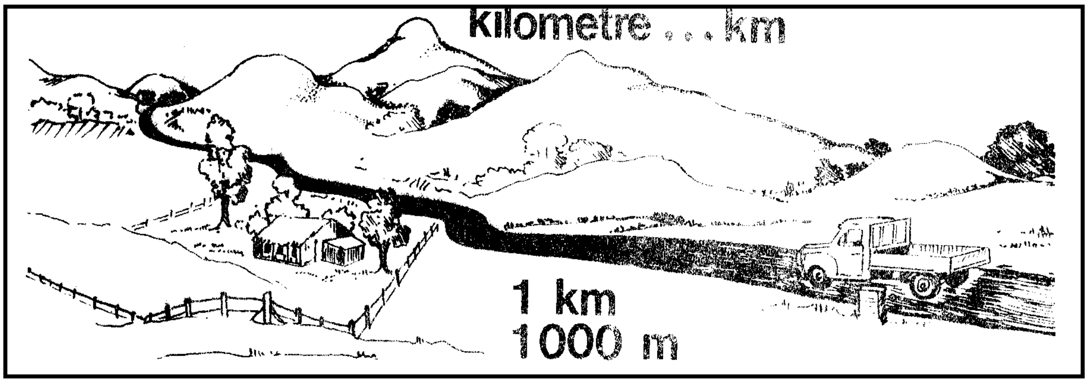



We said earlier that whichever is closer then that is the rounded value or approximate. So 87 cm rounded to the nearest 10 cm is 90 cm.

In symbols, **87 cm $\approx$ 90 cm**

Example 2

Kuri and his family went to the village and traveled 103 km by truck.




Find the approximate value of 103 km to the nearest 100 km.

Follow the rules:

*1. The value 103 is between 100km and 200 km.*

*2. Which value is closer to 103 km?*

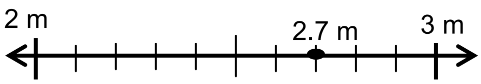
***3. Answer: 103 km $\approx$ 100 km.***


Example 3

Round off 2.7m to the nearest metre.

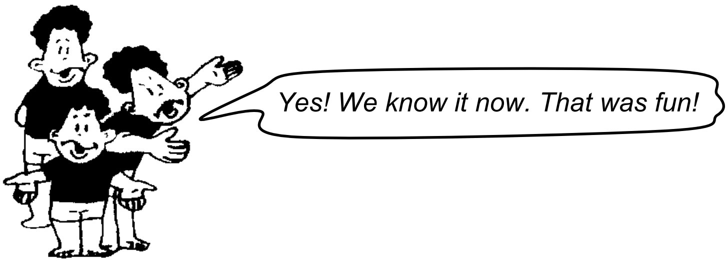
We use the same rules in decimals:

1. The nearest two numbers: 2 m and 3 m




2. Which one is closer to 2.7 m?

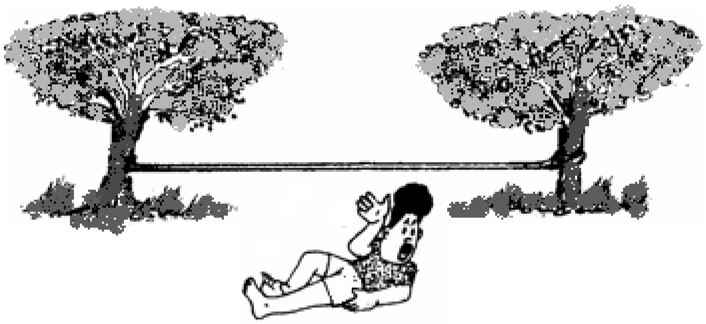
**3. Answer: 2.7 m $\approx$ 3 m**


Now that you know what is meant by rounding length measurements, let‟s look at some harder problems.

Example 4

Siku wants to tie a hammock between the two trees in his backyard. He measured the distance to find out the length of the rope he will be using. The distance is 425 cm.



Round off your answer to the nearest **metre**.


Solution:

1. First change **425 cm to metre.**

$$425 \text{ cm} \times \frac{1 \text{ m}}{100 \text{ cm}} = \mathbf{4.25 \text{ m}}$$

**Remember your conversion of units here. (1 m = 100 cm )**

2. Then, look at which two numbers are closer to 4.25.

   Is it 4m or 5m?

3. Since 4.25 is closer to 4m, then

   **Answer: 425 cm $\approx$ 4m**


Example 5

Round off 6 800 m to the **nearest km**.

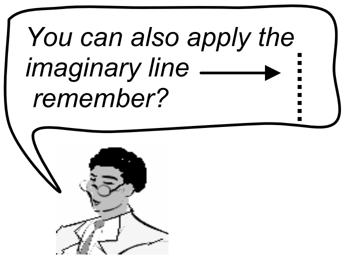
Follow the rules:

1. *Change 6 800 m to km* $\longrightarrow$ $6\,800 \text{ m} \times \frac{1 \text{ km}}{1000 \text{ m}} = 6.8 \text{ km}$
2. *The nearest two numbers are:* 6 km and 7 km
3. *Which one is closer to 6.8 km?* 7 km
4. **Answer: 6 800 m $\approx$ 7 km**

Example 6

Round off 8.75 m to **one** decimal place.

Again, follow the rules:




1. *The two nearest numbers:* 8.70 and 8.80
2. *Which is closer?* 8.75 is halfway between so we round up
3. **Answer: 8.75 m $\approx$ 8. 8 m**

Example 7

Round off 10.6101 km to **two** decimal places.

1. *The two nearest numbers:* 10.60 and 10.70
2. *Which is closer?* 10.6101 go to the lower number, so
3. **Answer: 10.6101 km $\approx$ 10.61 km**

---

**NOW DO PRACTICE EXERCISE 21**

## Practice Exercise 21

1. Complete the table below. An example has been done for you.

| Measurement | To the nearest | The Two Values | Answer |
|---|---|---|---|
| **Example: 56m** | **10 m** | **50 and 60** | **60 m** |
| (a) 512 mm | 100 mm | | |
| (b) 2700 m | 1000 m | | |
| (c) 94 cm | 10 cm | | |
| (d) 2687 m | 10 m | | |
| (e) 851 m | 100 m | | |
| (f) 1031 km | 1000 km | | |
| (g) 33 cm | 10 cm | | |
| (h) 957 km | 100 km | | |
| (i) 66 mm | 10 mm | | |
| (j) 1594 cm | 1000 cm | | |

2. Round the following measurements.

(a) 4.3 km to the nearest km ___________

(b) 3.54 cm to one decimal place ___________

(c) 10.842 km to two decimal places ___________

(d) 74.49 m to the nearest m ___________

(e) 102.59 km to the nearest km ___________

(f) 6 800 m to the nearest km ___________

(g) 241 cm to the nearest m ___________

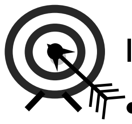
(h) 744 mm to the nearest cm ___________

(i) 587 m to the nearest km ___________

(j) 1029 mm to the nearest cm ___________

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4**

# Lesson 22: Rounding Off Money Amounts



You learnt to round off length measurements in Lesson 21.

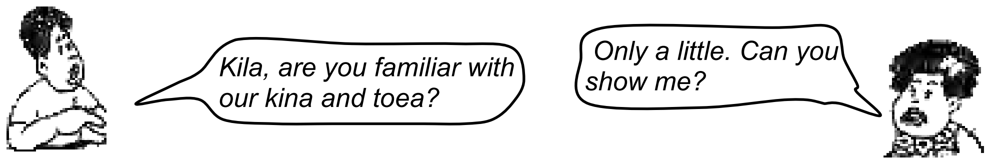
In this lesson, you will:

- round off money to the nearest toea
- round off money to the nearest kina.

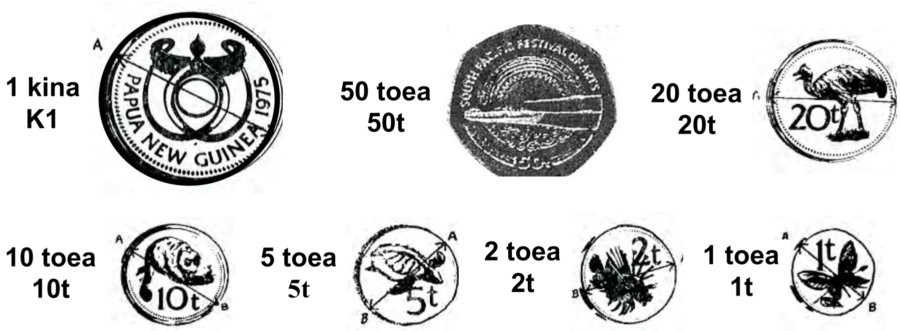
For most of us, Mathematics means money. The Mathematics you do daily involves money.

Money is used to make exchanges easier. Money is used to buy the things we need.

In Papua New Guinea, the name of the money we use is **KINA** (K) and **TOEA** (t).




Here are the toea coins.




The biggest amount is 1 kina and the smallest is 1 toea. However, the 2t and 1t coins are no longer accepted in stores and shops now.

There are six different kina notes that are currently used. Some of these have new designs and color like the five, ten and twenty kina. The One Hundred kina was only introduced in 2007.

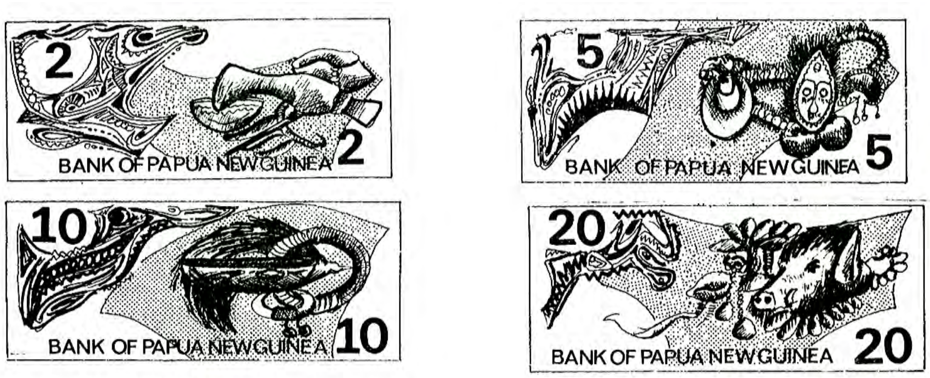
Below are the kina notes:

Here is how to write in toea.

K1 or K1.00 | 50t or 0.50 | 20t or 0.20 | 10t or 0.10 | 5t or 0.05

Here is how to write in Kina.

**K2 or K2.00** **K5 or K5.00**




**K10 or K10.00** **K20 or K20.00**

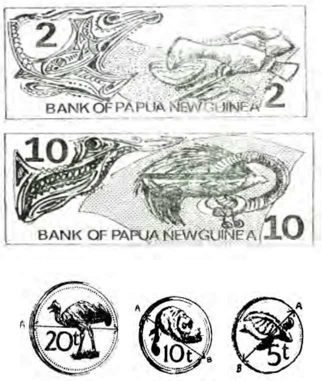
You will notice that the decimal point is used. The ***whole number is for kina*** and the ***2 decimal places are for toea***.

Kina sign ← **K10. 35**

**Kina** **toea**

How do you write the amount below?

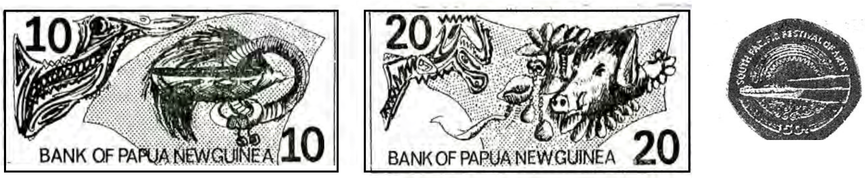
*It is easy. Look, it should be like these?*



$$= \begin{array}{r} \textbf{K 2.00} \\ \textbf{10.00} \\ \textbf{0.20} \\ \textbf{0.10} \\ \underline{\textbf{0.05}} \\ \textbf{K12.35} \end{array}$$

*Adding or subtracting money is just like doing decimals. So, always remember to align the decimal point.*

Example 1



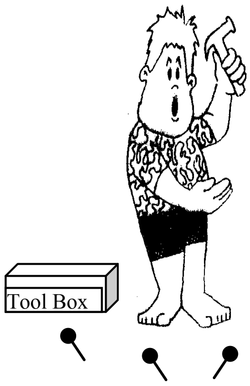
**= K30.50**

Example 2

**= K25.85**

Now, we will learn how to round money to the nearest toea and kina.

Rounding money amounts will be the same as rounding whole numbers and decimals.



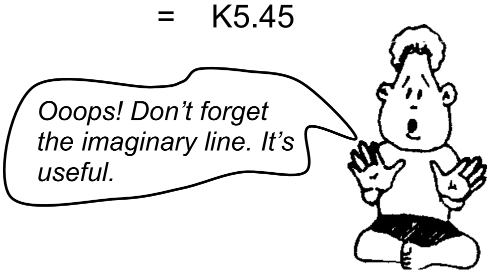

**Rules in Rounding Numbers**

1. ***If the digit to be dropped is less than 5, don't do anything.***
2. ***If the digit to be dropped is equal to or greater than five, add 1.***

Below are examples of rounding off money to the nearest toea.

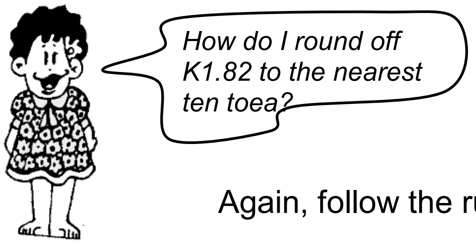
| Round: | Rounded off to the nearest toea. | | |
|---|---|---|---|
| K1.820 | K1.82 ~~0~~ | = | K1.82 |
| K65.9343 | K65.93 ~~43~~ | = | K65.93 |
| K0.8201 | K0.82 ~~01~~ | = | K0.82 |
| K5.4545 | K5.45 ~~45~~ | = | K5.45 |

If digits to be dropped are less than 5, DO NOTHING.



| Round: | Round off to the nearest toea. | | | |
|---|---|---|---|---|
| K1.825 | K1.825 | If digits to be dropped are equal to or greater than 5, add 1. | = | K1.83 |
| K65.9361 | K65.9361 | | = | K65.94 |
| K0.8250 | K0.8250 | | = | K0.83 |
| K5.4590 | K5.4590 | | = | K5.46 |

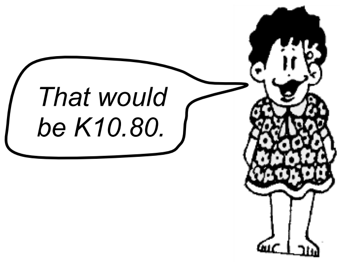
**Rounding an amount to the nearest ten toea means to change toea into 10t, 20t, 30t, 40t, 50t, 60t, 70t, 80t and 90t whichever is the closest but not those in between.**




Again, follow the rules:

1. *The nearest two numbers:* 80t and 90t
2. *Which one is closer to 82?* 80
3. **Answer: K1.82 $\approx$ K1.80**

Round K10.745 to the nearest ten toea




Now, you will be rounding amounts to the **nearest Kina.**

**Rounding to the nearest kina, ten kina, hundred kina and so on is simply dropping the toea amount and replacing with zeros, then follow the rules for whole numbers and decimals.**

Example 1

Round off K33.80 to the nearest **kina**.

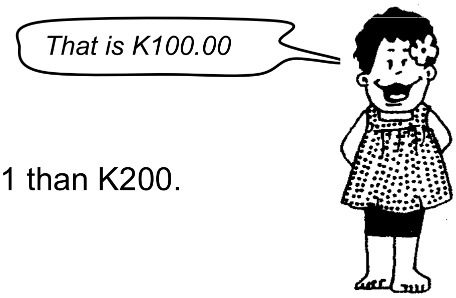
1. Drop 80 and replace with zeros.
2. 8 is in the group of ( 5,6,7,8 9) so add 1.

   K33.00 + K1 = K34.00

3. So, K33.80 to the nearest kina is K34.00

Example 2

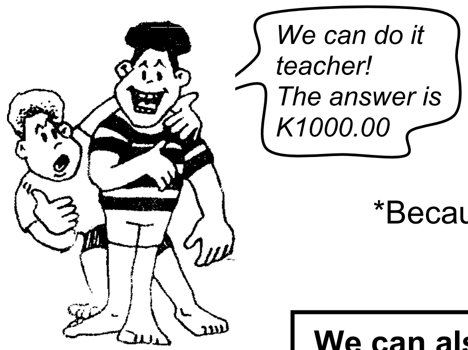
Round K101.00 to the nearest hundred kina.




* Because K100 is closer to K101 than K200.

Example 3

Round off K1035.65 to the nearest thousand kina.




*Because K1035.65 is closer to K1000 than K2000.

**We can also remove the two zeros when writing a whole kina.**

**Example: K105.00 is the same as K105.**

**K1079.00 is the same as K1079.**

Now, you are ready to do the exercises on the next page.

---

**NOW DO PRACTICE EXERCISE 22**

## Practice Exercises 22

1. Write the value of the following:

| | | |
|---|---|---|
| a) K10 K5 10t 10t K1 ________ | b) K2 K10 K20 K50 ________ | c) K100 K1 20t ________ |
| d) K50 K20 K5 50t 5t K1 20t 20t 20t ________ | e) K10 K100 50t K1 20t K100 ________ | f) K10 K5 K10 10t 10t K1 50t 50t 50t ________ |

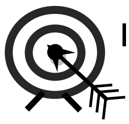
2. Round the following amount of money:

| Amount of Money | To the nearest | Answer |
|---|---|---|
| Example: K35.789 | toea | K35.79 |
| K101.50 | kina | K102.00 |
| K258.00 | Hundred kina | K300.00 |
| a. K61.55 | Ten toea | |
| b. K1357.00 | Thousand Kina | |
| c. K109.256 | Toea | |
| d. K505.00 | Hundred Kina | |
| e. K129.58 | Kina | |
| f. K77.40 | Ten kina | |
| g. K9.2568 | Ten toea | |
| h. K1.35 | Kina | |
| i. K5742.75 | Thousand kina | |
| j. K 99.99 | Hundred kina | |
| k. K752.8720 | Toea | |
| l. K108.33 | Kina | |
| m. K1523.00 | Hundred kina | |
| n. K35.21 | Ten kina | |
| o. K454.50 | Hundred Kina | |

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3**

# Lesson 23: Estimation of Money

You learnt to round off money amounts to the nearest toea and kina in the last lesson.



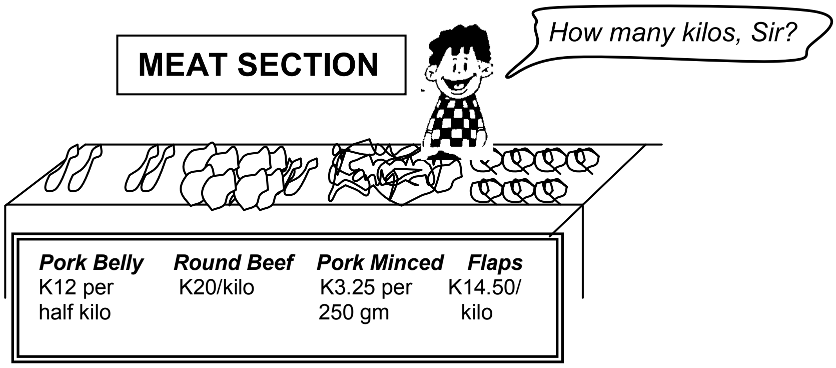
In this lesson, you will:

- estimate sums of money
- use mental approximations to estimate a price.

Read the problem below.

Kali goes to the shop to buy a kilogram of minced pork for his family‟s dinner. He has K15.00. The price of minced pork is K3.25 per 250 g.

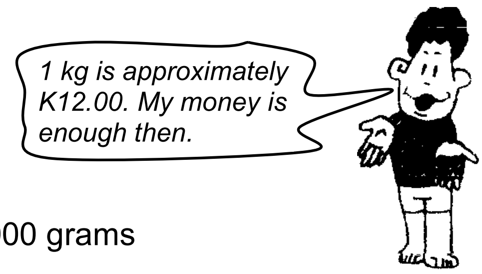
Will his money be enough? How much would 1 kg cost?




How will we help Kali?

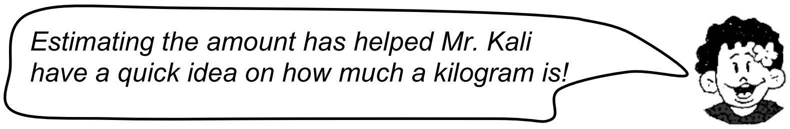
The easiest way to do that is by estimation. Estimating the price means approximating before calculating the actual value.

In the example above, we say,




- K3.25 is close to K3.00
- 250 grams is one quarter of 1 kg ; 1 kg = 1000 grams
- So a kg would cost 4 times which gives K12.00 as the approximate price of 1 kg.

Actual computation: K3.25 X 4 = K13.00 per kilogram



Example 2

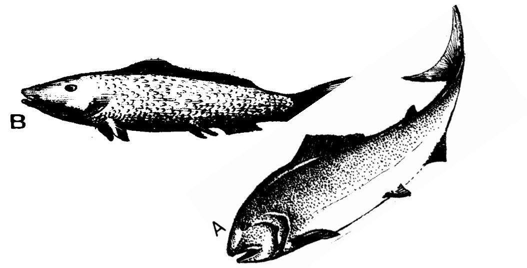
If 750 g of biscuits costs K8.99, estimate the cost of 1 kg.


Follow these steps:

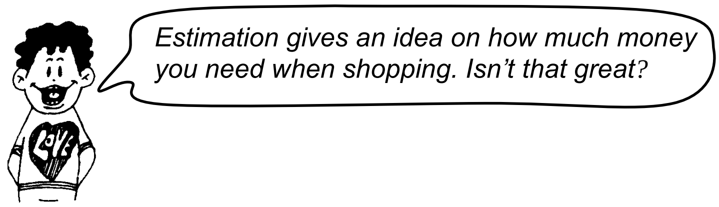
- K8.99 $\approx$ **K9.00** is the approximate price for 750g
- 750 gm is three quarters of l kg ; one quarter of l kg = 250 gm.
  This would cost one third of the price which is K3.00.
- If 750g $\approx$ K9.00 and 250g $\approx$ K3.00, then a full kilogram would cost K12.00.
- **Answer: 1 kg $\approx$ K12.00**

Example 3

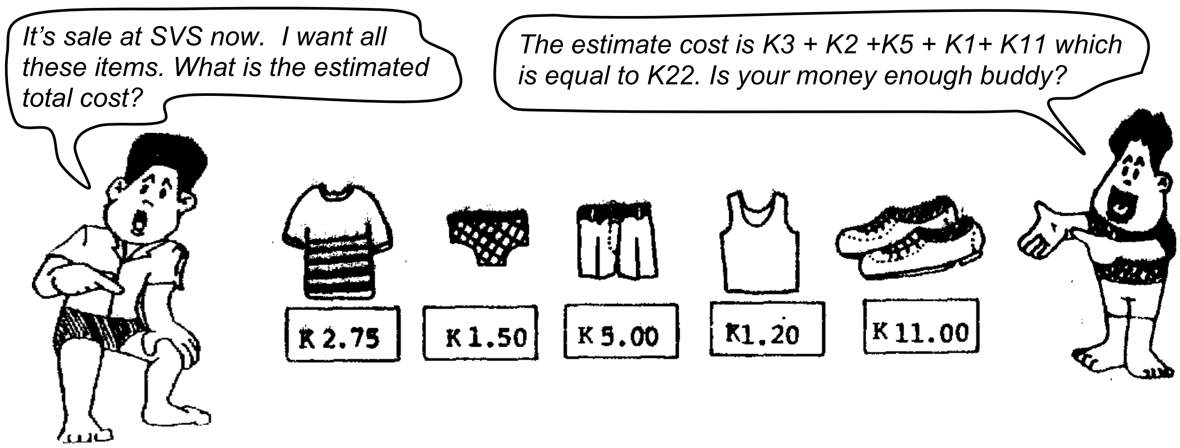
500 g of fish costs K6.75, what would the approximate cost for 2 kg be?




- K6.75 $\approx$ K7.00
- 500 gm is half of a kilogram; so a full kilogram would cost K14.00
- **Answer: 2 kg $\approx$ K28.00**



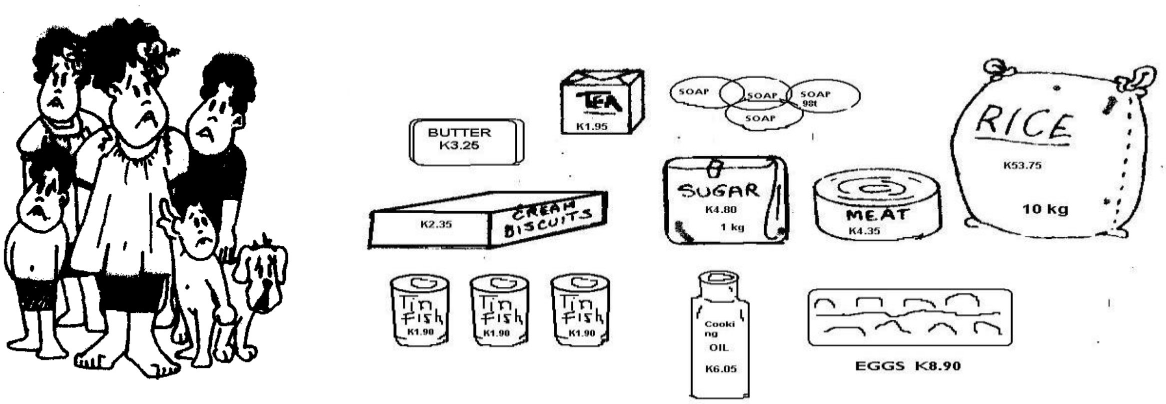

Example 4



Example 5

The Malika family has a K100 budget to buy some items they need in the village.

Estimate the cost of their shopping. Will a K100.00 budget be enough?




Price List

| | | | |
|---|---|---|---|
| Rice | K53.75 | Cooking Oil | K6.95 |
| Meat | K4.35 | Sugar | K4.80 |
| Tea | K1.95 | Tin Fish | K1.90 each |
| Soap | 98t each | Butter | K3.25 |
| Biscuits | K2.35 | Eggs | K8.90 |

**Estimate Cost: K96.00**

---

**NOW DO PRACTICE EXERCISE 23**

## Practice Exercise 23

1. Using the estimation strategy, solve the following problems:

   a) Mr. Nou wanted to buy 8 exercise books costing K2.59 each. He had K25 in his pocket. Did he have enough money to buy the 8 exercise books?

   b) At The Moresby Show, Mary has K15 to spend. Laki bags cost K2.35 each. Did Mary have enough to buy 7 bags?

   c) Mr. Aihi has K40 in his wallet and wanted to buy 3 tins of paint. Each tin cost K12.49. Did he have enough money with him?

   d) Andrew has K18.12. Does he have enough money to buy 4 model kits costing K4.69 each?

2. Estimate the total cost of the shopping lists below.

a) People"s Pharmacy

| Items | Price |
|---|---|
| 3 films @ K6.98 ea.<br>2 tins powder @ K4.44 ea.<br>4 bandages @ 96t ea.<br>1 pkt tablets @ K3.86<br>1 pkt diaper @ K10.47<br>6 pcs soap @ K1.10<br>TOTAL: | |

Will a K50 budget be enough?

b) Libu"s Dry Goods

| Items | Price |
|---|---|
| 3 pairs jeans @ K26.95 a pair<br>4 pairs socks @ K1.80 a pair<br>2 shirts @ K16.95 ea<br>3 singlets @ K4.50 ea<br>5 laplaps @ K 13.75 ea<br>TOTAL : | |

Will a K200 budget be enough?

---

3. The cost of a 250 g fish is K3.80. What would the approximate cost for 2 kg be?

---

4. If 750 g of sausage cost K5.90, estimate the cost of I kg.

---

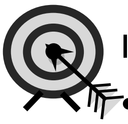
5. Half kg of grapes cost K9.95. Estimate the cost of two and a half kilograms.

---

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3.**

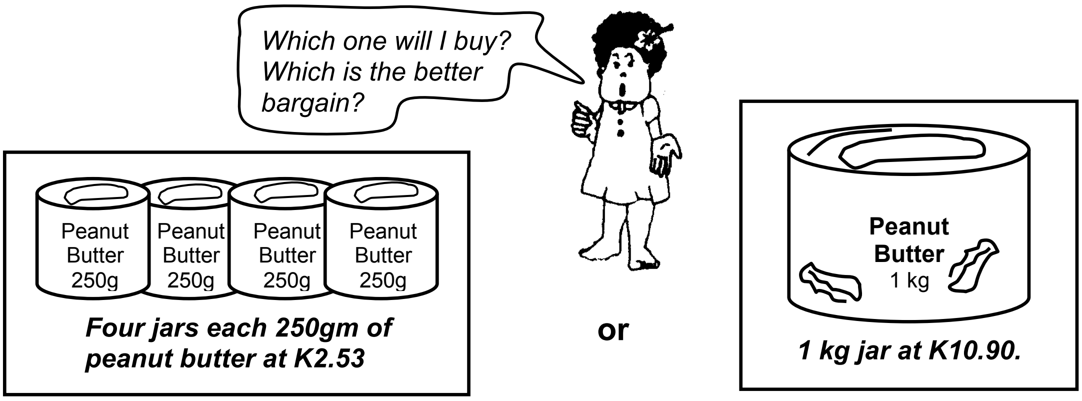
# Lesson 24: The Best Buy

In Lesson 23, you learnt to estimate sums of money and used mental approximations to estimate prices of goods.



In this lesson, you will:

- estimate what is the best bargain.




In a shop you probably won‟t have a calculator, so the best thing to do is **ESTIMATE!**

Solution:

**Estimation:** We estimate K2.53 to the nearest toea = K2.50 x 4 = K10.00, which is cheaper than a 1 kg jar at K10.90.

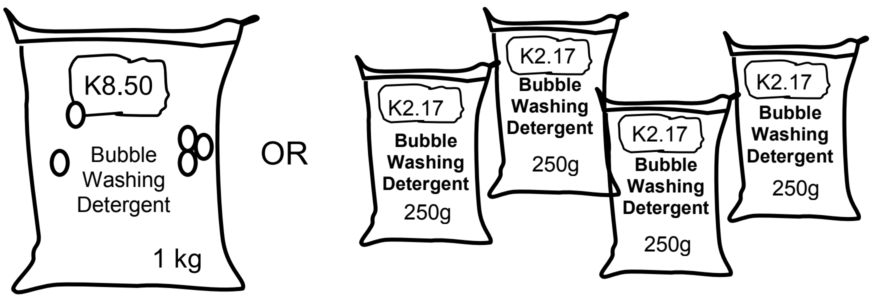
Is the estimate comparable to the actual computation?

**Actual computation:**

K2.53 x 4 = K10.12, so if you buy four small jars you get 1 kg for K10.12, which is cheaper and you get a saving of K10.90 - K10.12 = 78 toea.

Example 2

Which pack of detergent soap is the better buy?




Solution:

**Estimation:** K2.17 to the nearest toea is K2.20 x 4 = K 8.80 for 4 packs, which is more expensive than 1kg at K8.50.

Will the estimate be comparable to the actual computation? Let‟s see.

**Actual computation:** K2.17 x 4 = K8.68, so if you buy the 1kg pack, you have a saving of 18 toea (K8.68 – K8.50 = 18 toea).

*Now we can tell Mom about it and help her shop for the best buy.*

Now, you have some idea on how the estimation strategy helps you in making a good buy or choosing the best bargain in the shop.

Now, we will use cost rates to determine the best buy.

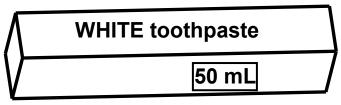
*Finding rates lets you make comparisons. Comparing rates is particularly useful when you are buying things.*
*This means you have to compute the unit price of different sizes of a given product.*

***Unit Price = Cost ÷ Quantity***

In this case we will not use estimates anymore but workout the actual cost rate of a unit to determine the best buy.

Example 1

A certain brand of toothpaste comes in two sizes. The 25 ml tube sells for K7.25 while the 50 ml tube costs K11.40. Which size cost less per mL of toothpaste? Which is the better buy?


Solution:

Unit price = $\frac{\text{Cost}}{\text{Quantity}}$

Unit price = $\frac{\text{K7.25}}{\text{25 mL}}$

Unit price = K0.29 per mL

Unit price = $\frac{\text{Cost}}{\text{Quantity}}$

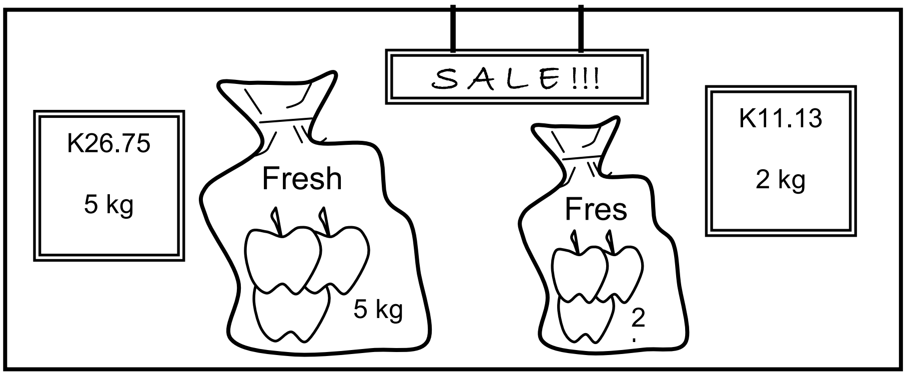
Unit price = $\frac{\text{K11.40}}{\text{50 mL}}$

Unit price = K0.23 per mL

**The 50 mL tube is the better buy because it costs less per mL.**

We may think that the higher price is more expensive but computing for the unit cost will give us the actual value and give us the better idea on which item is the best buy.

Example 2

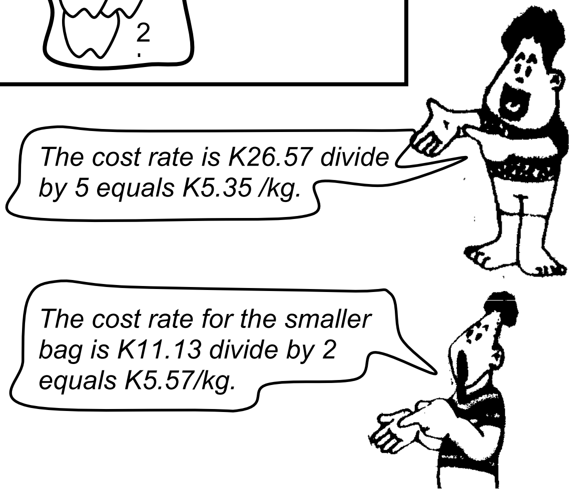



Which one will you buy?

What is the cost rate for the larger bag of apples?

What is the cost rate for the smaller bag?

Which is the better buy?





Work this out.

*Sale!! Sale !!*

2 cakes for K1.00
5 cakes for K2.50

1) What is the cost per cake in the 2 cake pack?

2) What is the cost per cake in the 5 cake pack?

3) Which pack is the better buy?

You should have the same answers as shown below.

1) K0.50 each
2) K0.50 each
3) same

---

**NOW DO PRACTICE EXERCISE 24**

## Practice Exercise 24

1. In each of the following, calculate exactly which is the better value and show by how much.

   (a) 2.5 m of string for 90t or 6 m for K2.75

   (b) 3 kg of sweet potato for K1.25 or 800 g for 80t

   (c) 5 coconuts for K2.10 or 8 coconuts for K4

   (d) 300 mL of cordials for 60t or 1 L for K2

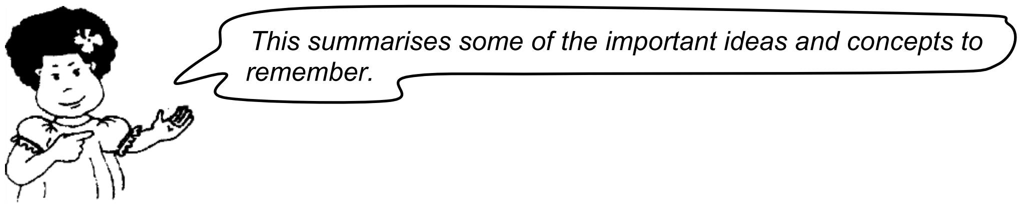
   (e) 4 bananas for K2.10 or 8 bananas for K4

2. A stall sells 1kg of carrots for K9. Another stall sells 750 g of carrots for K6. Which stall gives the better buy?

3. Notebooks sold at K4.50 each at Theodist Ltd. may be bought for K45 a dozen in other shops. Which shop offers a better buy?

**CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 3.**

## SUB-STRAND 4: SUMMARY




- Estimation means guessing, predicting or assuming an approximate value, for example, the size of an object or cost of an item.
- Rounding off means changing to the nearest possible unit above or below.
- Rounding off numbers means giving the estimated value of the numbers to the nearest tens, hundreds, thousands and so on.
- To round off decimal numbers, we first identify the digit in the given place value where we will round off, then we look at the digit to the right of the given place value.
    - ❖ If the digit to the right of the given place value is equal to or greater than 5, we increase the digit in the given place value by 1 and drop all the digits after it.
    - ❖ If the digit to the right of the given place value is less than 5, we retain the digit in the given place value and just drop all the digits to its right.
- To round off length measurements and money, we follow the same rules as in rounding off decimals.
- Kina and toea are the names of the units of money used in Papua New Guinea.
- Best buy means getting the best value for your money.

**REVISE LESSONS 19 – 24 THEN DO SUB-STRAND TEST 4 IN ASSIGNMENT 3.**

# ANSWERS TO PRACTICE EXERCISES 19 - 24.

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**Practice Exercise 19**

1. Round off to the nearest ten, hundred and thousand.

| | Ten | Hundred | Thousand |
|---|---|---|---|
| a. 6459 | 6 460 | 6 500 | 7 000 |
| b. 72 811 | 72 810 | 72 800 | 73 000 |
| c. 7406 | 7 410 | 7 400 | 7 000 |
| d. 695 989 | 695 990 | 696 000 | 696 000 |
| e. 5555 | 5 560 | 5 600 | 6 000 |

2. Round off each number to the indicated place values

| | 8 074 952 | | 92 341 702 |
|---|---|---|---|
| Tens | 8 074 950 | Hundreds | 92 341 700 |
| Hundreds | 8 075 000 | Thousands | 92 342 000 |
| Thousands | 8 075 000 | Ten Thousands | 92 340 000 |
| Ten Thousands | 8 070 0000 | Hundred Thousands | 92 300 000 |
| Hundred Thousands | 8 100 000 | Millions | 92 000 000 |

3. Estimate each answer by rounding off each number to the nearest ten. Then compare this to the exact answer.

| | Estimate | Exact Answer |
|---|---|---|
| Example: 37 + 52 | 40 + 50 = 90 | 37 + 52 = 89 |
| (a) 18 + 23 + 42 | 20 + 20 + 40 = 80 | 18 + 23 + 42 = 83 |
| (b) 118 ÷38 | 120 ÷ 40 = 3 | 118 ÷38 = 3.1 |
| (c) 37 x 32 | 40 x 30 = 1200 | 37 x 32 = 1184 |
| (d) 987 - 778 | 990 – 780 = 210 | 987 - 778 = 209 |
| (e) 94 + 152 + 35 + 653 | 90 + 150 + 40 + 650 = 930 | 94 + 152 + 35 + 653 = 934 |

4. Problem Solving

   (a) 420 (b) 400 (c) 800

5. 500

6. K38 000 000

7. i. 5 350
   ii. 5 000

**Practice Exercise 20**

1. (a) thousandths
(b) tenths
(c) millionths
(d) ones
(e) tenths
(f) thousandths
(g) hundreds
(h) thousandths
(i) thousand
(j) hundred thousandths

2.

| | Tenths | Hundredths | Thousandth | Ten-Thousandth |
|---|---|---|---|---|
| 1. 0.5064089 | 0.5 | 0.51 | 0.506 | 0.5064 |
| 2. 0. 0009235 | 0.0 | 0.00 | 0.001 | 0.0009 |
| 3. 9.2055055 | 9.2 | 9.21 | 9.206 | 9.2055 |
| 4. 78.010987 | 78.0 | 78.01 | 78.011 | 78.0110 |
| 5. 63. 456789 | 63.5 | 63.46 | 63.457 | 63.4568 |

3. Round off each number as indicated.

(a) 8. 249075

Nearest whole number 8
Tenth 8.2
Hundredth 8.25
Thousandth 8.249
Ten - thousandth 8.249

(b) 1250.635892

nearest ten 1250
nearest hundred 1300
nearest whole number 1251
nearest hundredth 1250.64
nearest hundred- thousandth 1250.63589

(c) 7249.0505055

nearest ten 7250
nearest hundred 7200
nearest thousand 7000
nearest whole number 7249
nearest tenth 7249.10
nearest hundredth 7249.05
nearest thousandth 7249.051
nearest ten-thousandth 7249.0505
nearest hundred-thousandth 7249.05051
nearest millionth 7249.050506

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**Practice Exercise 21**

1.
(a) 500 & 600; 500 mm
(b) 2000 & 3000; 3000 m
(c) 90 & 100; 90 cm
(d) 2680 & 2690; 2690 m
(e) 800 & 900; 900 m
(f) 1000 & 2000 ; 1000 km
(g) 30 & 40; 30 cm
(h) 900 & 1000; 1000 km
(i) 60 & 70; 70 mm
(j) 1500 & 1600; 1600 cm

2.
(a) 4 km
(b) 3.5 cm
(c) 10.84 km
(d) 74 m
(e) 103 km
(f) 7 km
(g) 2 m
(h) 74 cm
(i) 1 km
(j) 10 cm

---

**Practice Exercise 22**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1. | (a) | K16.20 | (b) | K82.00 | (c) | K101.20 |
| | (d) | K77.15 | (e) | K211.70 | (f) | K27.70 |
| 2. | (a) | K61.60 | (f) | K80.00 | (k) | K752.87 |
| | (b) | K1000.00 | (g) | K9.30 | (l) | K108.00 |
| | (c) | K109.26 | (h) | K1.00 | (m) | K1500.00 |
| | (d) | K500.00 | (i) | K6000.00 | (n) | K40.00 |
| | (e) | K130.00 | (j) | K100.00 | (o) | K500.00 |

---

**Practice Exercises 23**

1. (a) Estimate : 8 x K3.00 = K24.00 - YES Actual: 8 x K2.59 = K20.72 -YES
   (b) Estimate: 7 x K2.00 = K14.00 – NO Actual: 7 x K2.35 = K16.45 – YES
   (c) Estimate: 3 x K12.00 = K36.00 – YES Actual: 3 x K12.49 = K37.47 – YES
   (d) Estimate: 4 x K5.00 = K20.00 – NO Actual: 4 x K4.69 = K18.76 - NO

2. (a) Estimate Total Cost: K72.00 - NO
   (b) Estimate Total Cost: K208.00 - NO

3. 2 kg = K32.00

4. 1 kg = K8.00

5. 2 and half kg = K50.00

---

**Practice Exercises 24**

1. (a) 2.5 m for 90t; about 10t per m cheaper
   (b) 3 kg for K1.25; 58.4t per kg cheaper
   (c) 5 coconuts for K2.10; 8t per coconut cheaper
   (d) same
   (e) 8 bananas for K4.00; 20t cheaper

2. 750 g for K6 is the better buy because of K1 per kg cheaper

3. Other shops offers a better buy because notebooks are K9 per dozen cheaper.

---

**END OF SUB-STRAND 4**

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