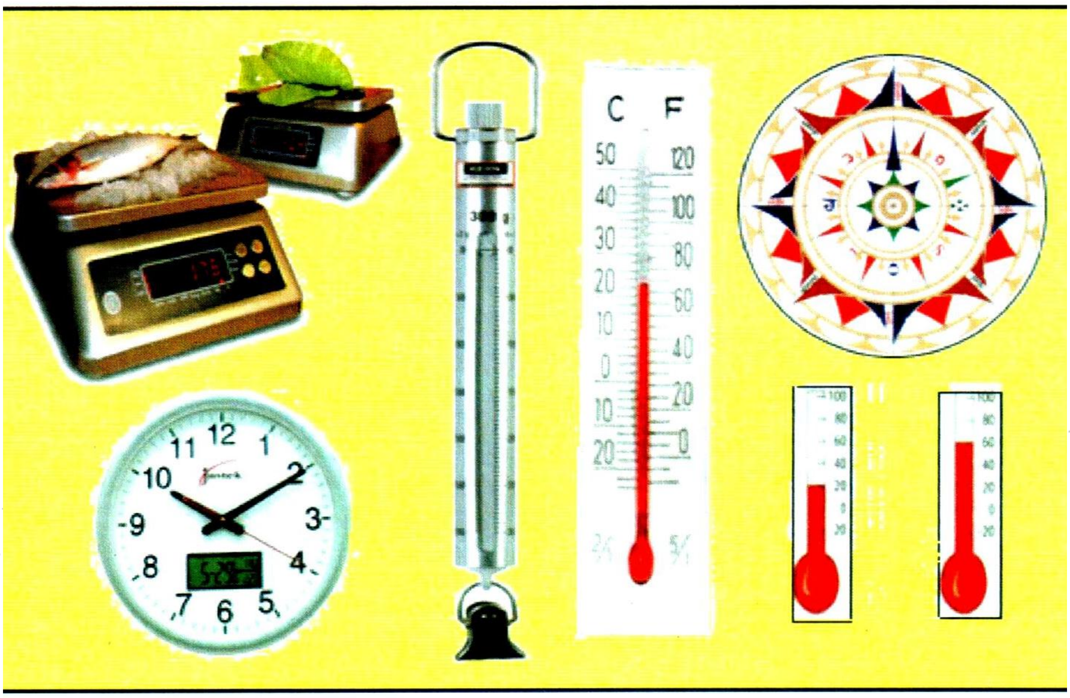
DEPARTMENT OF EDUCATION

GRADE 7

MATHEMATICS

STRAND 4



MEASUREMENTS (2)

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PAPUA NEW GUINEA

GRADE 7

MATHEMATICS

STRAND 4

MEASUREMENTS (2)

SUB-STRAND 1:	**WEIGHTS**
SUB-STRAND 2:	**TEMPERATURES**
SUB-STRAND 3:	**TIME**
SUB-STRAND 4:	**DIRECTIONS**

Acknowledgements

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

Special thanks to the Staff of the Mathematics Department of FODE who played active role in coordinating writing workshops, outsourcing lesson writing and editing processes, involving selected teachers of Madang, Central Province and NCD.

We also acknowledge the professional guidance provided by the Curriculum Development and Assessment Division throughout the processes of writing and, the services given by the members of the Mathematics Review and Academic Committees.

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CONTENTS

SECRETARY‟SMESSAGE

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 4: MEASUREMENTS (2)

Dear student,

This is the Fourth 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: Weights
Sub-strand 2: Temperature
Sub-strand 3: Time
Sub-strand 4: Directions

Sub-strand 1 – **Weights** – You will use charts and graphs to read and record weights and solve problems related to weight.

Sub-strand 2 –**Temperature** – You will learn to read a thermometer and compare temperature measurements.

Sub-strand 3 – **Time** – You will learn to manipulate time to solve problems.

Sub-strand 4 – **Directions** – You will learn to give the directions of a location relative to others as bearings.

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 you enjoy studying this book.

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 the 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: Weights

Then go on to the next Lesson. Repeat the 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 Contents 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 4.

Then go on to the next Sub-strand. Repeat the same process until you complete all of the four Sub-strands in Strand 4.

Assignment: (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 for that Sub-strand in your Assignment. The Strand 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

WEIGHTS

SUB-STRAND 1: WEIGHTS

Introduction

In everyday usage, „weight" is often used interchangeably with mass, and the units are often taken as kilograms. For example a person may state that his/her weight is 75 kg. In proper scientific use, however, the two terms refer to different properties of matter but are related.

It's important to know and understand the difference between **weight** and **mass**.

Mass is a measure of the amount of matter in an object, so the mass of an object is constant.
Weight is a measure of the force of attraction of the earth (called *gravity*) acting on an object. The weight of an object is not constant.

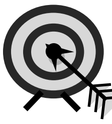
Mass is a more fundamental quantity than weight. There is no English word equivalent to the verb *weigh* that can be used to describe what happens when the mass of an object is measured. You are therefore likely to encounter the terms *weigh* and *weight.*

In this Sub-strand, you will:

- discuss the meaning of weight and identify the basic units used to measure weight
- use appropriate units of weight (mg, g, kg or tonne) for the quantity being measured
- solve weight problems involving the four operations (addition, subtraction, multiplication and division)
- calculate average weight of a given series of weight measurements
- read and record weights using graphs and charts.

Lesson 1: Measures of Weight

You learnt how to measure length, angle, area and volume in Strand 3.



In this lesson, you will:

- define weight
- identify the different units used to measure weight
- convert between the different units of weight

In everyday practical situation, you weigh to find out how heavy something is. The heaviness of something is **weight**.

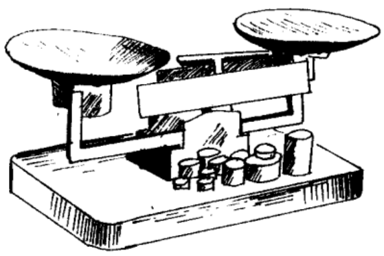
In commercial usage, the word „weight“ is often used instead of „mass“ even though scientifically, they are not quite the same and entirely different concepts.

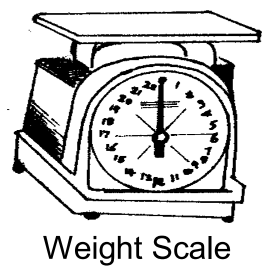
For example, in every local market you go to, you will see many things like pawpaw, potatoes and vegetables being sold. Some are bought by piece, by bundle, by heap and by sack. However, these days, if you go to the supermarket, these are bought by the „kilo“, popular name for „kilogram“ (kg) the standard unit of weight in the metric system.

The kilogram, strictly speaking, is the unit of measure for **mass**, the amount of matter an object contains. **Weight** is the measure of the pull of the earth on an object. The **weight** of an object is how hard gravity is pulling on it.

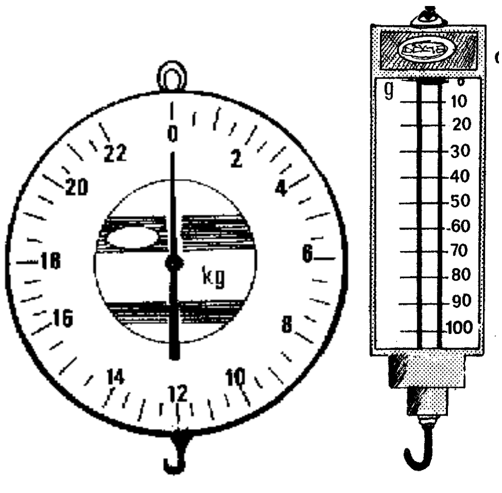
However, in daily life, it is **weight** we measure. Thus, we buy one or two kilos of potatoes, 5 kilos of sugar and so on.

We use different kinds of balances to measure weight. Below are pictures of some of them.





Weight Scale



Spring balances

Can you describe the different kinds you have seen or used?

The units of weight most commonly used and their relationships are:

10 milligrams	= 1 centigram
10 centigrams	= 1 decigram
10 decigrams	= 1 gram
10 grams	= 1 decagram
10 decagrams	= 1 hectogram
10 hectograms	= 1 kilogram
1000 kilograms	= 1 tonne

Commonly known and used units:

1000 milligrams = 1 gram

1000 grams = 1 kilogram

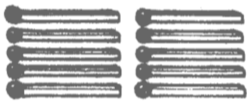
We symbolize these units as follows:

milligram	= mg
centigram	= cg
decigram	= dg
gram	= g
decagram	= Dg
hectogram	= hg
kilogram	= kg
tonne	= t

At present, the metric system uses the units milligrams, grams, kilograms and tonnes to measure weights or mass.

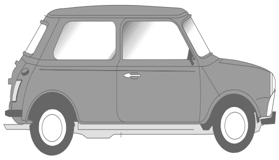
Here are some examples of objects that are 1 unit of mass or weight.

a grain of sand weigh about 1 milligram



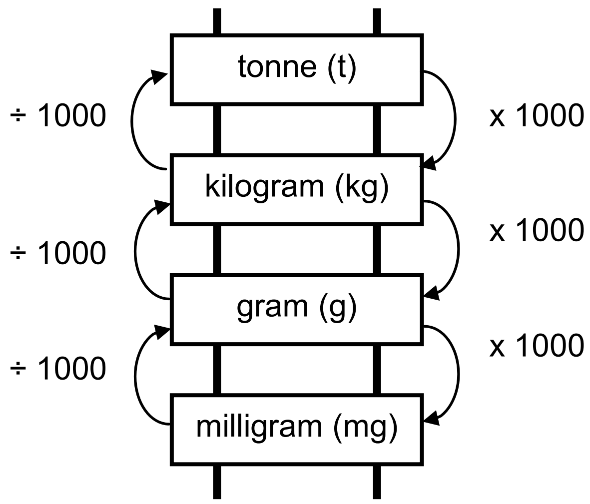
10 matches weigh about 1 gram

A bag of sugar weighs about 1 kilogram



A small car weighs about 1 tonne

The relationship between these units is shown by the conversion ladder below:



The units are connected by either multiplication or division using the numbers on the ladder.

- When climbing down the ladder, multiply.
  This means that **in changing larger unit to smaller unit, multiply the number by the unit equivalence**

- When climbing up the ladder, divide.
  This means that **in changing smaller unit to larger unit, divide the number by the unit equivalence.**

Examples

Complete the following conversions.

1. 3 tonnes = _________kilograms

Solution: This is converting larger unit to smaller unit so you multiply.

1 tonne (t) = 1000 kilograms (kg)

Multiplying the given number of tonnes by 1000

We have, 3 tonnes = 3 x 1000

= 3000

Therefore, **3 t = 3000 kg**

2. 6520 kilograms = __________tonnes

Solution: This is converting smaller unit to larger unit so you divide.

1000 kilograms (kg) =1 tonne (t)

Dividing the given number of tonnes by 1000

You have 6520 kilograms = 6520 ÷ 1000

= 6.52

Therefore, **6520 kg = 6.52 t**

3. 53 000 mg = __________grams

Solution: This is converting smaller unit to larger unit so you divide

Since 1000 mg = 1g

Dividing the given number of tonnes by 1000

You have 53 000 mg = 53 000 ÷ 1000

= 53

Therefore, **53 000 mg = 53 g**

4. 2.65 t = __________kg

Solution: This is converting larger unit to smaller unit so you multiply.

1 tonne (t) = 1000 kilograms (kg)

Multiplying the given number of tonnes by 1000.

We have, 2.65 t = 2.65 x 1000

= 2650

Therefore: **2.65 t = 2650 kg**

Sometimes you encounter problems in real life that needs conversion of units.

Example 1

A bird weighs 100g, a cat weighs 1000 g and a dog weighs 10 000 g. Which of these animals weighs 1 kg?

Solution: Since all the animals are weighed in grams, change all of these to kilograms.

So, if a bird weighs100 g, then it weighs 0.1 kg. (less than 1 kg)

if a cat weighs 1000 g, then it weighs 1 kg. (1000 g = 1 kg)

if a dog weighs 10 000 g, then it weighs 10 kg. (more than 1 kg)

Therefore, the cat has a weight of 1 kg.

Example 3

Thomas has eight piglets each weighing 3850 g. Find the total weight of the piglets in kilograms.

Solution: Step 1: Find the total weight of the piglets.

Each piglet is 3850 g

so, total weight = 8 x 3850 g

= 30800 g

Step 2: Convert 30 800 g to kilogram

30 800 g = 30 800 ÷ 1000

= 30.8 kg

Therefore, total weight in kg **is 30.8 kg.**

NOW DO PRACTICE EXERCISE 1

Practice Exercise 1

1. Convert these units of weight.

a) 3090 kg = __________t

b) 4000 mg = __________g

c) 6.08 kg = __________g

d) 10.02 t = __________kg

e) 21 500 kg = __________t

f) 40 500 mg = __________g

g) 990 g = __________mg

h) 5.3 kg = __________mg

i) 22 600 g = __________t

j) 3.67 t = __________g

---

2. Write these weights below in order from lightest to heaviest.

36 mg, 4t, 56 g, 18 kg

Answer: __________

---

3. Vincent is helping to unload a truck. He can carry up to 4 kg. Each box on the truck has weight of 2000 g.

How many boxes can Vincent carry at one time?

Answer: __________

4 Sebona‟s cat weighs 4 kg. Carl's cat weighs 2,900 grams.

Whose cat is heavier? Explain.

Answer: __________

5. Kira bought a 4-kilogram container of ice cream. She ate 535 grams, Jean ate 60 grams and 1.5 kg was used in milkshakes.

Find the amount of ice cream that was left in the container in:

a) Grams

Answer: __________

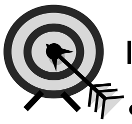
b) kilograms.

Answer: __________

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

Lesson 2: Choosing an Appropriate Unit

You learnt the meaning of weight and identified the different units used to measure weight as well as converting between units of weight in Lesson 1.



In this lesson you will:

- use milligrams, grams, kilograms or tonnes as appropriate for the quantity being measured.

If you have to pick something up, it is good to know how heavy it is, and in the metric system, it would be measured in milligrams, grams, kilograms and tonnes.

The table shows the most commonly used units in measuring how heavy something is.

Name of unit	Symbol	Typical item measured in this unit
milligram	mg	medicine
gram	g	small amounts of food or jewelry
kilogram	kg	body mass, weight of household furniture and large objects, bag of rice, sugar, etc.
tonne	t	weights of cars, boats, ships, etc.

You used the milligrams and grams to measure the weight of light objects. You use the kilograms and tonnes to measure the mass of heavier objects.

Before you can measure something, you need to know what unit to use. You can do this by making an estimate of its approximate weight.

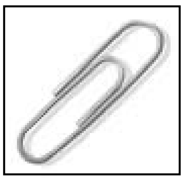
When you estimate the weight of an object, think of these examples:

1. 

The weight of a medicine capsule is about 500 milligrams.

Once you have 1000 milligrams, you have 1 gram.

Milligrams are often written as mg for short, so “500 mg” means “500 milligrams”.

2. 

The weight of a medium paper clip is about 1 gram.

Hold one small paperclip in your hand. Does that weigh a lot? No! A gram is very light. That is why you often see things measured in hundreds of grams.

Grams are often written as g (for short), so "300 g" means "300 grams".

A loaf of bread weighs about 700 g. (for a good sized loaf)

Once you have 1000 g, you have 1 kg.

3.

A packet of rice bought at the supermarket is one kilogram.

Kilograms are great for measuring things that can be lifted by people (sometimes very strong people are needed of course!).

Kilograms are often written as kg (that is a "k" for "kilo" and a "g" for “gram”, so "10 kg" means "10 kilograms".

When you weigh yourself on a scale, you would use kilograms.

An adult weighs about 70 kg.

How much do you weigh?

Once you have 1000 kg, you have 1 tonne.

But when it comes to things that are **very** heavy, we need to use the tonne.

4.

This car weighs about 2 tonnes.

Things like cars, trucks and large cargo boxes are weighed using the tonne

Tonnes (also called Metric Tons) are used to measure things that are very heavy.

NOW DO PRACTICE EXERCISE 2

Practice Exercise 2

1. List the unit that is most appropriate to express the weight of the following.

a) a car ___________
b) a feather ___________
c) a brick ___________
d) a pencil ___________
e) an elephant ___________
f) a piece of paper ___________
g) an ant ___________
h) a person ___________
i) five big books ___________
j) a trailer load of sand ___________

2. Complete the statement by writing g or kg.

a. A table tennis ball is about 5 ___________.
b. A magazine is about 200 ____________.
c. A bicycle is about 20 ___________.
d. A sled is about 4 ___________.
e. A shoelace is about 20 ___________.
f. A bowling ball is about 6 ___________.

3. Choose the best answer from the alternatives given below each statement.

I. A pencil weighs about ___________.

a) 3 grams b) 500 grams c) 1.2 kilograms

II. A gallon of milk weighs about ___________.

a) 39 grams b) 3.9 kilograms c) 39 kilograms

III. A pineapple weighs about___________.

a) 2.2 kilograms b) 22 kilograms c) 222 grams

IV. A squirrel weighs about ___________.

a) 10 grams b) 100 grams c) 1 kilogram

V. A cell phone weighs about ___________.

a) 1 gram b) 120 grams c) 2 kilograms

4. Choose the best estimate for each object or animal shown. Circle the correct answer.

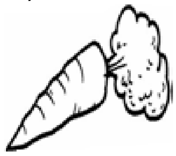
a)

100 grams
1 kilogram
100 kilograms

b)

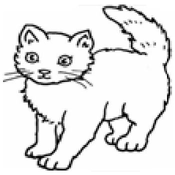
960 grams
18 kilograms
3 kilograms

c)



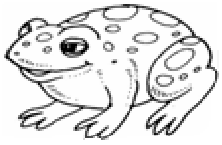
18 grams
4 kilograms
8 kilograms

d)



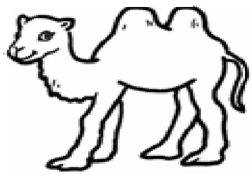
570 grams
7 kilograms
37 kilograms

e)



3 grams
300 grams
3 kilograms

f)

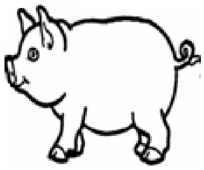


600 kilograms
60,000 kilograms
6,000 grams

g)

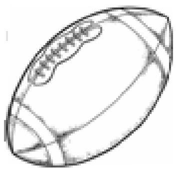
1 gram
50 grams
1 kilogram

h)



900 grams
9 kilograms
90 kilograms

i)



20 grams
500 grams
18 kilograms

---

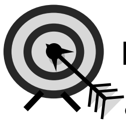
5. June's pet guinea pig weighs 950 grams. Larry's pet rabbit weighs 2.1 kilograms.

How much more does Larry's pet weigh than June's? Explain how you found your answer.

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

Lesson 3: Solving Weight Problems

You learnt the use of milligrams, grams, kilograms or tonnes as appropriate for the quantity being measured in Lesson 2.



In this lesson you will:

- solve weight problems involving addition, subtraction, multiplication and division operations.

There are activities in daily life, where you use what you know about units of weight and weighing objects. Real problems involving operations on weights whether at home, in the market, in the office and in any field requires application of the skills and knowledge of weight measurement.

Study the following examples.

Example 1

Find the sum of the following weights: 45 g, 350 g, 4 kg and 0.6 kg.

Solution: To find the sum, all units must be the same.
Since 1 kg = 1000 g
Then, 4 kg = 4000 g
0.6 kg = 600 g

So, 45 g + 350 g + 4000 g + 600 g = 4995 g

Therefore, the sum is 4995 g.

Example 2

A box of chocolates weighs 700 g and contains 50 chocolates. How much does each chocolate weigh?

Solution: To find how much each chocolate weighs, divide the weight of the box of chocolates by the number of chocolates it contains.

So, $\text{Weight of each chocolate} = \dfrac{\text{Weight of box}}{\text{number of chocolates}}$

$= \dfrac{700\text{ g}}{50}$

$= 14\text{ g}$

Therefore, each chocolate weighs 14 g.

Example 3

Barbra bought the following vegetables from the market:

450 g peas
120 g mixed salad
1.25 kg of onions
0.7 kg carrots
850 g mushrooms
2.5 kg of potatoes

a. Find the total weight of vegetables bought in kg.
b. How much heavier were the potatoes compared to the onions?
c. If all the vegetables were packed into a box which then weighed 6.84 kg, find the weight of the box.

Solution:

a. To find the total weight of the vegetables, we use the operation addition.

Since some of the vegetables are weighed in grams, we need to convert grams to kilograms first before we can add.

1000 g = 1 kg

So,	450 g peas	= 0.45 kg	(450 ÷ 1000 = 0.45)
	120 g mixed salad	= 0.12 kg	(120 ÷ 1000 = 0.12)
	850 g mushrooms	= 0.85 kg	(850 ÷ 1000 = 0.85)
	0.7 kg carrots	= 0.7 kg	
	2.5 kg potatoes	= 2.5 kg	
	1.25 kg onions	= 1.25 kg	
	Total weight	**= 5.87 kg**	**(**Add all the weights in kg)

b. To find how much heavier the potatoes were compared to onions, we subtract the two weights.

So, 2.5 kg – 1.25 kg = 1.25 kg

Therefore, the potatoes were 1.25 kg heavier than the onions.

c. To find the weight of the box, subtract the total weight of the vegetables from the total weight when packed.

So, Weight of box = Total weight – weight of vegetables
= 6.84 kg – 5.87 kg
= 0.97 kg

Therefore, the box weighs 0.97 kg

Example 4

Ralph‟s mother sells four bags of avocados at the local market. The first bag weighs 15 kg, the second weighs 30 kg, the third weighs 78kg and the fourth weighs 8900 grams.

a) What is the total weight of all the bags of avocados in kilograms?

b) What would the weight be in tonnes?

c) How many kilograms of avocados will be left if Ralph‟s mother sells $\frac{3}{4}$ of the avocados?

Solution:

a) To find the total weight of all the bags of avocados in kilogram, add the weights of the four bags. (Make sure all are of the same units)

Using addition, we have

Total weight = 15 kg + 30 kg + 78 kg + **8.9 kg** ⟵(change 8900 g to kg)
= 131.9 kg

b) To find the weight in tonnes, convert 131.9 kg to tonnes, divide by 1000

Using division, we have

Weight in tonnes = 131.9 ÷ 1000 (Move decimal point 3 places to the left.)
= 0.1319 tonnes

c) To find the number of kilograms of avocados that will be left if Ralph‟s mother sells $\frac{3}{4}$ of the avocados, subtract the weight of avocados sold from the total weight of the avocados.

If the Total weight of avocados is 131.9 kg and $\frac{3}{4}$ of it were sold,

then, Weight in kg left = 131.9 kg – ($\frac{3}{4}$ of 131.9 kg)
= 131.9 – 98.925
= 32.975 kg

Therefore, 32.975 kg of avocados were left.

NOW DO PRACTICE EXERCISE 3

Practice Exercise 3

---

1. Find the sum of the following.

a) 12 g + 250 g + 2000 g Answer: ___________

b) 48 g + 560 g + 4500 g + 2100 g Answer: ___________

c) 28 mg + 54 mg + 400 mg + 320 mg Answer: ___________

d) 54 kg + 2.8 kg + 16.2 kg + 400 kg Answer: ___________

---

2. Write the answers to the following in kilograms.

a) the total weight of 12 piglets each weighing 3.85 kg

Answer: ___________

b) the total weight of 210 chickens each weighing 300 g

Answer: ___________

c) the total weight of 45 rabbits each weighing 1500 g

Answer: ___________

---

3. A construction worker is loading a truck with soil. He can dig 2 kg of soil on his shovel at a time.

a) How much soil is loaded after 1000 shovelfuls?

Answer: ___________

b) How many tonnes of soil is this?

Answer: ___________

4. A jar containing 480 jelly beans weighs 4 kg. If the empty jar weighs 2.5 kg, what is the weight of the jelly beans?

Answer: __________

---

5. On passing a weigh-bridge, a truck registered a weight of 12.5 tonnes.

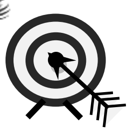
   If the load was 9.75 tonnes, what was the weight of the truck in kilograms?

Answer: __________

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

Lesson 4: Average Weight

You learnt to solve weight problems involving addition, subtraction, multiplication and division operations in Lesson 3.



In this lesson you will:

- calculate average weight.

Let us start the lesson by considering the table below.

ASI'S WEIGHT FOR SIX MONTHS	
Month	**Weight**
January	3.750 kg
February	4.075 kg
March	4.390 kg
April	4.942 kg
May	5.265 kg
June	5.742 kg

The table shows the weight of Asi for the last six months from January to June. You can find the average monthly weight of Asi. Finding the average weight takes two steps:

1) Add all the weights

3.750 kg
4.075 kg
4.390 kg
4.942 kg
5.265 kg
+ 5.742 kg
28.164 kg

2) Divide the sum by the number of weights

4. 694 ← Average
6 ⟌ 28.164
24
4 1
3 6
56
54
24
24
0

Therefore, the average weight of Asi for six months is 4.694 kg.

Looking at the two steps, we can formulate the rule in calculating the average weight as:

Average weight is equal to the total weight divided by the number of weights

or use the formula:

.

$$\textbf{Average weight} = \frac{\textbf{Total weight}}{\textbf{number of weights}}$$

Now look at the examples.

Example 1

Bobby has eight eggs. Half of them weigh 50 grams each, three weigh 55 grams and one weighs 65 grams. What is their average weight?

Solution: Step 1: Find the total weight of the eggs.

Total Weight = (4 x 50 g) + (3 x 55 g) + 65 g
= 200 g + 165 g + 65 g
= 430 g

Step 2: Use the formula:

$$\text{Average weight} = \frac{\text{Total weight}}{\text{number of weights}}$$

$$\text{Average weight} = \frac{430\text{ g}}{8}$$

$$= 53.75$$

Therefore, the average weight of the eggs is 53.75 g.

Example 2

Here is a table which shows weights for some known animals. Work out their average weight.

WEIGHTS OF KNOWN ANIMALS	
Animal	**Weight**
wild pig	239 kg
cow	795 kg
eagle	3 kg
dog	19 kg
cat	7 kg
camel	700 kg

Solution:

Step 1: Find the total weight of the animals.

Total Weight = 239 kg + 795 kg + 3 kg + 19 kg + 7 kg + 700 kg
= 1763 kg

Step 2: Use the formula:

$$\text{Average weight} = \frac{\text{Total weight}}{\text{number of weights}}$$

$$\text{Average weight} = \frac{1763\text{ kg}}{6}$$

$$= 293.8$$

Therefore, the average weight is 293.8 kg.

Example 3

Here is a table which shows weights for some domestic birds. Work out their average weight.

WEIGHTS OF KNOWN ANIMALS	
Bird	**Weight**
Turkey	9 kg
Fowl	3.9kg
Duck	2.95 kg
Albatross	13.8 kg
Eagle Owl	4.5 kg
Pigeon	0.985 kg

Solution:

Step 1: Find the total weight of the animals.

Total Weight = 9 kg + 3.9 kg + 2.95 kg + 13.8 kg + 4.5 kg + 0.985 kg

= 35.135 kg

Step 2: Use the formula:

$$\text{Average weight} = \frac{\text{Total weight}}{\text{number of weights}}$$

$$\text{Average weight} = \frac{35.135 \text{ kg}}{6}$$

$$= 5.856 \text{ kg}$$

Therefore, the average weight is 5.856 kg.

Example 4

The total weight of 18 piglets is 67.5 kg. What is the average weight of the piglets?

Solution: Given: Total weight = 67.5 kg
No. of piglets = 18

Substitute them in the formula:

$$\text{Average weight} = \frac{\text{Total weight}}{\text{number of piglets}}$$

$$\text{Average weight} = \frac{67.5 \text{ kg}}{18}$$

$$= 3.75 \text{ kg}$$

Therefore, the average weight is 3.75 kg.

Sometimes you can estimate the average weight mentally.

For example

1) Estimate the average of the following weights: 53 g, 48 g, 52 g, 47 g and 51g.

Solution: All the weights are about 50, so the average will be about **50 g.**

2) Look at the table showing Asi"s weight for six months.

ASI"S WEIGHT FOR SIX MONTHS	
Month	**Weight**
January	3.750 kg
February	4.075 kg
March	4.390 kg
April	4.942 kg
May	5.265 kg
June	5.742 kg

Round off Asi"s monthly weights to the nearest whole number and calculate her total weight and average weight.

Solution: Total weight = 4 kg + 4 kg + 4 kg + 5 kg + 5 kg + 6 kg
= 28 kg

$$\text{Average weight} = \frac{\text{Total weight}}{\text{number of weights}}$$

$$= \frac{28}{6}$$

$$= 4.67 \approx 5$$

Therefore the estimated average weight is 5 kg.

You can go back to your Strand 3 Sub-strand 4 Lessons in case you forget the meaning of estimation and how to estimate.

NOW DO PRACTICE EXERCISE 4

Practice Exercise 4

1. Find the average weight of the following weights.

   a) 128 mg + 254 mg + 320 mg + 400 mg

   b) 5.4 kg + 2.8 kg + 16.2 kg + 8.4 kg + 4.6 kg

   c) 48 g + 56 g + 36 g + 27 g + 66 g + 43 g

---

2. Vincent has twelve apples. Half of them weigh 150 grams each, five weigh 85 grams and one weighs 65 grams. What is their average weight?

---

3. The total weight of 40 chickens is 67.5 kilograms. What is the average weight of the chicken?

---

4. Dodi has five pet animals each of which weighs 18.8 kg, 19.85 kg, 22.6 kg, 20.5 kg and 17.65 kg. What is the average weight of Dodi‟s pet animals?

5. Here is a table which shows weights for some known dog breed. Work out their average weight.

WEIGHTS OF KNOWN TEN DOG BREED	
DOG	**Weight**
German shepherd	38.6 kg
Golden Retriever	30.9 kg
Labrador Retriever	34.09 kg
Beagle	11.36 kg
Boxer	29.54 kg
Poodle, Standard	21.81 kg
Shih Tzu	7.3 kg
Bulldog	22.75 kg
Yorkshire Terrier	3.18 kg
Dachshund	14.54 kg

Estimate the total weight then find the average weight.

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

Lesson 5: Reading and Recording Weights

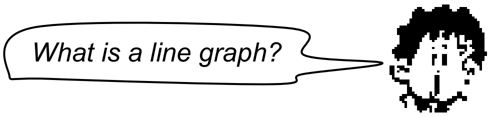
You learnt to calculate average weight using the formula in Lesson 4.

In this lesson you will:

- read and record weights using charts and graphs.

In your Lower Primary Mathematics, you learnt something about charts and graphs. In this lesson, you will read and record weights using charts and graph.

First, you are going to look at a line graph and comment meaningfully on it.



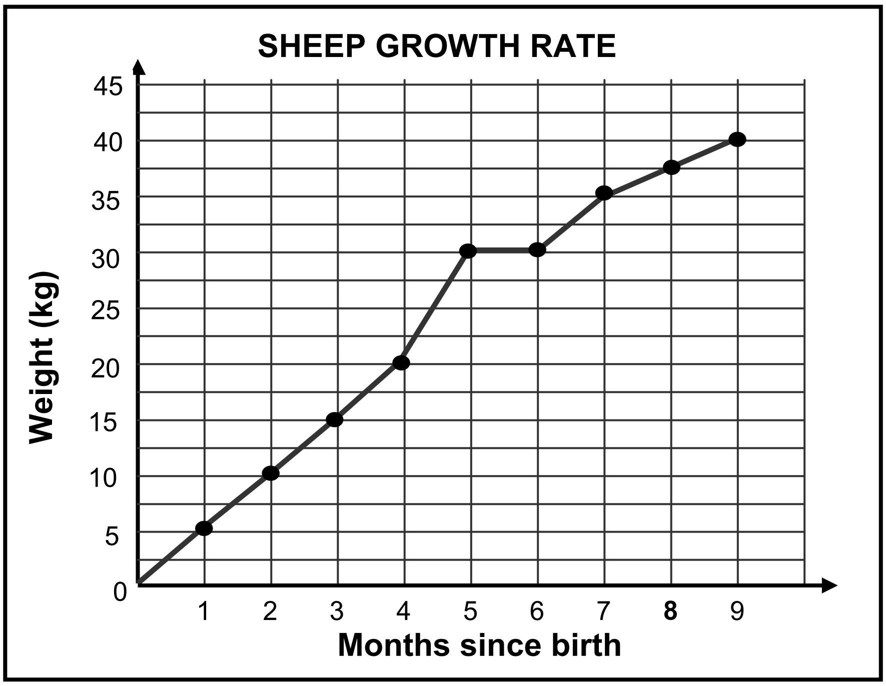
A line graph is a kind of graph that shows quantities that are continually changing over time.

Line graphs are made by plotting points and then drawing line segments to join the points. A value can be read along the graphed line. More about line graphs will be discussed in Strand 5 of your Grade 7 Mathematics.

You will need to use what you have learnt about units of weight and weighing objects to solve the following problems in this lesson.

Example 1

Samuel kept records of the monthly weight of his sheep from birth for nine months as shown in the graph below.



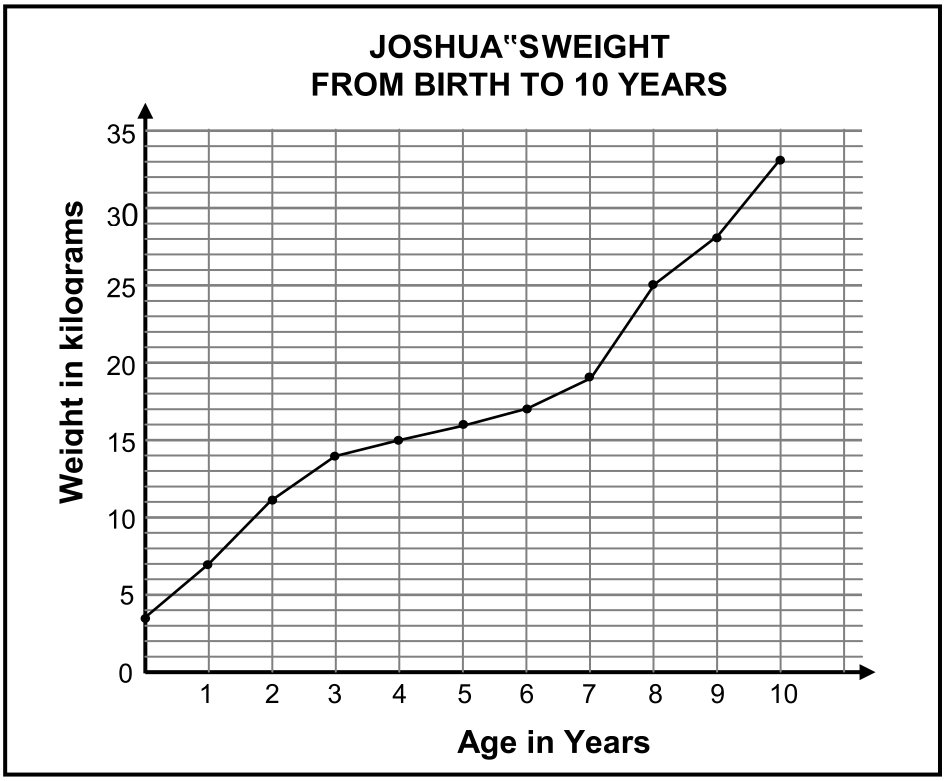
By looking and understanding the graph, we can find the weight of the sheep every month. For example, the sheep has a weight of 35 kg on the seventh month (see the point where the vertical and horizontal lines meet), and 40 kg on the ninth month.

Now, can you find in which months the sheep‟s weight remain the same?

Your answer must be the **5th** and **6th** months. Why? Because in the graph you will see that the line is level between the points representing the fifth month and the sixth month. This means that during the fifth and sixth month the sheep did not gain any weight and so the weight remains the same at **30 kg**.

Example 2

This graph shows Joshua‟s yearly weight from birth to ten years.



Joshua weighed 3.5 kilograms when he was born. During the next ten years, he puts on 3.5 kg, 4 kg, 3 kg, 1 kg, 1 kg, 1 kg, 2 kg, 6 kg, 3 kg and 5 kg.

a) What is Joshua‟s weight in ten years?

b) Between what ages did Joshua gain the greatest weight?

c) During what ages did his weight gain remain about the same for consecutive years?

Solutions:

a) To find Joshua‟s weight in ten years, add all the weight he put on from birth up to the tenth year. So,

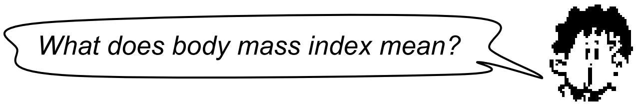
Joshua‟s weight in 10 years = (3.5 + 3.5 + 4 + 3 + 1 + 1+ 1 + 2 + 6 + 3 + 5) kg

= 33 kg

b) Joshua gained the greatest weight between the 7th and 8th years. It is the steepest portion of the line in the graph.

c) His weight gain remains about the same at the ages 3 and 4, 4 and 5, 5 and 6. It is shown on the graph that he was gaining weight along the same pattern from 3 years until he was 6 years old.

It is essential to learn the status of your health and the best way to know your healthy weight, is to find your body mass index.



Body mass index (BMI) is a measure of body fat based on height and **weight** that applies to adult men and women.

BMI is determined by calculating the weight in kilograms divided by the height in meters squared.

Formula: $$\textbf{BMI} = \frac{\textbf{weight in kilograms}}{\textbf{height in metres squared}}$$

$$\textbf{BMI} = \frac{\textbf{weight in kg}}{(\textbf{height in m})^2}$$

For example, average weights for men are around 66 kg (based on height of 173 cm), and for women around 60 kg (based on height of 165 cm).

If we find the BMI for a typical man of weight 66 kg and a height of 173 cm, we have:

```
        22.83
2.89 ) 6600.00
       578
        820
        578
       2420
       2312
        1080
         867
         213
```

$$\text{BMI} = \frac{\text{Weight in kg}}{\text{height in metre squared}}$$

$$\text{BMI} = \frac{66 \text{ kg}}{1.7 \text{ m} \times 1.7 \text{ m}}$$ (remember that 1 metre = 100 cm)

173 cm = 1.73 m
= 1.7 m correct to 1 dec. place.

$$\text{BMI} = \frac{66}{2.89}$$

BMI = 22 (rounded to nearest whole number)

If we find the BMI for a typical man of weight 60 kg and a height of 165 cm, we have:

```
        22.058
2.72 ) 6000.00
       544
        560
        544
        16 0
         000
         1600
         1360
          240
```

$$\text{BMI} = \frac{60 \text{ kg}}{1.65 \text{ m} \times 1.65 \text{ m}}$$ (remember that 1 metre = 100 cm)

165 cm = 1.65 m
= 1.6 m correct to 1 dec. place.

$$\text{BMI} = \frac{60}{2.7225}$$

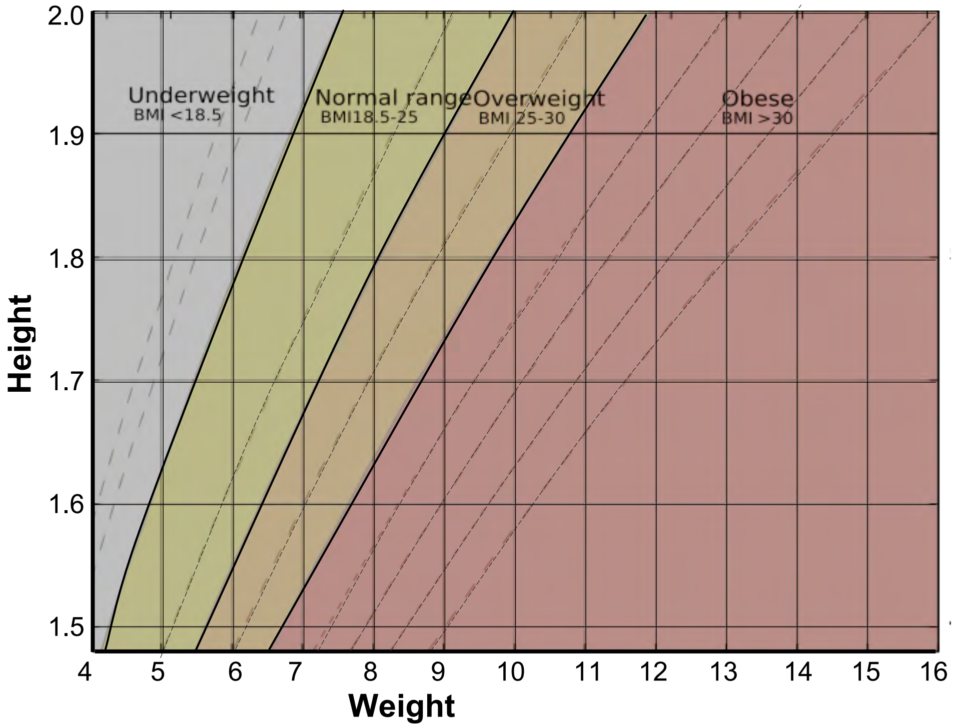
BMI = 22 (rounded to nearest whole number)

This indicates a healthy BMI. Any BMI value between 18.5 and 25 indicates a healthy BMI. Below 18.5 you are considered underweight and above 25 you are considered overweight and above 30, obese.

Now check if you are obese, overweight, underweight or average weight using the chart below.

The chart shows the ideal weight for men and women (18 and above) based on height and Body Mass Index (BMI).

HEIGHT AND WEIGHT CHART BASED ON BMI



Understanding the chart and comparing your height and weight to the standard range will help you know your health status.

For example:

If you are in the **underweight** range, there are a number of possible reasons for this.

If you are in the **normal** range, it means you have a healthy weight for your height. However, to stay in good health, it is important to eat a balanced diet and do at least 30 minutes of physical activity five days a week.

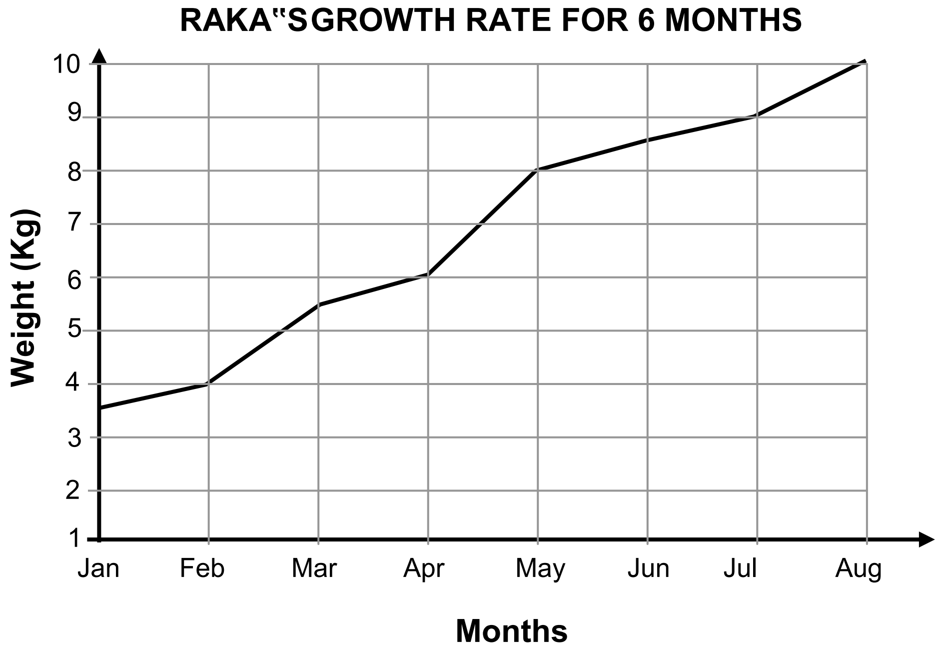
If you are in any of these **Overweight, obese or very obese** ranges, you are heavier than someone who is healthy for your height. Excess weight puts you at an increased risk of heart disease, stroke and diabetes. It is time to take action.

It is essential to maintain height and weight balance to prevent any health risks. Comparing your height and weight to a standard range will help you begin an effective exercise program that will help bring your weight under control.

NOW DO PRACTICE EXERCISE 5

Practice Exercise 5

1. Refer to the chart below to answer the questions that follow.



a) What is Raka‟s weight progress from January to July?

Answer: ___________

b) Between which months did Raka gain the greatest weight and by how much?

Answer: ___________

c) Between which months did Raka‟s weight remain almost the same?

Answer: ___________

d) Find Raka‟s total weight for the last seven months? How much is this in grams?

Working Out:

Answer: ___________

e) Calculate Raka‟s average weight for seven months.

Working Out:

Answer: ___________

2. Use the BMI formula and calculate the BMI of the students whose weight and heights are indicated on the table below.

Student	**Weight (kg)**	**Height (cm)**	**BMI**	**Health status**
Tau	120	180		
Moris	76	190		
Mary	87	185		
Jack	90	176		
Ata	55	180		

Working Out:

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

SUB-STRAND 1: SUMMARY

- We often use the terms **"mass"** and **"weight"** interchangeably in our daily speech, but to an astronomer or a physicist they are completely different things. The **mass** of a body is a measure of how much matter it contains while **weight** is the measure of the pull of the earth on an object.
- The standard units of weight used in the metric system are **milligrams, grams, kilograms and tonnes.**
- Spring balances, beam balances and weight scales are the instruments used to measure weight.
- To convert a smaller unit of weight to a larger unit, multiply the given number by the unit equivalence.

  e.g. 4 kilogram to gram = 4 x 1000 = 4 000 grams
- To convert a larger unit of weight to a smaller unit, divide the given number by the unit equivalence.

  e.g. 5000 gram to kilogram = 5000 ÷ 1000 = 5 kilograms
- The **Average weight** is equal to the total weight divided by the number of weights

  Formula:

  $$\text{Average weight} = \frac{\text{Total weight}}{\text{number of weights}}$$
- We use line graph to read and record weights. Line graphs are made by plotting points and then drawing line segments to join the points. A value can be read along the graphed line.
- The **Body mass index** (BMI) is a measure of body fat based on height and **weight** that applies to adult men and women.

  Formula:

  $$\text{BMI} = \frac{\text{Weight in kg}}{\text{height in metre squared}}$$
- A person is normally healthy if the BMI is between 18.5 and 25. Below 18.5 you are underweight, above 25 overweight and above 30 obese.

REVISED LESSONS 1-5 THEN DO SUB-STRAND TEST IN ASSIGNMENT 4.

ANSWERS TO PRACTICE EXERCISES 1- 5

Practice exercise 1

1 a) 3.09 t f) 40.5 g
b) 4 g g) 990 000 mg
c) 6080 g h) 5 300 000 mg
d) 10 020 kg i) 0.0226 t
e) 21.5 t j) 3 670 000 g

2. 36 mg, 56 g, 18 kg, 4 t

3. 2 boxes at a time

4. Sebona‟s cat is heavier. Since 4 kg = 4000g, Sebona‟s cat is heavier than Carl‟s cat by 1100 grams.

5. a) 1905 g b) 1.905 kg

Practice Exercise 2

1. a) a car tonne
b) a feather gram
c) a brick kilogram
d) a pencil gram
e) an elephant tonne
f) a piece of paper gram
g) an ant milligram
h) a person kilogram
i) five big books kilogram
j) a trailer load of sand tonne

2. a) grams b) grams c) kilograms
d) kilograms e) grams f) kilograms

3. I. (a) 3 grams IV. (c) 1 kilogram
II. (b) 3.9 kilograms V. (b) 120 grams
III. (a) 2.2 kilograms

4. a) I kilogram b) 960 grams c) 18 grams
d) 7 kilograms e) 300 grams f) 600 kilograms
g) 1 gram h) 90 kilograms i) 500 grams

5. Larry's rabbit weighs 1,150 grams (or 1.2 kg) more than June's guinea pig.

To find this, convert the weight of Larry's rabbit to grams (2,100 grams) and subtract the weight in grams of June's guinea pig.

Practice Exercise 3

1. a) 2262 g
   b) 7208 g
   c) 802 mg
   d) 473 kg
2. a) 46.2 kg b) 63 kg c) 67.5 kg
3. a) 2000 kg b) 2 tonnes
4. 1.5 kg
5. 3000 kg

Practice Exercise 4

1. a) 275.5 mg b) 7.48 kg c) 46 g
2. 115.83 g
3. 1.6875 kg
4. 19.88 kg
5. Total estimated weight is 210 kg; Average weight is 21 kg

Practice Exercise 5

1. a) increasing
   b) April and May; by 2 kg
   c) January to February, March to April, May to June and June to July
   d) 54.5 kg; 54500 g
   e) 7.8 kg or 7800 g
2.

Student	Weight (kg)	Height (cm)	BMI	Health status
Tau	120	180	**37**	**Obese**
Moris	76	190	**21**	**Normal**
Mary	87	185	**25**	**Overweight**
Jack	90	176	**29**	**Overweight**
Ata	55	180	**17**	**Underweight**

END OF SUB-STRAND 1

SUB-STRAND 2

TEMPERATURE

SUB-STRAND 2: TEMPERATURE

Introduction

The concept of temperature is as fundamental as the three fundamental quantities of mechanics - mass, length, and time.

Temperature is a measure of the average heat of the particles in a substance. Since it is an average measurement, it does not depend on the number of particles in an object.

In that sense temperature does not depend on the size of the object. For example, the temperature of a small cup of boiling water is the same as the temperature of a large pot of boiling water. Even if the large pot is much bigger than the cup and has millions and millions more water molecules.

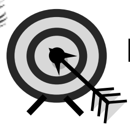
We experience temperature every day. When it is very hot outside or when we have a fever we feel hot and when it is snowing outside we feel cold. When we are boiling water, we wait for the water temperature to increase and when we make popsicles we wait for the liquid to become very cold and freeze.

In this sub-strand, you will:

- describe temperature using the appropriate word such as cold, hot and warm.
- identify the instruments and units used to measure temperature.
- compare temperature readings in ºC (Celsius) to ºF (Fahrenheit) of the boiling point and freezing point of water.
- convert temperature from ºC to ºF scales and vice versa.
- read temperature off the thermometer scale accurately.
- solve word problems involving temperature in real life situations.

Lesson 6: Thermometers and Measures of Temperature

You learnt to describe temperature using the appropriate words such as hot, cold and warm in your Lower Primary Mathematics.



In this lesson, you will:

- define temperature
- identify the instrument used to measure temperature and the units used in expressing temperature.

You have probably asked the question “why?” for the following statements:

1. It is very cold in the morning hours of the night at around 3:30 to 4:30 a.m.
2. It is very hot towards midday at around 11 a.m., 12 noon and 1 p.m. during the day.
3. You feel warm wearing jackets during cold nights, especially in the Highlands.
4. It is generally warm during the nights down in the coast than the highlands where it is very cold.

Temperature plays an important role in determining the conditions in which living things can exist.

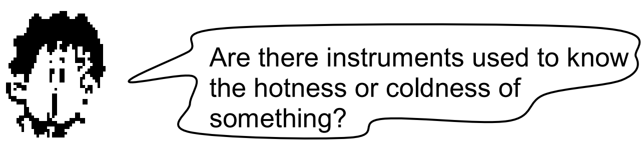
What is temperature?

Temperature is the degree of hotness or coldness of a body or environment. It is the measurement of how hot or cold something is.

The higher the temperature, the hotter it is and the lower the temperature, the colder it is.

We can describe the temperature of an object as something which determines the sensation of warmth or cold felt from contact with it.

It is easy to demonstrate this, when two objects of the same material are placed together. Objects of low temperature are cold, while various degrees of higher temperatures are referred to as warm or hot.



Many methods have been developed for measuring temperature. Most of these rely on measuring some physical property of a working material that varies with temperature. Quantitatively, temperature is measured with thermometers, which may be fixed or corrected to a variety of temperature scales.

One of the earliest inventors of a thermometer was probably Galileo. We know him more for his studies about the solar system and his "revolutionary" theory (back then) that the earth and planets rotated around the sun. Galileo is said to have used a device called a "thermoscope" around 1600 – that is 400 years ago!!

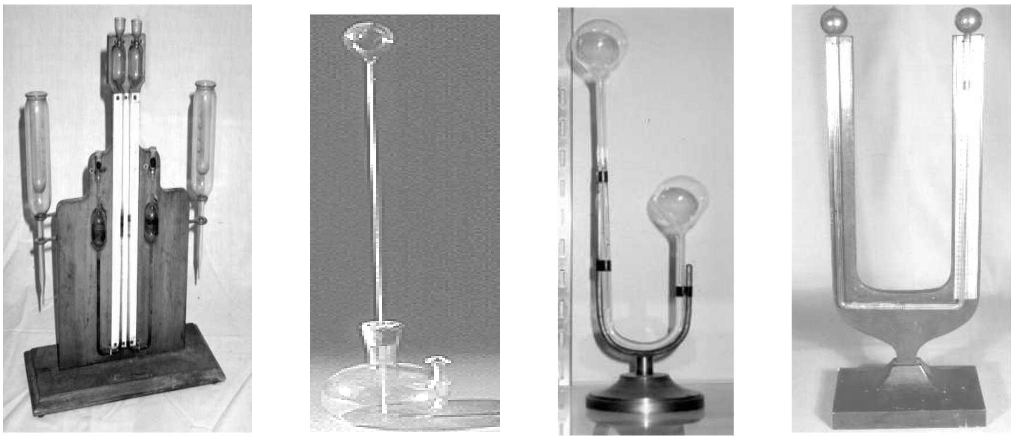
The earliest devices used to measure the temperature were called **thermoscopes.**

What is a thermoscope?

- **A thermoscope is a device for detecting and displaying temperature changes.**
- **Thermoscope is an instrument for indicating changes in temperature of a substance, without accurately measuring them, by observing the accompanying changes in volume.**

Before the thermometer, there was the earlier and closely related thermoscope, best described as a thermometer without a scale. A thermoscope only showed the differences in temperatures, for example, it could show something was getting hotter. However, the thermoscope did not measure all the data that a thermometer could, for example an exact temperature in degrees.

Below is an example of a Thermoscope.



Thermoscopes

The thermometers we use today are different from the ones Galileo may have used. There is usually a bulb at the base of the thermometer with a long glass tube stretching out at the top. Early thermometers used water, but because water freezes there was no way to measure temperatures less than the freezing point of water. So, alcohol, which freezes at temperature below the point where water freezes, was used.

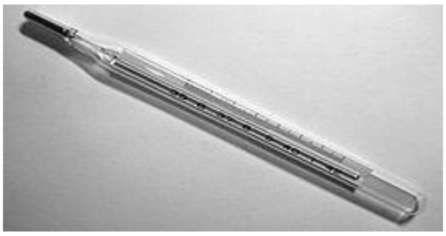
What is a Thermometer?

A thermometer is a device that measures the temperature of things. The name is made up of two smaller words: "Thermo" means heat and "meter" means to measure.

You can use a thermometer to tell the temperature outside or inside your house, inside your oven or even the temperature of your body.

Thermometers measure temperatures using materials like mercury and alcohol that change in some way when they are heated or cooled. In a mercury or alcohol thermometer, the liquid expands as it is heated and contracts when it is cooled, so the length of the liquid column is longer or shorter depending on the temperature.

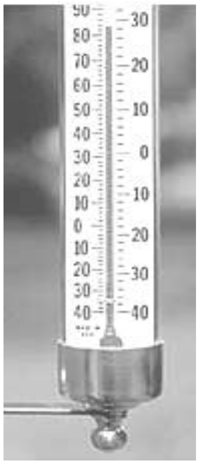
Below are some examples of thermometers.



Clinical Thermometer

SpringThermometer

Galileo‟s Thermometer



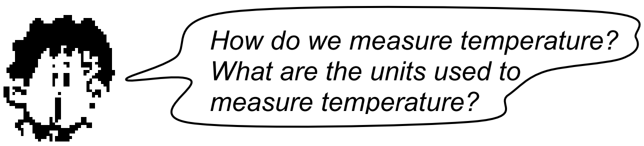
Bulb Thermometer

Let us discuss some of these different types of thermometer.

1. Clinical thermometer - The clinical thermometers are used to measure the body temperature of patients. There are three types of clinical thermometers depending on the body part the thermometer is used to measure the temperature.
2. Food Thermometers- there are many food thermometers that are used to measure food temperatures.
3. Outdoor Thermometers - The outdoor thermometers are used to measure the temperature of the surrounding air.

If you look around, you will find lots of different devices whose purpose is mainly to detect or measure changes in temperature**:**

- The thermometer in the backyard tells you how hot or cold it is outside.
- The meat and candy thermometers in the kitchen measure food temperatures.
- The thermometer in the furnace tells when to turn on or off the furnace.
- The thermometer in the oven helps to keep a set temperature (hot).
- The thermometer in the refrigerator helps to keep a set temperature (cold).
- The fever thermometer in the medicine cabinet measures temperature accurately over a very small range.



A thermometer can help us determine how cold or how hot a substance is. There are three temperature scales that are used in science and industry today. They are as follow:

1. **Fahrenheit Scale** - was developed by Daniel Gabriel Fahrenheit in 1714. He set the freezing point of water at 32 degrees and the boiling point at 212 degrees. These two points formed the anchors for his scale. The unit used to express temperature is Degree Fahrenheit which is denoted by the symbol **ºF**.

2. **Celsius or Centigrade Scale** – was developed by Anders Celsius in 1742. Using the same anchor points, he determined the freezing temperature for water to be 0 degrees and the boiling temperature to be 100 degrees. The unit used to express the temperature is Degree Celsius or Centigrade which is denoted by the symbol **ºC**. The Celsius scale is known as a Universal System Unit. It is used throughout science and in most countries.

3. **Kelvin Scale** – was developed by Lord Kelvin in 1848. The unit used in expressing temperature is Kelvin which is denoted by the symbol **K**. The degree is not used in this scale.

Today, temperatures in science and in most of the world are measured and reported in degrees Celsius (^oC). In the United State of America, it is common to report temperature in degrees Fahrenheit (^oF). On both the Celsius and Fahrenheit scales the temperature at which ice melts (water freezes) and the temperature at which water boils, are used as reference points. We call these points as the **Freezing point** and **Boiling point.**

- **Freezing point is the temperature at which the liquid changes state from a liquid to a solid.**
- **Boiling point is the temperature at which a substance changes its state from liquid to gas.**

There is a limit to how cold something can be. The Kelvin scale is designed to go to zero at this minimum temperature. This scale has absolute zero as the starting point. Some temperatures matching the Celsius scale are the following;

Absolute Zero: 1K = 273.15ºC theoretically the lowest (attainable temperature).

Freezing point of water: 273.15 K = 0ºC
Boiling point of water: 373.15 K = 100ºC

NOW DO PRACTICE EXERCISE 6

Practice Exercise 6

Complete the following statements by filling in the blank spaces with the appropriate word.

1) __________ is the degree of hotness or coldness of a body or environment. It is the __________ of how __________ or __________ something is.

2) A __________ is a device that measures the temperature of things.

3) The word thermometer is made up of two smaller words: __________ means __________ and __________ means __________.

4) __________ is the temperature at which the liquid changes state from a liquid to a solid.

5) __________ is the temperature at which a substance changes its state from liquid to gas.

6) ___________was one of the earliest inventors of thermometer.

7) The earliest devices used to measure the temperature were called ________.

8) There are three temperature scales used in science and industry today. These are the ______________, ______________ and _____________.

9) Of these three temperature scales, _______________is known as the Universal System unit.

!0) In the Kelvin Scale, the freezing point is _________ and the boiling point is __________.

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

Lesson 7: The Fahrenheit Scale and the Celsius Scale

You learnt to identify the instruments used to measure temperature and the units used in expressing temperature.

In this lesson you will:

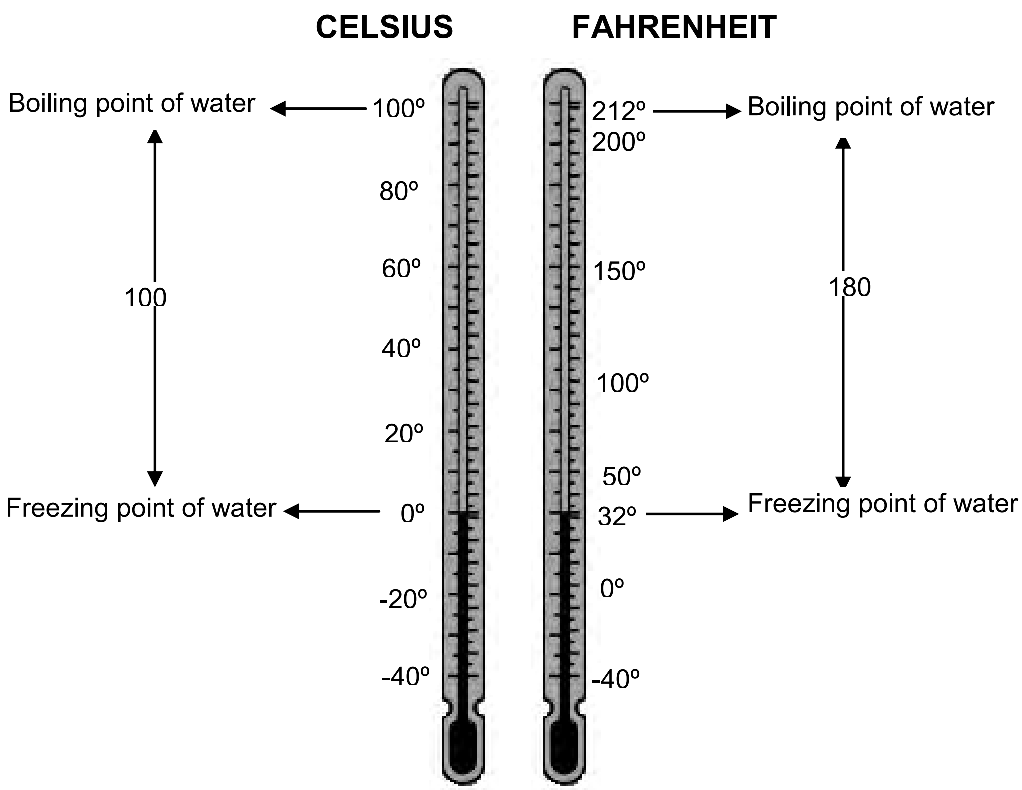
- compare the temperature readings in degrees Centigrade and degrees Fahrenheit of the boiling and freezing point of water.

As you learnt in the previous lessons, temperature is measured by an instrument called the thermometer. You also learnt that, there are two standard units of temperature used to measure temperature, Celsius and Fahrenheit.

In the early years of the eighteenth century, Gabriel Fahrenheit (1686-1736) created the Fahrenheit scale. He set the freezing point of water at 32 degrees and the boiling point at 212 degrees. These two points formed the anchors for his scale.

Later in that century, around 1743, Anders Celsius (1701-1744) invented the Celsius scale. Using the same anchor points, he determined the freezing temperature for water to be 0 degree and the boiling temperature 100 degrees. The Celsius scale is known as a Universal System Unit. It is used throughout science and in most countries.

Below is a figure showing the comparison between the Celsius and the Fahrenheit Temperature Scales.

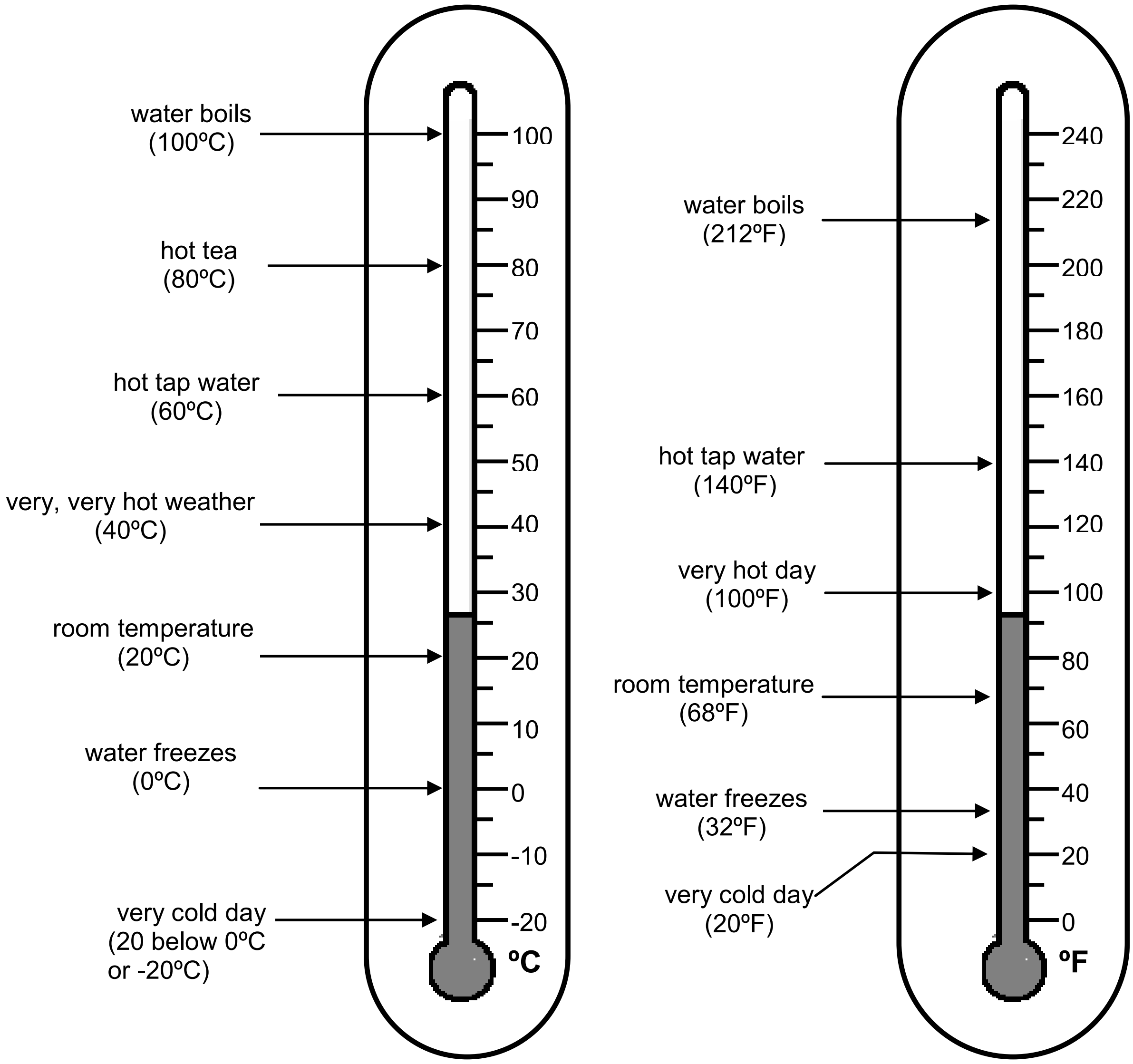


Looking at the diagram, how many divisions are there between the boiling point and the freezing point of water in Celsius (ºC)? How many divisions are there between the same temperature limits on the Fahrenheit Scale?

You will notice that the range of the Fahrenheit thermometer between the freezing point and the boiling point is 180° (32° to 212° = 180°).

On the Celsius thermometer, the range is 100° (0° to 100° = 100°) from the freezing point to the boiling point.

Now look at the diagrams which show examples of some Celsius and Fahrenheit Temperatures.



Knowing these temperatures can help you estimate other temperatures.

Example 1

In the Celsius Scale, the temperature on a cool day is probably less than the room temperature but more than the temperature of freezing water. The temperature is probably between 0ºC and 20ºC, or about 10ºC.
In the Fahrenheit Scale, the temperature is probably between 32ºF and 68ºF, or about 50ºF.

The table below shows examples of typical temperatures and the comparison of the temperature readings in Celsius (ºC) and Fahrenheit (ºF) of the boiling point and freezing point of water.

TYPICAL TEMPERATURES

Description	°C	°F
Water boils	**100**	**212**
Hot Bath	**40**	**104**
Body temperature	**37**	**98.6**
Beach weather	**30**	**86**
Room temperature	**25**	**77**
Cool Day	**10**	**50**
Freezing point of water	**0**	**32**
Very Cold Day	-18	0
Extremely Cold Day (and the same number!)	**-40**	**-40**
(**bold** are exact)		

NOW DO PRACTICE EXERCISE 8

Practice Exercise 7

Use the table below showing comparisons of the temperature readings in Celsius (ºC) and Fahrenheit (ºF) of the boiling point and freezing point of water to answer the following questions.

ºC	ºF
-10	14
-5	23
0	32
10	50
20	68
30	86
40	104

1. Which is warmer 30ºC or 30ºF?

Answer: __________

2. Which is colder 10ºF or 10ºC?

Answer: _________

3. Gwen is looking at holiday brochures. She wants a comfortable temperature and knows that this is about 20ºC. She should choose a place where the temperature is about 70ºF. Is it True or False?

.

Answer: _________

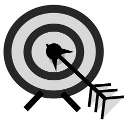
4. Ippo is used to a temperature of about 60ºF at home. This is about 15ºC. Is it true or false?

Answer: _________

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

Lesson 8: Conversion of Temperature from ºC to ºF or Vice Versa

You learnt the meaning of boiling point and freezing point and compared temperature readings in ºC and ºF of the boiling point and freezing point of water in the previous lesson.



In this lesson you will:

- convert temperature readings from ºF to ºC and vice versa.

Today often times, it is the Celsius degree that we read in newspapers or see on television or hear from radio broadcasts when they talk about temperature.
The ratio of 100ºC to 180ºF is 5:9, meaning that for every 5º in the Celsius scale there are 9º in the Fahrenheit Scale. This is the reason why we have the following relation and formula $\mathbf{^\circ C = \frac{5}{9}(^\circ F - 32^\circ)}$ and conversely $\mathbf{^\circ F = \frac{9}{5}\,^\circ C + 32^\circ}$.

It is still useful to know how to convert from one unit to the other.

To convert Fahrenheit reading to Celsius, we use the formula

$$\boxed{^\circ C = \frac{5}{9}(^\circ F - 32^\circ)}$$

To convert Celsius reading to Fahrenheit, we use the formula

$$\boxed{^\circ F = \frac{9}{5}\,^\circ C + 32^\circ}$$

Example 1

Convert 45ºF to ºC.

Solution: Use the formula: $^\circ C = \frac{5}{9}(^\circ F - 32^\circ)$

Substitute $C = \frac{5}{9} \times (45 - 32)$

$C = \frac{5}{9} \times (13)$

$C = \frac{65}{9}$

$C = 7.22^\circ$

Therefore, 45ºF = 7.22ºC.

Example 2

Express 60ºC in ºF.

Solution: Use the formula: $°F = \frac{9}{5}°C + 32°$

Substitute: $F = (\frac{9}{5} \times 60) + 32$

$F = \frac{540}{5} + 32$

$F = 108 + 32$

$F = 140°$

Therefore, 60ºC = 140ºF.

Example 3

Express 18ºC in ºF.

Solution: Use the formula: $°F = \frac{9}{5}°C + 32°$

Substitute: $F = (\frac{9}{5} \times 18) + 32$

$F = \frac{162}{5} + 32$

$F = 32.4 + 32$

$F = 64.4°$

Therefore, 18ºC = 64.4ºF.

Example 4

Express 108ºF in ºC.

Solution: Use the formula: $°C = \frac{5}{9}(°F - 32°)$

Substitute $C = \frac{5}{9} \times (108 - 32)$

$C = \frac{5}{9} \times (76)$

$C = \frac{380}{9}$

$C = 42.22°$

Therefore, 108ºF = 42.22ºC.

Example 5

Rigo"s temperature as recorded by the school nurse was 40ºC. What is the Fahrenheit reading of Rigo"s temperature?

Solution: a. Given = 40ºC

b. Formula: $°F = \frac{9}{5}°C + 32$

c. Substitute: $F = (\frac{9}{5} \times 40) + 32$

$F = \frac{360}{5} + 32$

$F = 72 + 32$

$F = 104°$

Therefore, Rigo's temperature is 104ºF.

Example 4

A kettle of water is about to boil at 200ºF. Calculate the temperature in degree Celsius.

Solution: a. Given = 200ºF

b. Formula: $°C = \frac{5}{9}(°F - 32°)$

c. By substitution: $°C = \frac{5}{9}(200° - 32°)$

$°C = \frac{5}{9}(168°)$

$°C = \frac{5 \times 168}{9}$

$°C = 93.33$

Therefore the temperature in degree Celsius is 93.33ºC.

NOW DO PRACTICE EXERCISE 8

Practice Exercise 8

1. Find the corresponding Celsius reading for each Fahrenheit reading.

a) 65°F b) 49°F c) 112°F

Answer:__________ Answer:__________ Answer:__________

d) 420°F e) 250°F f) 510°F

Answer:__________ Answer:__________ Answer:__________

2. Express each Celsius reading in Fahrenheit reading.

a) 8°C b) 98°C c) 110°C

Answer:__________ Answer:__________ Answer:__________

d) 150°C e) 45°C f) 129°C

Answer:__________ Answer:__________ Answer:__________

3. The temperature of Roby‟s soup is 72ºF below the temperature of boiling water.

   What is the temperature of the soup in degree Celsius?

Answer:__________

---

4. The highest temperature ever recorded in California was 56ºC on the 10th of July 1913.

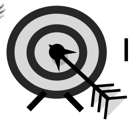
   What was the temperature in Fahrenheit reading?

Answer:__________

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

Lesson 9: Reading Temperature

You learnt to convert temperature readings from ºC to ºF and vice versa in the previous lesson.



In this lesson you will:

- read temperatures off the thermometer scale accurately.

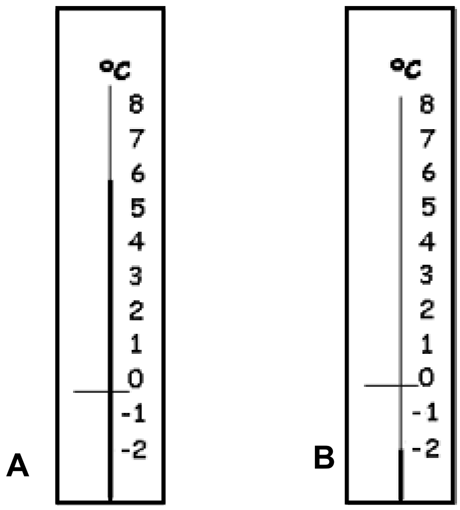
As you learnt earlier, there are two scales for measuring temperature. One is the **Fahrenheit** scale. This was used in UK and is still used in USA. The other is the **Celsius** scale. This is now used in UK and the rest of Europe and most part of the world. The Celsius scale is sometimes called the Centigrade scale. They are the same thing.

Temperatures may be above or below zero.

A temperature of **- 4** can be said as **minus four** or **negative four**. Usually when we're talking about the weather it would be said as 'four degrees below zero', 'four degrees below freezing', or simply as 'minus four degrees‟.

Look at the diagrams below.

Thermometer A shows a temperature of six degrees above zero. (It is simply stated as 'six degrees'.)



A few hours later it has fallen. Thermometer B shows the new temperature of minus two degrees.

The freezing point of water is zero degrees Celsius or 0ºC. Thermometer B is reading 2ºC below zero. So that is 2 degrees below freezing.

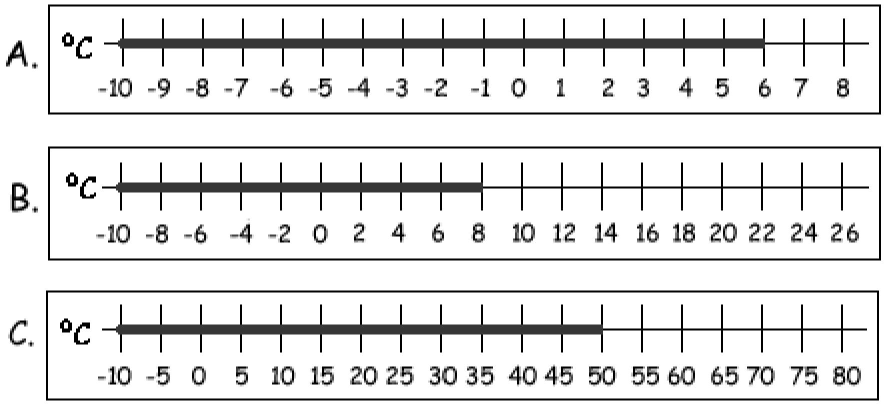
Hint: you can see that with vertical scales, the reading you take will be above zero (a positive reading) or below zero (a negative reading).

Reading Scales

Most thermometers show the temperature marked on a scale. Each division on the scale represents the same number of degrees.

The first thing to do when you read a thermometer is to check the scale.

The three thermometers shown below use different scales



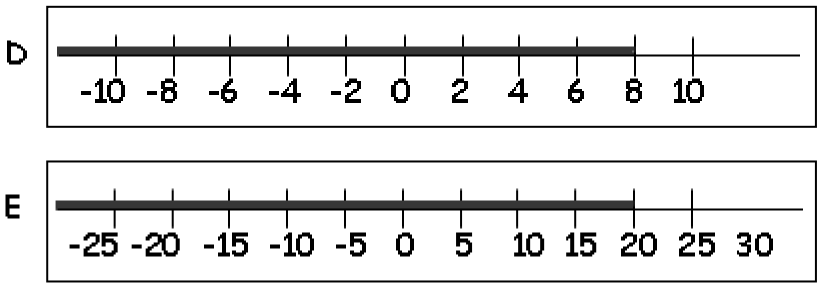
- Each division on A represents one degree. It is showing 6ºC.
- Each division on B represents two degrees. It is showing 8ºC.
- Each division on C represents five degrees. It is showing 50ºC.

If you look only at the black line, rather than reading the scale, it is easy to get a wrong answer to a question. For example:

Example 1) 8ºC on scale B looks lower than 6ºC on scale A.

Example 2) -3ºC on scale A looks higher than 10ºC on scale C.

Now look at these two thermometers:

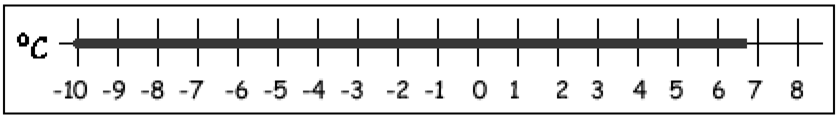


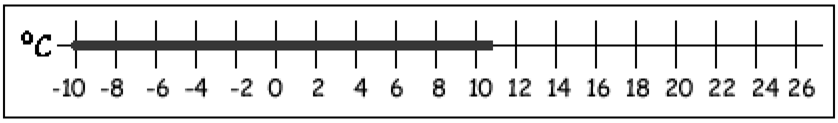
Although the zero on each of these two thermometers is in the same position, and the divisions are the same distance apart, they show very different temperatures.

The scale on **D** is marked in twos and **E** in fives, so although the black lines seem to be the same length the temperature shown by **E** (20ºC) is much higher than that shown by **D** (8ºC).

Since temperature is measured on a continuous scale, so the reading is not always just on a marked division. In this case you can give the reading of the nearest number on the scale.

Look at these two thermometers. What are the readings?

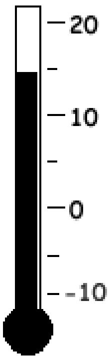
A.


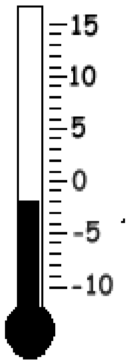
B.


The reading for **A** is about 7ºC and for **B** about 10ºC.

Some thermometers have scales with both marked and unmarked divisions. You must first make sure what each small division represents.

Study the thermometers below.

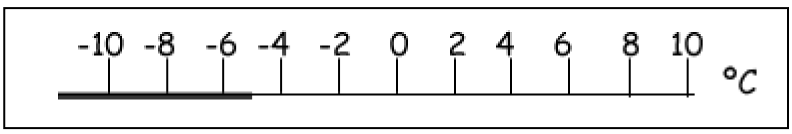
A.


B.


Thermometer **A** is marked in tens. The unmarked division between each pair of marked ones is the halfway value (-5, 5, 15...), so the reading is closest to the 15ºC division.

Thermometer **B** is marked in fives, with four unmarked divisions between each pair. That means the unmarked divisions are each 1 degree apart. The reading is 2 degrees below the 0ºC mark, so the temperature is -2 ºC

Here is thermometer.

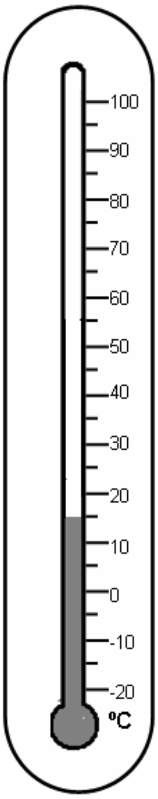


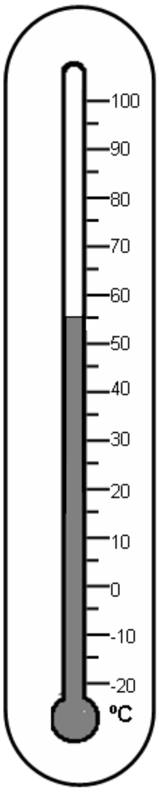
Here the temperature is halfway between -6ºC and -4ºC. Because the temperature is half way between -6ºC and -4ºC, we could estimate the temperature as -5ºC.

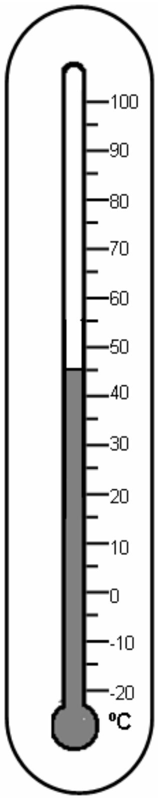
NOW DO PRACTICE EXERCISE 9

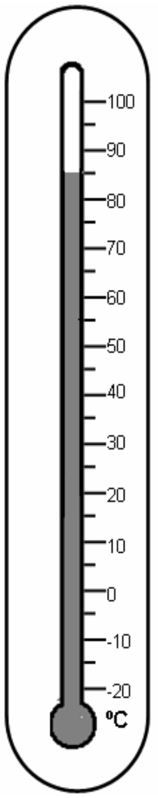
Practice Exercise 9

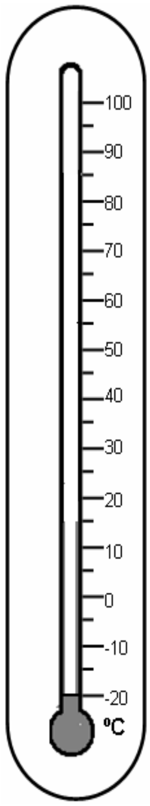
1. What temperature is shown in these thermometer readings?

a) 

b) 

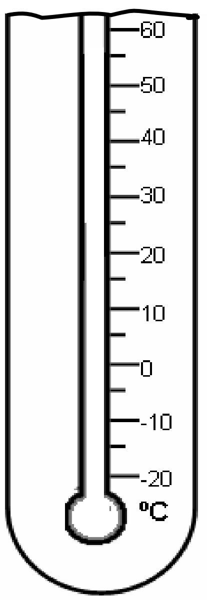
c) 

d) 

e) 

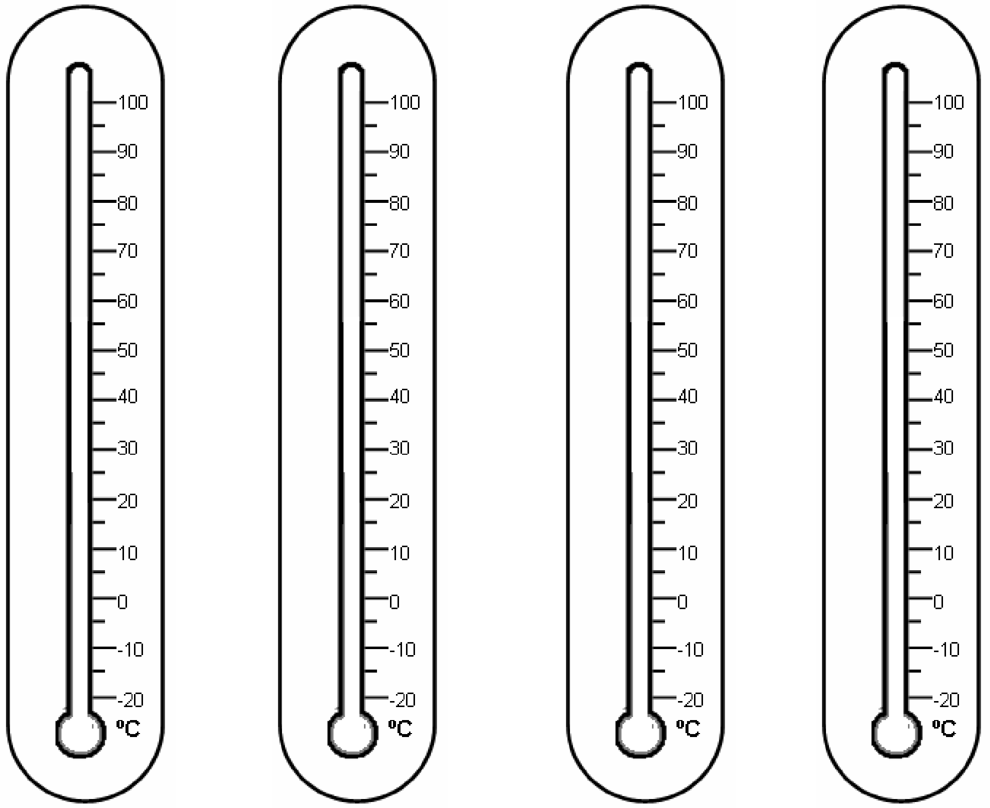
Answers: a = _______, b = _______, c = _______, d = _______, e = _______

2. The temperature outside Sue‟s house was -10ºC. Mark in and indicate this reading on the diagram below.



3. Using the thermometers below show the following temperature readings.

a) 100ºC b) 70ºC c) -10ºC d) 40ºC



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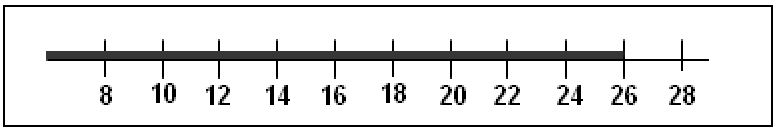
4. Luke bought a houseplant. The label said „Prefers a temperature below 20ºC.

Is this thermometer showing a suitable temperature?

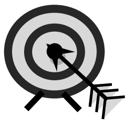


Answer:

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

Lesson 10: Solving Problems Involving Temperature

You learnt to read temperatures off the thermometer scales in Lesson 10.



In this lesson you will:

- solve problems involving temperature in real life situations.

Let us start the lesson with the weather report below.

The National Newspaper

Breaking News

"The maximum temperature today was 32ºC. Tomorrow‟s temperature is expected to be higher. "

By studying the report, can you tell how much warmer it will be tomorrow?

To find the difference, you subtract today‟s temperature which is 32ºC from tomorrow‟s temperature. But one fact is missing. You need to know what tomorrow‟s temperature will be. You can‟t solve the problem without this information.

So, in solving problems, always understand and read the problem carefully. Identify what the main question is and all the information needed to answer the question. Organize the facts within the problem and choose which operations will serve you best to solve the problem. Is subtraction needed? Is addition needed? Will you need to multiply, or will you need to divide? Then work out the problem and check your answer to make sure it makes sense.
Now let us do the following example.

Example 1

On a hot day in Port Moresby, it gets as hot as 33ºC. During the night it gets as cool as 18ºC. What is the difference between the temperatures?

Solution: The problem asks for the difference between the two temperatures so you need to use subtraction.

To find the difference, you subtract the temperature during the night from the temperature during the day.

So, Difference = 33ºC – 18ºC

= 15ºC

Therefore, the difference between the two temperatures is 15ºC.

Example 2

The outside temperature is 10ºC. The temperature inside the house is 6ºC warmer. What is the temperature inside?

Solution: The problem asked for the temperature inside.

Since the temperature inside is 6 degrees warmer, you need to use addition.

To find the temperature inside add 6 degrees to the outside temperature.

So, the temperature inside = 10ºC + 6ºC

= 16ºC

Therefore, the temperature inside is 16ºC.

Example 3

It is 28ºC below zero at the top of a mountain. The temperature at the base of the mountain is 19ºC warmer.

What is the temperature at the base of the mountain?

Solution: 28ºC below zero = -28 ºC

Since the temperature at the base of the mountain is 19ºC warmer than at the top of the mountain we use addition.

So, -28ºC + 19ºC = -9ºC

Therefore, the temperature at the base of the mountain is -9ºC.

Example 4

The temperature of the water in a pot is 63ºC. How many more degrees does it need to heat up before it boils?

Solution: The boiling point of water is 100ºC.

So, 100ºC – 63ºC = 37ºC

63ºC is 37 degrees away from the boiling point of water

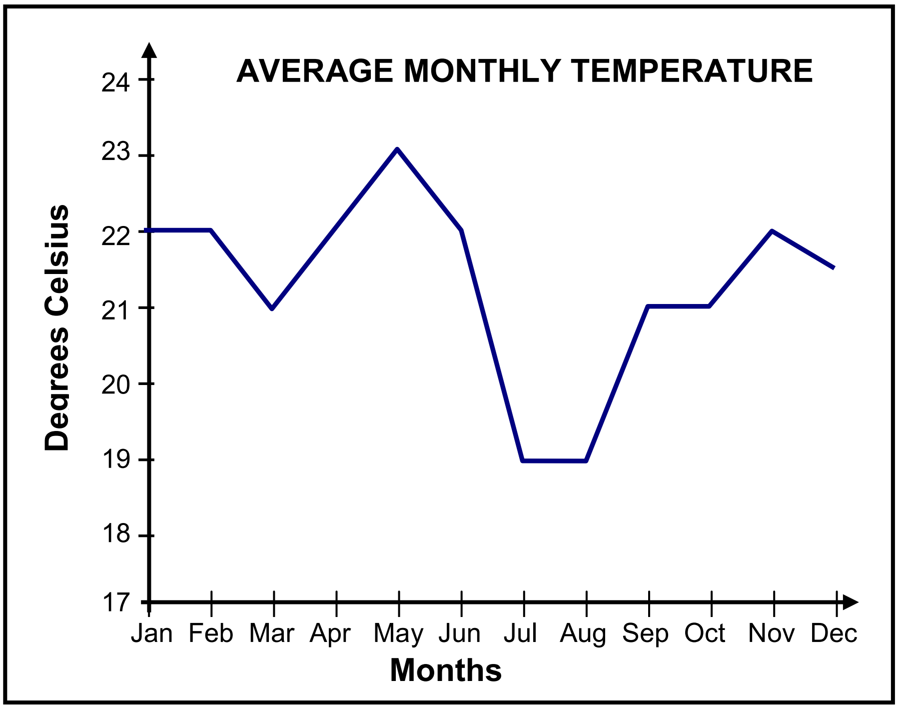
Therefore, the water in the pot needs 37ºC to heat up before it boils.

Sometimes we need to solve temperature problems using given information on charts or graphs.

See example on the next page.

Example 5

This graph shows the mean monthly temperature in Letty‟s village last year.



a) Which month was the hottest in the village?
b) Which was the coolest month?
c) If the mean air temperature for November this year is 20ºC, how does this compare to the mean temperature for November shown in the graph?
d) List the months that are hotter than March according to the graph.
e) Which month is warmer: February or September?

By understanding the graph, you can answer correctly the questions above.
Answers:

a) The hottest month is May. It corresponds to the highest point of the line representing 23ºC
b) The coolest months are July and August. They both correspond to the lowest part of the line representing 19ºC.
c) It is 2ºC lower since on the graph the mean temperature for November is 22ºC.
d) The months hotter than March are: January, February, April, May, June, November and December.
e) February is warmer than September by 1ºC.

NOW DO PRACTICE EXERCISE 10

Practice Exercise 10

Solve the following:

1. Last night it was 18ºC. Today the maximum temperature is expected to be 36ºC.

   How much warmer than last night will the temperature be today?

   Answer:__________

---

2. Today's high temperature will be 33°C. Tomorrow's high temperature will be 7 degrees warmer than today's.

   What will tomorrow's high temperature be?

   Answer: __________

---

3. The highest temperature ever recorded in California was 56ºC on the 10th of July 1913. The lowest temperature was 43ºC below zero on the 20th of January 1937.

   What is the difference between the highest and lowest temperatures?

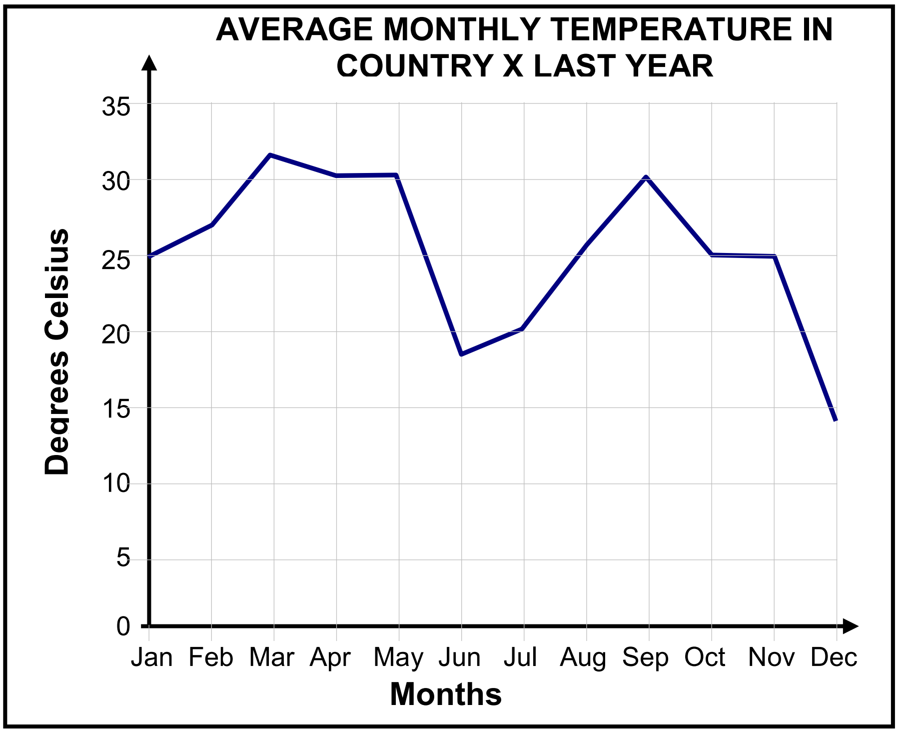
   Answer: __________

---

4. The weather report in the school paper said it will be 3ºC warmer today than yesterday.

   What will the temperature be today, if the temperature was 26ºC yesterday?

5. Refer to the graph below and answer the questions that follow.



a) Which month was the hottest in Country X?

Answer:__________

b) Which was the coolest month?

Answer:__________

c) If the mean air temperature for June this year is 20ºC, how does this compare to the mean temperature for June shown in the graph?

Answer:__________

d) List the months that are hotter than February according to the graph.

Answer:__________

e) Which month is cooler: June or July?

Answer:__________

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

SUB-STRAND 2: SUMMARY

This summarizes some of the important ideas and concepts to remember.

- Temperature is the degree of hotness or coldness of a body or environment. It is the measurement of how hot or cold something is.
- A thermoscope is a device for detecting and displaying temperature changes. It is an instrument for indicating changes in the temperature of a substance, without accurately measuring them, by observing the accompanying changes in volume.
- A thermometer is a device that measures the temperature of things. The name is made up of two smaller words: "Thermo" means heat and "meter" means to measure.
- **Three temperature scales** are in common use in science and industry. Two of these scales are SI metric:
  1. **Fahrenheit Scale** the unit used to express temperatures in this scale is Degree Fahrenheit which is denoted by the symbol **ºF**.
  2. **Celsius or Centigrade Scale** the unit used to express temperatures in this scale is Degree Celsius which is denoted by the symbol **ºC**.
  3. **Kelvin Scale** the unit used in expressing temperatures in this scale is Kelvin which is denoted by the symbol **K.**
- The freezing point is the temperature at which a liquid changes state from liquid to solid.
- The boiling point is the temperature at which a substance changes its state from liquid to gas.
- To convert Fahrenheit readings to Celsius, we use the formula

$$\boxed{^\circ C = \frac{5}{9}(^\circ F - 32^\circ)}$$

- To convert Celsius readings to Fahrenheit, we use the formula

$$\boxed{^\circ F = \frac{9}{5}\,^\circ C + 32^\circ}$$

REVISE LESSONS 6-10 THEN DO SUB-STRAND TEST IN ASSIGNMENT 4.

ANSWERS TO PRACTICE EXERCISES 6 -10

Practice exercise 6

1. temperature, measure, hot , cold
2. thermometer
3. thermo, heat; meter, measure
4. freezing point
5. boiling point
6. Galileo
7. thermoscope
8. Fahrenheit Scale, Celsius or Centigrade Scale, Kelvin Scale
9. Celsius Scale
10. Freezing point =237.15 K; boiling point = 373.15 K

Practice exercise 7

1. The table shows that 30ºC is about 86ºF. That is warmer than 30ºF.
2. The table shows that 10ºC is 50ºF. 10ºF is colder than that. So, is colder than 10ºC
3. True. The table tells you that 20ºC is 68ºF. This is close to 70ºF. So it is close to the temperature he wants.
4. True. Look down the ºF column of the table. 60ºF is not there, but 50ºF and 68ºF are there. 60ºF is about half way between these two.
   So it is halfway between the temperatures they match up to.
   So it is halfway between 10ºC and 20ºF.So it is about 15ºC.

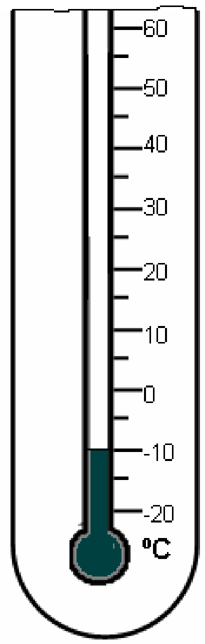
Practice exercise 8

1. a) 18.33ºC b) 9.44ºC c) 44.44ºC
   d) 215.56ºC e) 121.1ºC f) 265.56ºC
2. a) 46.4ºF b) 208.4ºF c) 230ºF
   d) 302ºF e) 113ºF f) 264.2ºF
3. 22.22ºC
4. 132.8ºF

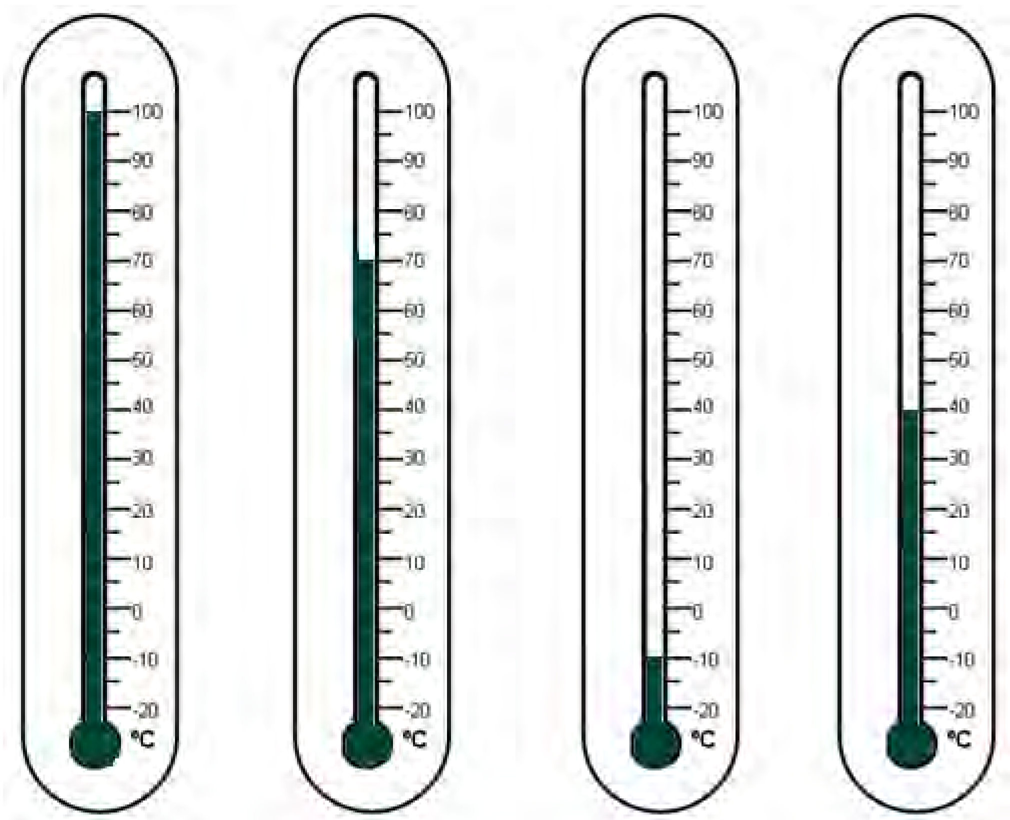
Practice exercise 9

1. a) 15ºC
   b) 55ºC
   c) 45ºC
   d) 85ºC
   e) -20ºC

2.



3.



4. No. The temperature is 26ºC which is too high.

Practice exercise 10

1. 18ºC
2. 40ºC
3. 13ºC

4. 29ºC

5. a) March
   b) December
   c) 2ºC warmer
   d) March, April, May and September
   e) June

END OF SUB-STRAND 2

SUB-STRAND 3

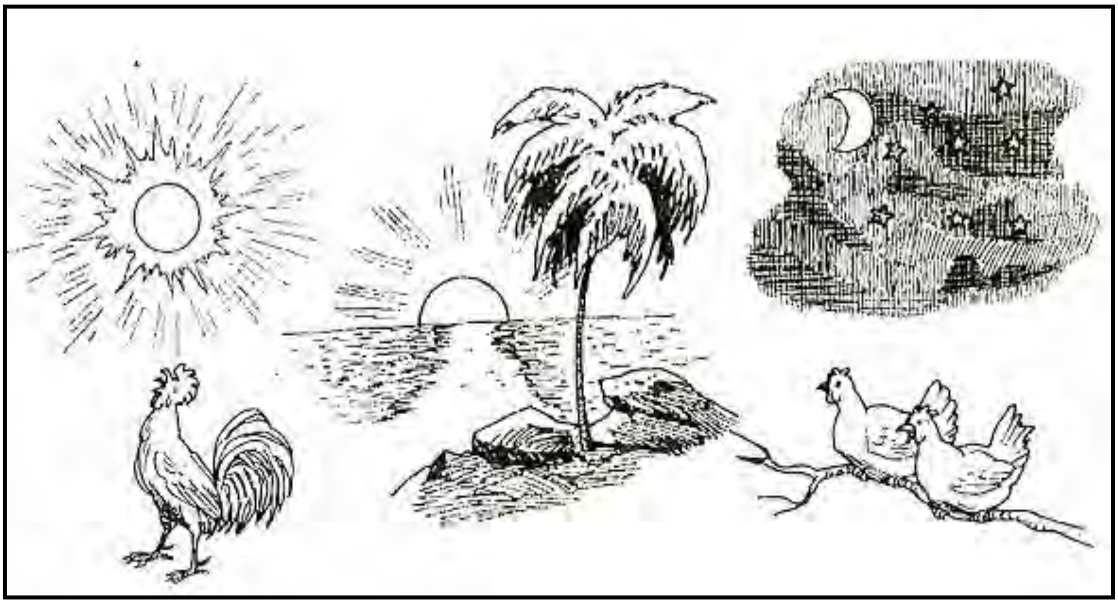
TIME

SUB-STRAND 3: TIME

Introduction

During ancient times, people took note of time with the help of the sun, stars, moon, and different seasons and also from signals produced by animals.

The illustration below will give you an idea of how time was measured from ancient times to present.



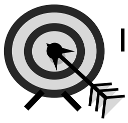
To our forefathers, time during the day was not measured by the hour. It was measured as: before sunrise, after sunrise, before noon, noontime, afternoon, before sunset, after sunset or evening. A day was divided into three segments only, morning, afternoon or evening. The sun to them was nature‟s giant clock.

In this Sub-strand, you will:

- convert units of time from smaller units to larger units or vice versa
- use the clock to measure and tell the time
- apply knowledge and skills to solve problems involving time.

Lesson 11: Changing Units of Time

You learnt about temperature in the previous lessons.



In this lesson you will:

- convert units of time from a larger unit to a smaller unit
- convert units of time from a smaller unit to a larger unit.

You learnt about measuring TIME in your Lower Primary Mathematics. In this lesson we will revise some ideas you should already know about measuring time.

Do you remember learning about the basic units of measuring time?

Time is measured in a number of units: seconds, minutes and hours for short periods; and days, weeks, months and years for longer periods. The basic units of time are shown in the following table.

MEASURES OF TIME CONVERSION

1 minute (min)	= 60 seconds (sec)
1 hour (h)	= 60 minutes (min)
1 day (d)	= 24 hours (h)
1 week (wk)	= 7 days (d)
1 month (mo)	= 28 to 31 days (d) = 4 weeks
1 year (yr)	= 52 weeks = 12 months = 365 days
1 leap year	= 366 days

Every multiple of four years is a leap year. It means that a leap year occurs when the year can be divided by four and have zero remainder.

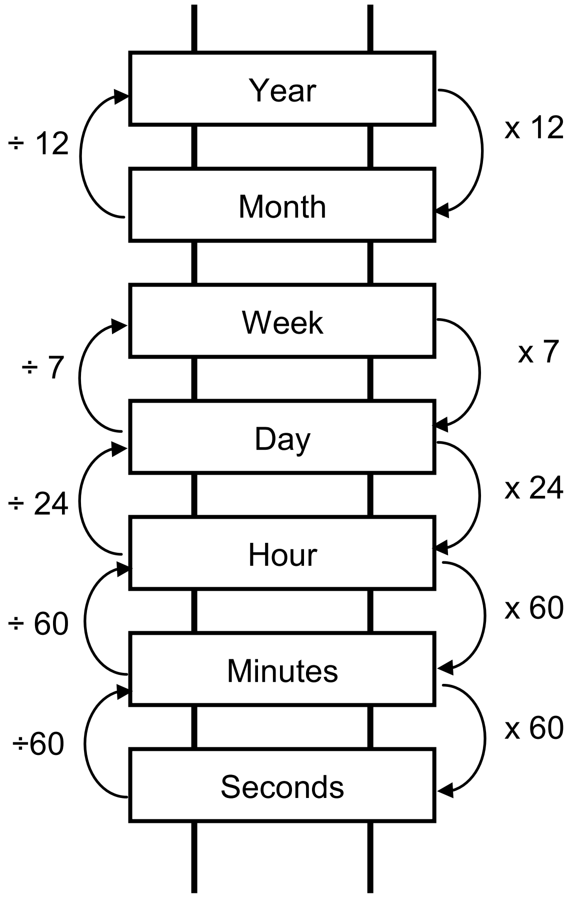
There are other units of time we may come across like the following:

1 decade	= 10 years
1 century	= 100 years
1 millennium	= 1000 years

In problems involving operations with time (usually addition and subtraction) we sometimes change or convert the units.

The diagram of a conversion ladder on the next page shows how to convert between different units of time.

CONVERSION LADDER



The units are connected by either multiplication or division using the numbers on the ladder.

- When climbing down the ladder, multiply.
  This means that in changing larger units to smaller units, multiply the number by the unit equivalence.
- When climbing up the ladder, divide.
  This means that in changing smaller units to larger units, divide the number by the unit equivalence.

Changing large units to smaller units

Example 1
Complete the following conversions.

a) 2 min = __________sec

Solution: 1 minute = 60 sec

So, 2 minutes = 2 x 60

= **120 sec**

b) 3 hours = __________min

Solution: 1 hour = 60 min

So, 3h = 3 x 60

= **180 min**

c) 5 days = __________hours

Solution: 1 day = 24 hours

Therefore, 5 days = 5 x 24

= **120 hours**

d) 12 hours = ____________ seconds

Solution: 1 hour = 60 minutes and 1 minute = 60 seconds

Therefore, 12 hours = 12 x 60 x 60

= 12 x 3600

= 43 200 seconds

e) 2 hours and 25 minutes = ___________minutes

Solution: 1 hour = 60 minutes

Therefore, 2 h and 25 min = 2 x 60 + 25 min

= 120 + 25 min

= **145 minutes**

Example 2

Kirara is able to run around an obstacle course in 48 minutes, while Susie takes three-quarters of an hour to complete the course. Who is quicker in completing the course?

Solution: Kirara took 48 minutes

Susie‟s time is $\frac{3}{4}$ of an hour

To compare the two times, we must have both times in the SAME UNITS.

We usually change both times to the SMALLER unit.

So change both times to minutes.

Kirara took 48 minutes.

Susie‟s time is $\frac{3}{4}$ of an hour $= \frac{3}{4}$ of 60 since 1 h = 60 min

$= \frac{3}{4} \times 60$

= 45 min

So, Susie took 45 minutes.

Since, Kirara took 48 minutes and Susie took 45 minutes.

Therefore, Susie is the quicker runner because she took less time than Kirara in completing the course.

Example 3

Joe and Mark set out on bicycles for a 30 km journey. Joe completed the journey in 2 h 41 min and Mark took 154 min. Who cycled faster?

Solution: Times are given in hours and minutes.

Change to the smaller unit - minutes.

Joe took 2 h 41 min = 2 x 60 min + 41 min

= 120 min + 41 min

= 161 min

Mark took 154 min.

Mark took less time. So, Mark was faster.

Example 4

Mauro wanted to set a dancing record in his village. He danced for 2 days and 4 hours without stopping.

For how many hours did he dance?

Solution:

I day = 24 h

So 2 days = 24 x 2 h

= 48 h

2 days + 4 h = 48 h + 4 h

= 52h

Answer: 52 hours

Now, here are some examples where we must change to a larger unit.

Changing smaller units to larger units

Example 1

Complete the following conversion

a) 120 seconds = ____________minutes

Solution: 60 sec = 1 minute

Therefore, 120 seconds = $\frac{120}{60}$

= **2 minutes**

b) 7200 minutes = ____________hours

Solution: 60 minutes = 1 hour

Therefore, 7200 minutes = $\frac{7200}{60}$

= **120 hours**

c) 3600 hours = ____________ days

Solution: 24 hours = 1 day

Therefore, 3600 hours = $\frac{3600}{24}$

= **150 days**

d) 520 weeks = ____________years

Solution: 52 weeks = 1 year

Therefore, 520 weeks = $\frac{520}{52}$

= **10 years**

Example 2

Cedrick ran home from school in 192 seconds. Change this time to minutes and seconds.

Solution: Time taken = 192 seconds

We have to find how many 60‟s are in 192

So, divide 192 by 60

We get 3 and the remainder is 12.

That is, 3 whole minutes and 12 seconds left over.

$$\begin{array}{r|l} & 3 \\ \hline 60 & 192 \\ & \underline{180} \\ & 12 \text{ remainder} \end{array}$$

Answer: 192 seconds = 3 minutes and 12 seconds.

Example 3

Change 418 minutes to hours and minutes.

Solution: 60 min = 1 h

We have to find how many 60‟s are in 418.

So, divide 418 by 60

We get 6 hours and 58 minutes left over.

So, 418 min = 6 h 58 min

$$\begin{array}{r|l} & 6 \\ \hline 60 & 418 \\ & \underline{360} \\ & 58 \text{ remainder} \end{array}$$

Answer: 6 h 58 min

Example 4

Change 80 hours to days and hours.

Solution: 24 hours = 1 day

So, divide 80 by 24.

We get 3 days and 8 hours left over.

So, 80 h = 3 days and 8 hours

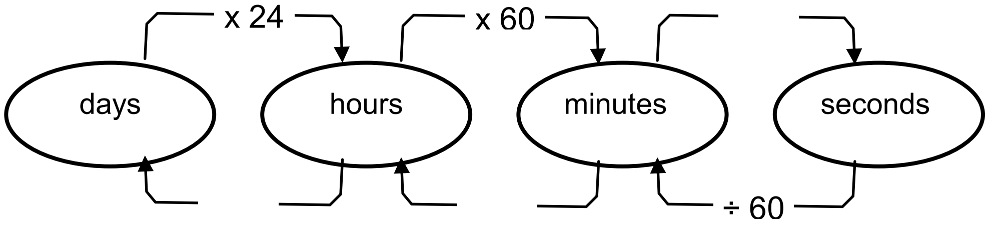
$$\begin{array}{r|l} & 3 \\ \hline 24 & 80 \\ & \underline{72} \\ & 8 \text{ remainder} \end{array}$$

Answer: **3d 8 h**

NOW DO PRACTICE EXERCISE 11

Practice Exercise 11

1. Complete the conversion diagram for time.



2. Convert the following to the unit indicated.

a)	15 min = ___________sec	f)	350 sec = ___________min
b)	12 h = ___________min	g)	5760 min = ___________h
c)	2 days = ___________min	h)	11520 sec= ___________d
d)	7 h = ___________sec	i)	8040 h = ___________d
e)	5 mo = ___________wk	j)	2920 d = ___________yr

3. Convert the following. The first one is done for you.

(a) 142 min = ______h ______min

$$= \frac{142}{60}$$

$$= 2 \text{ h } 22 \text{ min}$$

(b) 225 s = _________ min _________s

(c) 78 h = _________ d __________h

(d) 199 min = __________h _________min

(e) 85 h = __________d _________h

4. A fortnight is 2 weeks. How many days are there in a fortnight?

---

5. Thomas runs 1 km in 200 seconds. Arthur runs 1 km in 3 minutes and 26 seconds.

   Who is the faster runner?

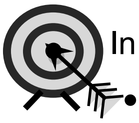
---

6. Joe boasts that he can balance a marble on his nose for $2\frac{1}{2}$ minutes while Sam says he can do it for 140 seconds. Who can balance the marble the longest?

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

Lesson 12: Telling the Time

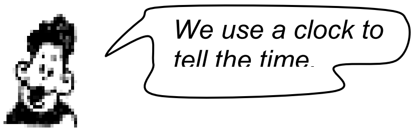
You learnt to convert units of time in the last lesson.



In this lesson you will:

- familiarize yourself with the two main types of clocks and watches
- read and tell time on analogue and digital clocks.

How do we tell the time of day?



Clocks are measuring instruments. They use a unit of time, constantly repeat that unit and give a count of the number of times the unit is used.

In our world we have **digital clocks** (they have digits like 0,1, 2, 3) ...

... and **analog clocks** (they have hands) ...




Digital Clocks

Digital Clocks show us the time using numbers. The number on the left of the (**:**) is Hours, and the number on the right is Minutes:

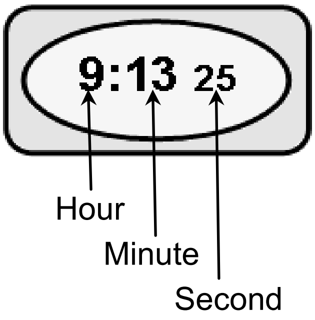
This is a digital clock.

It shows the hours and minutes in a 24 hour system.

This clock shows 12 hours and 34 minutes.

The 24 hour time will be further discussed in Lesson 16.

Here is another digital clock.



It shows the hours, minute and seconds.

This clock shows the time as

9 hours 13 minutes 25 seconds.

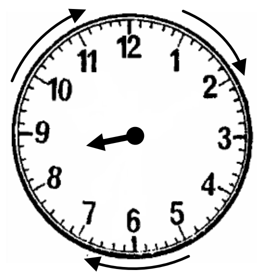
Clocks with Hands

Clocks can also use hands to show us the Hours and Minutes. We call them "**analog" clocks**.

The analog clock has hour, minute and second hands that both move around the clock-face and describe time using a 12 hour system.

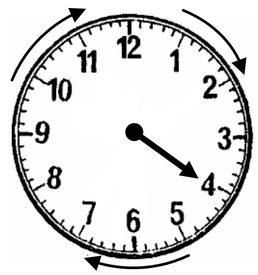
Here is an analog clock with 12 hours marked on it.

The short hand is the hour hand. It moves very slowly. It takes ONE HOUR to move from one number to the next.



Now it is between 8 and 9. The time is somewhere between 8 and 9 o‟clock.

The long hand is the minute hand. It goes around once in 1 hour. The space between any two numbers is divided into 5 parts. Each part is 1 minute. So, each number shows 5 minutes.



Now it points to 4 so, 4 x 5 = 20 min.

Both hands move around this way, in a clockwise direction.

Using both the short hand and the long hand let us understand exactly what time it is.

We say: the time is "twenty minutes past eight" or "eight twenty".

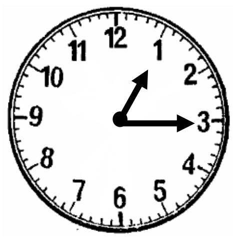
We write: 8:20

Here are some examples.

Example 1

What is the time shown by each of these clocks?

(a)



The hour hand is just past 1 but closer to 1 than 2.

The minute hand is at 3. 3 x 5 = 15 minutes

We say: The time is (i) A quarter past one

or (ii) One- fifteen

or (iii) 15 minutes past one.

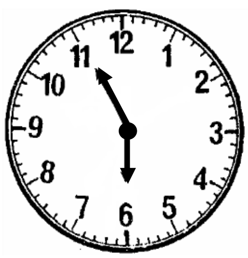
We write: 1:15

(b)

We say: Nine thirty five or twenty five to ten

We write: 9:35

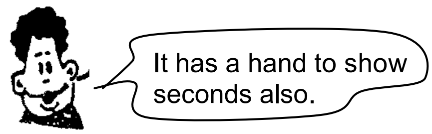
(c)



We say: Five fifty-five or five to six.

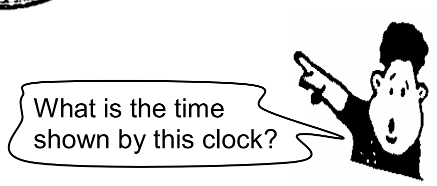
We write: 5:55

Now look at this clockface:



Second hand

It moves fast and we can see it moving.



The second hand goes around once in ONE MINUTE. 1 min = 60 seconds.

There are 60 small divisions. These 60 divisions are useful to say how many SECONDS of a minute have passed.

When the <u>second hand</u> goes around once, the minute hand moves through <u>one small division</u>

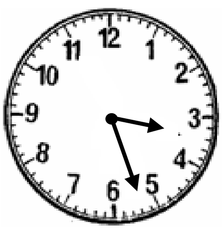
The time shown is 10 minutes and 32 seconds past 11 o"clock.

Here are some more examples about how to read the time from a clock.

Example 1

What is the time shown by these clocks?

a)



There is only an HOUR HAND and a MINUTE HAND.

<u>HOUR HAND</u> - the time is between 3 and 4 o'clock.

<u>MINUTE HAND</u> - shows 2 divisions after 5

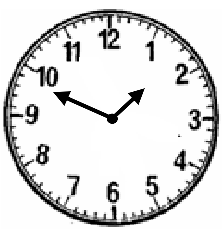
So 2 minutes after <u>5 x 5</u> = 25 minutes

25 + 2 = 27

<u>We say</u>: Three-twenty seven or 27 minutes past 3.

So, the time shown is 3:27.

(b)



<u>HOUR HAND</u>: The time is between 1 and 2 o'clock

<u>MINUTE HAND</u>: 1 division before 10

So, 1 less than 10 x 5 min

So, 50 - 1 minute is 49 minutes

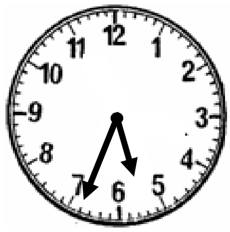
<u>We say</u>: One-forty nine or eleven minutes to 2.

So, the time shown is 1:49.

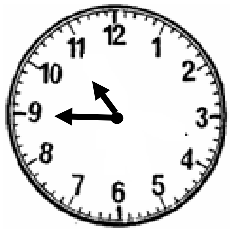
Now we will draw some times on some clocks.

Examples

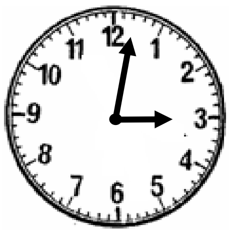
a) Show the time 26 minutes to 6 or 5:34.



(b) Show the time a quarter to 11 or 10:45.



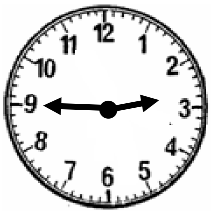
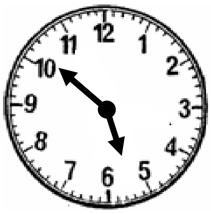
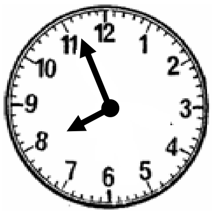
(c) Show the time 2 minutes past 3 or 3:02.



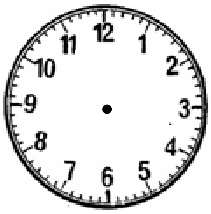
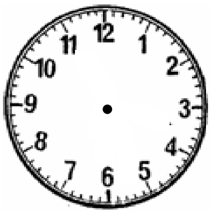
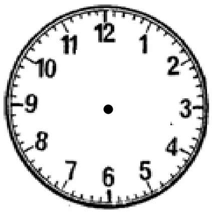
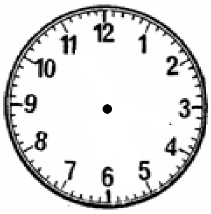
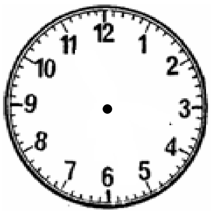
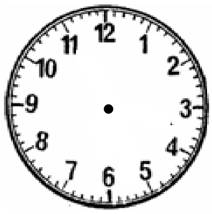
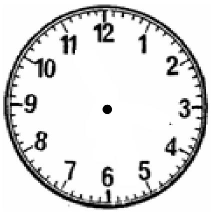
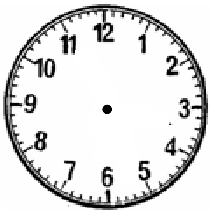
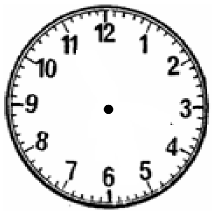
NOW DO PRACTICE EXERCISE 12

Practice Exercise 12

1. Write 2 ways of saying the time shown by these clocks.

Clock I	Clock II	Clock III
		
The time is ________	The time is ________	The time is ________
or ____________	or ____________	or ____________

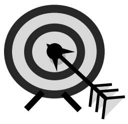
2. Draw the time on the clock faces below.

a) 20 past 3	b) 4 o‟clock	c) quarter to 11
		
d) half past 12	e) quarter past 8	f) five forty five
		
g) 16 minutes to 5	h) $\frac{1}{4}$ to 7	i) $\frac{1}{2}$ past 9
		

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

Lesson 13: The 12-Hour time

In the last lesson, you learnt to read, write and tell the time of day using analog and digital clocks.



In this lesson you will:

- read and record time using the AM or a.m. and PM or p.m. notation.

As you learnt in Lesson 12, we can tell the time of day using either an analog clock or the digital clock.

The time of day is usually given either by using the clock face system such as half past 6 or the digital system such as 5:30. This system operates in two groups of 12 hours, morning (midnight to noon) and afternoon (noon to midnight).

There are two major ways to show the time:

1. With the 12-hour time
2. With the 24 hour time

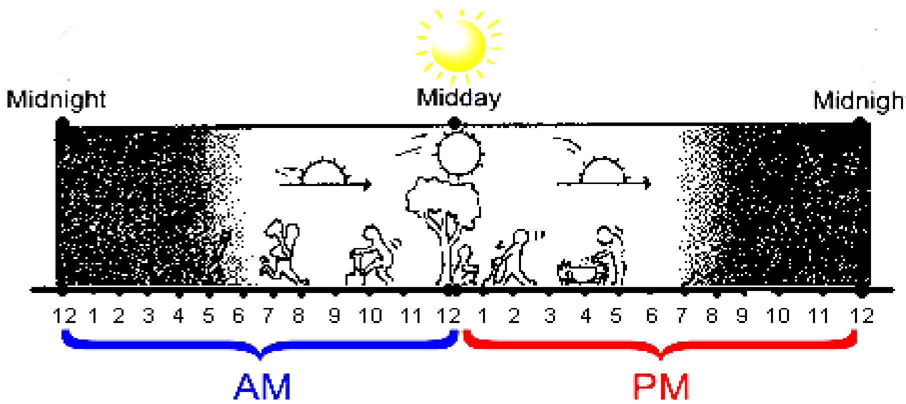
The **12-hour clock** is a time conversion standard in which the 24 hours of the day are divided into two periods called:

a.m. from **ante-meridian** which means the time from 12 midnight up to before twelve noon. It means **morning time** (before midday).

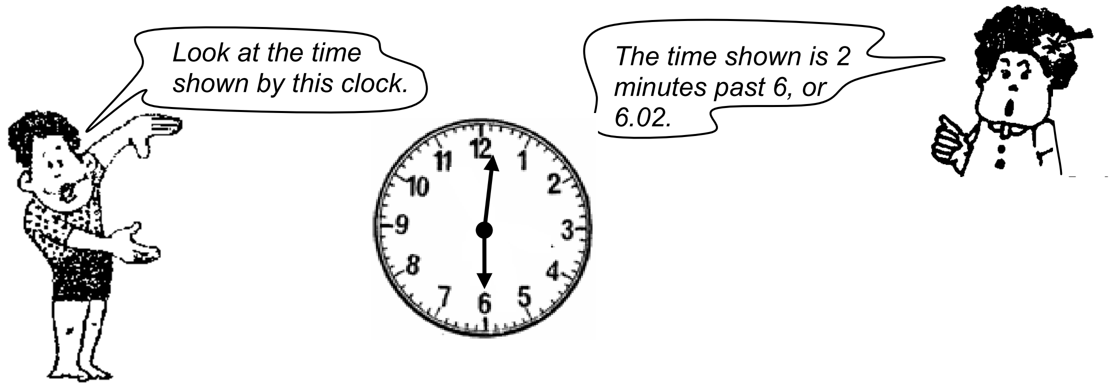
p.m. from **post-meridian** which means the time from 12 noon up to before12 midnight. It means **evening time** (after midday).

Each period consists of 12 hours numbered: *12* (acting as zero), *1, 2, 3, 4, 5, 6, 7, 8, 9, 10,* and *11*.

Here is a time line showing times from one midnight to the next.
Times are marked as shown by a 12 hour clock.



The 12-hour clock was developed over time from the mid-second millennium BC to the 16th century AD.



It can be 2 minutes past 6 or 6:02 morning time (before midday) or,

it can be 2 minutes past 6 or 6:02 evening time (after midday).

So, when we tell the time using a 12-hour clock we must say whether it is MORNING TIME or EVENING TIME.

REMEMBER

a.m. means MORNING TIME (before midday)

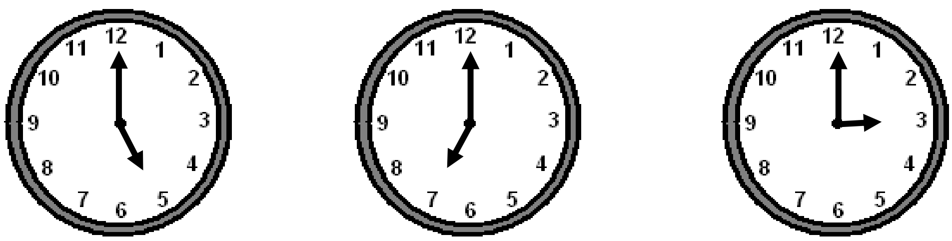
p.m. means EVENING TIME (after midday)

For 6:02 morning time, we write 6:02 a.m.

For 6:02 evening time, we write 6:02 p.m.

Here are three clocks.

Clock A Clock B Clock C



In 12 hour time, if each clock shows the time in the morning, the time in

Clock A is 5:00 a.m. (5 o‟clock in the morning)

Clock B is 7:00 a.m. (7 o‟clock in the morning)

Clock C is 3:00 a.m. (3 o‟clock in the morning)

If each clock shows the time in the afternoon, the time in

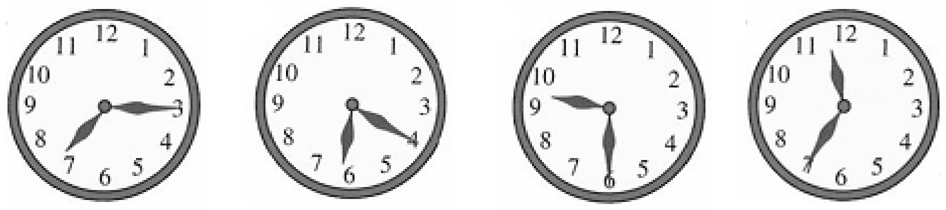
Clock A is 5:00 p.m. (5 o‟clock in the afternoon)

Clock B is 7:00 p.m. (7 o‟clock in the evening)

Clock C is 3:00 p.m. (3 o‟clock in the afternoon)

Here are some more clocks.

A B C D



Write the time shown using the 12 hour notation.

Answers: AM TIME

Clock A is 7:15 a.m. (A quarter past 7 in the morning)

Clock B is 6:20 a.m. (20 minutes past 6 in the morning)

Clock C is 9:30 a.m. (half past 9 in the morning)

Clock D is 11:35 a.m. (25 minutes before noon)

PM TIME

Clock A is 7:15 p.m. (A quarter past 7 in the evening)

Clock B is 6:20 p.m. (20 minutes past 6 in the evening)

Clock C is 9:30 p.m. (half past 9 in the evening)

Clock D is 11:35 p.m. (25 minutes before midnight)

NOW DO PRACTICE EXERCISE 13

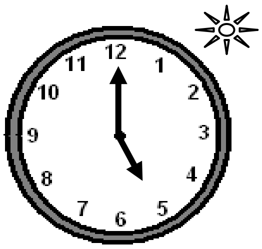
Practice Exercise 13

1. Fill in the blank spaces on the following.

   a) a.m. came from _______________. It means ______________.
   b) p.m. came from _______________. It means ______________.

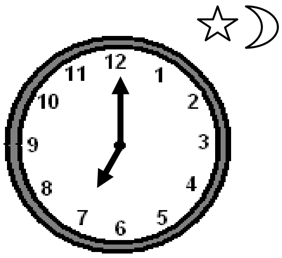
2. Write the following times using the a.m. and p.m. notation.

Clock A



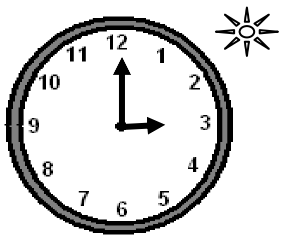
Answer: __________

Clock B



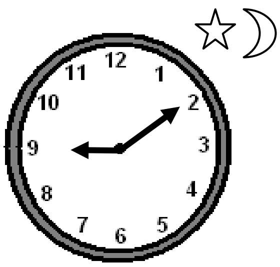
Answer: __________

Clock C



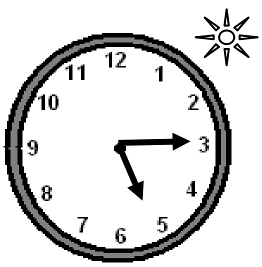
Answer: __________

Clock D



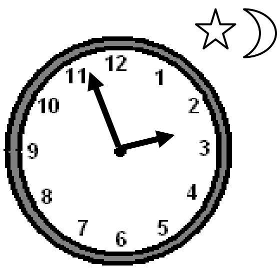
Answer: __________

Clock E



Answer: __________

Clock F



Answer: __________

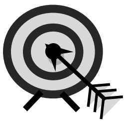
3. Read each statement and write the times in standard 12-hour time indicating whether each is a.m. or p.m.

   a. A quarter past 2 in the morning ____________
   b. 10 minutes after midnight ____________
   c. 5 minutes after noon ____________
   d. 23 minutes to 4 in the morning ____________
   e. 5 minutes before midnight ____________

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

Lesson 14: The 24-Hour Time

You learnt the meaning of a.m. and p.m. in Lesson 13. You also read and recorded time using the a.m. and p.m. notation.

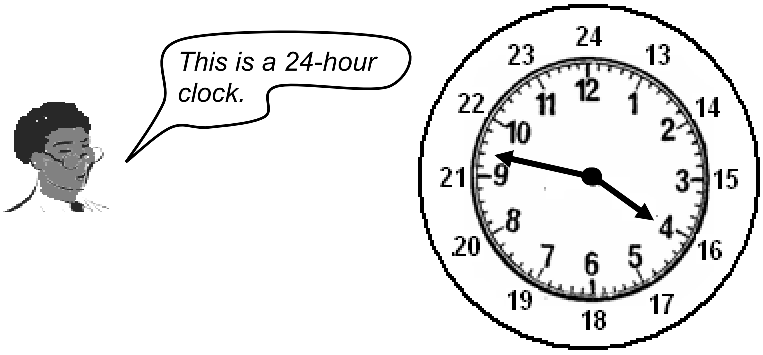


In this lesson you will:

- read and record time using the 24-hour time notation.

First let us revise what we learnt in Lesson 13 about a 12 hour time. We learnt that a 12 hour clock has 12 hours marked on it, but there are 24 hours in a day. This means the hour hand goes around ONCE in the morning and ONCE AGAIN in the evening, to make 24 hours.

If we marked 24 hours on a clock, we would show it like this:



The **24-hour clock** notation is a way of telling the time in which the day runs from midnight to midnight and is divided into 24 hours, numbered from 0 to 24.

On the INSIDE it reads 1, 2, 3, …, 12.

On the OUTSIDE it reads 13, 14, 15, …, 24.

For reading minutes

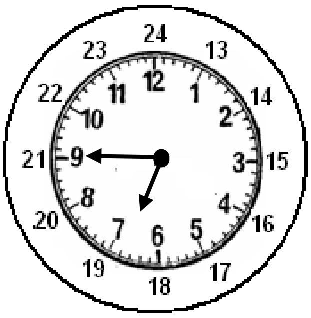
Read the INSIDE as in normal clocks.

For reading hours

We can read a.m. time on the INSIDE

p.m. time on the OUTSIDE

For example, here is a 24 hour clock.



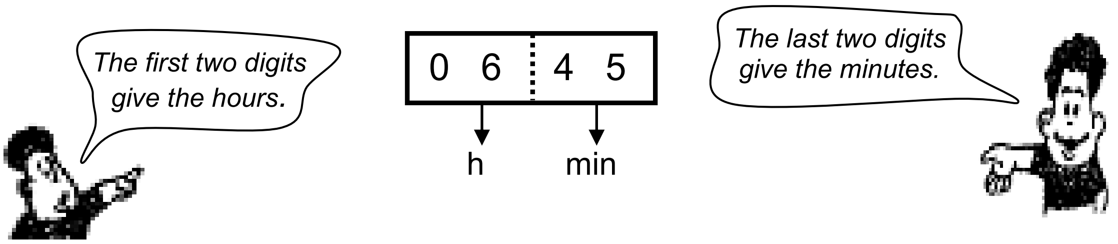
To find the time shown by the clock, if it is morning time, we read the inside numbers to find the hours.

The time is quarter to 7 in the morning or 6:45 a.m.

We write 24 hour time in a special way.

6.45 a.m. is written **0645 h.** You say, “Zero six forty five hours”.

We write the 4 digits without a full stop. We put hours (h) at the end.

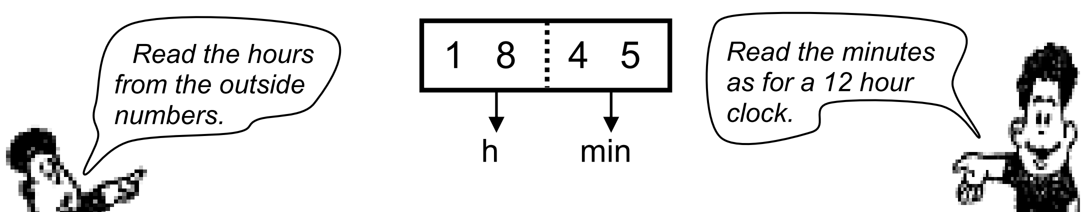


Now, to find the time shown by the clock if it is evening time, we read the outside numbers to find the hours.

The hour hand is past 18 and had not yet reached 19.

We read the minutes as usual ... 45 minutes.

So, the time is **1845h** if it is evening time. You say, “Eighteen forty five hours”.



We write all 4 numbers without a full stop.
We put an **h** at the end.

NOW DO PRACTICE EXERCISE 14

Practice Exercise 14

1. Write the 24-hour clock time for the time shown on these clock faces below. Each one shows time in the morning.

Clock A

Clock B

Clock C

Clock D

Clock E

Clock F

Answers:

Clock A ________________

Clock B ________________

Clock C ________________

Clock D ________________

Clock E ________________

Clock F ________________

2. Write the 24-hour clock time for the time shown on these clock faces below. Each one shows time in the evening.

Clock M

Clock N

Clock O

Clock P

Clock R

Clock S

Answers:

Clock M ________________

Clock N ________________

Clock O ________________

Clock P ________________

Clock R ________________

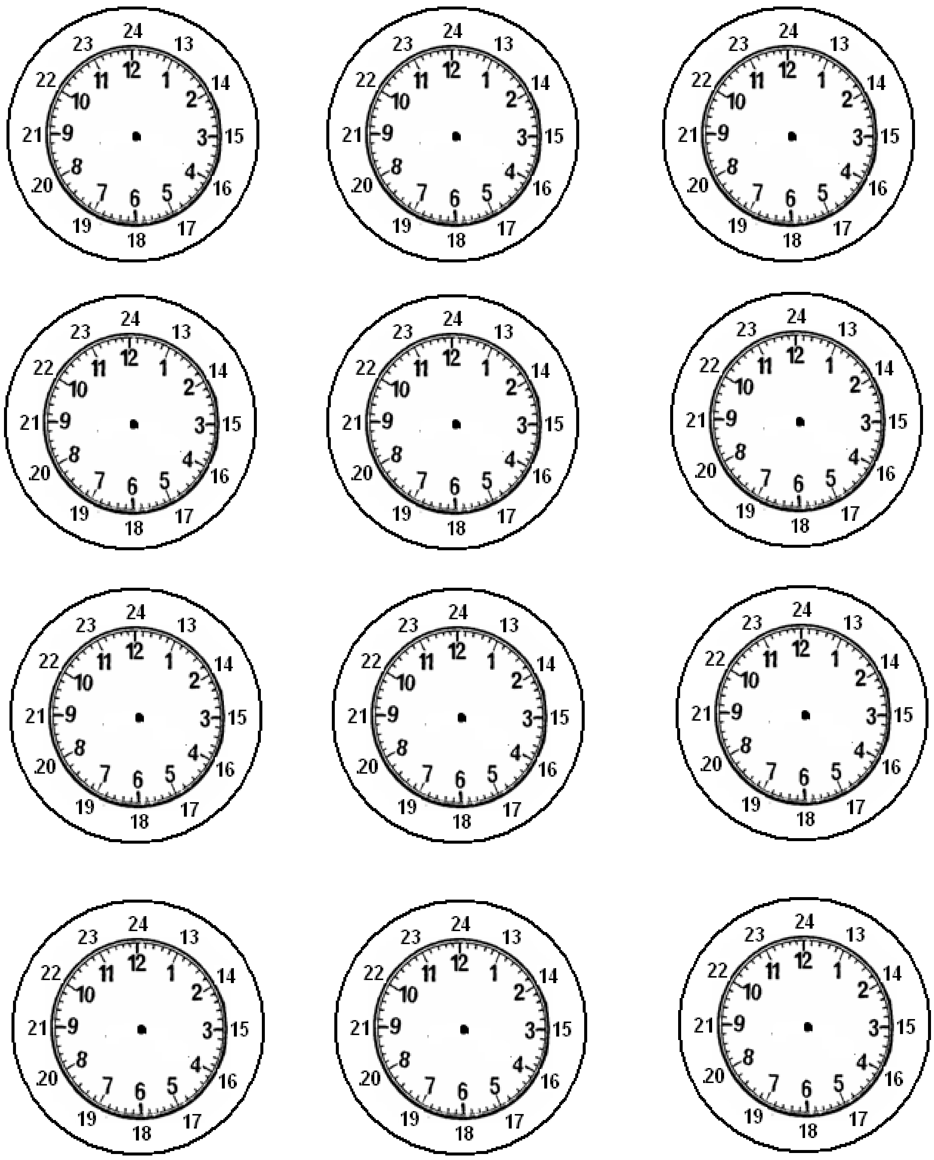
Clock S ________________

3. Write whether each of the following is morning or evening time.

a) 0915 hours ____________
b) 1145 hours ____________
c) 1217 hours ____________
d) 2020 hours ____________
e) 1600 hours ____________
f) 0500 hours ____________
g) 0800 hours ____________
h) 1900 hours ____________
i) 0100 hours ____________
j) 1735 hours ____________
k) 0200 hours____________
l) 2150 hours ____________

---

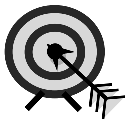
4. Draw the times in Question 3 using the 24-hour clock faces below.



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

Lesson 15: Changing 12-Hour Time to 24-Hour Time

You learnt to read and record time using the 24-hour time in Lesson 14.



In this lesson you will:

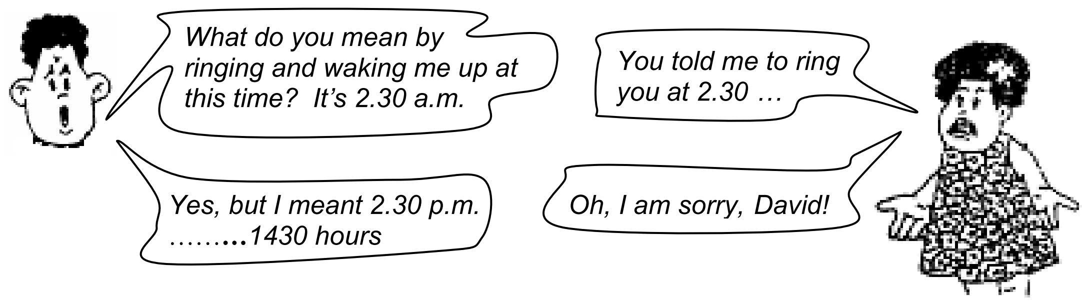
- convert 24 hour time notation to a.m. and p.m. notation and vice versa.

As you have learnt in the previous lessons, there are two major ways to show time: "AM/PM" or "24 Hour Clock".

- With the **24 Hour Clock** the time is shown as so many hours and minutes since midnight.
- With **AM/PM** (or "12 Hour Clock") the day is split into the 12 Hours running from Midnight to Noon (the AM hours) and the other 12 Hours running from Noon to Midnight (the PM hours).

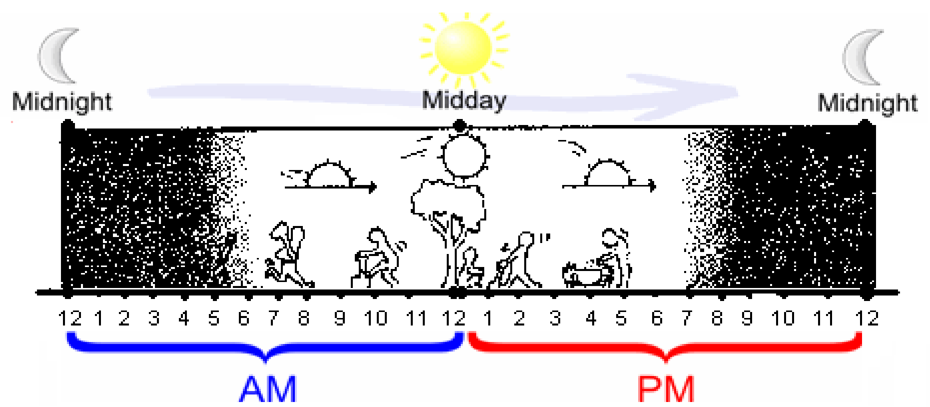
In this lesson, you will learn how to change 12-hour time to 24-hour time.

Let us start the lesson by studying this conversation between David and Eope.

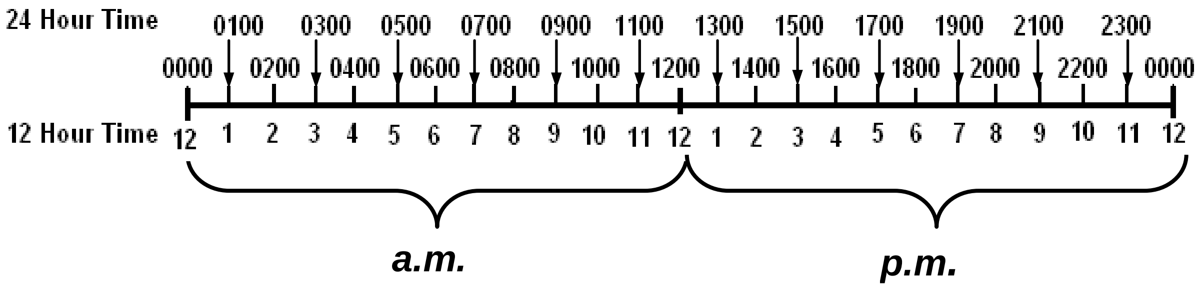


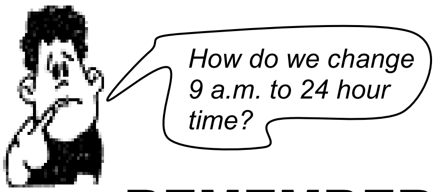
If you say 2.30, it can mean either 2.30 a.m. or 2.30 p.m. This is because 12 hour time can be a.m. (morning) time or p.m. (evening) time. However, if you use 24 hour time, it means only one time of the day.

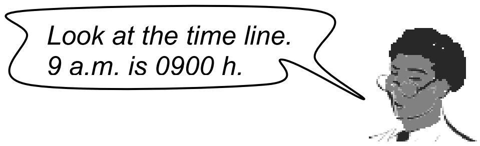
Here is again the time line showing times from one midnight to the next.
Times are marked as shown by a 12 hour clock.



Here are more time lines showing both 12-hour and 24-hour times.







REMEMBER

The first two digits give the hours.
The last two digits give the minutes.
We do not put a full stop between hours and minutes.
We write **h** after the number.

For hours 1, 2, 3 **...**up to 9 we write a zero (0) in front, like this: 01, 02, 03,**…** up to 09.

We do the same for minutes 1, 2, 3 up to 9 also.

Example 1

Change 5 minutes past 6 a.m. to 24 hour time.

Solution: 5 minutes past 6 a.m. is 6.05 a.m.

In 24 hour time it is 0 6 0 5 h You say "zero six o" five hours".

hours *minutes*

Note: The time at midnight is zero hours.

So, 0000h (zero hours) is 12 O'CLOCK MIDNIGHT.
It is the beginning of a day.

Example 2

Change these morning (a.m.) times to 24 hour time.

(1) 12.09 a.m. This is nine minutes past midnight (zero hours).

So we write it as 1 2 0 9 h

hours *minutes*

ANSWER: 1209 h You say "twelve o" nine hours".

(2) 8.45 a.m. This is eight hours forty five minutes after midnight.

So, we write it as $\underbrace{\underline{0\,8}}_{\text{hours}}\quad\underbrace{\underline{4\,5}}_{\text{minutes}}$ h

ANSWER: 0845h (zero eight forty five hours).

Example 3

Change these evening (p.m.) times to 24 hour time.

(1) 12:48 p.m.

Solution: This is twelve hours forty eight minutes after midnight.
So, we write it as 1248 h

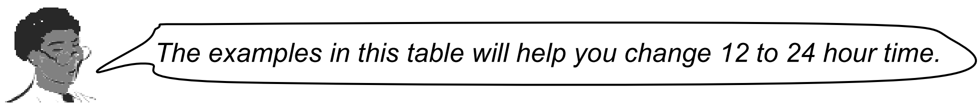
ANSWER: 1248 h (twelve forty eight hours).

(2) 7:00 p.m.

Solution: This is 7 hours after 12 midday.
But, 12 midday is 12 hours after midnight.
After 12 midday we continue counting 13, 14 … up to 24 hours.

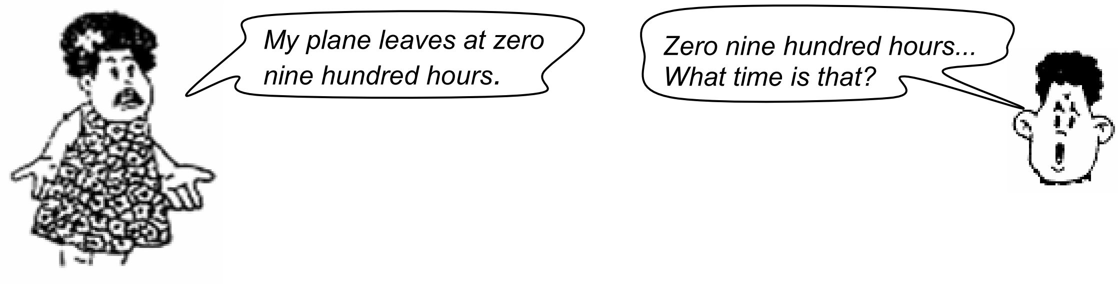
So, 1 p.m. is 12 + 1 = 13 hours after midnight.
2 p.m. is 12 + 2 = 14 hours after midnight.
7 p.m. is 12 + 7 = 19 hours after midnight.

Answer: We write 7:00 p.m. as 1900 h. (You say nineteen hundred hours).

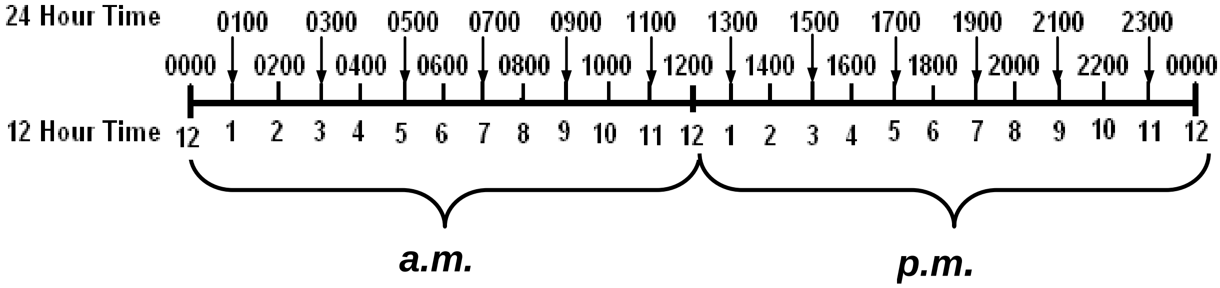


12 HOUR TIME		24 HOUR TIME	YOU SAY
12 midnight	→	0000 h	Zero hours
12.08 a.m.	→	0008 h	Zero o‟ eight hours
12.17 a.m.	→	0017 h	Zero seventeen hours
2.00 a.m.	→	0200 h	Zero two hundred hours
9.03 a.m.	→	0903 h	Zero nine o‟ three hours
9.25 a.m.	→	0925 h	Zero nine twenty five hours
12 noon	→	1200 h	Twelve hundred hours
12.06 p.m.	→	1206 h	Twelve o‟ six hours
12.45 p.m.	→	1245 h	Twelve forty five hours
9.52 p.m.	→	2152 h	Twenty one fifty two hours
11.00 p.m.	→	2300 h	Twenty three hundred hours

Now you will learn how to change 24 hour time to 12 hour time.

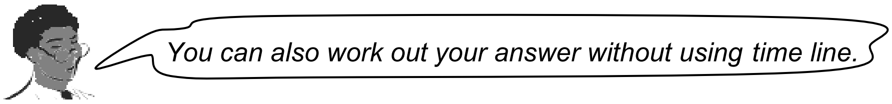


Here is our time line again.



You can see that 0900 h is 9 a.m. on the time line.

In the same way, we can read other times on the time line.
Eleven hundred hours is 1100 h and 11 a.m. in 12 hour time
Sixteen hundred hours is 1600 h and 4 p.m. in 12 hour time.



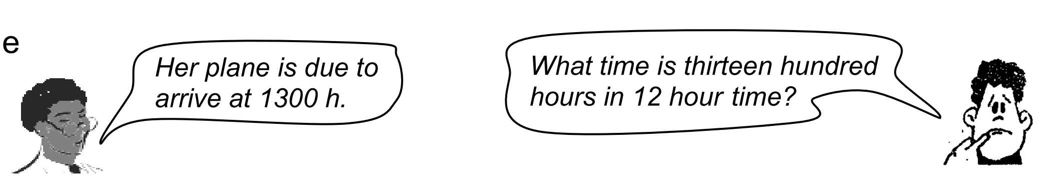
0900 h is <u>09 hours</u> and <u>00 minutes</u> after midnight.

That is, <u>9 hours zero minutes</u> after midnight.

So, the time is, **9 a.m.** in 12 hour time.

Here is another example.

Example



1300 h is 13 hours and 00 minutes after midnight.

But, a 12 hour clock only shows up to 12 hours, then begins at 1 again and shows 1 o‟clock, 2 o‟clock, 3 o‟clock, etc.

13 hours after midnight is <u>1 hour after midday.</u>

This is evening time (p.m.)

So, **1300 h = 1 p.m.** (Look at the Time Line above to check this answer)

If the number of hours is more than 12, we start counting from 1 again.

Here are some more examples.

Example 1

I finish work at 1606 h. What is this in 12 hour time?

Solution: 1606 h is 16 hours and 06 minutes after midnight.
16 hours is more than 12 hours.
So, the morning has passed and it is evening time.
16 hours is (16 – 12) = 4 hours after midday.
So, **1606 h = 4:06 p.m.**

Example 2

Change the following to 12 hour times.

(a) 1120 h

Solution: 11 2 0 h = 11 hours 20 minutes after midnight.
11 hours is LESS than 12. It is still MORNING time.
So, **1120 h = 11:20 a.m**.

(b) 1845 h.

Solution: 1845 h = 18 hours 45 minutes after midnight.
18 hours is MORE than 12. It is EVENING time.
18 hours is (18-12) = 6 hours after midday.
So, **1845 h = 6:45 p.m**.

With all the examples so far, we have come to the following generalizations:

To convert 12 hour time (a.m. and p.m.) to 24-hour time

a) For the first hour of the day (12 Midnight to 12:59 a.m.), subtract 12 Hours
Examples: 12 Midnight = 0:00, 12:35 a.m. = 0:35
b) From 1:00 a.m. to 12:59 p.m., no change
Examples: 11:20 a.m. = 11:20, 12:30 p.m. = 12:30
c) From 1:00 p.m. to 11:59 p.m., add 12 Hours
Examples: 4:45 p.m. = 16:45, 11:50 p.m. = 23:50

To convert 24 Hour Clock to 12-hour time (a.m. and p.m.)

a) For the first hour of the day (0000 h to 0059 h), add 12 hours, make h "a.m."
b) From 1100 h to 1159 h, no change just make h “a.m.”.
c) From 1200 h to 1259 h, no change just make h "p.m.".
d) From 1300h to 2359 h, subtract 12 Hours, make h "p.m.".

NOW DO PRACTICE EXERCISE 15

Practice exercise 15

---

1. Write down how you say these 24 hour times. The first one is done for you.

a) 0700 h ____*zero seven hundred hours*________________

b) 1300 h ________________________________

c) 2120 h ________________________________

d) 2355 h ________________________________

e) 0000 h ________________________________

f) 0004 h ________________________________

g) 0015 h ________________________________

h) 1400 h ________________________________

---

2. Write these 24 hour times using digits. The first one has been done for you.

a) seventeen thirty hours. ___*1730 h*_______

b) eighteen forty five hours. ________________

c) fourteen oh five hours. ________________

d) zero oh three hours. ________________

e) zero twenty one hours. ________________

f) zero four hundred hours. ________________

g) twenty three twenty hours. ________________

h) zero two forty one hours. ________________

i) twelve oh nine hours. ________________

---

3. Change the following to 12 hour time. Remember to write a.m. and p.m. The first one has been done for you.

a) 0100 h _______*1:00 a.m.*_____

b) 1300 h ____________________

c) 2120 h ____________________

d) 2355 h ____________________

e) 1220 h ____________________

f) 1044 h ____________________

g) 0945 h ____________________

h) 1400 h ____________________

4. Change the following 12 hour times into 24 hour times. The first one has been done for you.

(a)	1:45 p.m.	=12 + 1 hours and 45 minutes after midnight =1345h
(b)	12:10 a.m.	= =
(c)	12:10 p.m.	= =
(d)	12:00 midnight	= =
(e)	8:00 a.m.	= =
(f)	8:00 p.m.	= =
(g)	4:40 p.m.	= =
(h)	10:20 p.m.	= =
(i)	12:00 noon	= =
(J)	5:20 p.m.	= =
(k)	11:00 a.m.	= =
(l)	9:00 p.m. .	= =
(m)	11:05 p.m	= =

5. Add "a.m." or "p.m." at the end of each sentence so that it makes sense.

   (a) Joshua woke up at 6:45 __________.

   (b) Miles came home from school at 3:55 __________.

   (c) Andy started his night shift at 10:15 __________.

   (d) Grace ate her lunch at 11:45 __________.

   (e) James went to bed at 8:55 __________.

---

6. Dave leaves home at 0900 and returns 7 hours later. What time does he get home?

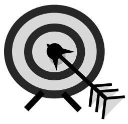
   (a) Write your answer in 24-hour clock time.

   (b) Write your answer in 12-hour clock time using a.m. or p.m.

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

Lesson 16: Working with Time

You learnt to convert between the 12-hour clock and the 24-hour clock in Lesson 15.



In this lesson you will:

- solve "time remaining" and "time since" problems involving hours and minutes.
- work out time lengths using the 12 hour and 24 hour times.

In everyday activities, it is important that you know how to organize your time and at the same time calculate the lengths to help you do things efficiently, effectively and productively. This means keeping checks on how much time elapsed or has been spent or taken for the job or things to finish from the time it is started.

In this lesson, you will need the skills you learnt in the previous lessons especially in problems involving operations with time (usually addition and subtraction) where you sometimes change the units.

Study the following examples.

Example 1

Find the total time spent by Jenny in doing her Geo Board project if she works 16 min 5 sec in the morning and 8 min 56 sec in the afternoon.

Solution: What is asked is the total time, so it requires addition.

16 min 5 sec + 8 min 56 sec = 24 min 61 sec

We know that 60 sec = 1 min. Since there are 61 sec after addition, we change 61 sec to 1 min and 1 sec.

So, 24 min 61 sec = 24 min + 1 min + 1 sec
= 25 min 1 sec

Therefore, Jenny‟s total time is **25 min 1 sec.**

In subtraction, regrouping is applied when the subtrahend (time to be subtracted) is greater than the minuend (time from which you subtract).

Example 2

Subtract 6 h 20 min from 9 h 7 min.

Solution: You need to regroup 9 h 7 min = (8 h + 1 h) + 7 min
= 8 h + 60 min + 7 min

1 h = 60 min

so, 9 h 7 min = 8 h 67 min

Therefore, 8 h 67 min – 6 h 20 min **= 2 h 47 min**

You can use the “adding on” method to find the difference between two pairs of times in hours and minutes on the same day.

Example 1

How long, in hours and minutes, is it from 7:30 a.m. to 11:15 a.m.?

Solution: From 7:30 a.m. to 10:30 = 3 hours
10:30 a.m. to 11:00 a.m. = 30 minutes
11:00 a.m. to 11:15 a.m. = 15 minutes

Total time = 3 hours 45 minutes

Therefore, **3 h 45 min** has passed from 7:30 a.m. to 11:15 a.m.

Or you can use the following steps.

Step 1: Look for the starting time and work out how many minutes to the next hour.

7: 30 a.m. to 8:00 a.m. = 30 min

Step 2: Work out how many whole hours before the finishing time.

8 a.m. to 11 a.m. = 3 hours

Step 3: Look at the remaining minutes to the finishing time

11 a.m. to 11: 15 a.m. = 15 min

Step 4: Add up the times you worked out.

3 h + 30 min + 15 min = 3 h 45 min.

Therefore, **3 h 45 min** has passed from 7:30 a.m. to 11:15 a.m.

Example 2

What is $6\frac{1}{2}$ hours after 11: 52 p.m.?

Solution: 1 h from 11:52 p.m. is 12:52 p.m.

5 h from 12:52 p.m. is 5:52 p.m.

8 min from 5:52 p.m. is 6:00 p.m.

22 min from 6:00 p.m. is 6:22 pm

The time added on is 1 h + 5 h + 8 min + 22 min = $6\frac{1}{2}$ hours

So, $6\frac{1}{2}$ hours after 11:52 p.m. is **6:22 p.m.**

Example 3

Lee leaves for school at 8:45 a.m. and returns for lunch at 11:15 a.m.

How long is he gone?

Solution: **Subtract** the two given times to solve.

11: 15 a.m. = 11 h 15 min = 10 h 75 min
8:45 a..m. = <u>8 h 45 min = 8 h 45 min</u>
= 2 h 30 min

(1 h = 60 min)
11 h 15 min = (10 h + 1 h) +15 min
= (10 h + 60 min) +15 min
= 10 h 75 min

Therefore, Lee is gone for 2 hours and 30 minutes.

To check your answer, try adding on method.

8:45 a.m. to 9:45 a.m. is 1 hour
9:45 a.m. to 10:45 a.m. is 1 hour
10:45 a.m. to 11:15 is 30 minutes

So, 8.45 a.m. to 11.15 a.m. is 2 hours and 30 minutes.

All the problems we have worked out in the above are examples in which both are a.m. and p.m. times.

Next we will look at an example where one time is a.m. and the other time is p.m. In this case, we must change both to 24 hour times and then subtract.

Example 4

The Cahill Family is going to see a movie at 5:50 p.m. It is 11:20 a.m. right now. How long do they have to wait to see the movie?

Solution: Change both times to 24 hour times (see Lesson 15).

5:50 p.m. is 1750 h
11:20 a.m. is 1120 h

Subtract the two given times to solve.

17:50 h. = 17 hours 50 minutes
11:20 h. = <u>11 hours 20 minutes</u>
= 6 hours 30 minutes

Therefore, Cahill family will wait for 6 hours and 30 minutes.

To check your answer, try adding on method.

11:20 a.m. to 5:20 p.m. is 6 hours
5:20 p.m. to 5:50 p.m. is 30 minutes

So, 11.20 a.m. to 5.50 p.m. is 6 hours and 30 minutes.

REMEMBER

- To find time lengths, if both times are a.m. times and/or both are p.m. times, subtract the two times.
- To find time lengths, if one time is a.m. time and the other is p.m. time change both times to 24 hour time, then subtract the two times.

We can also work out the time taken in a journey using the ideas and skills we learnt above given the time of departure and the time of arrival and using the formula;

TIME TAKEN = ARRIVAL TIME – DEPARTURE TIME

Here are some examples

Example 1

A group of people set out from Domara by canoe at 6.30 a.m. and arrived at Mogubo at 8.25 p.m. How long did the journey take?

Solution: Given: Departure is 6:30 <u>a.m.</u> and Arrival is 8:25 <u>p.m.</u>

Step 1: Change both times to 24 hour times (see Lesson 15).

6.30 a.m. is 0630h (Departure time)
8.25 p.m. is 2025h (Arrival time)

Step 2: Use the formula,

TIME TAKEN = ARRIVAL TIME – DEPARTURE TIME

So, time taken = 2025 h – 0630 h

= 13 h 55 min

Therefore, the journey took 13 hours and 55 minutes.

Example 2

Gelo left Kwikila at 8:40 p.m. and arrived at Port Moresby at 10:28 p.m. How long did his journey take?

Solution: Given: Departure time is 8:40 p.m. and Arrival time is 10:28 pm.
Both are p.m. times.

Using the formula:

TIME TAKEN = ARRIVAL TIME - DEPARTURE TIME

= 10 h 28 min - 8 h 40 min

= 1 h 48 m

10 h 28 min = (9 h + 60 min) + 28 min
= 9 h + 88 min
So, 9 h + 88 min – 8 h 40 min = 1 h 48

Therefore, Gelo took 1 hour and 48 minutes for his Journey.

You have noticed that knowing how to use 24 hour times is so important in working time lengths. In fact, most airline flight timetables use the 24 hour time.

See the other example on the next page.

Example 3

Use the information from this flight timetable to work out the time taken for the journeys in the questions below.

SATURDAY				SUNDAY			
FLT	DEP	STAGE	ARR	FLT	DEP	STAGE	ARR
PX701	0620	RAB-BUA	0745	PX751	0700	RAB-KVG	0750
PX700	0815	RAB-LAE	0940	PX751	0815	KVG-MAS	0925
PX707	1030	LAE-RAB	1155	PX751	0950	MAS-WWK	1110
PX710	1225	LAE-BUA	1300	PX750	1150	WWK-MAS	1310
PX710	1320	BUA-RAB	1415	PX750	1335	MAS-KVG	1445
				PX750	1510	KVG-RAB	1600

CODES

RAB – Rabaul
BUA – Buka
LAE - Lae
KVG – Kavieng
MAS – Manus
WWK - Wewak

a) What is the time taken by flight PX701 from Rabaul to Buka on Saturdays?

Solution: Find this part of the timetable:

FLT	DEP	STAGE	ARR
PX701	0620	RAB-BUA	0745

From the information in the timetable for Saturdays:

Departure time = 0620 h
Arrival time = 0745 h

so, Time taken = arrival time – departure time
= 0745 h – 0620 h
= 1 h 25 min

Therefore, the time taken by flight PX701 is 1 h 25 min.

b) How long will it take for Flight PX750 from Wewak to Manus on Sundays?

Solution: Find this part of the timetable:

FLT	DEP	STAGE	ARR
PX750	1150	WWK-MAS	1310

From the information in the timetable for Sundays:

Departure time = 1150 h
Arrival time = 1310 h

so, Time taken = arrival time – departure time
= 1310 h – 1150 h
= 1 h 20 min

1310 h = 13 h 10 min
= 12 h 70 min
1150 h = 11 h 50 min
= 1 h 20 min

Therefore, the time taken by flight PX750 is 1 h 25 min.

NOW DO PRACTICE EXERCISE 16

Practice Exercise 16

1. Add or subtract the following.

a)
```
   3 hours 10 minutes
+  2 hours  8 minutes
```

b)
```
   8 minutes 10 seconds
-  5 minutes 25 seconds
```

c)
```
  22 hours 23 minutes
- 10 hours  8 minutes
```

d)
```
   4 minutes 21 seconds
+  6 minutes 43 seconds
```

2. Laurel and Dina ran on a relay team. Laurel ran for 6 minutes and 27 seconds. Dina ran for 7 minutes and 3 seconds.

What is the difference between the times?

Answer: __________

3. What time is it?

a) $1\frac{1}{2}$ hours after 2:30 p.m.

Answer: __________

b) $4\frac{1}{2}$ hours before 9:05 p.m.

Answer: __________

c) 2 h 40 min before 3:10 p.m.

Answer: __________

4. P.M.V. bus number 13 left Koki at 7.55 p.m. and arrived at Waigani at 8.22 p.m.

How long did the trip take?

Answer: __________

---

5. The Cahill Family is going to see a movie at 4:50 p.m. It is 11:20 a.m. right now.

How long do they have to wait to see the movie?

Answer: __________

---

6. Here is part of an airline timetable.

MONDAY				TUESDAY			
FLT	DEP	STAGE	ARR	FLT	DEP	STAGE	ARR
PX830 PX834 PX835	0610 1530 1720	POM-LAE POM-LAE LAE-POM	0650 1610 1800	PX830 PX824 PX824	0610 1445 1600	POM-LAE POM-GKA GKA-MAG	0650 1535 1620

Use the timetable above to work out the answers to the following.

(a) Show the flight information for flight PX830 on Mondays by filling in the blank columns for the table below.

FLT	DEP	STAGE	ARR
PX830	0610		

(b) What is the time taken for PX830 TO GO FROM Port Moresby to Lae?

Answer: __________

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

SUB-STRAND 3: SUMMARY

- Time is measured in a number of units: **seconds, minutes** and **hours** for short periods, and **days, weeks months** and **years** for longer periods. There are also other units of time we come across like **decade, century** and **millennium**.
- When changing larger units of time to smaller units, multiply the number by the unit equivalence. e.g. 2 minutes to seconds = 2 x 60

  = 120 seconds
- When changing smaller units of time to larger units, divide the number by the unit equivalence.

  e.g. 720 minutes to hours $= \frac{720}{60}$

  = 2 hours
- The analog clock has hour, minute and second hands that move around the clock-face and describe time using a 12-hour system.
- Digital Clocks show us the time using numbers. The number on the left of the (**:**) is Hours, and the number on the right is Minutes:
- The time of day is usually given either by using the clock face system (such as half past 6) or its digital system equivalent of 6:30. This system operates in two groups of 12 hours, morning (midnight to noon) and afternoon (noon to midnight).
- The **12-hour clock** is a time conversion standard in which the 24 hours of the day are divided into two periods called:

  a.m. from **ante-meridian** which means the time from 12 midnight up to just before twelve noon. It means **morning time** (before midday).

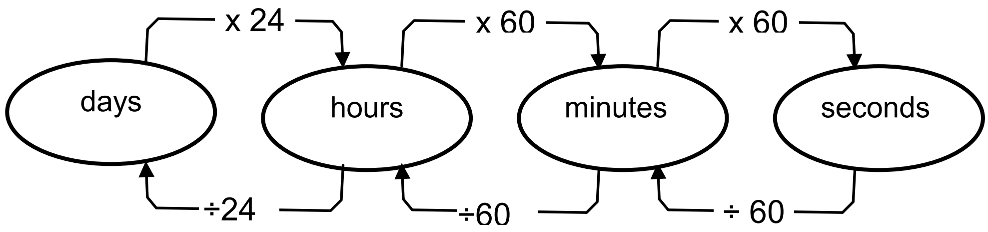
  p.m. from **post-meridian** which means the time from 12 noon up to just before12 midnight. It means **evening time** (after midday).
- The **24-hour clock** notation is a way of telling the time in which the day runs from midnight to midnight and is divided into 24 hours, numbered from 0 to 24.
- Converting a 12-hour time to 24-hour time is straight forward. From 1:00 p.m. to 11:59 p.m. you add 12 hours, and from 12:00 a.m. (midnight) to 12:59 a.m. you subtract 12 hours.
- To find time lengths, if both times are a.m. times and/or both are p.m. times, subtract the two times.
- To find time lengths, if one time is a.m. time and the other is p.m. time change both times to 24 hour time, then subtract the two times.

REVISE LESSONS 11 -16 THEN DO SUB-STRAND TEST 2 IN ASSIGNMENT 4

ANSWERS TO PRACTICE EXERCISES 11-16

Practice Exercise 11

1.



2. a) 900 sec f) 5.833 min
   b) 720 min g) 96 h
   c) 2880 min h) 3.2 d
   d) 25 200 min i) 335 d
   e) 20 wk j) 8 yr

3. b) 3 min45 sec
   c) 3 d 6 h
   d) 3 h 19 min
   e) 3 d 13 h

4. 14 days

5. Thomas

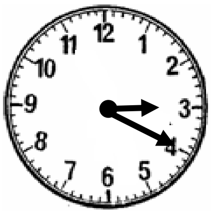
6. Joe

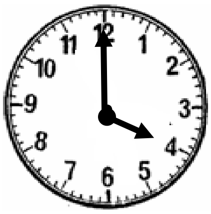
Practice Exercise 12

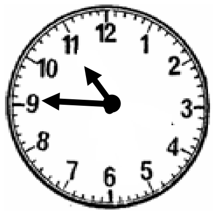
1. Clock 1: 45 minutes after 2 or quarter to 3

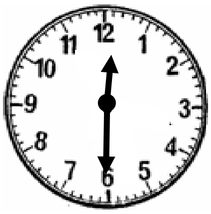
   Clock 2: 52 minutes after 5 or 8 minutes before 6

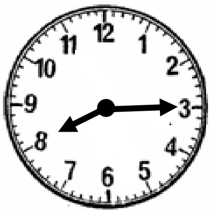
   Clock 3: 56 minutes past 7 or 4 minutes before 8

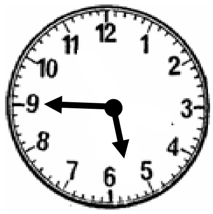
2. a)


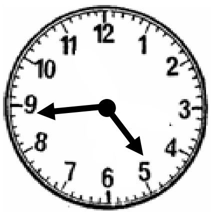
b)


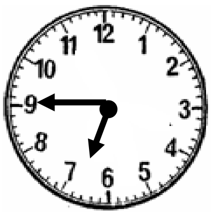
c)


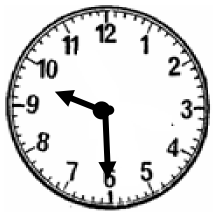
d)


e)


f)


g)


h)


i)


Practice Exercise 13

1. a) ante-meridian; morning time

   b) post-meridian; evening time

2. Clock A: 5:00 a.m.
   Clock B: 7:00 p.m.
   Clock C: 3:00 a.m.
   Clock D: 9:10 p.m.
   Clock E: 5:15 a.m.
   Clock F: 2:55 p.m.

3. a) 2:15 a.m.
   b) 12:10 a.m.
   c) 12.05 p.m.
   d) 3:37 a.m.
   e) 11:55 p.m.

Practice Exercise 14

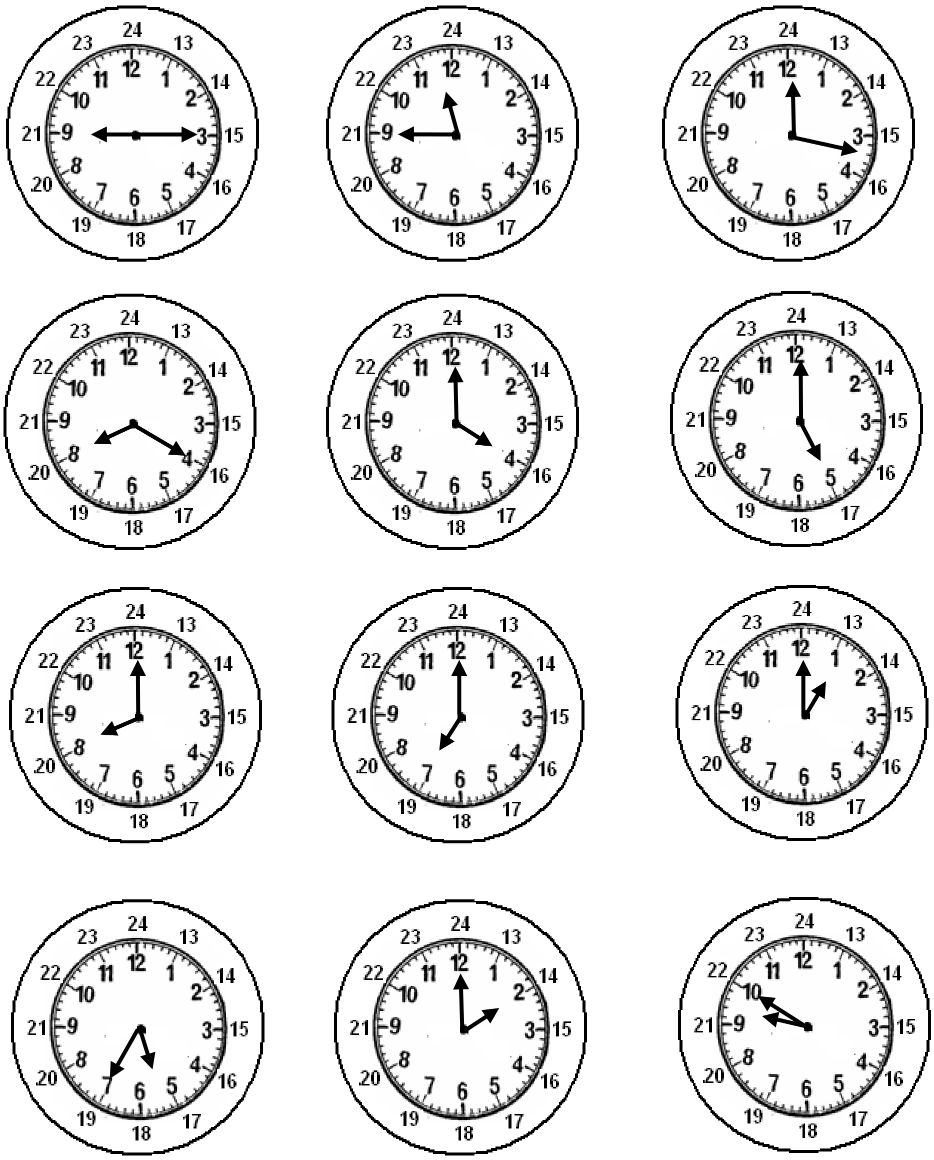
1. Clock A 0630 hours Clock D 0920 hours
   Clock B 0715 hours Clock E 0255 hours
   Clock C 0930 hours Clock F 0620 hours

2. Clock M 1455 hours Clock P 1315 hours
   Clock N 1700 hours Clock R 2335 hours
   Clock O 1500 hours Clock S 2130 hours

3.

(a)	Morning	(b)	Morning	(c)	Morning	(d)	Evening
(e)	Evening	(f)	Morning	(g)	Morning	(h)	Evening
(i)	Morning	(j)	Evening	(k)	Morning	(l)	Evening

4.



Practice Exercise 15

1. (b) thirteen hundred hours
   (c) twenty one twenty hours
   (d) twenty three fifty five hours
   (e) zero hours
   (f) zero o" four hours
   (g) zero fifteen hours
   (h) fourteen hundred hours

2. (b) 1845 h (c) 1405 h (d) 0003 h (e) 0021 h
   (f) 0400 h (g) 2320 h (h) 0241 h (i) 1209 h

3. (b) 1:00 p.m. (c) 9:20 p.m. (d) 11:55 p.m. (e) 12:20 p.m.
   (f) 10:44 a.m. (g) 9:45 a.m. (h) 2:00 p.m.

4. (b) 0010 h (c) 1210 h (d) 0000 h (e) 0800 h (f) 2000 h (g) 1640 h
   (h) 2220 h (i) 1200 h (j) 1720 h (k) 1100 h (l) 2100 h (m) 2305 h

5. a) Joshua woke up at 6:45 a.m.
   b) Miles came home from school at 3:55 p.m.
   c) Andy started his night shift at 10:15 p.m.
   d) Grace ate her lunch at 11:45 a.m.
   e) James went to bed at 8:55 p.m.

6. a) 1600 h b) 4:00 p.m.

Practice Exercise 16

1. a) 5 h 18 min b) 2 min 45 sec
   c) 12 h 15 min d) 11 min 4 sec

2. 36 seconds

3. a) 4 p.m. b) 4:35 p.m. c) 12:30 p.m.

4. 27 minutes

5. 5 hours and 30 minutes

6. a)

FLT	DEP	STAGE	ARR
PX830	0610	POM-LAE	0650

   b) 40 minutes

END OF SUB-STRAND 3

SUB-STRAND 4

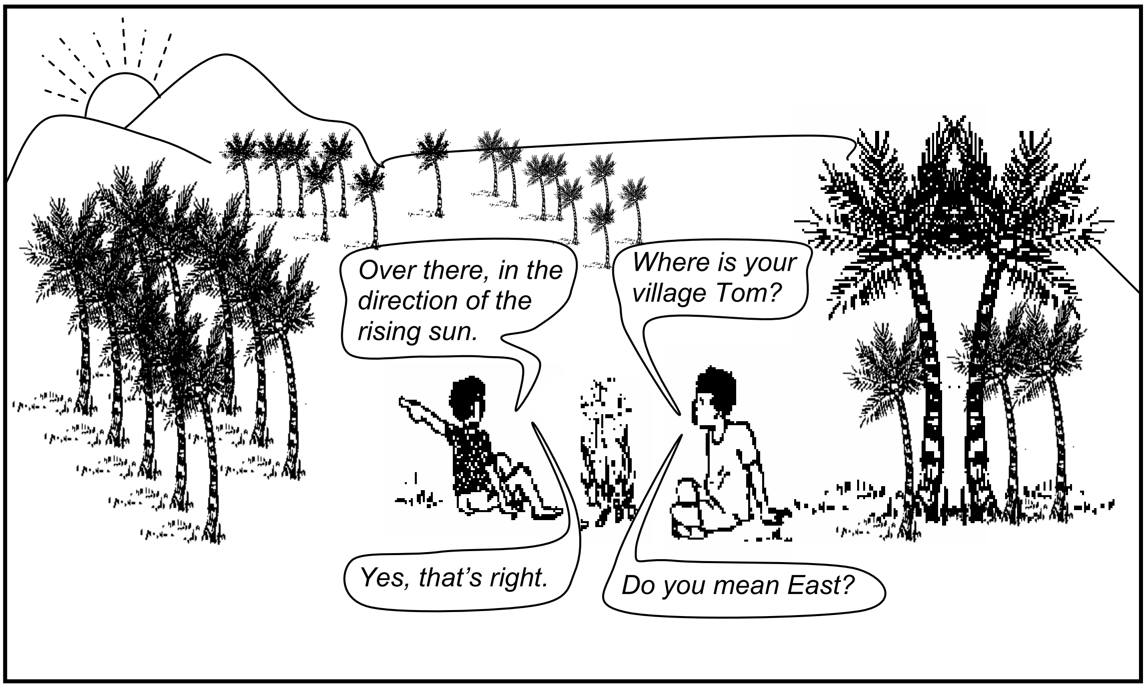
DIRECTIONS

SUB-STRAND 4: DIRECTIONS

Introduction

When we ask a “where” question, we ask something about **directions.**

For example,

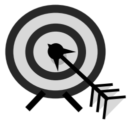


In this sub-strand, you will:

- identify and indicate the four main and intermediate compass directions using a compass and a compass rose
- identify, describe and give directions as bearings accurately
- determine directions from a given bearing
- read maps and keys
- use a scale to calculate distance in a given map
- identify a number plane and plot or locate points on the number plane using ordered pairs as coordinate reference
- record ordered pair coordinates of a point shown on the four quadrant number plane.

Lesson 17: Four Main Compass Directions

You learnt about time in the previous lessons.



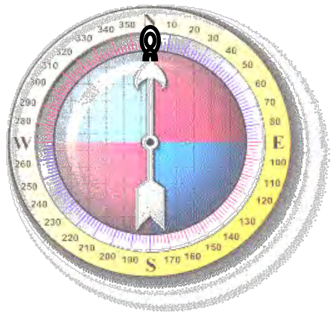
In this lesson you will:

- identify the four main compass directions and the intermediate directions
- use a compass rose to indicate each of the key directions.

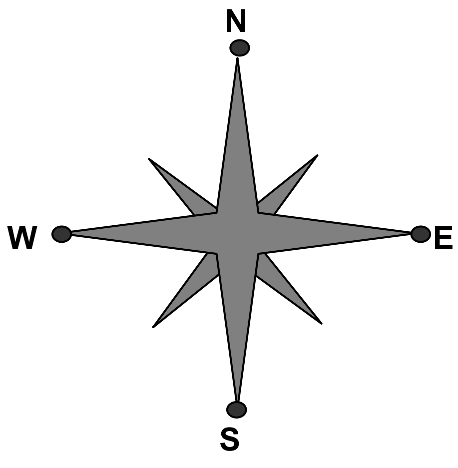
Often, people give directions using their knowledge of angles, using maps and a compass.

A compass is an instrument used to find directions. The needle of the compass always points to the north.

Some examples of **directional compasses** are shown below. They are used to find a direction.

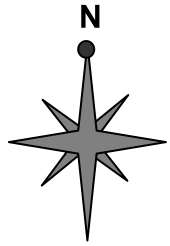


Most maps include a symbol showing compass directions. This symbol is referred to as the **compass rose**. Often only the direction of north is shown.

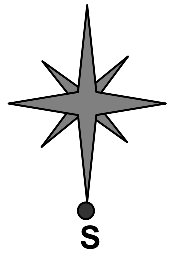


There are four basic points on a compass. These four points are at the top and the bottom, and on the right and left sides of a compass. They are called the **Cardinal Directions** or points of the compass.

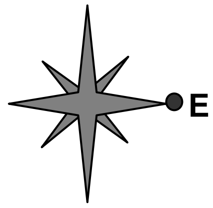
The point at the top is **North (N)**.



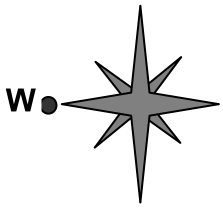
The point at the bottom is **South (S)**.



The point at the right is **East (E).**



The point at the left is **West (W)**.

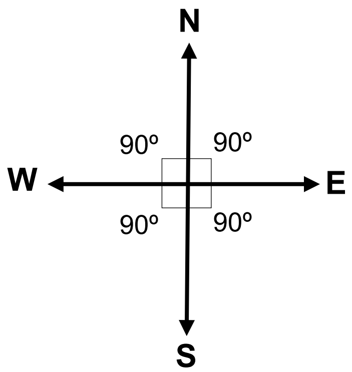


These are the four main compass directions. We use letters N, S, E and W as symbols for these directions.

North and South are opposite directions.

East and West are opposite directions.

A line from North to South is perpendicular to a line from East to West. So, the four main directions are at right angles to each other.



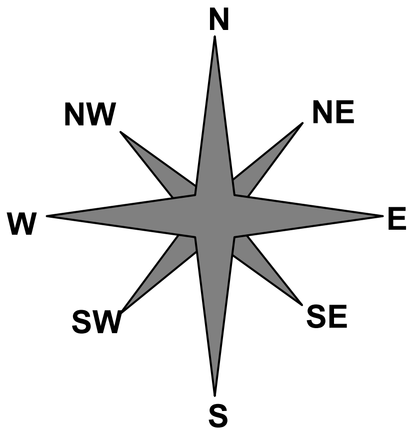
There are four other directions that exist between each main direction. They are halfway between the main directions. These are the:

1. North-east (NE) - the direction which is halfway between the North and East directions.

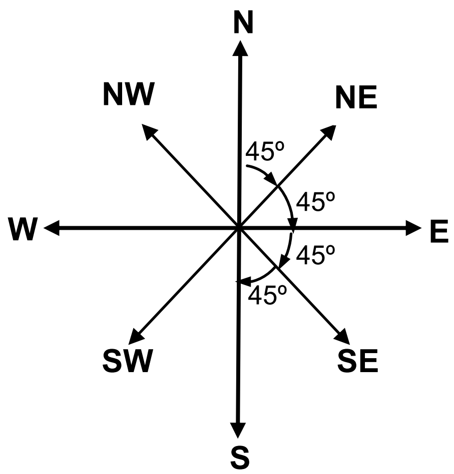
2. South-east (SE) – the direction which is halfway between the South and east directions.
3. North-west (NW) - the direction which is halfway between the North and West directions.
4. South-west (SW) - the direction which is halfway between the South and West directions.

These are called the **intermediate cardinal directions.**

Below is a diagram showing a compass rose with the four main directions and the intermediate compass directions.



As they are halfway between the main directions, they make 45º with the main directions.



Northeast (NE) and Southwest (SW) are opposite directions.

Southeast (SE) and Northwest (NW) are opposite directions.

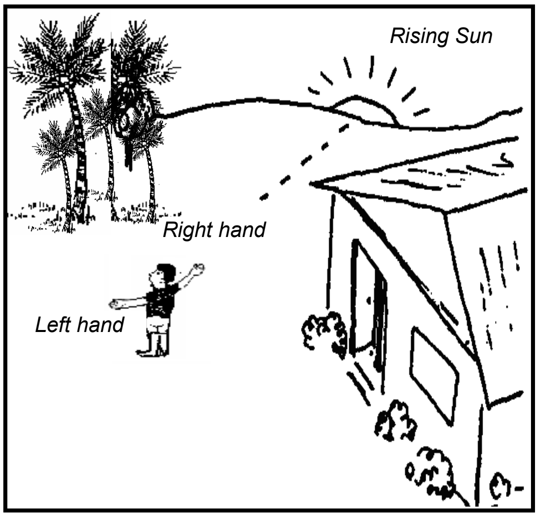
A line from NE to SW is perpendicular to a line from SE to NW.

We use the names of directions in everyday life.

For example, fishermen know that when the wind comes from a particular direction, called “South-east”, then there will be big waves and the sea will be rough so it is dangerous and not safe to go out in a canoe to fish.

Now you will learn how maps and compass can be useful to help us find directions.

Here is an activity for you to do.



Activity 1

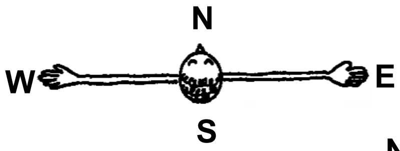
Go outside your house.
With your right hand, point to the direction in which the sun appears in the morning.

(Do you know which one is your right hand? Look at the drawing.)

With your left hand, point to the direction in which the sun sets every evening.

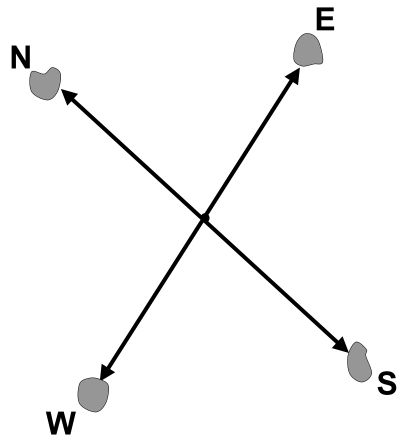
Your right hand is pointing East. Your left hand is pointing West. Your face is looking North. Your back is to the South.

Like this:



Now, mark the 4 main directions on the ground by drawing lines with a stick.

Put 4 stones at points to show the 4 directions, N, S, E and W. mark these with letters.



Do the following:

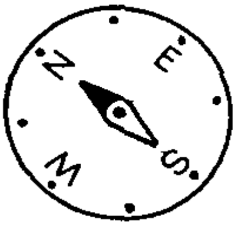
1. Walk 6 steps North.
2. Turn around facing South. Go back 6 steps to where you started from.
3. Face East. Walk 6 steps East.
4. Turn around, facing West. Go back 6 steps to where you started.
5. Face North-east. Walk 6 steps in a North-east direction.
6. Turn around, facing South-west. Go back 6 steps to where you started.
7. Face North-west. Walk 6 steps in a North-west direction.
8. Turn around, facing South-east. Go back 6 steps to where you started.

Now you have taken a short walk in each of the eight (8) directions you have learnt about.

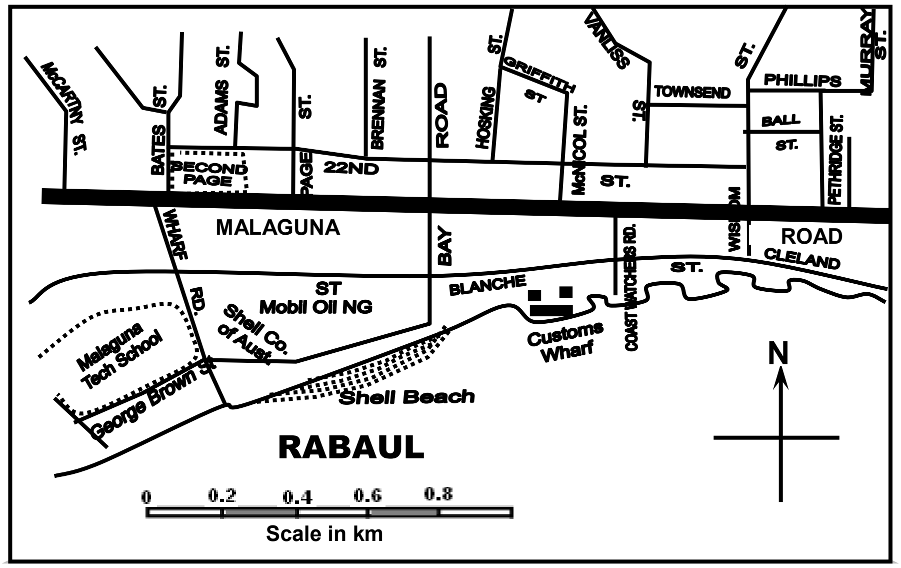
A map and a compass can help you to know which directions to go to get to a place.

Example 1

Below are a compass and a map of Rabaul. The North direction is shown.

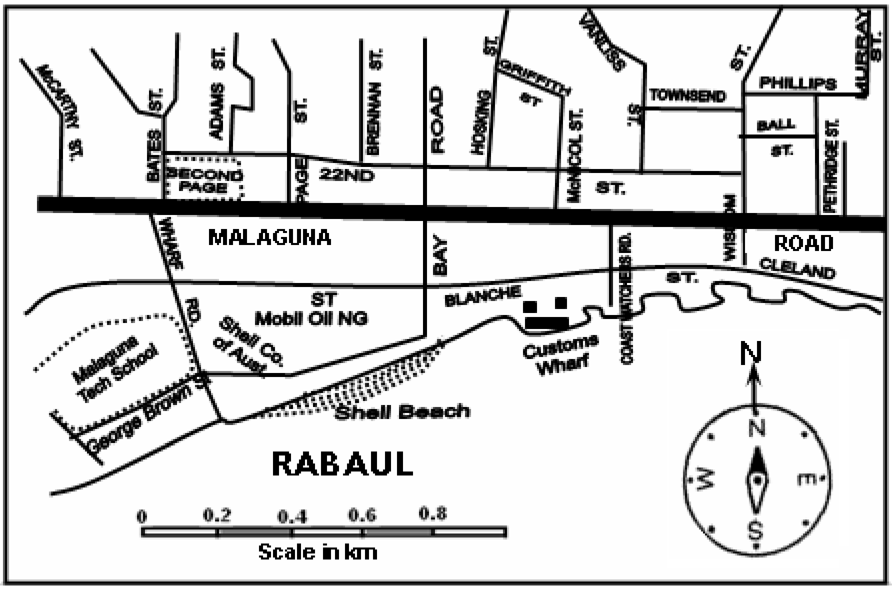


Compass is showing NORTH.



To use the map and compass together,

1. Put the map flat, e.g. on a table.
2. Put the compass on the map in the place where North is shown on the map.
3. Turn the map so the compass needle is lined up with N on the map.



Now you can tell all the directions in Rabaul town.

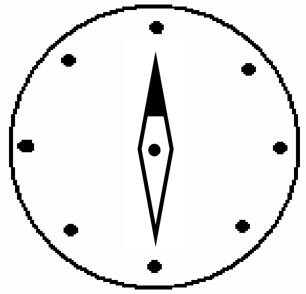
For example, if you want to go along Malaguna Road from McCartny Street, you must go East.

NOW DO PRACTICE EXERCISE 17

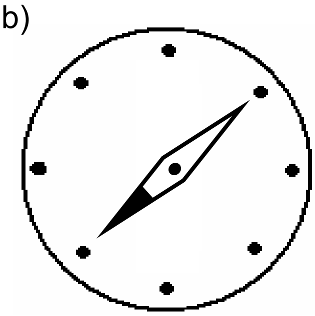
Practice Exercise 17

1. Below are diagrams of 3 compasses. The directions N, S, E, etc, have not been marked on the compasses. Mark in and label the 8 directions you have learnt about on each compass.

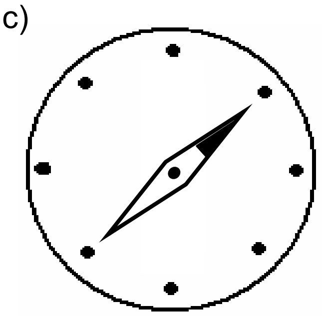
a)



b)



c)



2. Look at the map of Papua New Guinea below.

In what directions is:

Answers:

a) Port Moresby from Lae ____________

b) Kavieng from Rabaul ____________

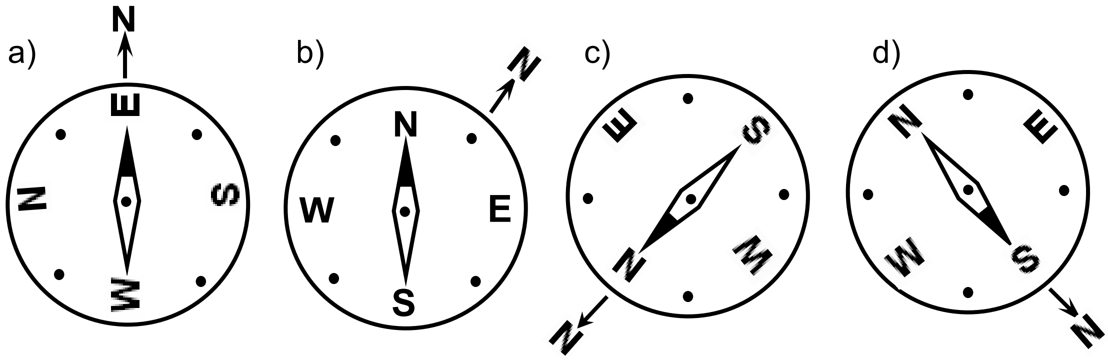
c) Rabaul from Port Moresby ____________

d) Alotau from Kavieng ____________

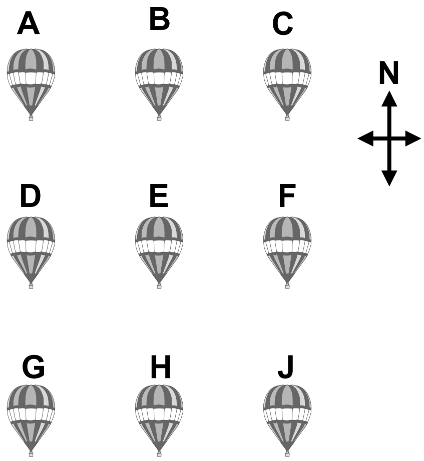
e) Wabag to Kimbe ____________

3. Jackson was using a map and a compass to find out which direction he should go. He placed the compass on the map. Which of the following shows the correct way?

a) b) c) d)



4. The balloons in this diagram represent towns on a map. The direction of North is shown.



Which way will you go if you want to travel

a) from A to B __________

b) from A to E __________

c) from C to G __________

d) from F to B __________

e) from D to B __________

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

Lesson 18: Directions and Bearings

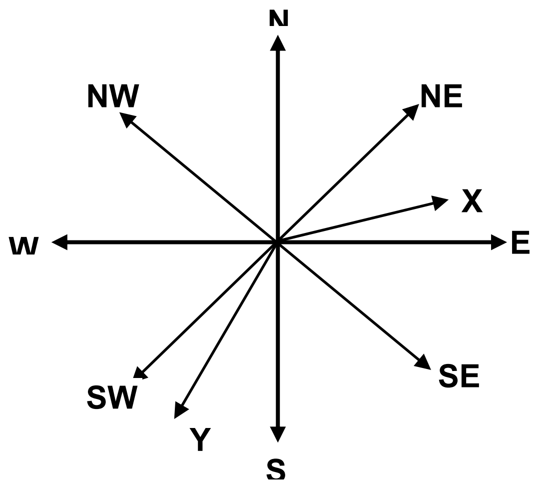
You learnt about the four main compass directions in the previous lesson.

In this lesson you will:

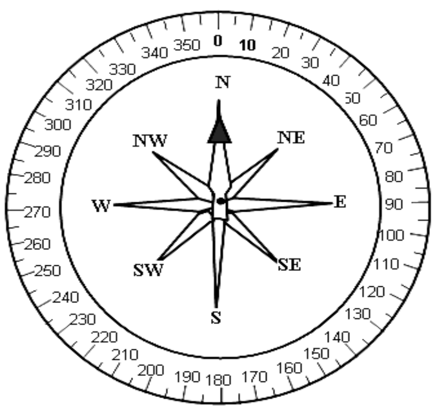
- identify directions accurately as bearings
- describe and give directions using bearings and compass directions
- determine a direction from a given bearing.

Knowledge of angles helps us to navigate or give directions. In Lesson 17, you learnt the different compass directions. You know north, east, west and south, and also north-east, south-east, south-west and north-west.

How could you describe the other directions, such as Direction X and Direction Y on the diagram below?



As you know, directions can also be given in degrees. The points on a compass form a perfect circle and can be divided into 360 equal parts.



Measuring by degrees from North in a clockwise direction, north is 0º and 360º. East is 90º, south is 180º and west is 270º.

There are two main ways of giving directions.

1. As true bearings or simple bearings.
2. As compass bearings.

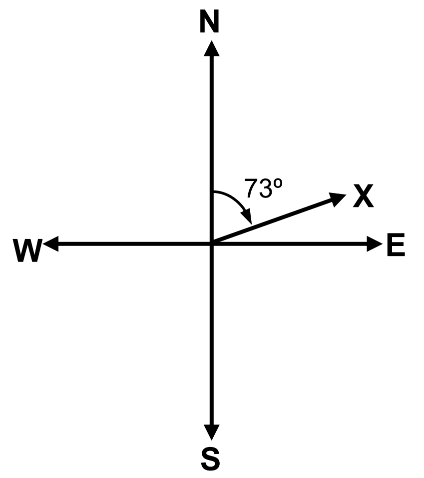
- **True Bearing is an amount of turn or number of degrees measured from north in a clockwise direction. Bearings are always taken clockwise from north.**
- **Compass bearing is the number of degrees east or west of the north to south line. Compass directions always begin with north or south.**

Going back to the first diagram on the previous page, we can describe the other directions such as direction **X** and direction **Y** as follow:

Direction X can be described as:

a) Bearing 073º. (It is traditional to use three digits to describe a bearing)

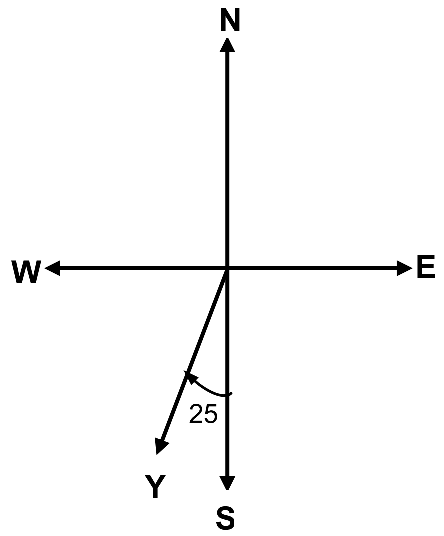
b) Compass direction N73ºE. This means 73º towards the east from north.



Direction Y can be described as:

a) Bearing 205º. This is the angle it makes clockwise from north

b) Compass direction S25ºW. This means 25º towards the west from south.

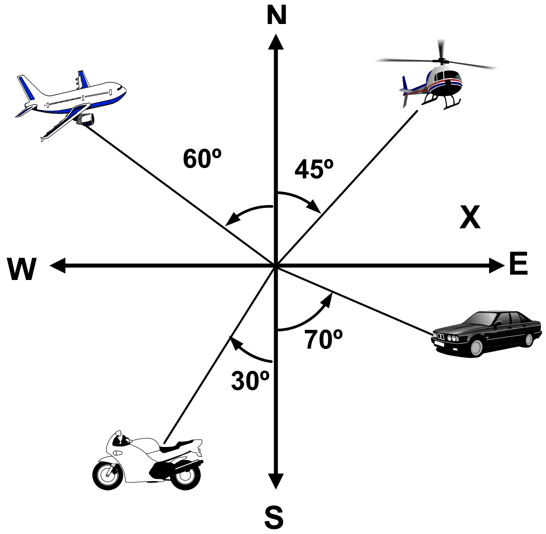


There are three things you have to remember when writing or giving directions;

1. Will the location be measured in relation to north or south?
2. What is the angle of the location in relation to the north-south line?
3. Is the location east or west of the north-south line?

Example

Refer to the diagram below.



Direction of the  can be described as:

a) Bearing 300º. This is the angle it makes clockwise from north.

b) Compass direction N60ºW. This means 60º towards the west from north.

Direction of the  can be described as:

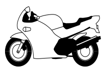
a) Bearing 045º. This is the angle it makes clockwise from north.

b) Compass direction N45ºE. This means 45º towards the east from north.

Direction of the  can be described as:

a) Bearing 110º. This is the angle it makes clockwise from north.

b) Compass direction S70ºE. This means 70º towards the east from south.

Direction of the  can be described as:

a) Bearing 210º. This is the angle it makes clockwise from north.

b) Compass direction S30ºW. This means 30º towards the west from south.

NOW DO PRACTICE EXERCISE 18

Practice Exercise 18

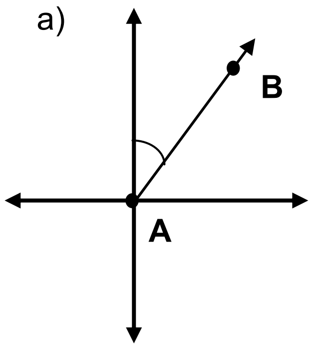
1. Knowing that north is 0º, how many degrees clockwise from north are the following compass points?

a) NE b) SE c) SW d) NW

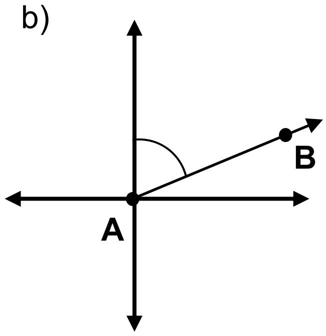
2. Complete the table by measuring the angles shown in the figures below with your protractor to find the bearing of the boy (**A**) to the girl (**B**).

	Angle, as shown, from the boy to the girl	**True bearing**	**Compass bearing**
a			
b			
c			
d			
e			

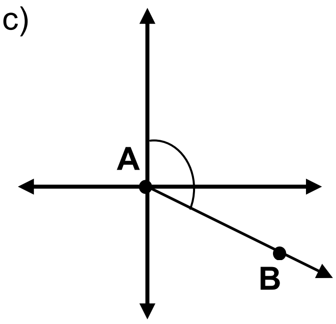
a)



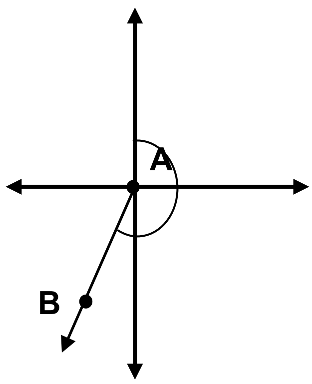
b)



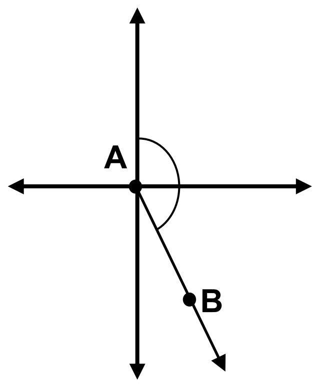
c)



d)

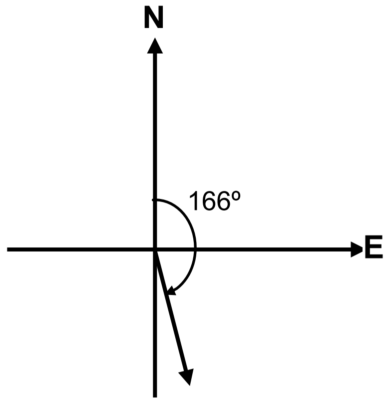


e)



3. Use your protractor to draw the diagrams to illustrate the true bearings and compass bearings of the following. the first one is done for you.

a) 166º



b) S15ºW

c) N85ºW

d) 035º

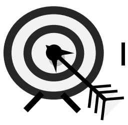
e) 315º

f) N35ºE

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

Lesson 19: Reading Maps

You learnt to identify, describe and give directions using bearings in Lesson 18.



In this lesson you will:

- read maps and use keys.

In Lesson 18, you learnt how a map and a compass can be useful to help you find in which direction to go to get to a place.

Let us start the lesson by defining a map and enumerating the different features of a map.

A map is simply a plan, chart, drawing or diagram of the ground on paper. The plan is usually drawn as how the land would be seen from directly above.

A map is simply a drawing or picture (in two dimensions) of a landscape or area of a country (in three dimensions).It could be anything from a sketch map for a visitor to find your school to a detailed map of a town centre or mountain range.

Using a map you can visualize in your mind what the place that you are going to looks like. You can also see landmarks and features that you will pass on the way to your destination.

Maps mean you know what to expect. They help you to know that you are going in the right direction and that you will arrive at your destination safely and quickly.

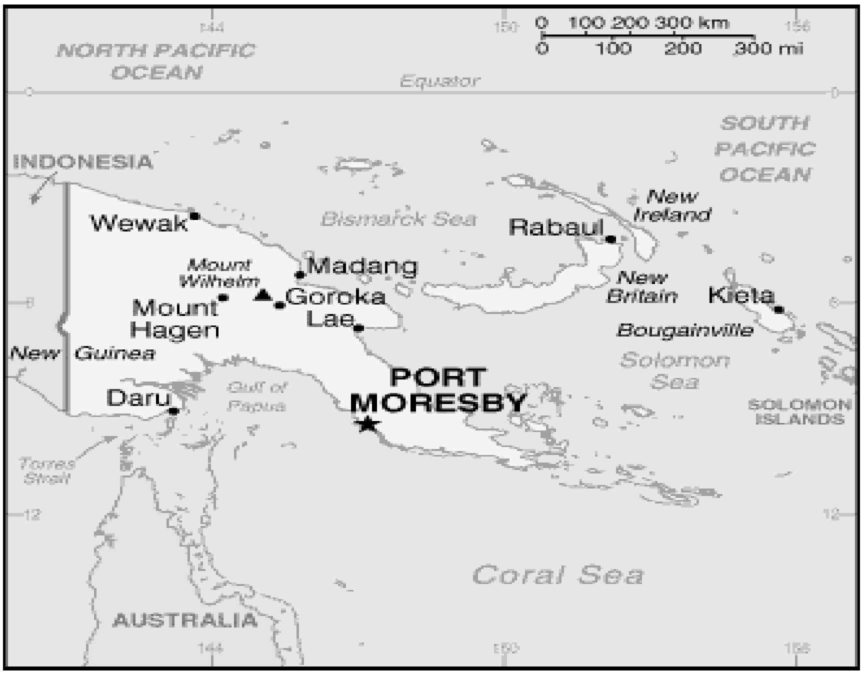
Maps are the basic tools of geography. They enable us to give a picture of the small or large portion of the earth on paper.

A map has the following features:

1. The names of important places and locations.
2. Standard symbols to show the location of key landmarks and features.
3. A key or a legend, to explain what the symbols on the map mean.
4. A scale and scale bar to allow you to measure distance on the map and convert it to the actual distance on the land.
5. A grid system of lines to allow you to pinpoint your location, orientate your map to the land and quickly estimate distances.
6. Contour lines to show relief, that is, the height of the ground above sea level and the steepness of the land.

See example of a map on the next page.

MAP OF PAPUA NEW GUINEA



In reading maps, one of the most useful features that you must know is the use of legend or key and symbols.

Map Symbols

Most maps use a number of special signs **or symbols**. These symbols are used on the map so that it will look neat and orderly and does not become cluttered with words.

Since a map is a reduced representation of the real world, map symbols are used to represent real objects. These symbols show the location of such things as mountains, rivers, towns, roads, railway lines and bridges. Without symbols, we wouldn't have maps. Where possible, the symbols are drawn so that they look like the things they represent.

Both **shapes** and **colours** can be used for symbols on maps.

For example,

A small circle may mean a point of interest, with a brown circle meaning recreation, red circle meaning services, and green circle meaning rest stop. Colours may cover larger areas of a map, such as green representing forested land and blue representing waterways.

To make sure that a person can correctly read a map, the meaning of all the symbols that have been used on the map must always be explained in the **legend**.

Map Legend is a key to all the symbols used on a map. It is like a dictionary so you can understand the meaning of what the map represents. The key is always found at the bottom of the map.

Here are some common symbols from a key on a Topographic Map.

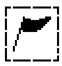
KEY

Meaning	Symbol
Main road	
Street	
Hospital	
Airport	
Forest/trees	
Mountain	
Railway Station	
Post Office	
Telephone Company	
Police Station	

Any of these features can be useful landmarks, helping you to check your position on the map.

Here are other examples of symbols used on some recreational maps.

KEY

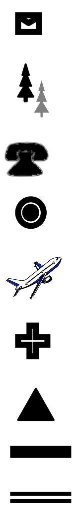
Meaning	Symbol
Sports track	
Swimming pool	
Stadium	
Golf course	
Golf driving range	
Campground; Picnic site	
Historic site or point of interest	

NOW DO PRACTICE EXERCISE 19

Practice Exercise 19

1. Match the symbols with their meanings using connecting lines.

Symbol

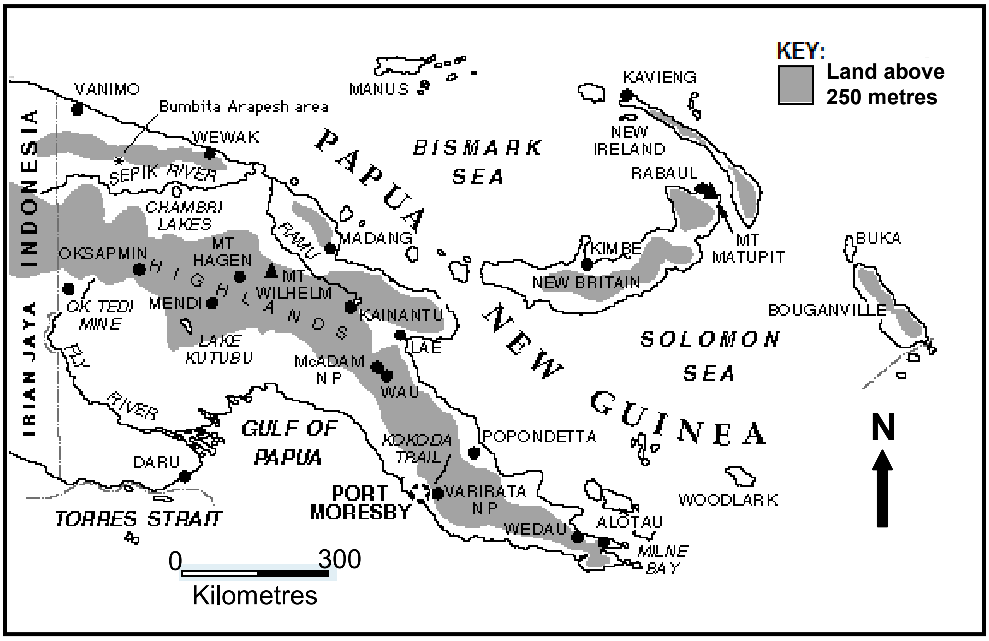


Meaning

Airport
Police station
Hospital
Mountain
Forest
Main road
Telephone company
street
Post office

2. Look at the Physical Map of Papua New Guinea and answer the questions that follow.

PHYSICAL MAP OF PAPUA NEW GUINEA



a. What is the height of the land around Mt. Hagen?

b. Name three towns not located located in areas above 250 metres.

3. Below is an example of a key from an atlas. Look at the key and answer the question that follows.

Minerals

Bauxille	⊗	Lead	▼
Coal	●	Oil	○
Copper	■	Silver	□
Diamonds	◇	Tin	T
Gold	+	Uranium	U
Iron Ore	X	Zinc	Z

What do the following symbols stand for? Write your answer in the space provided on the right.

a) □ ________________

b) U ________________

c) ○ ________________

d) ◇ ________________

e) ■ ________________

f) + ________________

g) ⊗ ________________

h) X ________________

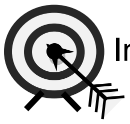
i) ● ________________

j) ▼ ________________

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

Lesson 20: The Scale for Length

You learnt how to read maps using symbols and keys in Lesson 19.



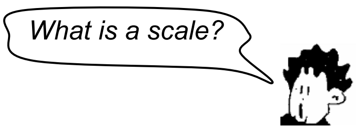
In this lesson you will:

- define a scale for length
- calculate the real distance between two points from a map using scale.

You probably know someone who has collections of model cars, aeroplanes or ships. Scale models come in different sizes and shapes. Scale models are made with great care so that they look just like the real thing, but usually much smaller. The real object has been **scaled down** so that the model is small enough to fit the shelf or a cupboard.

It is often useful to make a drawing of real life object which is smaller or larger than the object but which still has the same proportions. This is called **scale drawing**. The **scale** for such drawings tells us how the size of the drawing and the size of the real object are related.

The amount by which a model is smaller or larger than the real object is shown by the **scale.**



You have learnt something about Scale for Length in Sub-strand 4 Lesson 24 of your Grade 7 Mathematics Strand 1.

Here is the definition again.

A scale or scale for length is the ratio by which a shape is changed by increasing or decreasing its size.

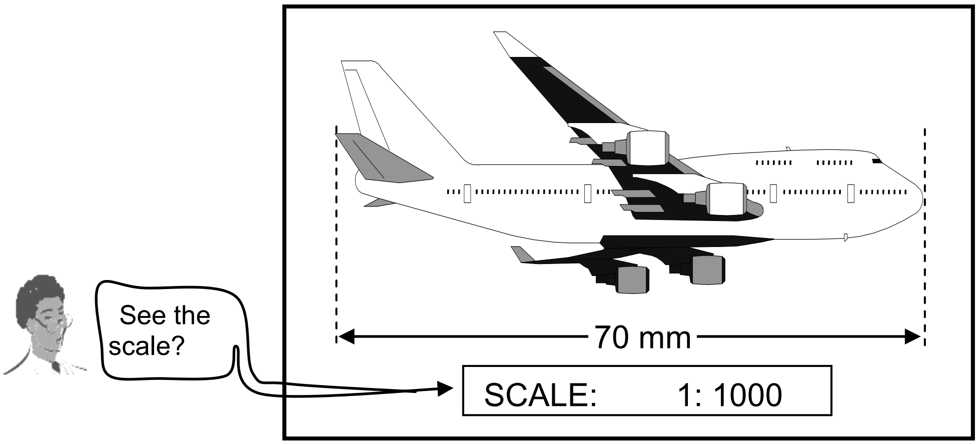
Scales for length are shown on drawings or diagrams such as maps or plans of buildings and can be used to work out actual lengths and distances.

For example, when an architect or an engineer designs a building or an aeroplane, a scale drawing is prepared to show exactly what the building or aeroplane will look like. The drawings show the shape, but if we have to find the real life size, we must know the scale for the drawing.

Scale = length on drawing : real length

The diagram shows a drawing of an aeroplane.

The real aeroplane is bigger than the drawing.



The scale for length of the drawing is shown.

SCALE: 1: 1000

This means that 1 unit on the drawing represents 1000 units on the real aeroplane. This also means:

1mm on the drawing represents 1000 mm on the real aeroplane.
1 cm on the drawing represents 1000 cm on the real aeroplane.

Showing one unit for the drawing measure compared with the number of units for the actual measure makes it easy to use the scale to change from a drawing measure to the actual measure.

For the scale 1: 1000 it means that the drawing measure is to be multiplied by 1000 to give the actual measure. We call 1000 the **scale factor**.

Example 1 The length of the aeroplane in the drawing above is 7 cm. The actual length of the aeroplane can be found in this way:

Actual length = drawing length x scale factor
= 7cm x 1000
= (7 x 1000) cm
= 7000 cm

Or a more useful way of writing this measurement would be in metres:

Actual length = 7000 cm
= (7000 ÷ 100)
= 70 m

Therefore, the actual length of the aeroplane is 70 m.

The idea of having to make things much smaller than they really are is important in drawing maps.

The scale of a map tells us the relationship between distance on the map and actual distance on the ground.

The scale of a map is the ratio of the map distance to actual distance.
SCALE = Map distance : Actual distance

The scale of a map is usually shown as a ratio in one of these three ways.

1. By writing it in words

e.g. 1 centimetre to 1 kilometre

This means that 1 centimetre on the map represents 1 kilometre in real life.

Other examples in words are:

a) 1 centimetre to 1 metre
b) 1 centimetre to 10 metres
c) 1 centimetre to 200 metres

2. By showing it in numbers as a representative fraction or ratio

e.g. as representative fraction $\frac{1}{1000}$

as ratio 1:1000

If a map has a scale of 1: 1000, then this means one distance on the map is one thousand times bigger in real life.

1:1000 means that:

- 1 mm on the map represents 1000 mm (or 1 m) in real life.
- 1 cm on the map represents 1000 cm (or 10 m) in real life
- 1 m on the map represents 1000 m (or 1 km) in real life.

Look at these examples used on some maps.

Map Scale	Meaning in words
1:25 000	1centimetre to 250 metres
1:50 000	1 centimetre to 500 metres
1:100 000	1 centimetre to 1 kilometres

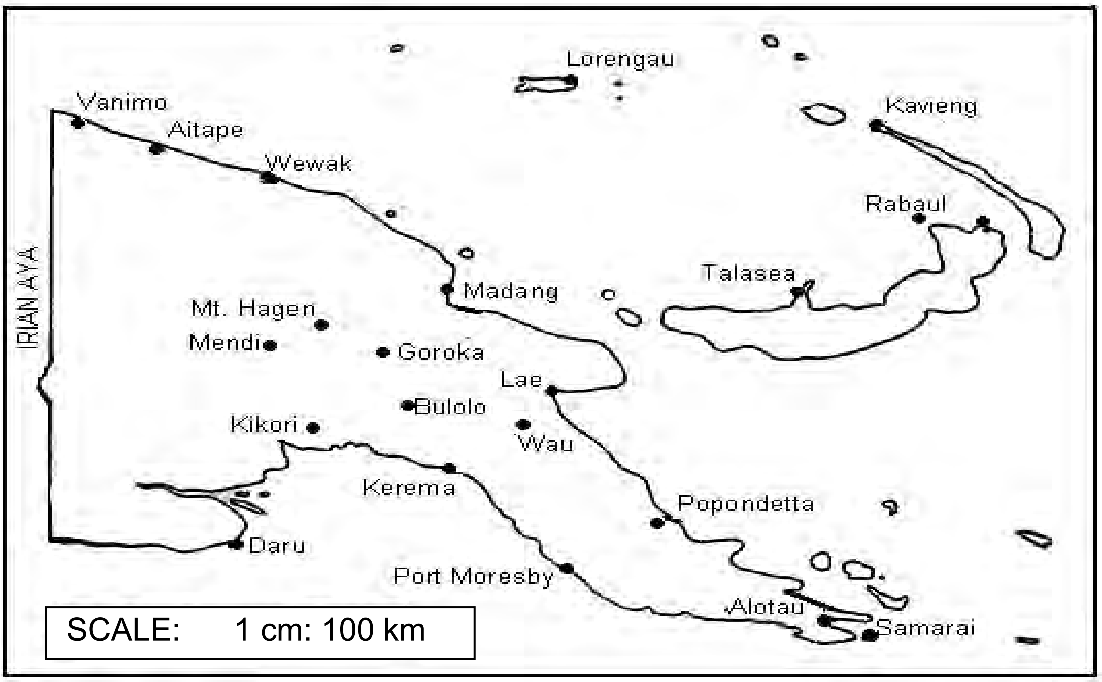
3. By drawing it as a line scale

Example: 

Kilometres

The length of the segment from 0 to 5 on the diagram is 5 cm. So for this map scale, 5 cm on the map represents 5 km actual distance. That is, 5 cm : 5 km. To write the scale in useful form we have 1: 200 000.

Now look at the map which shows part of Papua New Guinea.



The map of PNG is the same shape as PNG, but a different size.
The map is drawn using a scale for length of 1 cm : 100 km.
We can use the scale to work out the real distance between places on the map.

Example 1

What is the real distance between Kerema and Popondetta if their distance on the map is 3.5 cm?

Solution:

Use the scale for length shown on the map to work out the real distance.

The scale for length is 1 cm:100 km. This means that 1 centimetre on the map represent 100 km on the ground.

So, 3.5 cm = 3.5 x 100 km

= 350 km

Therefore, the distance from Kerema to Popondetta is **350 km.**

Example 2

If on the map, the distance between Madang and Wewak is 4 cm, what is their real distance?

Solution:

Use the scale for length of 1 cm :100 km

So, 4 cm = 4 x 100 km

= 400 km

Therefore, the distance between Madang and Wewak is **400 km**.

NOW DO PRACTICE EXERCISE 20

Practice Exercise 20

1. Write each of the following scales as a ratio.

   a. 1 centimetre to 3 kilometres ____________________
   b. 2 millimetres to 1 kilometre ____________________
   c. 1 centimetre to 15 metres ____________________
   d. 3 centimetres to 105 kilometres ____________________
   e. 1 millimetre to 25 metres ____________________

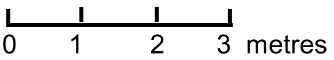
---

2. Express the following scales as a fraction;

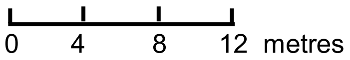
   a. 1 millimetre to 500 kilometres ____________________
   b. 3 millimetres to 5 kilometres ____________________
   c. 2 centimetre to 35 metres ____________________
   d. 1 centimetre to 10 metres ____________________
   e. 10 millimetres to 3 kilometres ____________________

---

3. Write each of the following linear scales in words.

   a. 

____

   b. 

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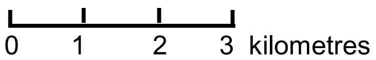
   c. 

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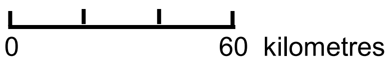
   d. 

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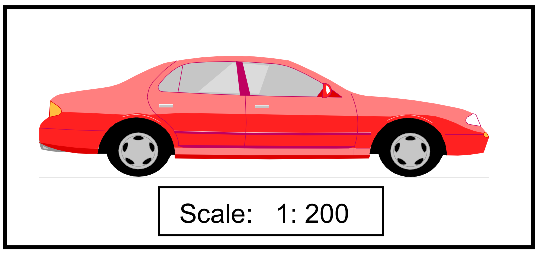
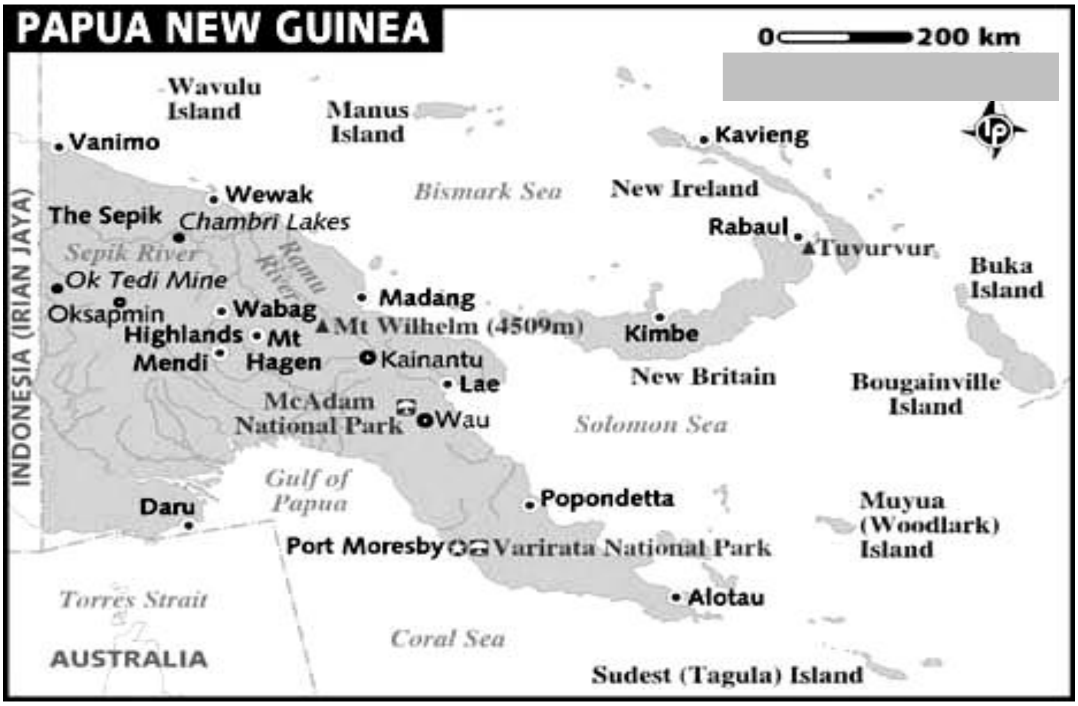
4. If the length of the drawing of the vehicle on paper is 6 cm, how long is the vehicle in real life?



Answer: ______________

5. Refer to the map of PNG to answer the following questions.



a) What scale is shown on the map?

Answer: ___________

b) Explain what the scale means.

Answer: ____

c) What are the actual distances shown by each of these map measurements?

i. 2 cm ___________

ii. 4.5 cm ___________

iii. 10 cm ___________

iv. 11.5 cm ___________

v. 8 cm ___________

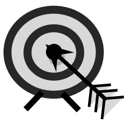
d) Using a ruler, measure the distance on the map. What is the actual distance between Port Moresby and Rabaul?

Answer: ___________

CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

Lesson 21: Coordinates and the Number Plane

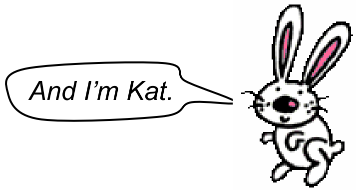
You learnt about scale for length and calculate real distance on the ground using the scale for length in Lesson 20.



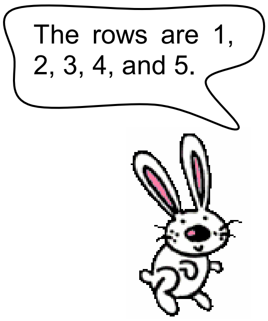
In this lesson, you will:

- define number plane
- plot points on the number plane using ordered pairs as coordinate reference.

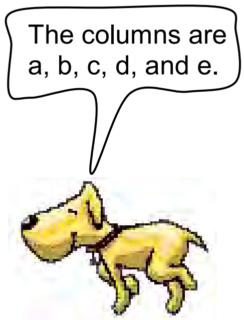
First let us revise some of the terms you have learnt in your Lower Primary about coordinates by starting our lesson with the example below. Our two friends Kit and Kat will help us in the discussion.



Look at this plan for a secret code.



ROWS					
5	A	B	C	D	E
4	F	G	H	I	J
3	K	L	M	N	O
2	P	R	S	T	U
1	V	W	X	Y	Z
	a	b	c	d	e
	COLUMNS				



We can find any letter on the plan by looking *first* at the COLUMNS and *second* at the ROWS.

e.g. The letter G is written as b4 (COLUMN b, ROW 4)

The letter O is written as e3 (COLUMN e, ROW 3)

So, we can write the word GO as b4, e3.

Example 1

Here"s how to write the secret message "GO TO SKULL CAVE" using the secret code.

	G O	T O	S K U L L	C A V E
Answer:	b4, e3	d2, e3	c2, a3, e2, b3, b3	c5, a5, a1, e5

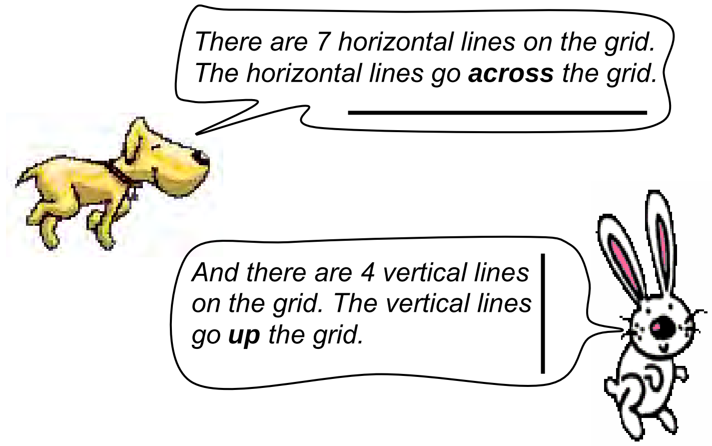
Example 2

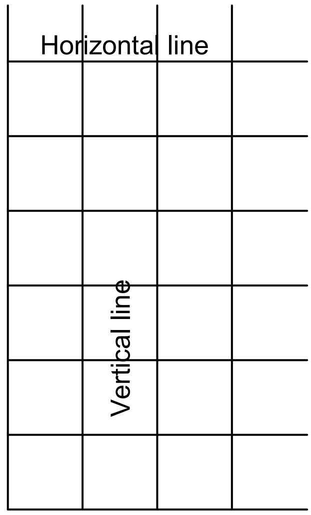
a) Write the sentence BELOW in secret code using the secret code plan in the previous page.

COME AT SIX

Answer: **c5, e3, c3, e5** **a5, d2,** **c2, d4, c1**

Now look at the GRID on the right.





A grid is a pattern of horizontal and vertical lines which are evenly spaced.

There are two special lines on the grid.

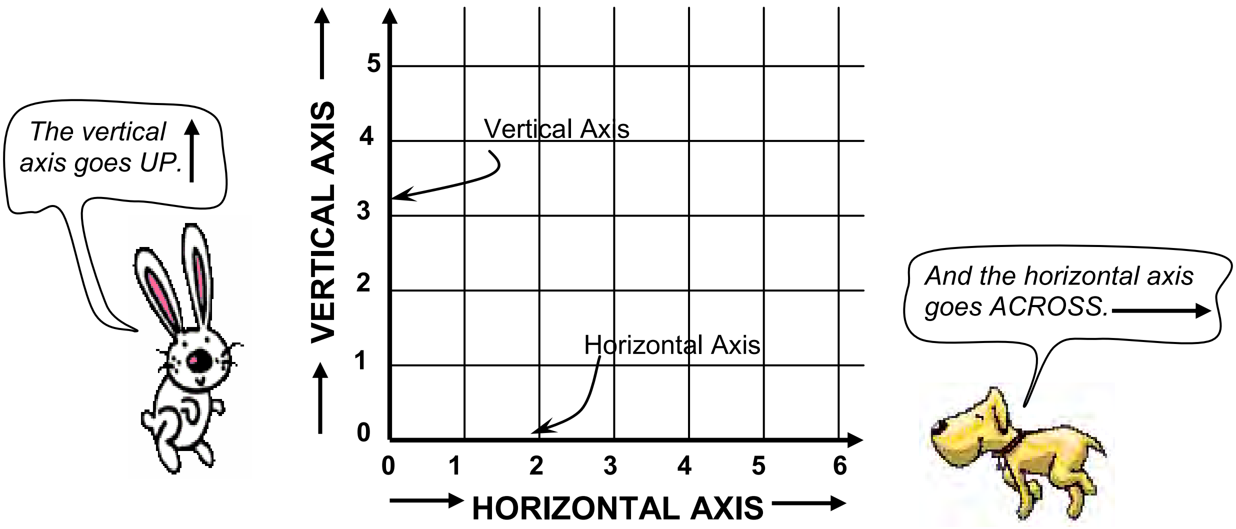
These two lines are: HORIZONTAL AXIS, and
VERTICAL AXIS

(The plural of AXIS is AXES. You say AKS-eez).

The grid lines are numbered on both axes.

The starting point on the grid is known as the origin.

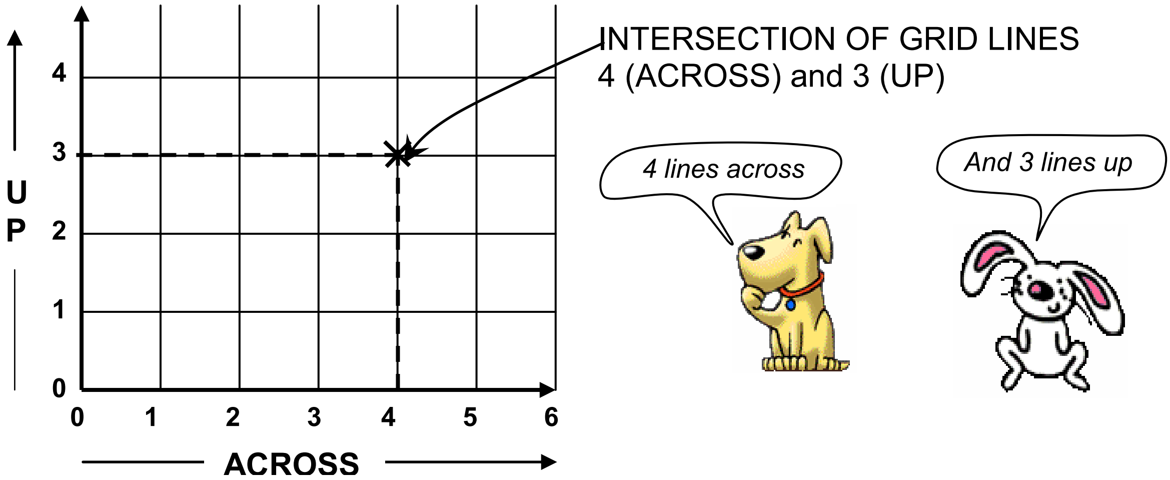
Axis is a line on a grid which has evenly spaced numbers on it (plural is Axes).



The lines on the grid cross in many places. The point where two lines cross each other is called INTERSECTION.

The intersection is the point where two lines meet or cross each other.

We can use the horizontal axis numbers and the vertical axis numbers to locate the position of any point on the grid.



We use two numbers to describe and represent the position of a point on the grid.

These two numbers are called COORDINATES. (*You say ko – ord – in –ates).*

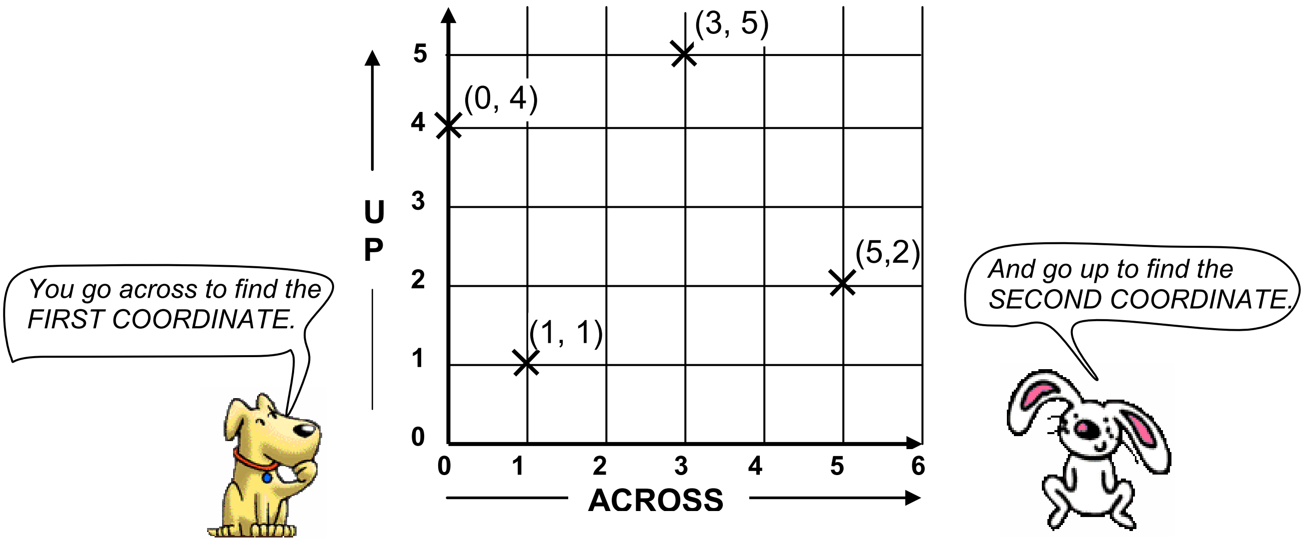
The first number means ACROSS and the second number means UP.

We sometimes called coordinates “ORDERED PAIRS”, because they are a pair (2) of numbers which are written in a special order.

A coordinate is an ordered pair of numbers which describe and represent the position of a point.

Look at the grid below. The points on the grid are named using their coordinates.

The points are named: (0, 4), (3, 5), (1, 1), (5, 2)



Example 1

In the diagram describe the position of the point (3, 5).

3 is the FIRST COORDINATE.

5 is the SECOND COORDINATE.

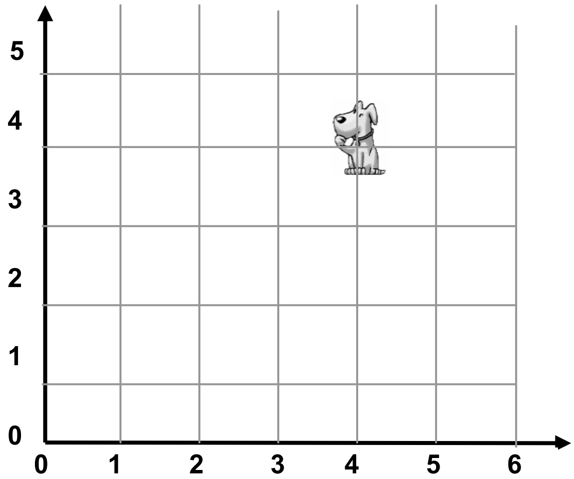
(3 , 5)

FIRST COORDINATE SECOND COORDINATE

Answer: **Point (3, 5) is "3 across and 5 up".**

Example 2

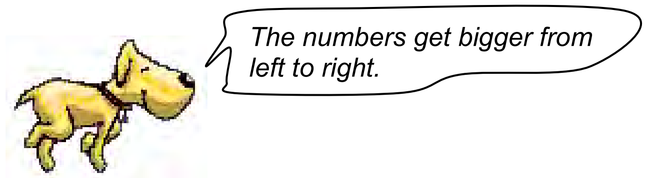
In the diagram, describe the position of the centre of Kit from the origin.



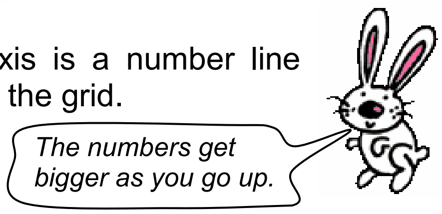
Answer: **Kit is 4 across and 4 up from the origin.**

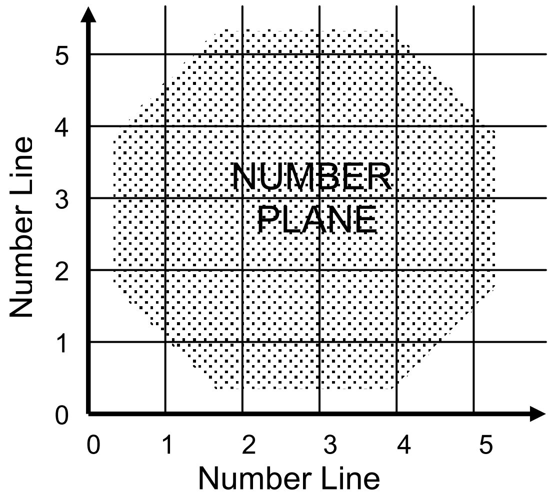
The *horizontal axis* and the *vertical axis* on a grid are ***number lines***.
The ***area*** marked by the grid is called a ***Number Plane***.

The horizontal axis is a number line which goes ***across*** the grid.



The vertical axis is a number line which goes ***up*** the grid.



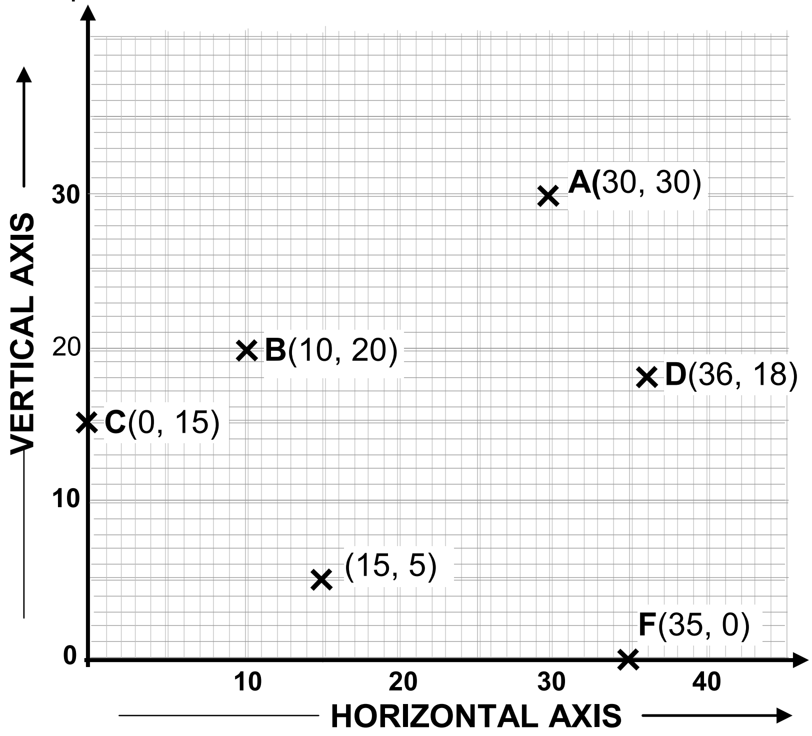


A number plane is a flat surface made up of all the set of points we can describe using coordinates.

Example 1

Give the coordinates of the points A, B, C, D, E, and F marked with x on the number plane below.

Answers:
Point A is (30, 30)
Point B is (10, 20)
Point C is (0, 15)
Point D is (36, 18)
Point E is (15, 5)
Point F is (35, 0)



Example 2

Give the coordinates of the points A, B, C, D, and E marked with a cross x on the number plane below.

Answers:

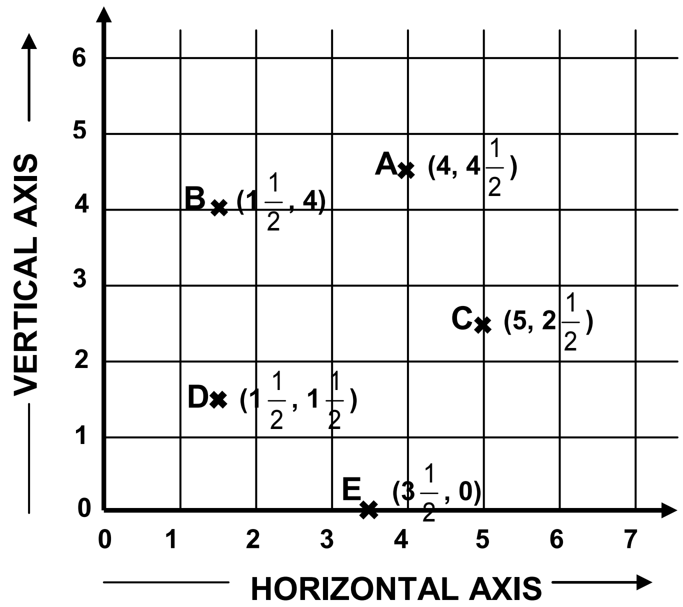
Point A is $(4, 4\frac{1}{2})$

Point B is $(1\frac{1}{2}, 4)$

Point C is $(5, 2\frac{1}{2})$

Point D is $(1\frac{1}{2}, 1\frac{1}{2})$

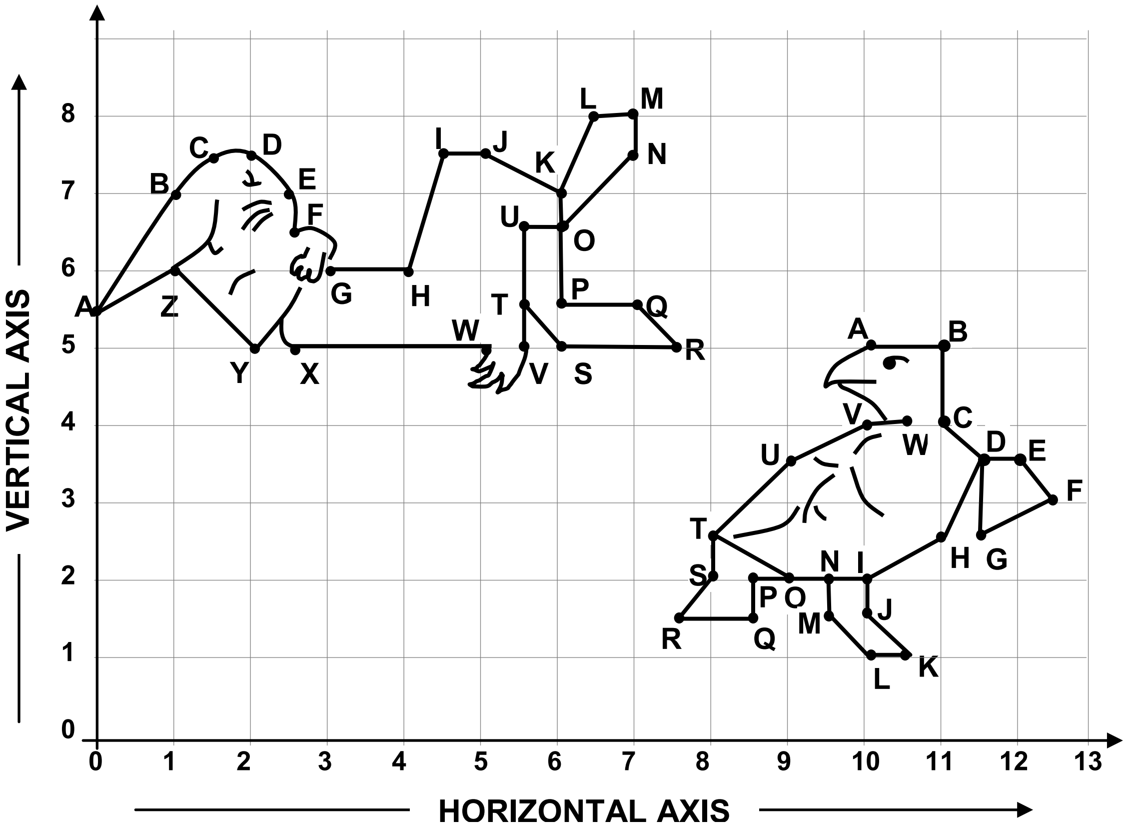
Point E is $(3\frac{1}{2}, 0)$



Example 3

Do you know the story of the HARE AND THE TORTOISE? The two decided to have a race. The hare ran faster, but he slept along the way. The tortoise went slower but he kept on. In the end, the tortoise was the winner.

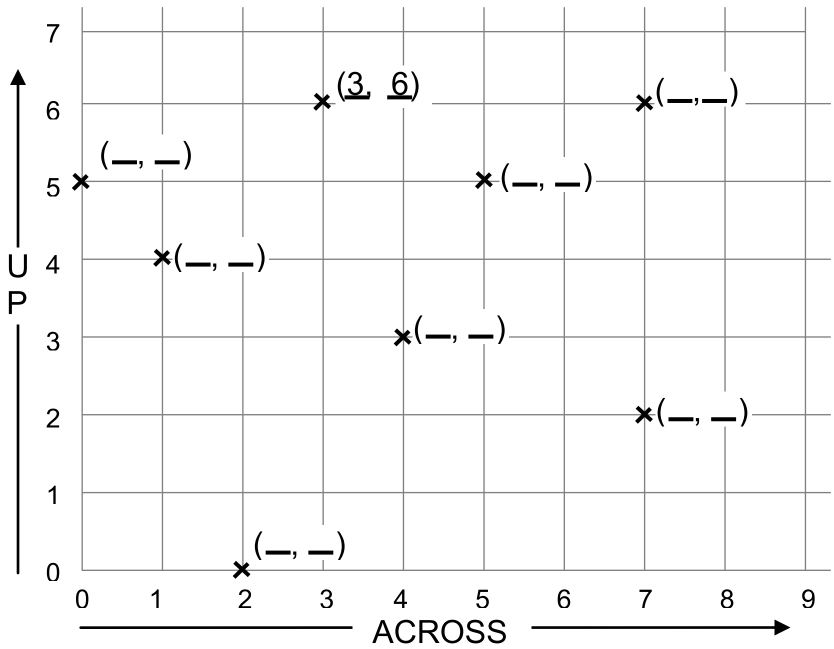
We have used coordinates to make this picture.



NOW DO PRACTICE EXERCISE 21

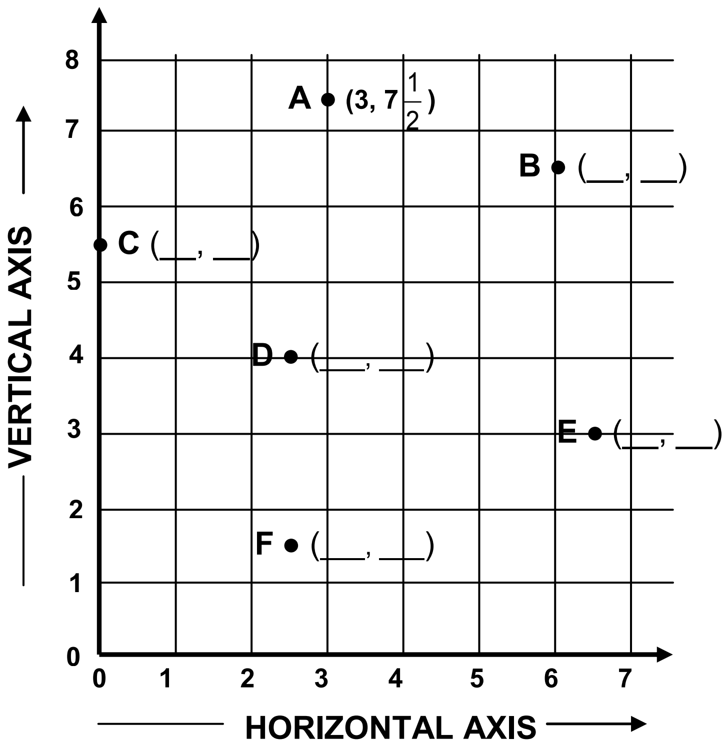
Practice Exercise 21

1. Write the coordinates of the points on the grid in the spaces provided. One of them has been done for you. It is the point (3, 6).

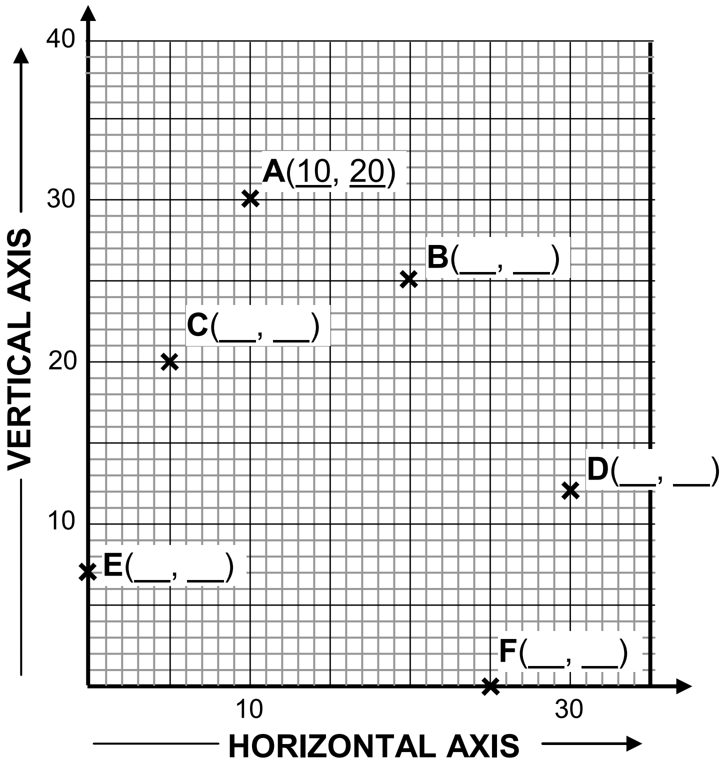


2. Give the coordinates of the points which are marked with the symbol ● or **x** on the number planes below. Write your answers in the spaces provided on the number planes. Examples are shown.

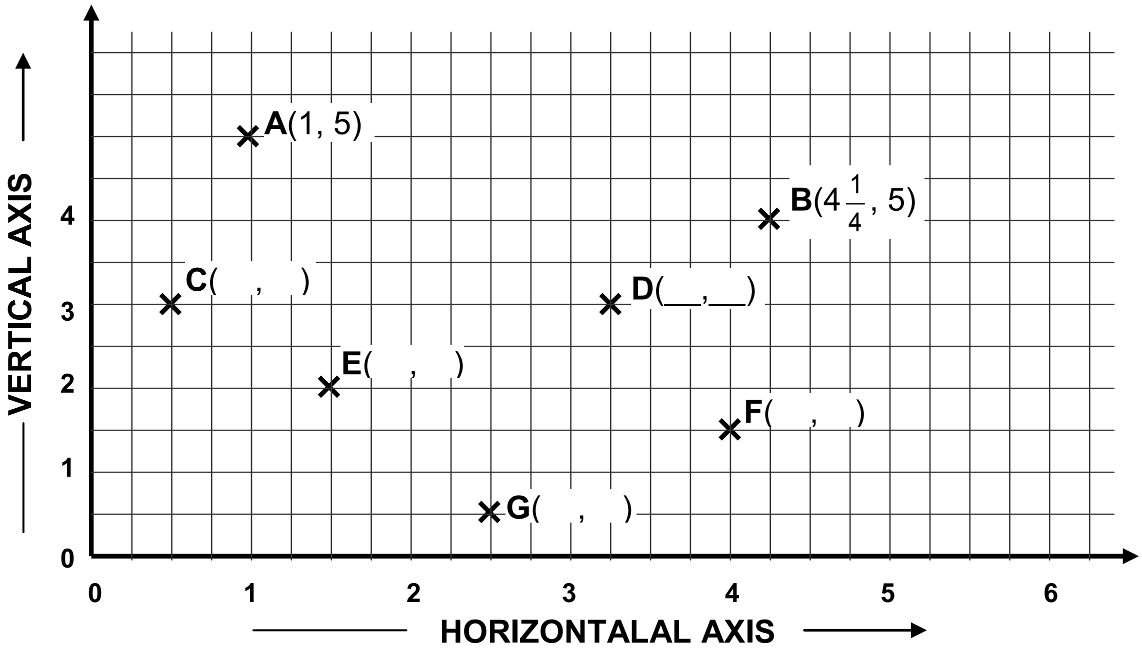
(a)



b)


40
30
20
10
A(10, 20)
B(__, __)
C(__, __)
D(__, __)
E(__, __)
F(__, __)
10
30
VERTICAL AXIS
HORIZONTAL AXIS

(c)


A(1, 5)
B(4 1/4, 5)
C(,)
D(__,__)
E(,)
F(,)
G(,)
0
1
2
3
4
5
6
VERTICAL AXIS
HORIZONTALAL AXIS

3. (a) Find the following points and mark them with an X on the grid.

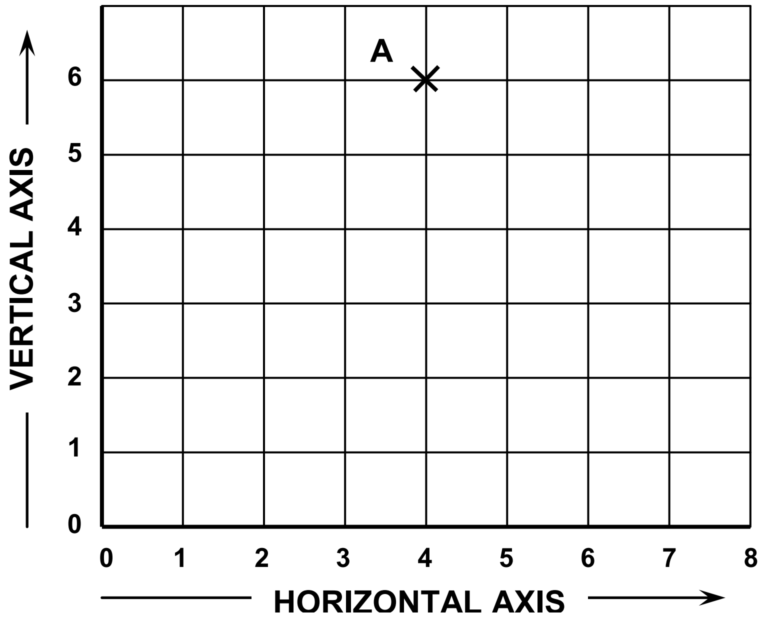
The first one has been done for you.

A = (4, 6)

B = (0, 2)

C = (2, 0)

D = (6, 4)



(b) Use your ruler and join A to B, B to C, C to D and D to A. What is the name of the shape you made?

THE SHAPE IS A ____________________________.

---

4. Using the diagram on the next page, find the points A, B, C, etc. by using their coordinates.

Mark the points with a dot on the number plane, like this: •**A**

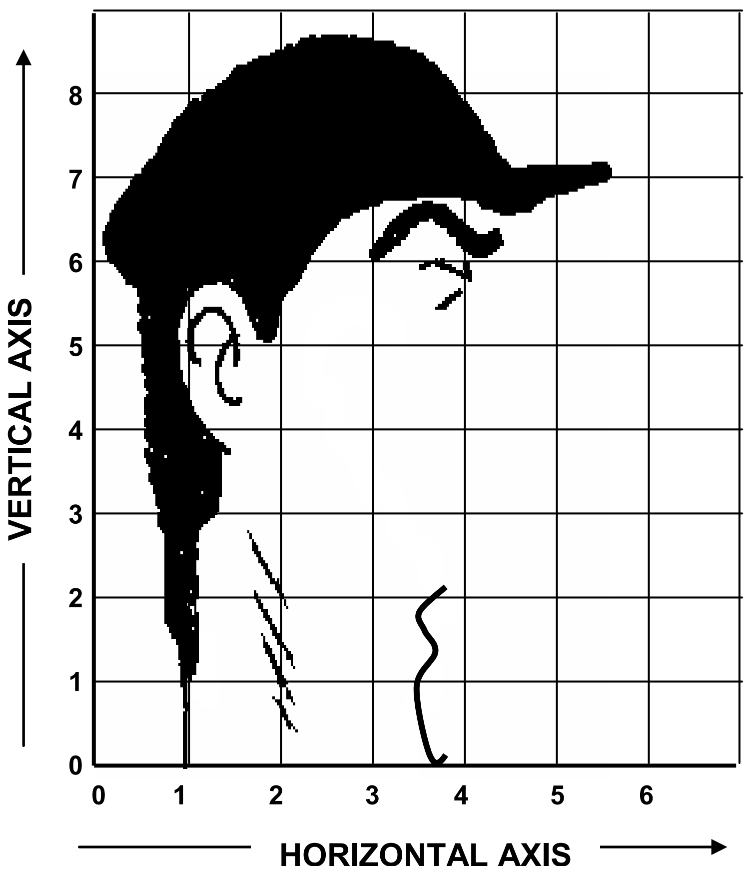
Coordinates:

A $(4\frac{1}{2}, 6\frac{1}{2})$ **B** (5, 6) **C** $(4\frac{1}{2}, 5\frac{1}{2})$ **D** $(5\frac{1}{2}, 5\frac{1}{2})$ **E** $(5\frac{1}{2}, 4\frac{1}{2})$

F $(5, 4\frac{1}{2})$ **G** (5. 4) **H** (4, 4) **I** $(3\frac{1}{2}, 4\frac{1}{2})$ **J** $(4, 3\frac{1}{2})$ **K** (5, 3)

L $(5\frac{1}{2}, 3)$ **M** $(5\frac{1}{2}, 1\frac{1}{2})$ **N** (4, 2) **O** $(2, 2\frac{1}{2})$ **P** $(1\frac{1}{2}, 3\frac{1}{2})$

Join A to B, B to C, C to D etc. to complete the picture of a funny face.



CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

Lesson 22: Finding Points on the Number Plane

You learnt that coordinates are an ordered pair of numbers which describe the position of a point in Lesson 21.

In this lesson you will:

- record the ordered pair of coordinates of a point shown on the four quadrant number plane.

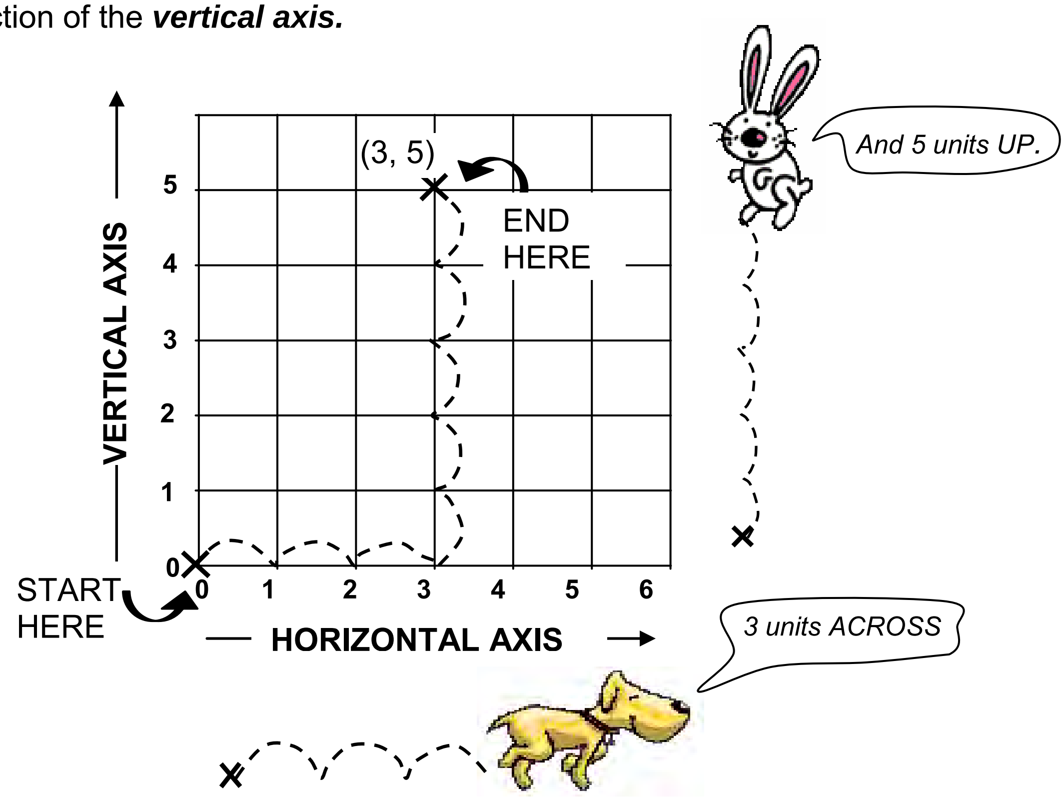
You know that coordinates are an ordered pair of numbers which describe the position of a point. Now you will use coordinates to find points on the number plane.

Example

Find the position of the point (3, 5).

The FIRST COORDINATE is 3, so you must go 3 units ***along*** the ***horizontal axis***, starting from zero (0).

The SECOND COORDINATE is 5, so next you must go 5 units ***up*** following the direction of the ***vertical axis.***



The dotted lines on this grid show the way you must go to find the point (3, 5).

Always start with zero.

Use the FIRST COORDINATE (3) first.

Use the SECOND COORDINATE (5) second.

The first coordinate gives you the number of units you go in the HORIZONTAL direction.

The second coordinate gives you the number of units you go in the VERTICAL direction.

Now you will learn to place points on the number plane between lines on the grid.

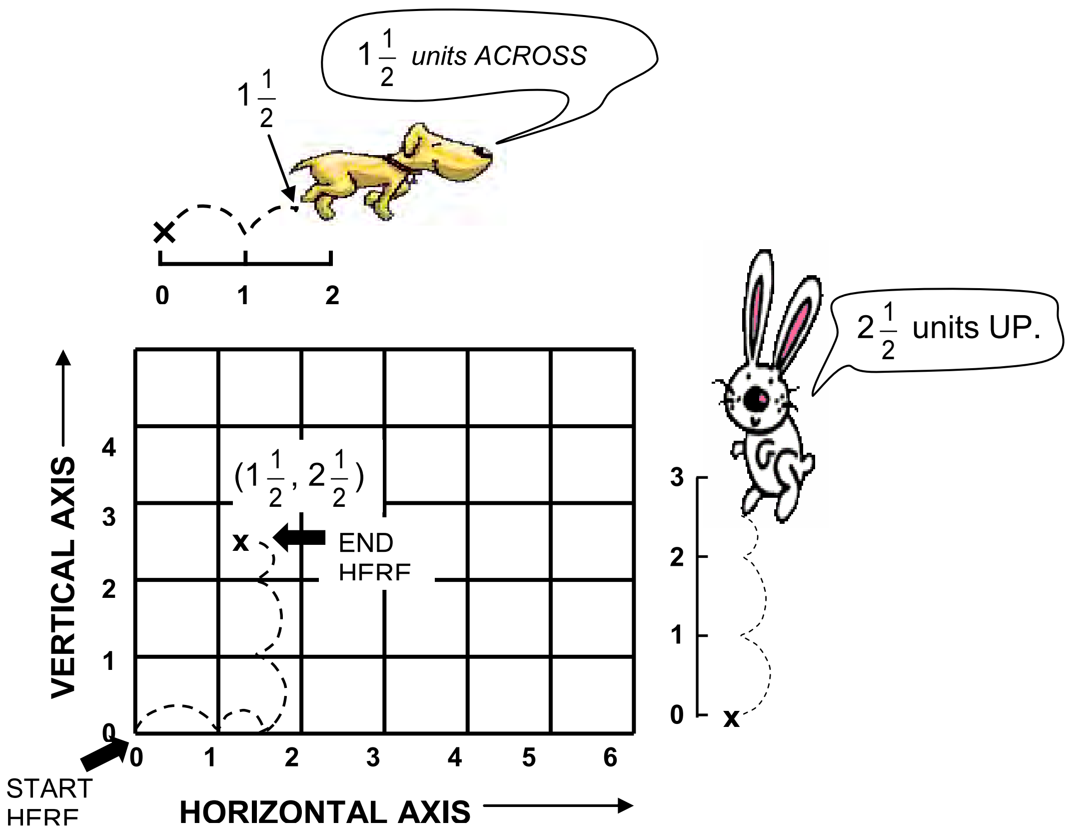
In Lesson 21 we revised work on Number Lines. You can find any point on the number plane using the two axes, which are both number lines.

Example

Find the point $(1\frac{1}{2}, 2\frac{1}{2})$ on the number plane.

Step 1: Go ***across*** the horizontal axis for $1\frac{1}{2}$ units.

Step 2: Go ***up*** $2\frac{1}{2}$ units.



The dotted lines on this grid show the way you must go to find the point $(1\frac{1}{2}, 2\frac{1}{2})$.

ALWAYS START AT ZERO.

Use the *First Coordinate* (**1**$\frac{1}{2}$) first.

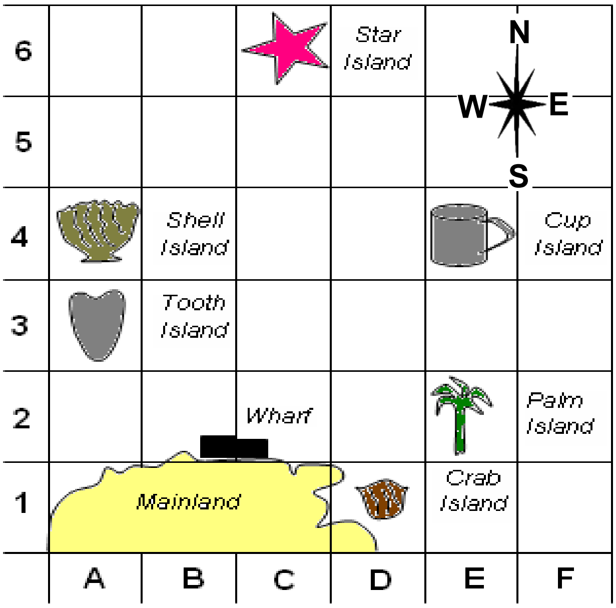
Use the *Second Coordinate* (**2**$\frac{1}{2}$) second.

You have learnt about maps in your Strand 2. Maps are used to give accurate information as to where places are located. Maps often include grid lines to specify a position more accurately.

To locate a point on a map we use coordinate points on a Cartesian number plane.

Example 2

Look at the map below.



On the map, the location of Star Island can be described by the coordinates (C6).

The letter C shows the location on the horizontal axis and the number 6 shows the location on the vertical axis.

Can you write down the name of the island that has these coordinates?

a) D1 ___________

b) A3 ___________

c) A4 ___________

d) E4 ___________

e) E2 ___________

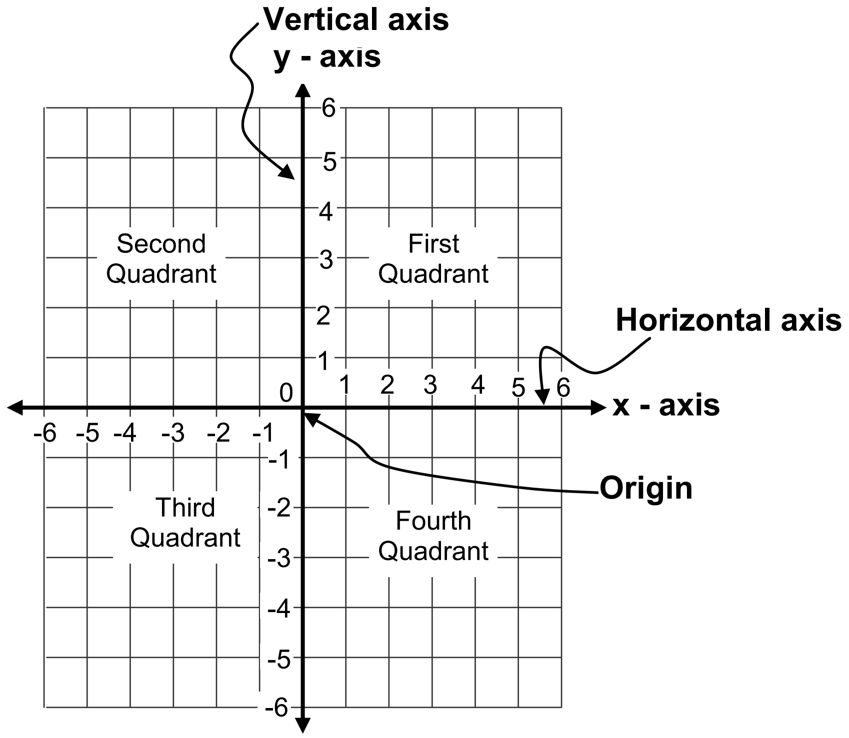
Answer:
a) Crab Island
b) Tooth Island
c) Shell Island
d) Cup Island
e) Palm Island

Your answers should be as the ones in the box.

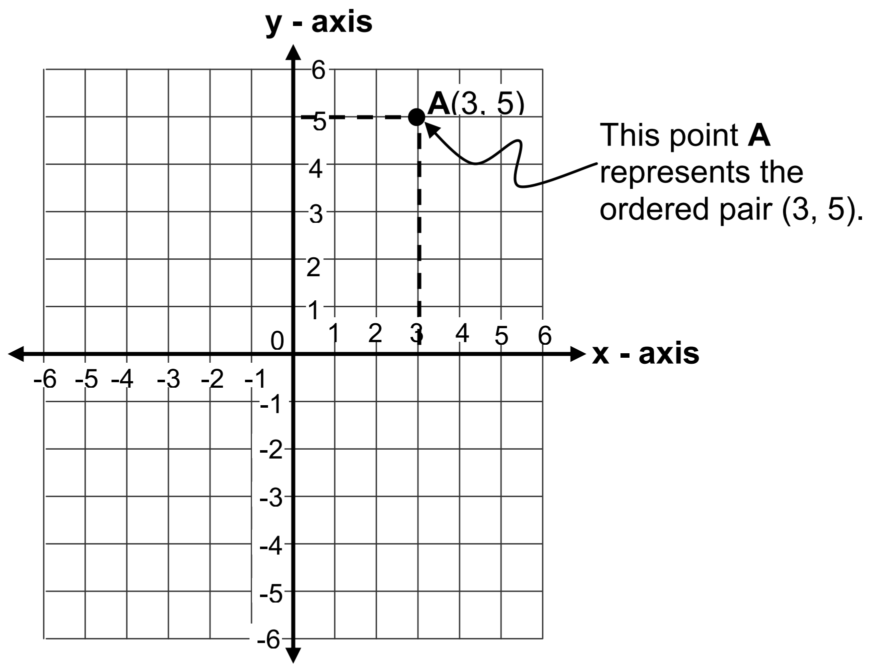
Now let us locate and record points on a four quadrant number plane, called the **Cartesian Coordinate Plane** or the **Rectangular Coordinate System.**

> **Cartesian Coordinate Plane** or the **Rectangular Coordinate System** consists of a vertical number line called the **vertical axis** and a horizontal line called the **horizontal axis** which meet at a point called the **origin.**
> The two axes divide the plane into four parts called **quadrants.**

Some names commonly used with a cartesian or rectangular coordinate system are shown in the figure below.



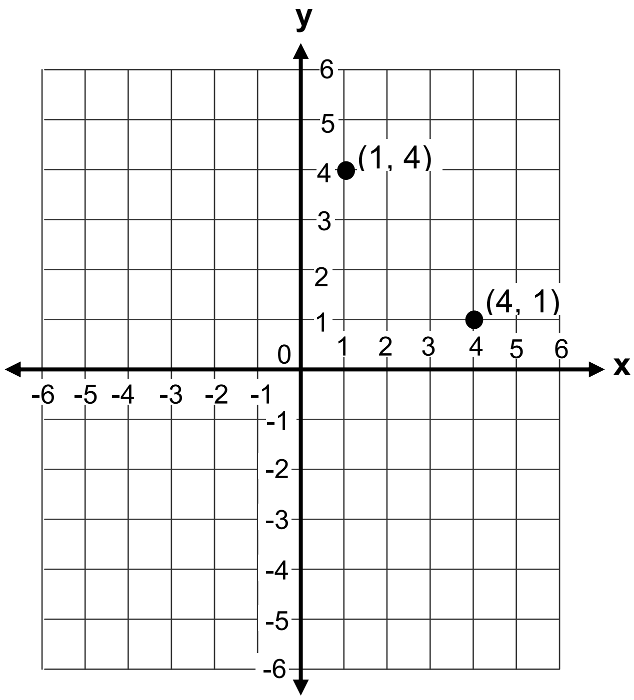
As you have learnt in Lesson 21, a point is represented by an ordered pair of numbers. The point (3, 5) is shown below.



The first number (3) of the ordered pair is called the horizontal coordinate of the point (3, 5) also called the x-coordinate or **abscissa.** A positve horizontal coordinate indicates that the point is **to the right** of the vertical axis. A negative horizontal coordinate indicates that the point is **to the left** of the vertical axis.

The second number (5) of the ordered pair is called the vertical coordinate of the point (3, 5) also called the y-coordinate or **ordinate.** A positve vertical coordinate indicates that the point is **above** the horizontal axis. A negative vertical coordinate indicates that the point is **below** the horizontal axis.

Note: When the order is changed in an ordered pair, we get a different point. For example, (1, 4) and (4, 1) are two different points. See the diagram below.



Points on the cartesian plane need not necessarily be confined to the first quadrant. They may comprise points from all four quadrants by using negative numbers.

A point whose first and second coordinates are both positive is located on the first quadrant. (+, +)

A point whose first coordinate is negative and second coordinate is positive is located on the second quadrant. (-, +)

A point whose first and second coordinates are both negative is located on the third quadrant. (-, -).

A point whose first coordinate is positive and second coordinate is negative is located on the fopurth quadrant. (+, -)

When the first coordinate of a point is zero, the point is located on the y-axis.

When the second coordinate of a point is zero, the point is located on the x-axis.

Plotting points on the Coordinate Plane.

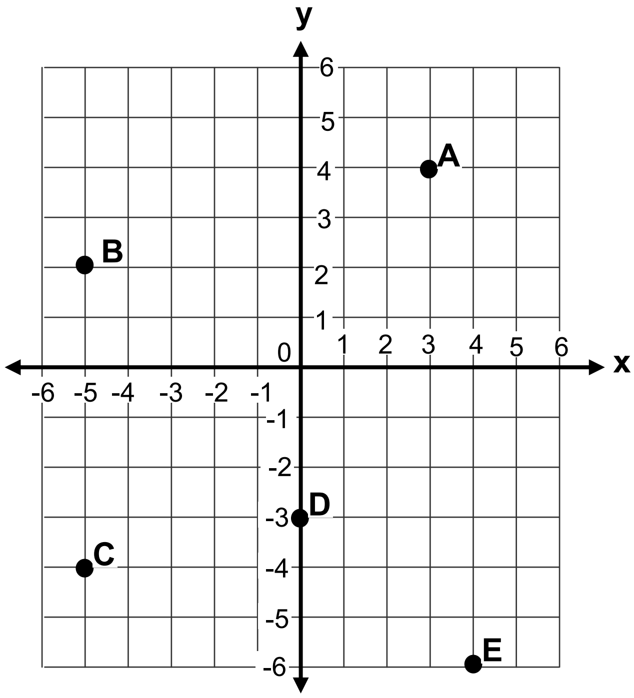
The phrase **„plot the points"** means the same as **„graph the points"**.

In plotting points on the coordinate plane, it is important to write the location of the x-axis first.

Example 1

Plot the points A(3, 4), B(-5, 2), C(-5, -4), D(0, - 3), E(4, -6).

Solution:



Point A is located at Quadrant 1, the coordinates are both positive.

Point B is located at Quadrant 2, the first coordinate is negative and second coordinate is positive.

Point C is located at Quadrant 3, the coordinates are both negative.

Point D is located on the y-axis, the first coordinate is zero and the second coordinate is negative.

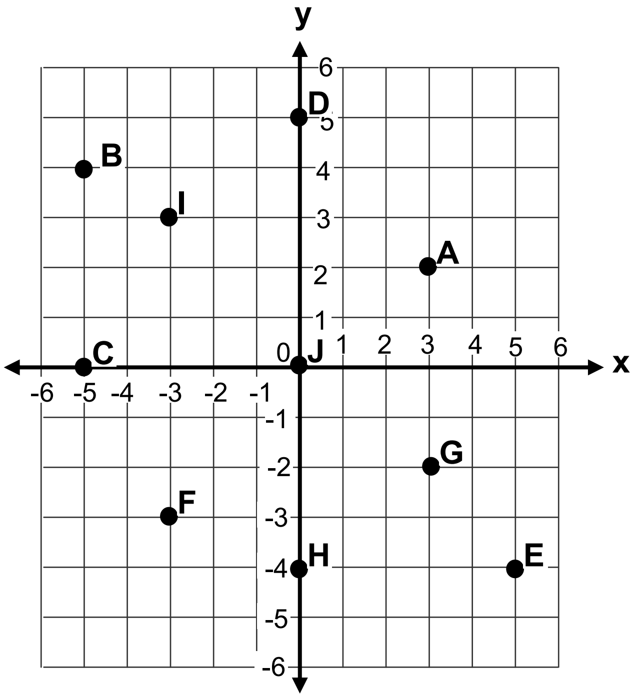
Point E is located at Quadrant 4, the first coordinate is positive and the second coordinate is negative.

NOW DO PRACTICE EXERCISE 22

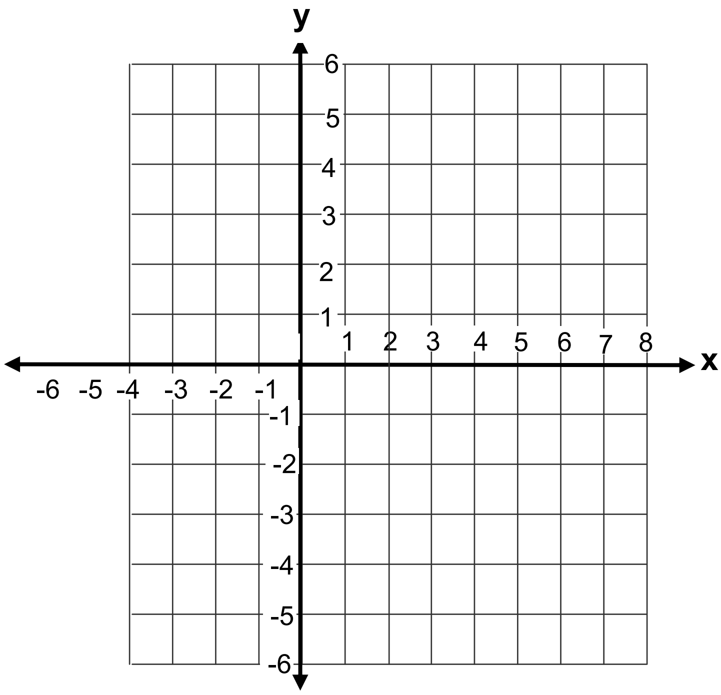
Practice Exercise 22

1. Give the coordinates of each of the points as shown on the coordinate plane .

A ________ F ________
B ________ G ________
C ________ H ________
D ________ I ________
E ________ J ________



2. Plot the following points A(-2, 2), B(4, 2) and C(8, 6) on the number plane below.



Join the points A to B, B to C and C to A. What figure is formed?

Answer:__________

3. Look at the map of Papua New Guinea below.

a) Write down the name of the province that has these coordinates.

1. (L, 8) __________
2. (K, 5) __________
3. (I, 3) __________
4. (C, 3) __________
5. (H, 5) __________

b) Write down the coordinates for the following towns:

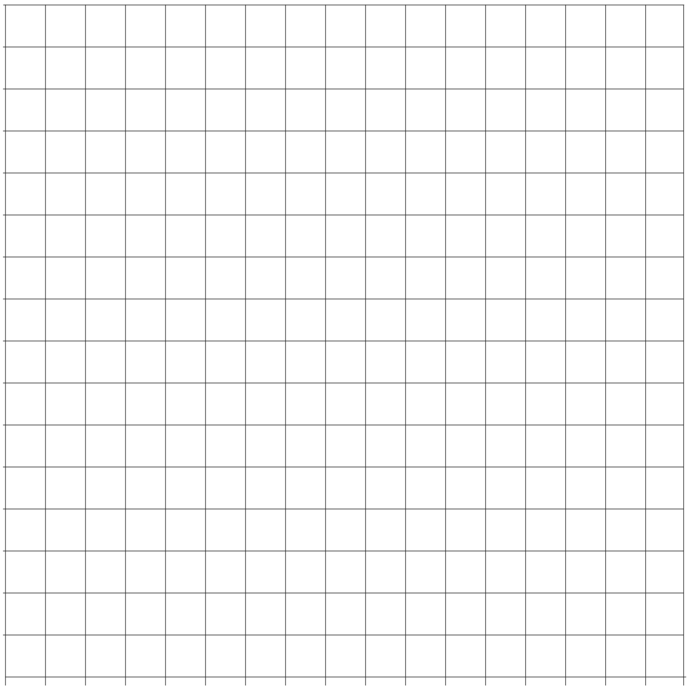
1. Alotau __________
2. Wewak __________
3. Mendi __________
4. Vanimo __________
5. Madang __________

c) Write two sets of coordinates for the following towns and provinces:

1. Wabag __________
2. Port Moresby __________
3. Mt. Hagen __________
4. Manus Island __________
5. Rabaul __________

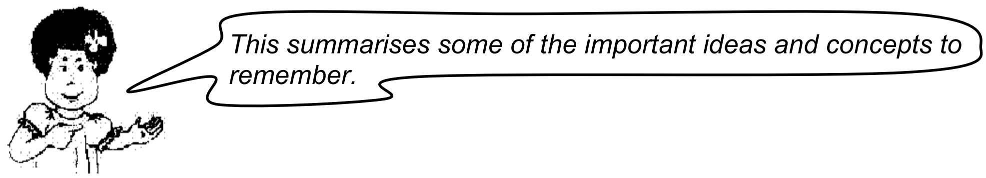
4. On the grid provided below, draw a set of axes, with the x-axis and the y-axis each marked in order from -6 to 6. On your axes, plot the following ordered pairs below.

a)	(4, 3)	e)	(-6, 0)
b)	(-5, 4)	f)	(0, 4)
c)	(-4, -6)	g)	(6, -2)
d)	(0, -5)	h)	(-1, 1)



CORRECT YOUR WORK. ANSWERS ARE AT THE END OF SUB-STRAND 4

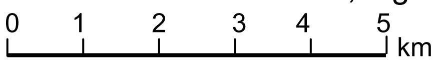
SUB-STRAND 4: SUMMARY



- A compass is an instrument used to find direction. The needle of the compass always points to the north.
- There are four main compass directions: **North, East, West and South**. These are called **Cardinal directions**. Half way between these main directions are four other directions: **Northeast, Northwest, Southeast and Southwest.** These are called the **Intermediate cardinal directions.**
- There are two main ways of giving directions: as **bearings** and as **compass bearings**
- True bearing is an amount of turn or number of degrees measured from North in a clockwise direction.
- Compass bearing is the number of degrees east or west of the north-south line.
- A map is simply a plan, chart, drawing or diagram of the ground on paper.
- In reading a map, one of the most useful features that you must know is the use of symbols and legends (keys).
- Map Symbols are special signs used to represent real objects.
- Map Legend is a key to all the symbols used on the map. It is like a dictionary that the reader can use to understand the meaning of what the map represents.
- A scale for length is the number used to change one shape to another. They are shown on drawings or diagram such as maps or plans. These are useful in working out actual lengths and distances.
- The scale of a map is the ratio of the map to actual distance. it is usually shown in three ways:

  1) by writing in words, e.g. one centimetre to one kilometre

  2) by showing it in numbers as a representative fraction or ratio, e.g. $\frac{1}{100}$ or 1: 100

  3) by drawing it as a line scale. e.g. 

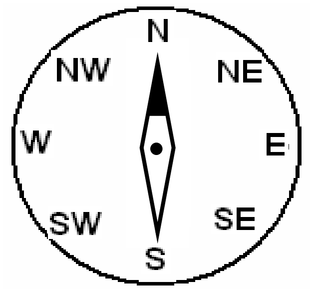
- A number plane is a flat surface made up of all the set of points we can describe using coordinates.
- A coordinate is an ordered pair of numbers which describe and represent the position of a point on a number plane.
- The **Cartesian Coordinate Plane or Rectangular Coordinate System** is a four quadrant plane consisting of a vertical number line called the **vertical axis** and a horizontal number line called the **horizontal axis**. These axes meet at a point called the **origin**. The two axes divide the plane into four equal parts called **quadrants.**

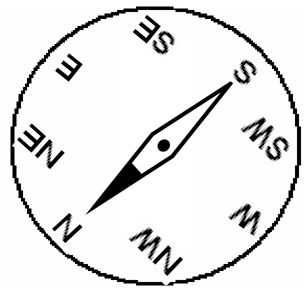
REVISED LESSONS 17-22 THEN DO SUB-STRAND TEST IN ASSIGNMENT 4.

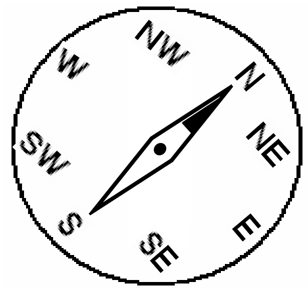
ANSWERS TO PRACTICE EXERCISES 17 -22

Practice exercise 17

1.







2. a) South
   b) Northwest
   c) Northeast
   d) South
   e) East

3. C

4. a) East
   b) Southeast
   c) Southwest
   d) Northwest
   e) Northeast

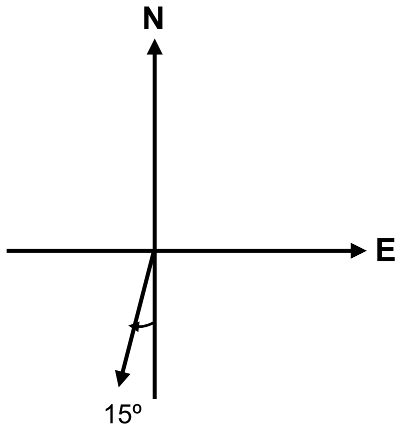
Practice exercise 18

1. a) 45º b) 180º c) 225º d) 315º

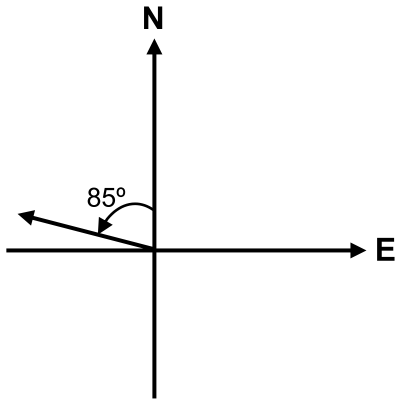
2.

	Angle, as shown, from the boy to the girl	True bearing	Compass bearing
a	35º	035º	N35ºE
b	65º	065º	N65ºE
c	115º	115º	S65ºE
d	200º	200º	S20ºW
e	155º	115º	S25ºE

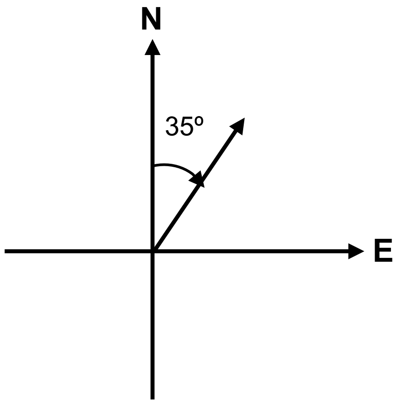
3. b) S15ºW



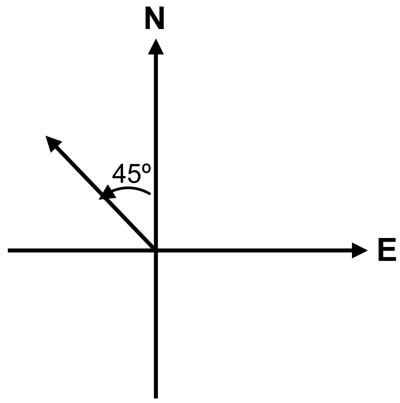
c) N85ºW



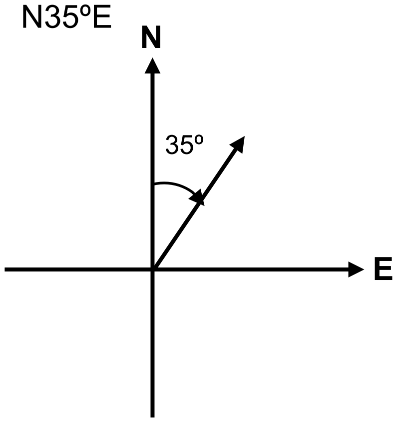
d) 035º



e) 315º

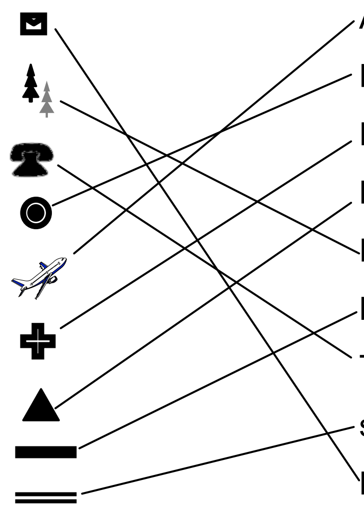


f) N35ºE



Practice Exercise 19

1. **Symbol** **Meaning**



Airport
Police station
Hospital
Mountain
Forest
Main road
Telephone company
street
Post office

2. a) above 250 metres
   b) Any 3 of the following: Vanimo, Daru, Popondetta, Kimbe, Rabaul , Kavieng, Alotau

3. a) silver f) gold
   b) uranium g) bauxille
   c) oil h) iron ore
   d) diamonds i) coal
   e) copper j) lead

Practice Exercise 20

1. a) 1: 300 000 b) 1: 500 000 c) 1: 1500
   d) 1: 3 500 000 e) 1: 25 000

2. a) $\frac{1}{500\,000\,000}$ b) $\frac{3}{5\,000\,000}$ c) $\frac{1}{1750}$

   d) $\frac{1}{1\,000}$ e) $\frac{1}{300\,000}$

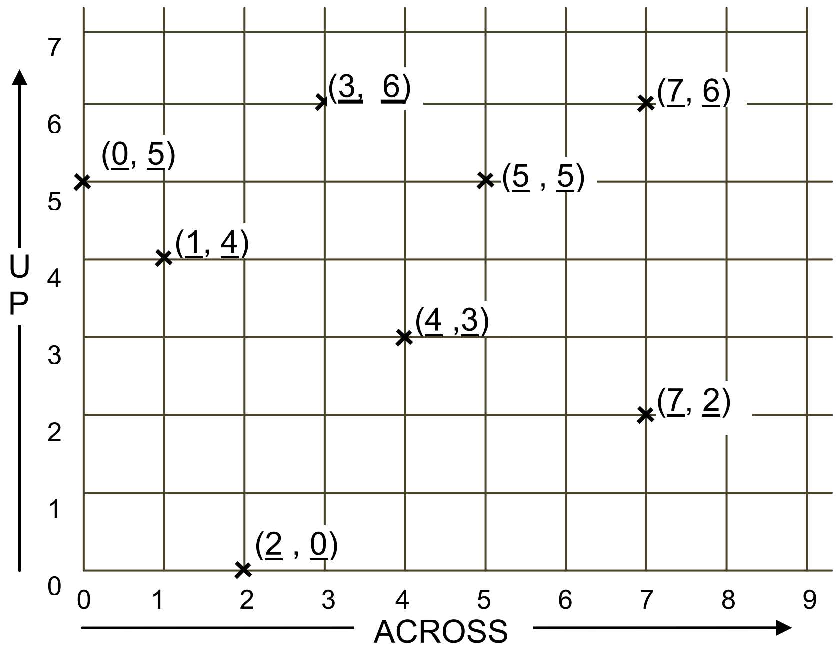
3. a) one centimetre represents 1 metre
   b) one centimetre represents 4 metres
   c) one centimetre represents 1 kilometre
   d) one centimetre represents 20 kilometres

4. 1200 cm or 12 m

5. a) 1: 20 000 000
   b) 1 centimetre on the map represents 200 kilometres
   c) i) 400 km ii) 900 km iii) 2000 km
      iv) 2300 km v) 1600 km
   d) 600 km

Practice Exercise 21

1.

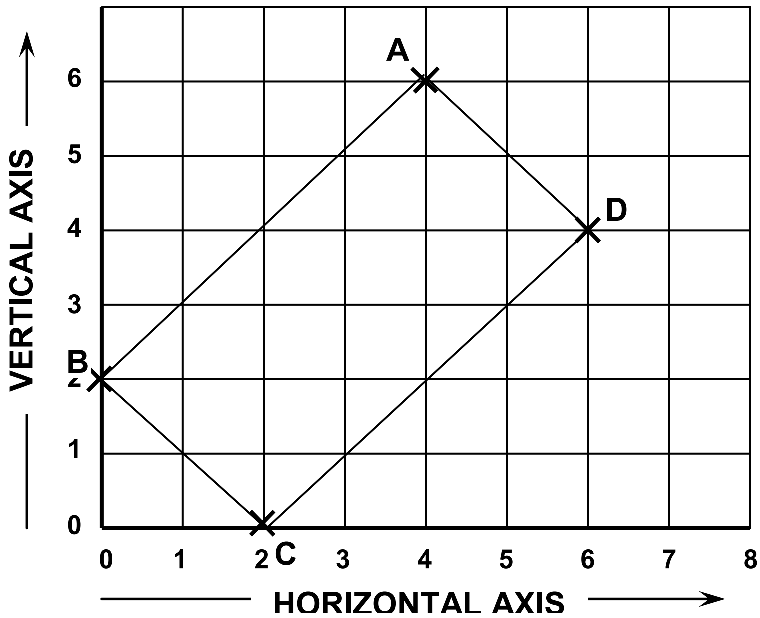


2. a) **B** $(6, 6\frac{1}{2})$ **C** $(0, 5\frac{1}{2})$ **D** $(2\frac{1}{2}, 4)$ **E** $(6\frac{1}{2}, 3)$ **F** $(2\frac{1}{2}, 1\frac{1}{2})$

   b) **B** (20,25) **C** (5, 20) **D** (30,12) **E** (0, 7) **F** (25, 0)

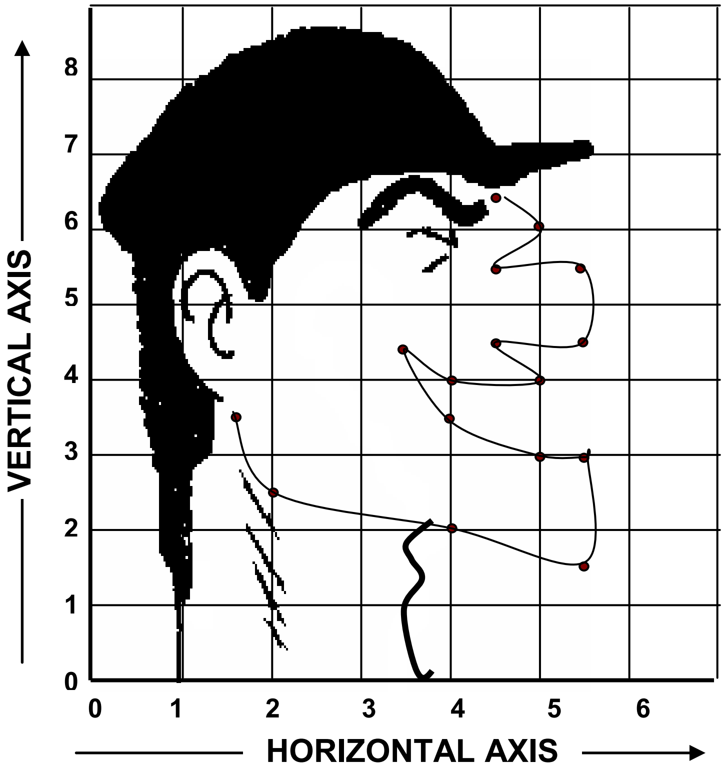
   c) **C** $(\frac{1}{2}, 3)$ **D** $(3\frac{1}{4}, 3)$ **E** $(3\frac{1}{2}, 2)$ **F** $(4, 1\frac{1}{2})$ **G** $(2\frac{1}{2}, \frac{1}{2})$

3. a)



   b) Rectangle

4.

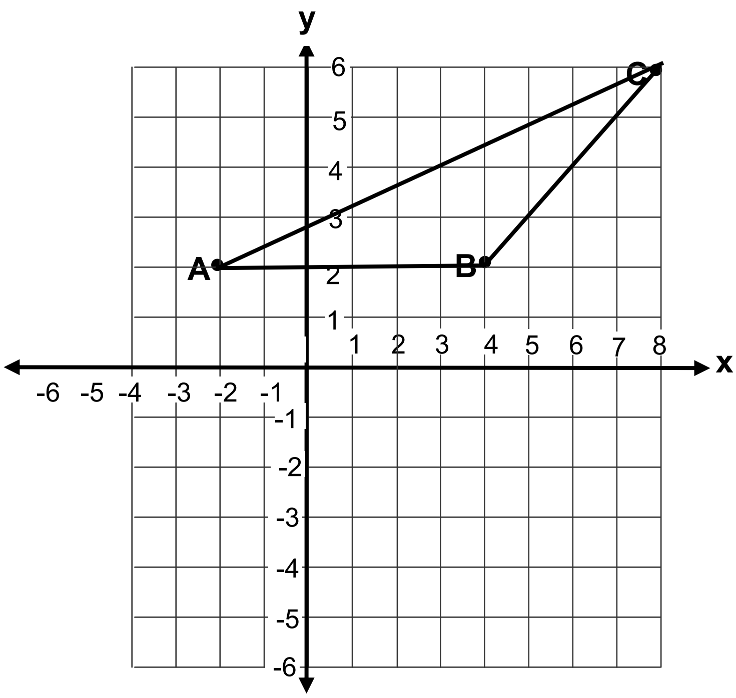


Practice Exercise 22

1.

A (3, 2)	**F** (-3, -3)
B (-5, 4)	**G** (3, -2)
C (-5, 0)	**H** (0, -4)
D (0, 5)	**I** (-3, 3)
E (5, -4)	**J** (0, 0)

2.

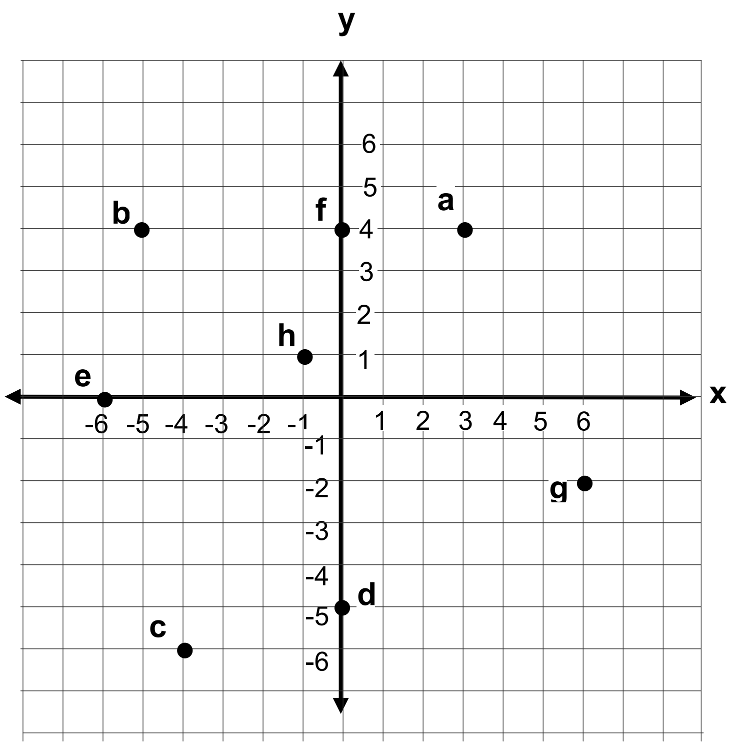


3. a)
   1. Kavieng
   2. Kimbe
   3. Popondetta
   4. Daru
   5. Lae

   b)
   1. (K, 2)
   2. (D, 7)
   3. (D, 5)
   4. (A, 8)
   5. (F, 6)

   c.
   1. (D, 5) and (D, 6)
   2. (H, 2) and (H, 3)
   3. (D, 5) and (E, 5)
   4. (G, 8) and (H, 8)
   5. (M, 6) and (M, 7)

4.



END OF SUB-STRAND 4

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