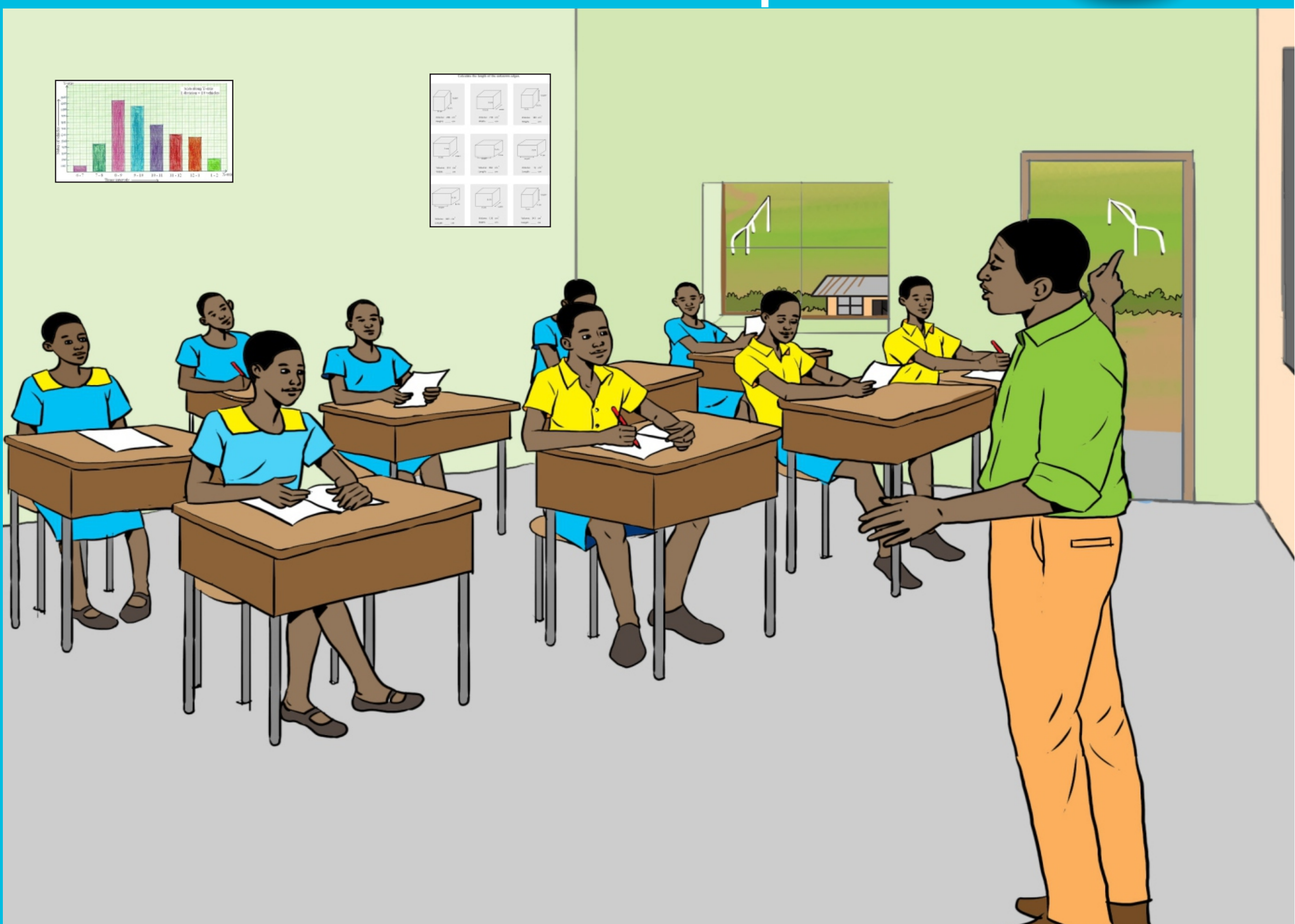
South Sudan

Primary Mathematics 8

Pupil's Book



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South Sudan

PRIMARY

8

Mathematics

Pupil's Book 8

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UNIT 1: NUMBERS

1.1 Factors and Multiples

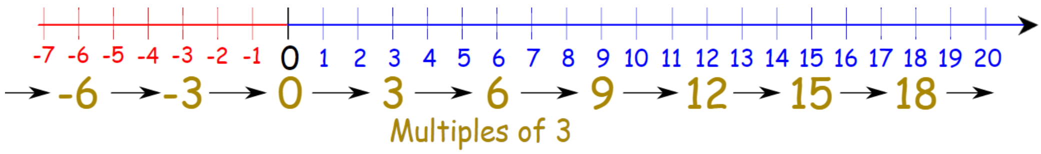
Factors and multiples are different things but they both involve multiplication:

Multiples

A multiple is the result of multiplying a number by an integer (not a fraction).

Example 1.

Multiples of 3:

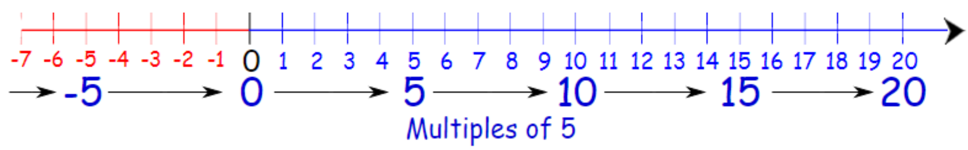


$$\ldots, -9, -6, -3, 0, 3, 6, 9, \ldots$$

15 **is** a multiple of 3, as $3 \times 5 = 15$
16 is **not** a multiple of 3

Example 2.

Multiples of 5:



$\ldots, -15, -10, -5, 0, 5, 10, 15, \ldots$

10 **is** a multiple of 5, as $5 \times 2 = 10$
11 is **not** a multiple of 5

Factors are what we can multiply to get the number.

Multiples are what we get after multiplying the number by an integer (not a fraction).

Example: the positive factors, and some multiples, of 6:

Factors:

$1 \times 6 = 6$, so **1** and **6** are factors of 6

$2 \times 3 = 6$, so **2** and **3** are factors of 6

Multiples:

$1 \times 6 = 6$, so **6** is a multiple of 6

$2 \times 6 = 12$, so **12** is a multiple of 6 and so on

(Note: there are negative factors and multiples as well)

Here are the details:

Factors

"Factors" are the numbers we can **multiply together** to get another number:

$$\underset{\text{Factor}}{2} \times \underset{\text{Factor}}{3} = 6$$

2 and 3 are factors of 6

A number can have **many** factors.

Example 3.

$3 \times 4 = 12$, so **3** and **4** are factors of 12

Also $2 \times 6 = 12$, so **2** and **6** are also factors of 12,

And $1 \times 12 = 12$, so **1** and **12** are factors of 12 as well.

AND because multiplying negatives makes a positive, -1, -2, -3, -4, -6 and -12 are also factors of 12:

$(-1) \times (-12) = 12$

$(-2) \times (-6) = 12$

$(-3) \times (-4) = 12$

So ALL the factors of 12 are:

1, 2, 3, 4, 6 and 12
AND **−1, −2, −3, −4, −6 and −12**

All Factors of a Number

Factors are the numbers you multiply together to get another number:

There can be many factors of a number.

Example: All the factors of **12**

$2 \times 6 = 12$,

but also $3 \times 4 = 12$,

And of course $1 \times 12 = 12$.

So **1, 2, 3, 4, 6 and 12** are factors of 12.

And also -1,-2,-3,-4,-6 and -12, because you get a positive number when you multiply two negatives, such as $(-2)\times(-6) = 12$

Answer: 1, 2, 3, 4, 6, 12, -1, -2, -3, -4, -6, -12

Factors are usually positive or negative whole numbers (no fractions), so $\frac{1}{2} \times 24 = 12$ is not listed.

Note: Negative numbers are also included, as multiplying two negatives makes a positive.

Example 4.

All the factors of 20.

Start at 1: $1\times20=20$, so put 1 at the start, and put its "partner" 20 at the other end:

1		20

Then go to 2. $2\times10=20$, so put in 2 and 10:

1	2		10	20

Then go to 3. 3 doesn't work ($3\times6=18$, $3\times7=21$).

Then on to 4. $4\times5=20$, so put them in:

1	2	4		5	10	20

There is no whole number between 4 and 5 so you are done! (Don't forget the negative ones).

1	2	4	5	10	20
-1	-2	-4	-5	-10	-20

1.2 Squares and square roots of perfect squares

Squares

A square of a number is a number multiplied by itself.

Example 5.

Find the square of 16.

This means 16 multiplied by itself.

$= 16 \times 16$
$= 256.$

256 is therefore the square of 16

A square can also be expressed as A^2

'A' being the number you want to square.

$$25^2 = 25 \times 25$$

$= 625$
Or $(25)^2 = 25 \times 25$
$= 625.$

A number whose square root is exact is called a **perfect square.**

Activity 1:

1. with your partner choose a number. Write all the factors of that number. Now write what you know about factors. Share with the rest of the class

1. Find the squares of these numbers.

a. 21	b. 453	c. 17	d. 27	e. 19
f. 221	g. 305	h. 41	i. 34	j. 635

2. Find the value of;

a. 23^2	b. 18^2	c. 51^2	d. 32^2	e. 65^2
f. 39^2	g. 47^2	h. 33^2	i. 36^2	j. 36^2

Exercise 1.

1. A square has a side of 156cm. what is the area in square centimetres?
2. A fisherman has a pond of a square in shape. If one side of the pond was 126M. What was the area covered by the fish pond.
3. What is the area in square metres of a house whose one side is 27m?
4. Find the product obtained after working out the square of 13 and 15.
5. Rita planted flowers on a square garden of 31M. What is the area planted with flowers?

Square roots of numbers

Square root can also be expressed in symbol as $\sqrt{}$.

Example 6.

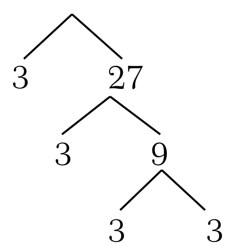
$\sqrt{81}$

Methods 1: Using prime factorization method

Find $\sqrt{81}$

81

Divide 81 by 3 since it is not divisible by 2



Prime factors of 81 $= 3 \times 3 \times 3 \times 3$

For every two same numbers pick one, and then find their product.

$$3 \times 3 = 9$$

$$\therefore \sqrt{81} = 9$$

Methods 2: Using average method.

Find $\sqrt{484}$

$484 \div 20$

$= \frac{484}{20}$

$= 24$ rem 4

$\frac{44}{2} = 22$

∴ Square root of 484 is 22

With the guide of the teacher;

Estimate the square root of 484 to a round figure. Thus 20 is our estimated square root $20 \times 20 = 400$ which is closer to 484.

Divide the estimated square root by the number given. Where we get 24 remainder 4, ignore the remainder then add the divisor 20 to the quotient 24.

Then find the average of the result.

$20 + 24 = 44$ Divide by 2 to give 22.

To check whether 22 is our correct answer, multiply $22 \times 22 = 484$.

Exercise 2.

1. Fill in the correct missing numbers.

a. $\sqrt{144} = 12 \times$ ___ b. $\sqrt{169} =$ ___ $\times 13$ c. $\sqrt{225} = 25 \times$ ___

d. $\sqrt{196} = 14 \times$ ___ e. $\sqrt{289} =$ ___ $\times 17$

2. Use any of the two methods to find the square root of;

a. 441 b. 576 c. 1296 d. 2209

e. 5041 f. 2025

Show your working out.

Activity 2:

In groups discuss and then work out the following; share your workings using mathematical language.

1. A square has an area of 2 116cm^2. What is the perimeter in metres?

2. A farmer planted vegetables on a square area of 2401 square metres. What was the measurement of one side of the vegetable garden?

3. Garang had 5 square shaped cowsheds whose total area was 55125m^2. He wanted to fence it using 4 strands of wire. How many kilometers of wire was enough to fence the cowshed?

4. What is the square root of the number obtained when 2704 is divided by 16?

5. What is the value of $\sqrt{195 + 17^2}$?

6. What is the sum of the square of 19 and square root of 1225?

7. Find the difference between the square root of 3136 and 6084.

8. What is the value of the square of 23 multiplied by the square root of 676?

9. Find the value of the square root of 9216 and the square root of 256.
10. What is the square root of the number obtained when 196 is multiplied by 4?

11. What is the square root of the number obtained after 4498 is added to 263?

12. Find the sum of $\sqrt{1\frac{11}{25} + 5\frac{1}{2}}$

1.3 Squares and square roots of decimals and fractions

Squares of decimal numbers and fractions

To find the squares of decimal numbers, change the given decimals into fractions with the denominator of 10.

E.g. 10, 100, 1000, 10 000, 100 000 and so on.

If the Fraction is a mixed fraction we convert it to an improper fraction.

Example 7.

Evaluate 0.4^2

$$= 0.4 \times 0.4 \; or \; \left(\frac{4}{10}\right)^2$$

$$= \frac{4}{10} \times \frac{4}{10}$$

$$= \frac{16}{100}$$

$$= \frac{16}{100} = 0.16$$

$$= 0.16.$$

Exercise 3.

1. Work out:

a) 0.5^2	b) 0.03^2	c) 0.035^2	d) 3.06^2
e) 0.16^2	f) 1.8^2	g) 0.25^2	h) 0.075^2
i) 0.15^2	j) 0.27^2	k) 4.5^2	l) 3.87^2
m) 0.23^2	n) 0.033^2	p) 0.025^2	

Square roots of decimals and fractions

To find the square root of decimals, write the given decimal number as a fraction with denominator of power 100.

E.g. 100, 10000, 1000000 and so on.
If the Fraction is a mixed fraction we convert it to an improper fraction.

Example 8.

(a) $\sqrt{0.36}$ (a) $\sqrt{0.0196}$ (a) $\sqrt{1.44}$

<u>**Solution**</u>

Find the square roots of both the numerator and the denominator.

(a) $\sqrt{0.36} = \frac{\sqrt{36}}{\sqrt{100}} = \frac{6}{10} = 0.6$

(b) $\sqrt{0.0196} = \frac{\sqrt{196}}{\sqrt{10000}} = \frac{14}{100} = 0.14$

(c) $\sqrt{1.44} = \frac{\sqrt{144}}{\sqrt{100}} = \frac{12}{10} = 1.2$

What do you notice about the decimal place of the given number and their square roots?

Numerators are significant figures of the decimal numbers.

.

Exercise 4.

Find the square root of:

a) 6.25	b) 2.25	c) 0.0169	d) 0.0144
e) 3.24	f) 26.01	g) 12.96	h) 3.61
i) 0.0081	j) 0.3136	k) 0.5625	l) 0.1225

1.4 Conversion of fractions to percentage and percentage to fractions

Conversion of fractions to percentage

Percentage means out of hundred $\left(\frac{x}{100}\right)\%$

Example 9.

Express $\frac{3}{8}$ as a percentage.

$\frac{3}{8}$ Out of hundred

$$= \frac{3}{\underset{2}{\cancel{8}}} \times \overset{25}{\cancel{100}}\% = \frac{75}{2}$$

$$= 35\frac{1}{2}\%$$

Exercise 5.

1. Convert these fractions to percentages. Show your working out.

a) $\frac{3}{3}$ b) $\frac{1}{3}$ c) $\frac{5}{6}$ d) $\frac{13}{20}$ e) $\frac{5}{8}$

2. Johana scored 13 out of 18 in Kiswahili test. What were his marks as percentage? Show your working out.

3. In a class of 45 pupils there are 18 girls. What percentage of the total number of pupils were boys? Show your working out.

4. Pamela had 60 hens. She sold 15 hens. What percentages of hens were unsold? Show your working out.

5. A basket had 36 fruits, 27 of them were ripe. What percentage of fruits was raw? Show your working out.

6. Abdi had 600 cattle. If he had 180 dairy cattle. What percentage were beef cattle?

7. In a tray there were 30 eggs. 11 eggs were rotten. What percentages of eggs were good?

Activity 3:

In groups discuss, where do we apply converting fractions to percentages.

Conversion of percentage to fractions

Example 10.

Write 35% as a fraction and write in simplest form.

35% is 35 out of 100

Change to a fraction $= \frac{35}{100}$

Simplify by cancelling the numerator and the denominator by a common divisor. $\frac{\cancel{35}}{\cancel{100}} = \frac{7}{20}$

$$= \frac{7}{20}$$

Example 11.

Express $33\frac{1}{3}\%$ as a fraction.

$$\frac{33\frac{1}{3}\times 3}{100\times 3} = \frac{100}{300}$$

$$= \frac{\cancel{100}}{\cancel{300}} = \frac{1}{3}$$

Multiply numerator and denominator by 3 to get whole number to get $\frac{100}{3\times 100} = \frac{100}{300}$

Then simplify by dividing 300 by 100 to get $\frac{1}{3}$

Exercise 6.

Convert these percentages to fractions in the simplest form.

a) 60% b) 75% c) 90% d) $32\frac{1}{2}\%$

e) $27\frac{1}{2}\%$ f) $2\frac{1}{4}\%$ g) $37\frac{1}{2}\%$ h) $66\frac{2}{3}\%$

Chose two questions tell your partner how you converted this percentages to fractions.

1.5 Conversion of decimals to percentage and percentage to decimals

Conversion of decimals to percentages

Example 12.

Express 0.05 as percentage.
Change to a fraction and multiply by 100%

$$0.05 = \frac{5}{\cancel{100}} \times \cancel{100}$$

$$= 5\%$$

Change it into fraction first i.e. $\frac{5}{100}$.

Then multiply by 100 and cancel 100 by 100 to get 5%

Activity 4:

In pairs, express the following as percentage.

a) 0.567 b) 0.4 c) 0.036 d) 0.48 e) 0.135

f) 1.75 g) 0.23 h) 2.8 i) 0.25 j) 3.75

Conversion of percentages to decimals

Example 13.

Convert 88% to a decimal

$88\% = \frac{88}{100} = 0.88$

Change it into fraction.

Then divide by 100

$= 0.88$

Exercise 7.

Convert the following percentages to decimals.

a) 77% b) 135% c) 265% d) 1%

e) 857% f) 13% g) 175% h) 8%

i) 19% j) 9%

Activity 5:

Where do we apply converting fractions to percentages?

1.6 Application of fractions, decimals and percentage

When we talk, we often use different words to express the same thing. For example, we could describe the same car as **tiny** or **little** or **small**. All of these words mean the car is not big.

Fractions, decimals, and percents are like the words tiny, little, and small. They're all just different ways of expressing parts of a whole.

Fractions

Fractions are used in the real world during jobs such as a chef or a baker because you need to know how much of something like butter or milk to put in a recipe

Decimals

Decimals are used in measurements for example my pen is 5.5 inches long.
Architects use decimals when they are measuring the height of a building.

Percent

In restaurant they have to use percent when they make a pizza so that they can cut it into equal pieces. Finally they use them when they decide how much of their budget goes to supplies.

Example 14.

In real life, fractions are used in games like soccer we talk of half time, as they are splint in to halves. Also fractions are used in food, i.e. $\frac{1}{2}$ cup of sugar.

In real life, percentages are used in liquids and food. i.e. 30% of tea is milk, 100% percent orange juice. Also in washing, we say what percentage of germs will be killed and how safe it is. i.e. 100% safe and kills 99.9% germs

Exercise 8.

In pairs, work out the following and share your working with your partner.

1. In a closing-down sale a shop offers 50% off the original prices. What fraction is taken off the prices?

2. In a survey one in five people said they preferred milk. What is this figure as a percentage?

3. Mary is working out a problem involving $\frac{1}{4}$. She needs to enter this into a calculator. How would she enter $\frac{1}{4}$ as a decimal on the calculator?

4. Deng pays tax at the rate of 25% of his income. What fraction of Deng's income is this?

5. When a carpenter was buying his timber, he had to put down a deposit of $\frac{1}{10}$ the value of timber. What percentage was this?

6. I bought my coat in January with $\frac{1}{3}$ off the original price. What percentage was taken off the price of the coat?

7. Brian bought a cloth that was 1.75 metres long. How could this be written as a fraction?

UNIT 2: MEASUREMENT

2.1 Perimeter of rectangle, square, triangle, circle and trapezium

Perimeter is the distance around a shape. Its symbol is **P**. In order to calculate the perimeter of a shape, you must add up the lengths of all its sides.

Example 1.

A rectangle has a width of 5cm and a length of 3cm, its perimeter would be:

3cm

5cm

PERIMETER = SUM OF LENGTH OF ALL FOUR SIDES

= 5 + 3 + 5 + 3

= 16cm

There are different types of geometric shapes.

They include:

Rectangle, Square, Triangle, Circle, Trapezium

There is a formula for calculating the perimeter of each shape.

Perimeter of a rectangle

A Rectangle is a four sided with two opposite sides equal to each other. The longer side is called the **Length** while the shorter side is called the **Width**.

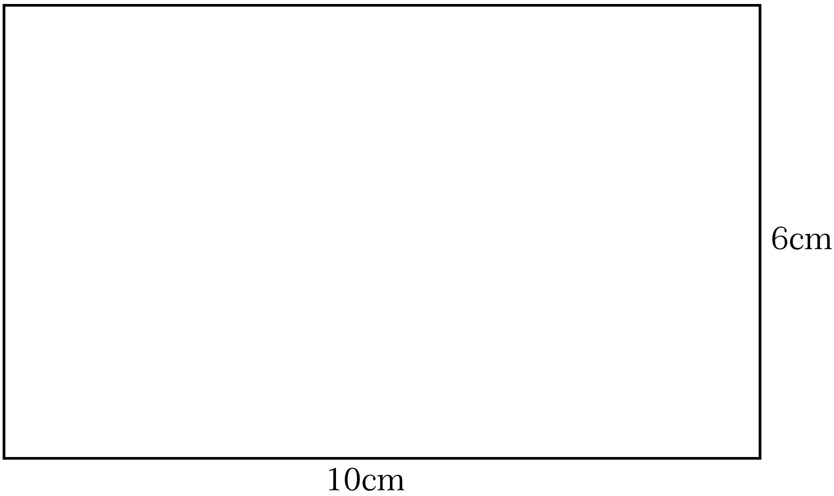
Perimeter of a rectangle = 2 (Length + Width)

$P = 2(L+W)$

$P = 2(10+6)$

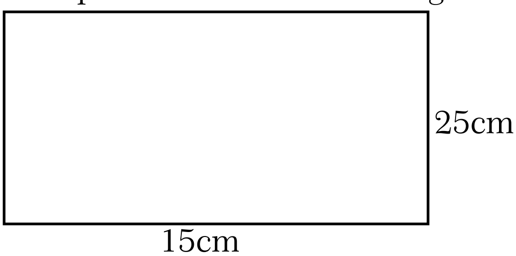
$P = 2 \times 16$

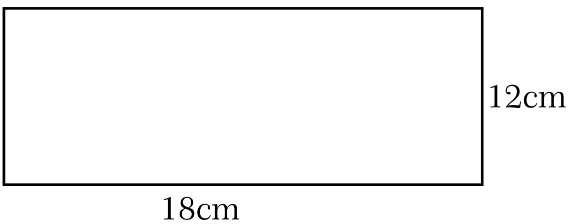
$P = 32$ cm

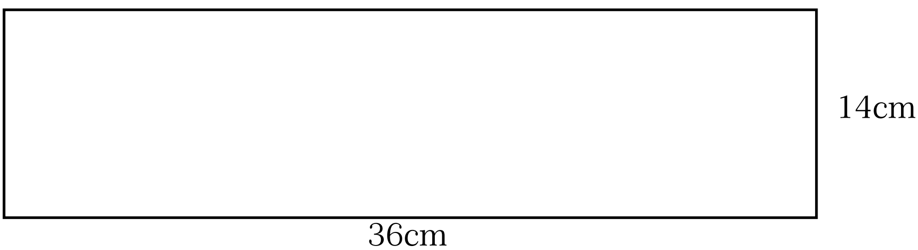


Exercise 1.

1. Find the perimeter of the following:

1. 

2. 

3. 

2. A rugby makes seven runs around a rugby field of length 90m and width 75m. Calculate the distance she covered.

3. A farmer wants to fence a field of length 800m and width 650m by surrounding it with a barbed wire, calculate the length of the barbed wire used.

4. To fence a rectangular plot of length 150m and width 100m, a landlord erects poles which are 50m apart. How many poles are required?

Activity 1:

Work in groups;

1. The perimeter of a rectangular playground is 46 m. If the length of the park is 7 m, what is the width of the park? Explain your working.

2. The perimeter of a rectangular field is 60 M and its width is 20 M. Find the perimeter of this field. Show your workings.

3. Before soccer practice, Laura warms up by jogging around the soccer field that is 80 M by 120 M. How many yards does she jog if she goes around the field two times?

Perimeter of a square

A Square is a four sided with all sides equal to each other.

Perimeter of a Square $= 4 \times$ Length

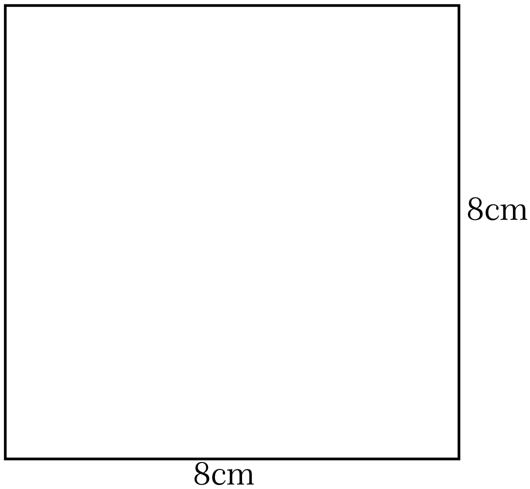
Example 2.

$P = 4L$

$= 8cm$

$P = 4 \times 8cm$

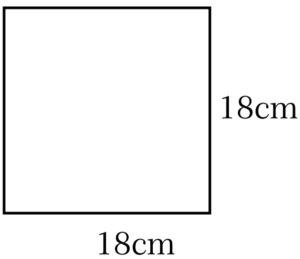
$P = 32\ cm$



Exercise 2.

1. In groups, find the perimeter of the following:

(i)



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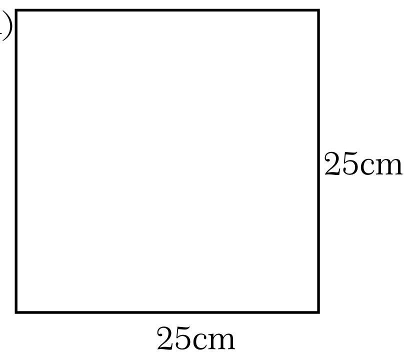

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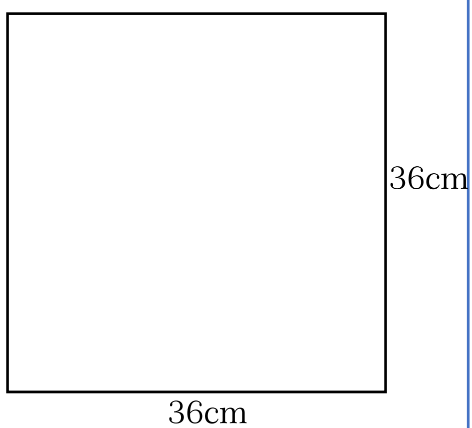


Activity 2:

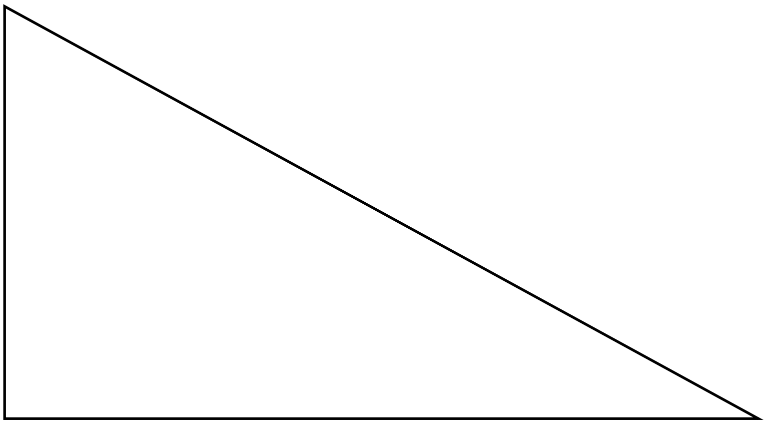
Work in groups;

1. A cricket player makes four runs around a pitch of length 90m. Calculate the distance he covered. Explain how you arrived at your answer.

2. A farmer wants to fence a square field of length 800m by surrounding it with a barbed wire, calculate the length of the barbed wire used. Present your working.

Perimeter of a triangle

A triangle is a three sided figure.



Perimeter of triangle is the sum of the lengths of all the sides.

Like any polygon, the perimeter is the total distance around the outside, which can be found by adding together the length of each side.

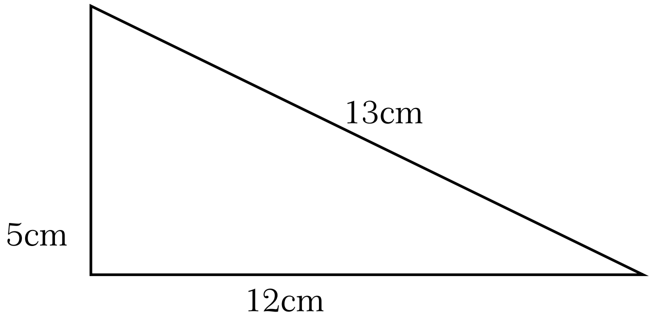
Or as a formula:

$$Perimeter = a + b + c$$

Where: a, b and c are the lengths of each side of the triangle.

Example 3.

Determine the perimeter of the triangle below:

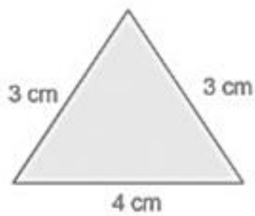


Perimeter = Sum of length of sides
= 12 + 13 + 5
= 30cm

Exercise 3.

In pairs, work out the perimeters of the triangles below. (Not drawn to scale)

1.



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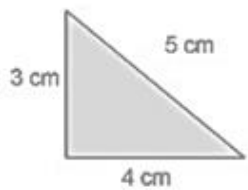

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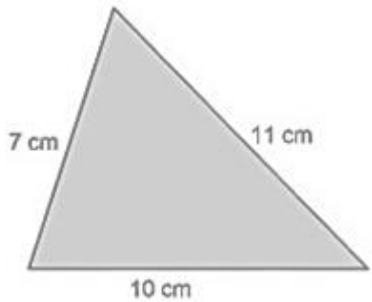

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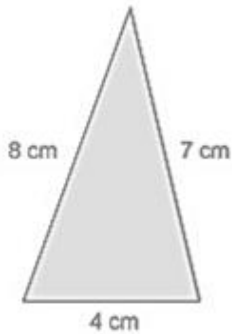
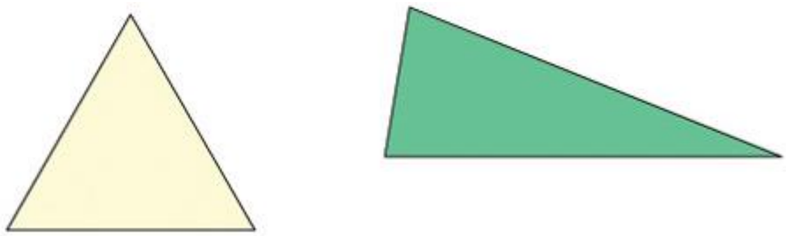


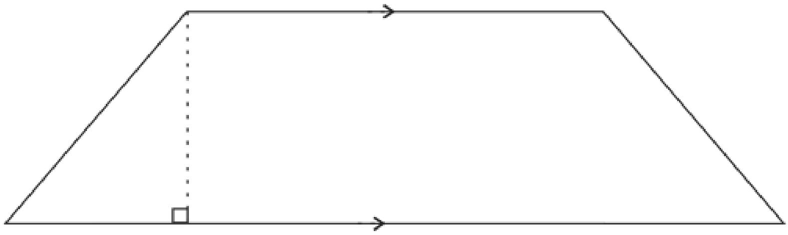
Activity 3:

Measure the lengths of the sides of this triangles and calculate their perimeters.



Perimeter of a trapezium

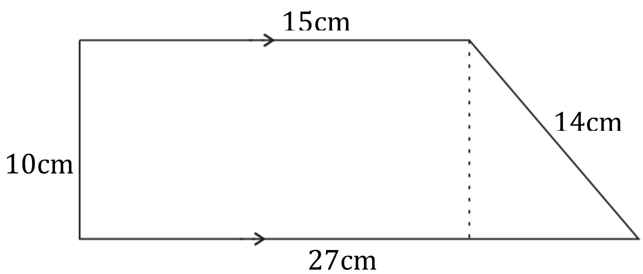
A trapezium has two parallel sides with one of the sides being shorter than the other.



The perimeter of a trapezium is the sum of the distances round the figure.

Example 7.

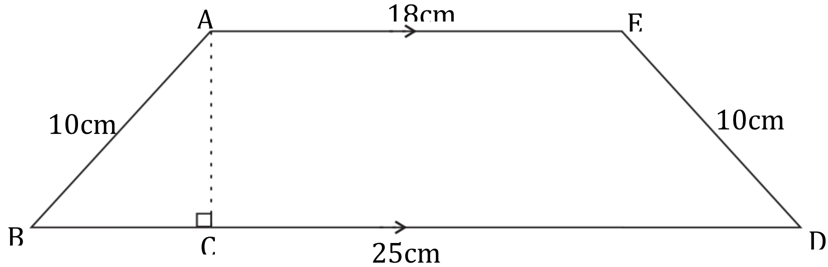
Calculate the perimeter of the figure below:



P $= 15 + 27 + 14 + 10$
$= 66$ cm

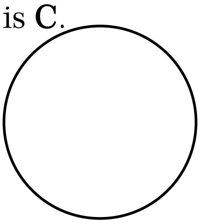
Activity 4:

Find the perimeter of the following figures:



Perimeter of a circle

The distance round a circle is known as the circumference. The symbol for circumference is **C**.



A circle has a line joining two points of the circle which cuts through the centre. The line is known as a **diameter (d)**. The distance between the centre of a circle and any point on the circumference is called a **radius (r)**.

Circumference = pi x diameter

$$C = \pi d$$

Pi (π) is approximately $\frac{22}{7}$ or 3.14.

Example 4.

Approximate the circumference of a circle with diameter of 7cm.

Circumference $= \pi d$

$= \frac{22}{7} \times 7\text{cm}$

$= 22\text{cm}$

Circumference can also be calculated using radius.

Circumference $= 2\pi r$

C $= 2\pi r$

Example 5.

Find the circumference of a circle with radius of 7cm.

Circumference $= 2\pi r$

C $= 2\pi r$

C $= 2 \times \frac{22}{7} \times 7cm$

C $= 44cm$

Exercise 4.

1) The radius of a circle is 5 inches. What is the
   (a) Diameter (b) circumference

2) The diameter of a circular rug is 35 cm.

   a) What is the radius? b) Circumference? c) Radius?

The radius, diameter, or circumference of a circle is given. Find the missing measures. Show your work.

Radius	Diameter	circumference
10inch		
	10	
		76.4
10.4		
		314
	1	

Activity 5:

1. In pairs, find the following;

    a) The circumference of a circle with a diameter of 15 cm.

    b) The radius of a circle with a diameter of 480 in.

    c) The circumference of a circle with a radius of 320 cm.

    d) The diameter of a circle with a radius of 522 ft.

2. The diameter of a bicycle wheel is 34 inches. What is the radius?

    a. How far will you move in one turn of your wheel?

    b. What is the distance covered in 5 turns of the wheel? Show your work to your partner.

Semi-circle

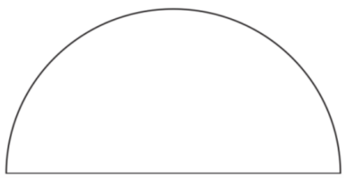
A half of a circle is called a semi-circle.

The circumference of a semi-circle is:

Circumference $= \frac{1}{2}\pi d + d$

Example 6.

Determine the circumference of the figure below:



C $= \frac{1}{2}\pi d + d$

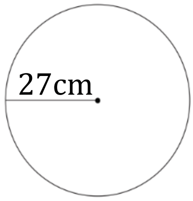
$= (\frac{1}{2} \times \frac{22}{7} \times 14) + 14$

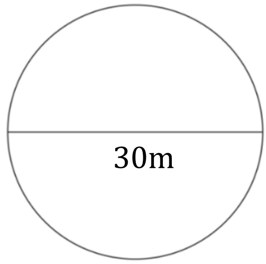
$= 36\text{cm}$

Exercise 5.

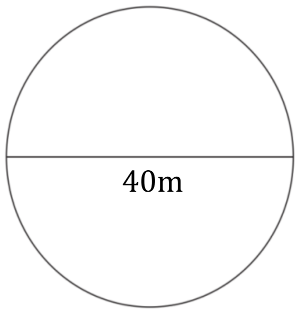
1. Determine the circumference of the following figures:

   a.





   b.



2. A motorcyclist is racing round a circular course of radius 49m. Determine the distance he makes five runs round the course.

3. Determine the circumference of a semicircular field of diameter 18 metres.

4. Calculate the diameter and radius of a circle whose circumference is 77cm.

5. To fence a circular field of diameter 35m, a farmer erects poles after every 10m. Determine the number of poles the farmer requires to fence the field.

Activity 6:

Working in groups, make a fact sheet to help learners understand hoe to work out the perimeter of two shapes

2.2 Area of rectangle, square, triangle, circle and trapezium

The area is the amount of a surface covered by a boundary. The symbol for area is **A**.
The units for area are square units such as square metres (m^2), square centimeters (cm^2), square kilometers (km^2), Ares, hectares (Ha).

$1m^2 = 1m \times 1m$

$1m^2 = 10000cm^2$

$1 \text{ Are} = 100m^2$

$1\text{Hectare} = 10000\ m^2$

Example 8.

To convert m^2 to cm^2, multiply the value given by 10000.

1. Convert $1.8m^2$ to cm^2

Solution

$1m^2 = 10000cm^2$

$1.8m^2 = 1.8 \times 10000$

$= 18000cm^2$

2. Convert $0.075m^2$ to cm^2

Solution

$1m^2 = 10000cm^2$

$0.075m^2 = 0.075 \times 10000$

$= 750cm^2$

To convert cm^2 to m^2, divide the value given by 10000.

1. Convert $1500cm^2$ to m^2

Solution

$10000cm^2 = 1m^2$

$1500cm^2 = \frac{1500}{10000}$

$= 0.15m^2$

2. Convert $28450cm^2$ to m^2

Solution

$10000cm^2 = 1m^2$

$28450cm^2 = \frac{28450}{100000}$

$= 2.845m^2$

Area of a rectangle

A Rectangle is a four sided with two opposite sides equal to each other. The longer side is called the **Length** while the shorter side is called the **Width**.

Area of a rectangle = Length x Width)

A = L × W)
A = 15 × 6

A = $90cm^2$

Activity 7:

In groups, solve the questions

1. The floor of a classroom has a length of 12m and a width of 9m. Calculate its area.

2. A farmer has a rectangular garden of length 800m and width 650m. Calculate the area of the garden on hectares.

3. A football field has length of 90m and a width of 75m. What is the area of its playing surface?

Area of a square

A Square is a four sided with all sides equal to each other.

Area of a Square = Length × Length

$A = L^2$

$A = 8^2$

$A = 64cm^2$

Activity 8:

1. Find the area of the following:

   (i) A square of sides 25cm.

   (ii) A square of sides 18cm.

   (iii) A square of sides 36cm.

2. A designer is using carpet to cover the floor of a room of area $169m^2$. Determine the dimensions of the carpet used.

Area of a right angled triangle

A triangle is a three sided figure.

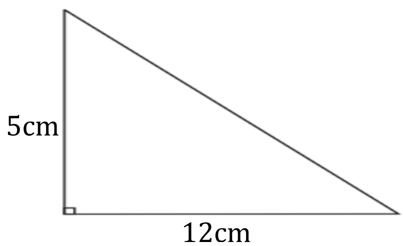
Area of triangle $= \frac{1}{2} \times base \times height$

$$A = \frac{1}{2}bh$$

The height and the base are the two sides which form a rich angle. The longest side of the triangle is called the hypotenuse. It is not used in calculation of the area.

Example 9.

Determine the area of the triangle below:



Area $= \frac{1}{2}bh$

$= \frac{1}{2} \times 12 \times 5$

$= 30cm^2$

Exercise 6.

1. A triangle with an area of $150cm^2$ has a base of 20cm. Calculate its height.
2. A triangular plot has a base of 12m and hypotenuse of 13m. Calculate its area.

Area of a circle

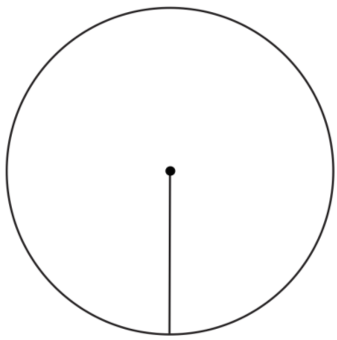
A circle has a line joining two points of the circle which cuts through the centre. The line is known as a **diameter (D)**.

The distance between the centre of a circle and any point on the circumference is called a **radius (r)**.

Area = pi × (radius) ^{2}

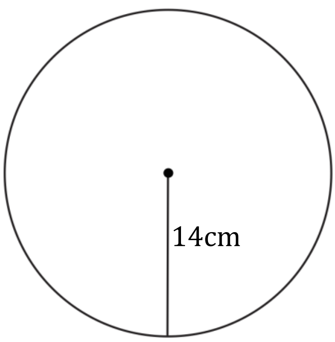
A $= \pi r^2$

Pi π *is appriximately* $\frac{22}{7}, 3\frac{1}{7}$ *or* 3.14



Example 10.

Find the area of the circle below:



Area of a circle $= \pi \times r \times r$

$\pi = \frac{22}{7}, 3\frac{1}{7}$ *or* 3.14

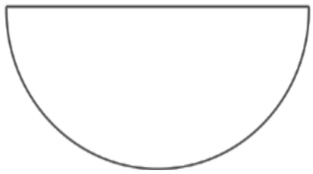
Area $= \frac{22}{\cancel{7}} \times \overset{2}{\cancel{14}}cm \times 14cm$

$= 44 \times 14cm^2$

$= 616cm^2$

Semi-circle

A half of a circle is called a semi-circle.



The area of a semi-circle is:

Circumference $= \frac{1}{2} \times\ pi\ \times (Radius)^2$

Example 11.

Determine the area of a semicircle of diameter 14cm.

A $= \frac{1}{2}\pi^2$

$= \frac{1}{2} \times \frac{22}{7} \times 7^2$

$= 77\text{cm}^2$

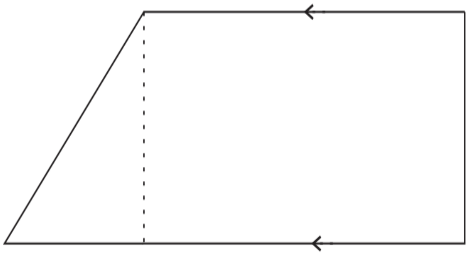
Exercise 7.

1. Determine the area of the following:
    a. Circle of radius 21 cm.
    b. Circle of diameter 30cm.
    c. Semi-circle of diameter 40cm.

2. A motorcyclist is racing round a circular course of radius 49m. Determine the area of the course.
3. A circular shaped lake covers a diameter of 7km. Determine the area of the surface covered by the lake.
4. Calculate the area of a circle which has a radius of 4cm
5. A circular playing field has an area of 242m^2. Calculate its circumference.
6. A semicircular disk has a diameter of 7cm. Find its area in square metres.

Area of a trapezium

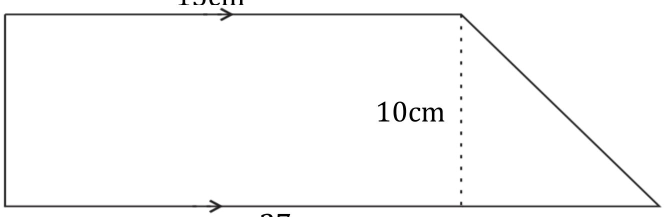
A trapezium has two parallel sides with one of the sides being shorter than the other. The two parallel sides are joined on one end by a height.



Area of a trapezium $= \frac{a+b}{2} \times height$.

Example 12.

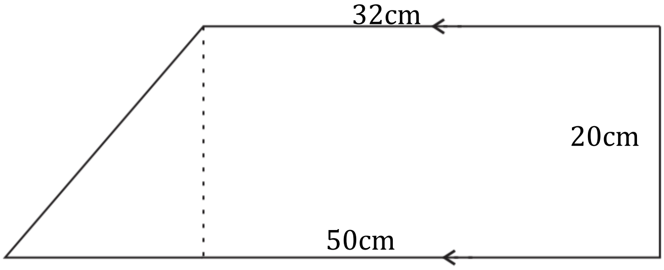
Calculate the area of the figure below:



A $= (15 + 27) \text{ x } 10$
$= 210\text{cm}^2$

Activity 9:

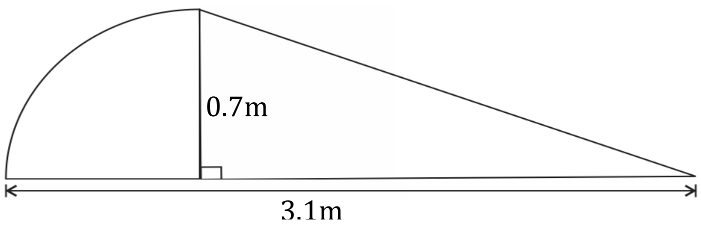
1. The two parallel sides of a trapezium shaped field are 280m and 160m. The field has an area of 3.3 hectares. Calculate the width of the field.
2. Calculate the area of figure below.



Exercise 8.

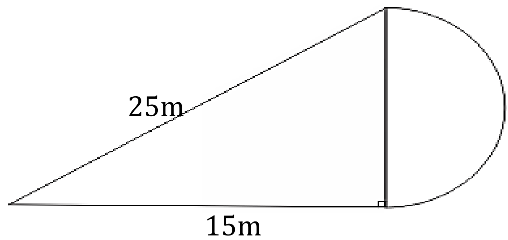
Show your working out. π ***is appriximately*** $\mathbf{3.14}$

1. The figure below represents a swimming pool in the shape of a quarter of a circle of radius 0.7m and a right-angled triangle.

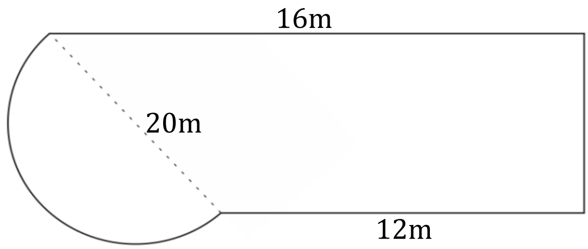


What is the area in cm^2 of the swimming pool?

2. The figure below represents a flower garden. What is the area in m^2?

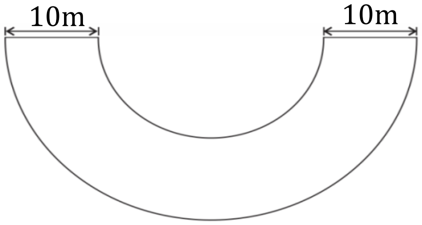


3. A cow shed is of the shape shown below, formed by a semi-circle and a trapezium.



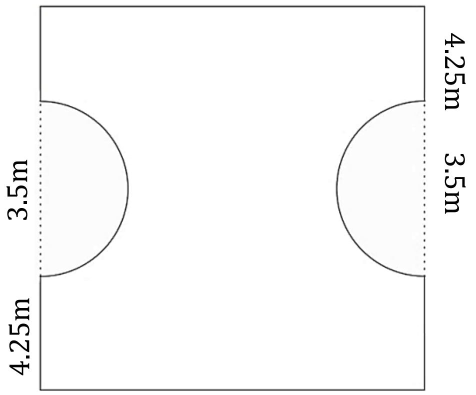
What is the area of the cow shed in square metres?

4. The figure below represents a potato garden enclosed by two semi circles 10m apart. The diameter of the larger circle is 40m.



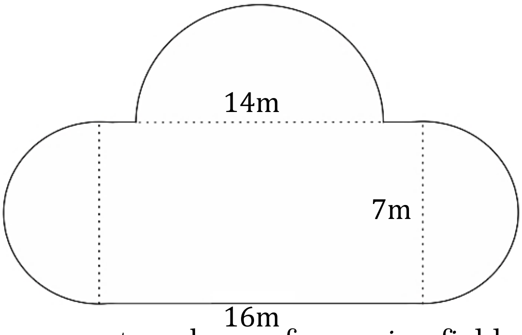
What is the area covered by the potato garden?

5. The figure below represents a flower garden formed by a square and two semi circles each of diameter 3.5m.

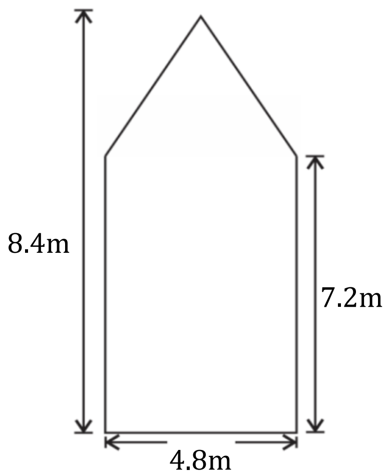


What is the area of the garden in square metres?

6. Find the area of the figure shown below?

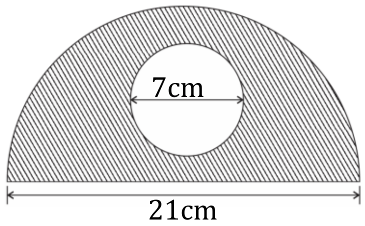


7. The diagram below represents a shape of a grazing field.

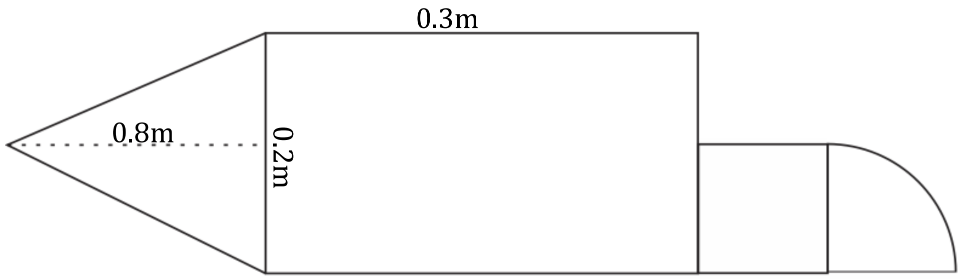


What was the area for grazing?

8. Find the area of the shaded figure below with a circle in the semi-circle.

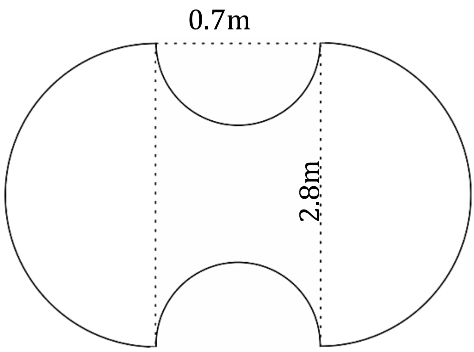


9. A piece of land is in the shape shown below. It consists of an isosceles triangle, a square and a quarter of a circle.



If the base of an isosceles triangle, is half one side of the square. What is the area of the whole figure in square centimetres?

10. The figure represents a piece of cardboard used to make certain furniture, with two opposite semi-circles.



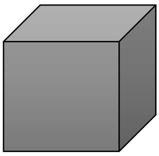
What is the area in square metres of the cardboard?

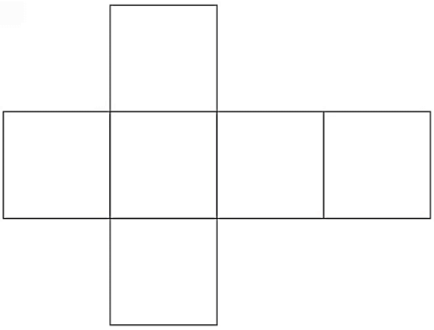
2.3 Surface area of a cube and cuboid

Surface area of a cube

A cube has 6 equal square faces.

An open cube has 5 equal square faces.





Formula of the surface area of a closed cube.

$$Surface\ area = (L \times W) \times 6\ faces$$

Example 13.

Find the surface area of a closed cube whose one side is 8m.

$$Surface\ area\ of\ a\ closed\ cube\ = (8 \times 8)m^2 \times 6$$

$$= 64m^2 \times 6 = 384m^2$$

Surface area of a cuboid

A cuboid has 2 equal opposite sides.

$$Surface\ area\ of\ a\ closed\ Cuboid\ = 2(L \times W) + 2(L \times W) + 2(L \times W)$$

Formula of the surface area of a closed cuboid.

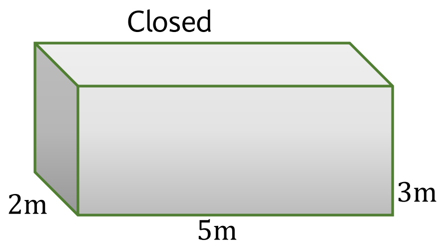
$$Surface\ area\ of\ a\ closed\ Cuboid$$
$$= 2(L \times W) + 2(L \times W) + 2(L \times W) square\ units$$

Activity 10:

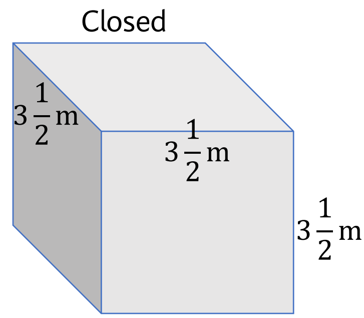
In groups, work out the questions below and explain your mathematical workings to other groups.

1. Find the surface area of the cubes and cuboids below.

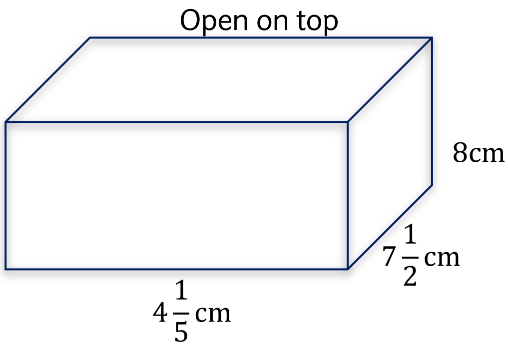
a)



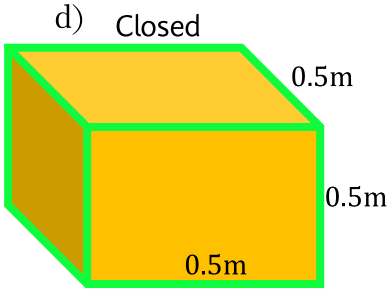
b)



c)



d)



2. One closed cuboid measures 4m by 1.5m by 2m, another open cuboid measures 8cm by 6cm by 5cm. What is the difference in their surface areas in square centimetres?

3. An open cuboid tin of 12cm by 9cm by 7cm was painted on the outside. What was the area painted altogether?

4. The base of a closed cuboid measures $4\frac{1}{2}$cm by $5\frac{1}{2}$cm by $7\frac{3}{4}$cm. The base and the top part of the cuboid are not painted. What is the total surface area of the parts which are not painted?

5. The volume of an open rectangular tank is $48.6m^3$. The tank has a square base. The height of the tank is 5.4m. What is the surface area of the tank in square metres?

2.4 Converting m^3 to cm^3

To convert m^3 to cm^3, multiply the value given by 1000000.

Example 14.

1. Convert $13.8m^3$ to cm^3

$$1m^3 = 1000000cm^3$$

$$13.8m^3 = 13.8 \times 1000000$$

$$= 13800000cm^3$$

2. Convert $0.075m^3$ to cm^3

$$1m^3 = 10000cm^3$$

$$0.075m^3 = 0.075 \times 1000000$$
$$= 75000cm^3$$

To convert cm^3 to m^3, divide the value given by 10000.

Example 15.

1. Convert $1500cm^3$ to m^3

$$1000000cm^3 = 1m^3$$

$$1500cm^3 = \frac{1500}{1000000}$$
$$= 0.0015m^3$$

2. Convert $28450cm^3$ to m^3

$$1000000cm^3 = 1m^3$$

$$28450cm^3 = \frac{28450}{1000000}$$

$$= 0.02845m^3$$

2.5 Volume of a cube and cuboid

Volume is the space occupied by matter. It can also be defined as the space enclosed by matter. The symbol for volume is **V**.

3.5.1 Volume of cubes and cuboids

$$Volume = Base\ area \times Height$$

Example 16.

Find the volume of the cube whose one side is 15Cm.

Solution

A cube is square based and all sides are equal.

$$\text{Base area} = L \times W$$

$$V = L \times W \times H$$

$$= (15 \times 15 \times 15)cm^3$$

$$= 3375cm^3$$

Volume is given in cubic units such as cubic centimetres (cm^3), cubic metres (m^3) etc.

Example 17.

Find the volume of a cuboid whose measurements are 12cm by 11cm by 8cm.

$$V = L \times W \times H$$

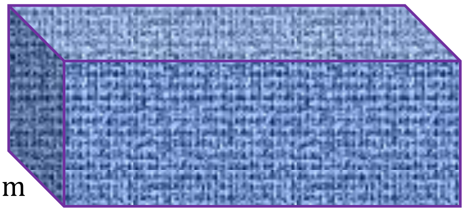
$$= (12 \times 11 \times 8)cm^3$$

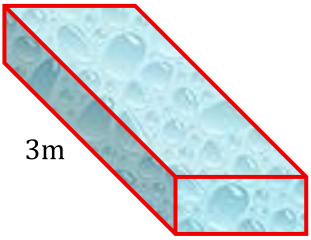
$$= 1056cm^3$$

Exercise 9.

Work individually

1. Find the volume in cubic metres.

a) 

b) 

2. One cube measures 8cm, another cube measures 11cm. What is the sum of their volumes in cubic centimetres?
3. A rectangular container with a base area of $350m^2$ and a height of 20m is filled with juice. If the juice was packed into $250cm^3$ packets, how many packets were packed?
4. The volume of a rectangular tank is $72.9m^3$. The tank has a square base. If the height is 8.1 metres, what is the measure of one side of the square base?
5. A rectangular tank 45cm long and 25cm wide was $\frac{3}{4}$ full of water. What is the volume of water required to fill the tank?
6. A cube-shaped tank of 7.5m was full of water. After removing $14600cm^3$ of water the level of water become 5cm high. What was the height of the container?
7. A container with a volume of 0.09 cubic metres is full of water. The water is then poured into 15cubic centimeter containers. How many such containers are used?
8. One cube measures 0.8m. Another cuboid measures $1.2m \times 5m \times 0.3m$. What is the difference in their volume in cubic centimetres?
9. A company packs 250 packets of $750cm^3$ of pineapple juice while another packs 485 packets of $500cm^3$ of pineapple juice each day. How many cubic metres of juice the two companies pack in the month of October?

Volume of cylinders

Volume is the amount of space in a container.

Formula of calculating the volume of the cylinder is equal to

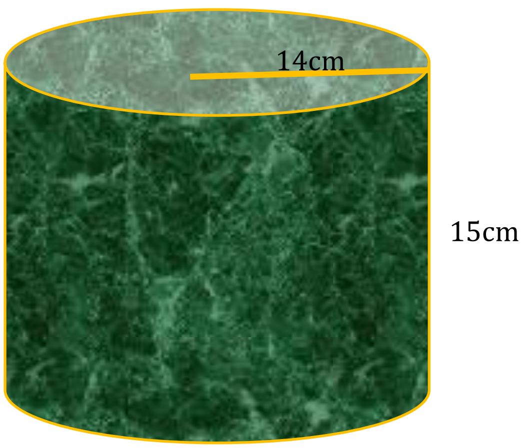
$$Volume = Base\ area \times height$$

$$= \pi r^2 \times h$$

$$= \frac{22}{7} r^2 \times h$$

Example 18.

Find the volume of the cylinder below.



$V = Base\ area\ \times Height$

$$\frac{22}{\cancel{7}} \times \overset{2}{\cancel{14}cm} \times 14cm \times 15cm$$

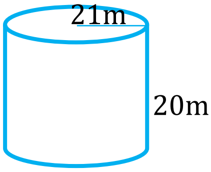
$$(22 \times 2 \times 14 \times 15)cm^3$$

$$= 9240cm^3$$

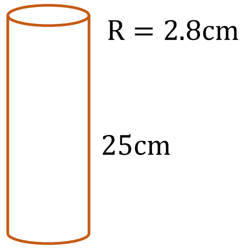
Activity 11:

1. Find the volume of the cylinders below. π *is approximately* $\frac{22}{7}$

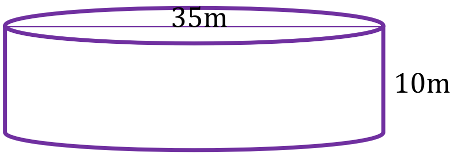
a)



b)

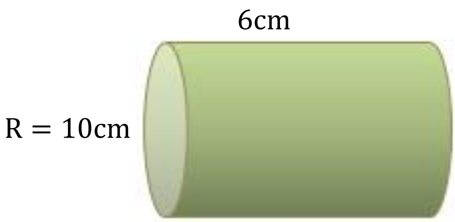


c)

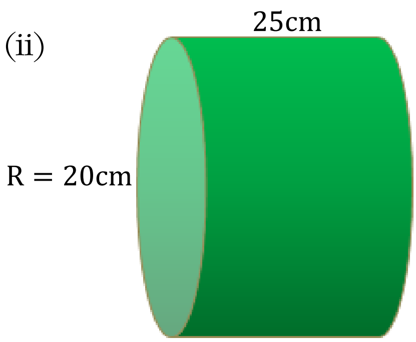


2. Find the volume of the cylinders below.

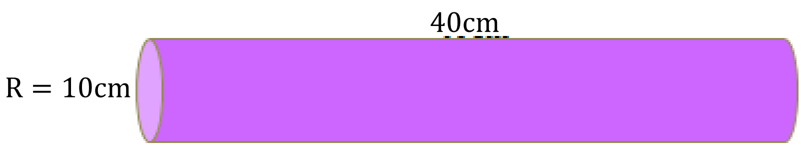
(i)



(ii)

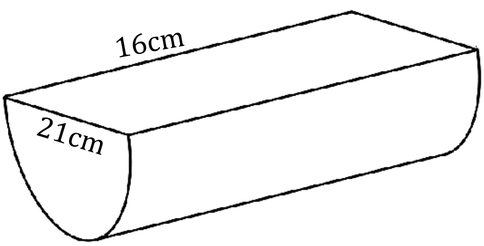


(ii)

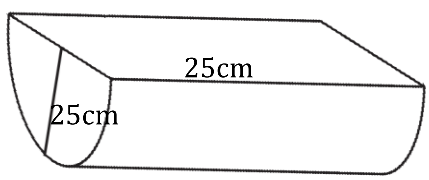


3. The figures below represent halves of cylindrical solids whose dimensions are shown. Find their volumes.

a)



b)



2.6 Problems involving Time, speed and distance

Formula

$Time\ taken = \ Distance \div Speed.$ $T = D \div S$

$Speed = \ Distance \div Time\ taken.$ $S = D \div T$

$Distance = Speed\ \times Time\ taken$ $D = S \times T$

Conversion of M/s to Km/h

Example 19.

Convert 15m/s to km/h

1000m = 1Km 15m =15÷1000km

3600sec = 1Hour 1Sec = 1÷3600 hour

Formula

$Speed = Distance \div (Time\ taken)$

$15min\ in\ 1sec\ = 15 \times 60sec$

$15 \times 60 \times 60m$ in 1 hour

$$\frac{15 \times 60 \times 60}{1000} km\ in\ 1\ hour$$

$$=54Km/h$$

NB 1: m/s $\longrightarrow$ Km/h

Take speed in $m/s \times \frac{3600}{1000}$

NB 2: Km/h $\longrightarrow$ m/s

Take speed in $km/h \times \frac{1000}{3600}$

Exercise 10.

Show how you got your answer

1. A cyclist took 18 minutes to travel from his home to school at a speed of 36Km/h. He took 20 minutes to travel back from school to his home. What was his average speed in M/s from school to his home?

2. A motorist left town C at 7.15a.m for town B a distance of 510km. He travelled the first 150km in$1\frac{1}{5}$ hours and stopped for15 minutes to take a cup of tea. He went on with the journey arriving in town D at 12.55p.m. What was his average speed for the whole journey?

3. A driver started on a journey of 450km at 7.30a.m travelling at an average speed of 90km/h. After travelling for 120km, he rested for 25minutes. He then continued with the rest of the journey at an average speed of 60km/h. At what time did he complete the journey?

4. In a relay race Faiza ran 100m which is $\frac{1}{3}$ of the race in 3 minutes. Mukami ran another 100m in 5 minutes while Cheromo ran the remaining part in 2 minutes. What was the average speed for the whole race in m/s?

5. Ayesha left home and walked for $1\frac{1}{3}$ hours at an average speed of 9km/h. She rested for 20 minutes and continued with the journey for 3hours at an average speed of $4\frac{2}{15}$km/h. What was the average speed for the whole journey?

6. Imran left town R at 7.15a.m for town S travelling at a speed of 75km/h, Saima left town S at 8.00a.m for town R at a speed of 9 km/h. The two met at a place 225km away from town R. What was the distance between town R and S?

7. A motorist driving at a speed of 80km/h was expected to arrive on time in town E 300km away. After driving for $2\frac{1}{4}$hours he rested for ¼ hour to take lunch. At what speed in km/h did he drive after taking lunch if he had to arrive at the expected time?

8. A Bus travelling from town M to town N at an average speed of 80km/h took 48minutes. Another bus took 40minutes to travel the same distance. What was the difference in their speed in km/h?

9. A motor bike travelled 450km at an average speed of 90km/h. On the return journey the average speed decreased to an average speed of 60km/h. Calculate the average speed in km/h for the whole journey.

10. Abdallah left home at 8.15a.m for Juba a distance of 300km. After driving for $2\frac{1}{4}$hours, he rested for 45minutes. He then continued with his journey and reached Kisumu at midday. What was his average speed for the journey?

Check your answers with your partner, explain how you worked it out.

UNIT 3: GEOMETRY

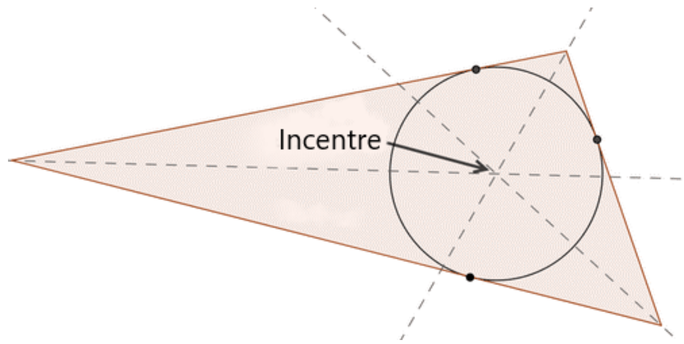
3.1 Inscribing and circumscribing circles of triangles

Given a triangle, what's the difference between the **inscribed circle** of the triangle and the **circumscribed circle** of the triangle?

Inscribing a circle

Given a triangle, an **inscribed circle** is the largest circle contained within the triangle. The inscribed circle will touch each of the three sides of the triangle in exactly one point. The center of the circle inscribed in a triangle is the **incentre** of the triangle, the point where the angle bisectors of the triangle meet.

NB: The inscribed circle of a triangle is inside the triangle.

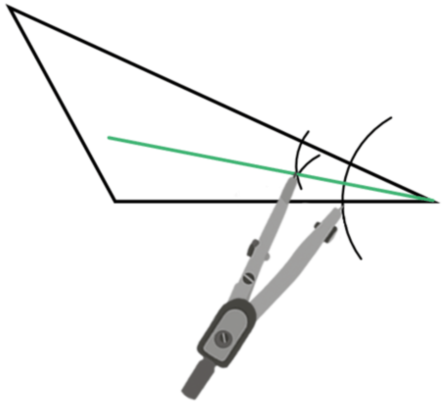


Steps to construct the inscribed circle:

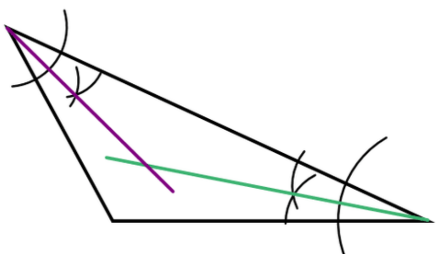
Bisect the angles of the triangle and produce them such that they intersect somewhere within the circle. The point of intersection is known as the incentre.

Draw a triangle. Construct the angle bisectors of two of its angles. Why is the point of intersection of the two angle bisectors the incentre of the circle?

Use your Pair of compasses and straightedge to construct the angle bisector of one of the angles.



Repeat with a second angle.



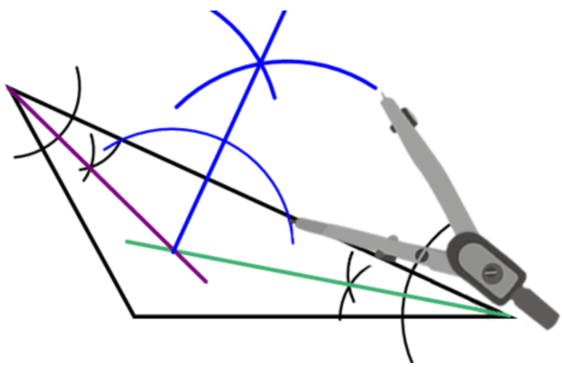
The point of intersection of the angle bisectors is the incentre.

It is not necessary to construct all three angle bisectors because they all meet in the same point. The third angle bisector does not provide any new information.

The segment connecting the incentre with the point of intersection of the triangle and the bisector is the radius of the circle.

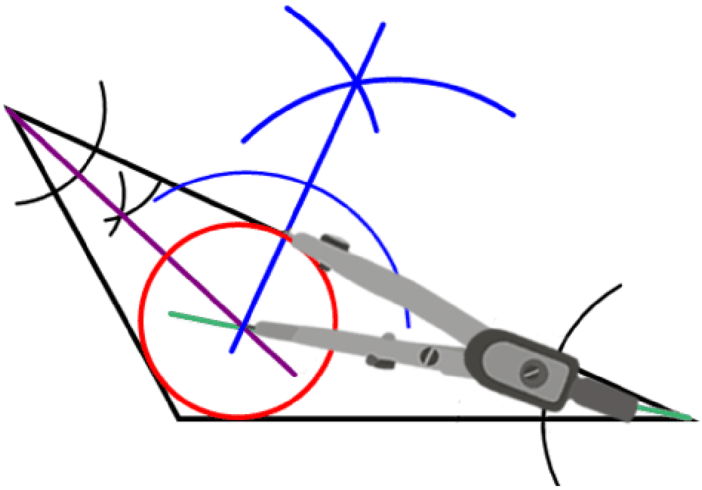
Construct a circle centered at the incentre that passes through the point of intersection of the side of the triangle and the perpendicular line from the problem above.

Construct a line perpendicular to one side of the triangle that passes through the incentre of the triangle.



Use your Pair of compasses and straightedge to construct a line perpendicular to one side of the triangle that passes through the incentre.

Note that this circle touches each side of the triangle exactly once.



Activity 1:

In groups, do the activity

1. Draw a triangle and construct the angle bisector of two of its angles.

2. Continue with your triangle from 1. Construct a line perpendicular to one side of the triangle that passes through the incentre of the triangle.

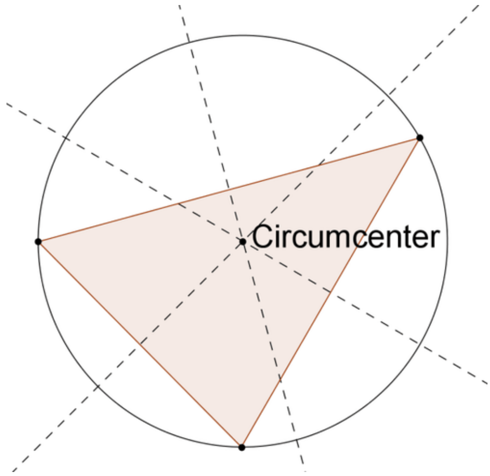
3. Continue with your triangle from 1 and 2. Construct the inscribed circle of the triangle.

4. Why is it not necessary to construct the angle bisector of *all three* of the angles of the triangle?

5. Explain why the incentre is equidistant from each of the sides of the triangle.

Circumscribing a circle

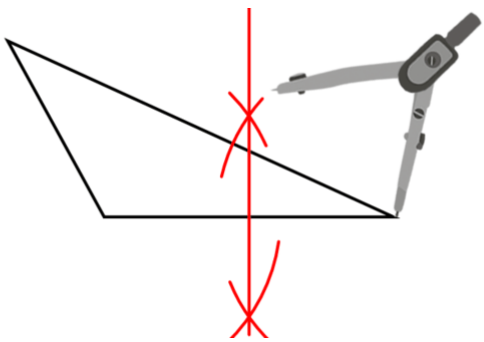
Given a triangle, the circumscribed circle is the circle that passes through all three vertices of the triangle. The center of the circumscribed circle is the circumcenter of the triangle, the point where the perpendicular bisectors of the sides meet.

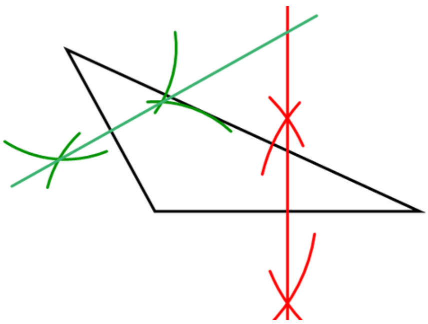


Steps to construct the circumscribed circle:

Bisect the sides of the triangle and produce them such that they intersect somewhere within or outside the circle. The point of intersection is known as the circumcenter.

Use your Pair of compasses and straightedge to construct the perpendicular bisector of one side.



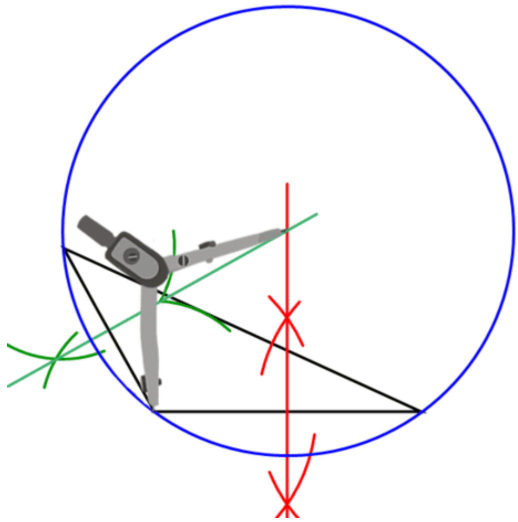


Repeat with a second side.

The point of intersection of the perpendicular bisectors is the circumcenter.

It is not necessary to construct all three perpendicular bisectors because they all meet in the same point. The third perpendicular bisector does not provide any new information.

Construct a circle centered at the circumcenter that passes through one of the vertices of the triangle. This circle should pass through *all three* vertices.



Activity 2:

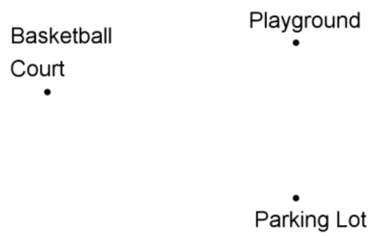
In groups, do the activity

1. Draw a triangle and construct the perpendicular bisector of two of its sides.
2. Continue with your triangle from 1. Construct the circumscribed circle of the triangle.
3. Explain why the circumcenter is equidistant from each of the vertices of the triangle.

Exercise 1.

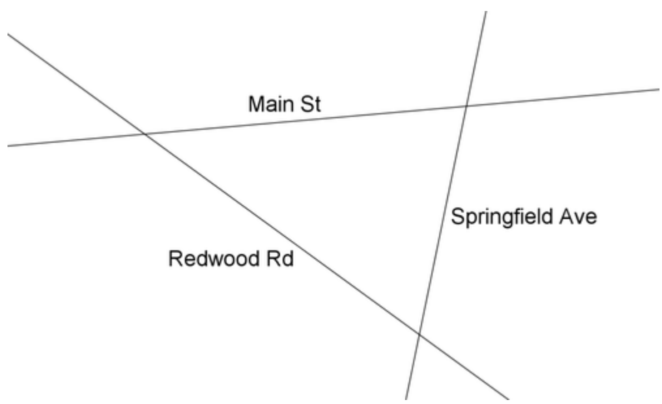
Work in groups;

1. You work selling food from a food truck at a local park. You want to position your truck so that it is the same distance away from each of the three locations shown on the map below.



   a. Is the point of interest the incentre or the circumcenter? How do you know, explain your thinking to the group.
   b. Find the point on the map that is equidistant from each of the three locations.

2. A new elementary school is to be constructed in your town. The plan is to build the school so that it is the same distance away from each of the three major roads shown in the map below.



   a. Is the point of interest the incentre or the circumcenter?
   b. Find the point on the map that is equidistant from each of the three roads.

Activity 3:

1. Draw two triangles of different shapes and then construct the circle that circumscribes them. Next, draw two triangles and then construct the circle that inscribes them.

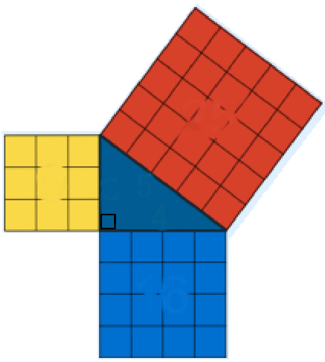
2. Construct a triangle PQR such that lines QR= 4.5cm, QP= 6.9cm and angle PQR= 100˚. Construct a circle touching the three vertices. What is the radius of the circle?

3. Construct triangle ABC in which line AB= 6cm, CA= 9cm and angle BCA= 140˚. Draw a circle that touches the three sides of the triangle. What is the length of the radius of the circle?

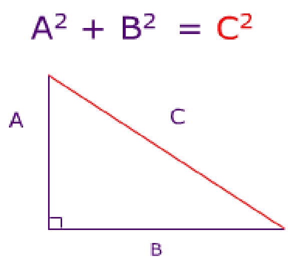
Pythagoras Theorem

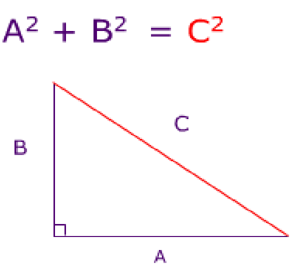
What is the Pythagoras' Theorem?

The Pythagorean Theorem or Pythagoras' Theorem is a formula relating the lengths of the three sides of a **right angled triangle**.



A right angled triangle consists of two shorter sides and one side called the **hypotenuse**. The hypotenuse is **the longest side** and is **opposite the right angle.**





If we take the length of the **hypotenuse** to be c and the length of the **other sides** to be a and b then this theorem tells us that:

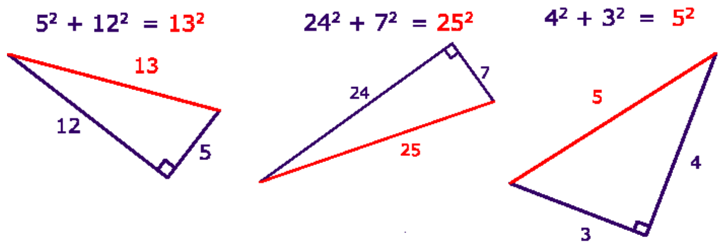
$$c^2 = a^2 + b^2$$

Pythagoras' Theorem states that; ***'In any right angled triangle, the sum of the squared lengths of the two shorter sides is equal to the squared length of the hypotenuse.'***

Pythagoras' theorem only works for **right angled triangles.**

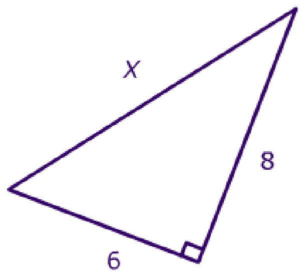
When you use the Pythagorean Theorem, just remember that the hypotenuse is always 'C' in the formula above.

Look at the following triangles to see pictures of the formula.



Example 1.

Use the Pythagorean Theorem to determine the length of X



Step 1
Identify the shorter and the hypotenuse of the right triangle.

The shorter have length 6cm and 8cm. X is the hypotenuse because it is opposite the right angle.

Step 2
Substitute numbers into the formula (remember 'C' is the hypotenuse)
$A^2 + B^2 = C^2$
$6^2 + 8^2 = X^2$

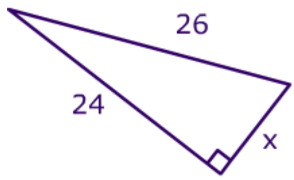
Step 3

Solve for the unknown

$$A^2 + B^2 = C^2$$
$$6^2 + 8^2 = X^2$$
$$36 + 64 = X^2$$
$$100 = X^2$$
$$X = \sqrt{100}$$
$$X = 10cm$$

Example 2.

Use the Pythagorean Theorem to determine the length of X



Step 1

Identify the length and width and the hypotenuse of the right triangle.

The length have length 24cm and x is width. The hypotenuse is 26cm.

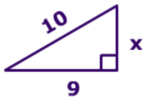
Step 2

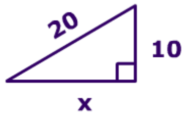
Substitute values into the formula.

$$A^2 + B^2 = C^2$$
$$X^2 + 24^2 = 26^2$$
$$X^2 + 576 = 676$$
$$X^2 = 100$$
$$X = \sqrt{100}$$
$$X = 10cm$$

Exercise 2.

1. Calculate the value of X.

a. 

b. 

2. A wheelchair ramp is needed at the entrance to a building. There is only 10 metres of space available for the ramp. How long should the ramp be?

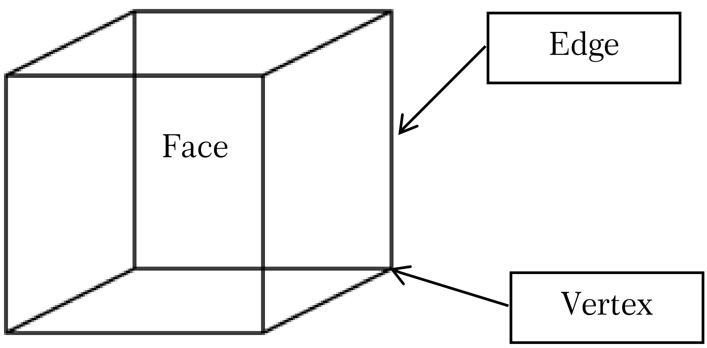
3. A roof is being placed on a frame that is 9 metres tall and 30 metres wide. How long are the diagonal pieces of the frame?

4. Which one of the following sets of measurements can be used to construct a right-angled triangle?
   (A) 4.5cm, 6cm, 9cm
   (B) 3.75cm, 5.25cm, 6cm
   (C)2.25cm, 3cm, 3.75cm
   (D) 5.25cm, 9cm, 11.25cm

5. A painter used a ladder to paint a wall of a storey building which was 24metres high. The ladder was placed 7metres away from the wall. What was the height of the ladder?

3.2 Pyramids and prisms

Remember from primary six.



Faces are flat shapes
Edges are lines where faces meet

Pyramids and prisms are two different shapes. The main difference between a pyramid and prism is the fact that a prism has two bases, while the pyramid only has one.

The type of pyramid is determined by the base. For example: a triangular pyramid will have a triangular base, while a square pyramid will have a square base, and so on.

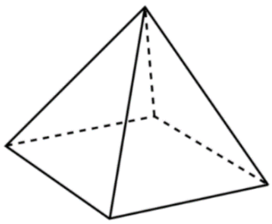
The type of prism is determined by the shape of the base. For example: a triangular prism will have triangular bases, while a rectangular prism will have rectangular bases, an octagonal prism will have octagon bases, and so on.

Activity 4:

Collect different objects with the shapes below and use them to investigate.

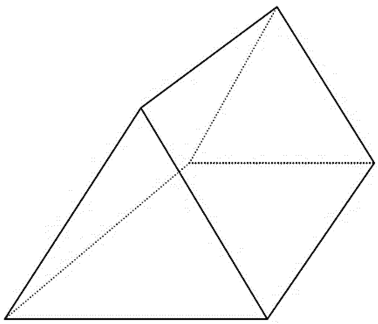
1. The diagram below represents a triangular square based pyramid
   What is the total number of?

   Faces
   Vertices
   Edges



2. The diagram below represents a triangular prism
   What is the total number of?

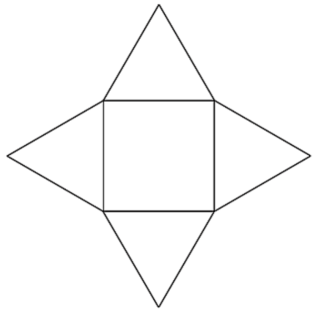
   Faces
   Edges
   Vertices



Exercise 3.

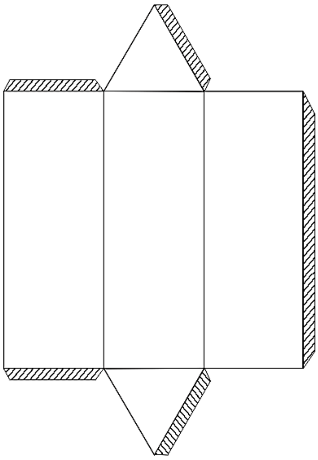
Work in pairs, draw the patterns below, cut them out and fold them along the lines.

1. The figure below shows a net made up of a square and 4 equilateral triangles



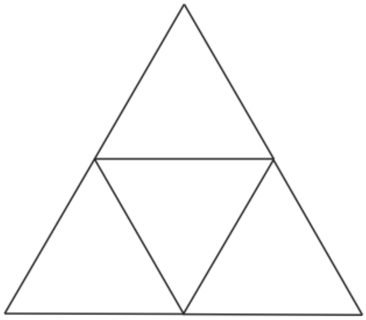
If folded which solid can be formed from this net?

2. Below is a net of a solid. The shaded parts are to be folded and glued.



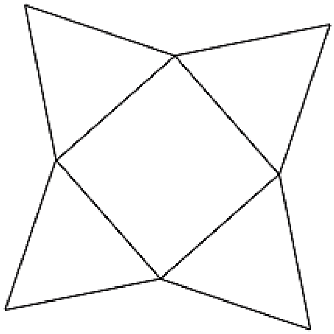
Which solid can be formed from the net?

3. The figure below represents the net of a solid.



The net is folded to form a solid. Which solid can be formed from the net?

4. The figure below represents the net of a solid.

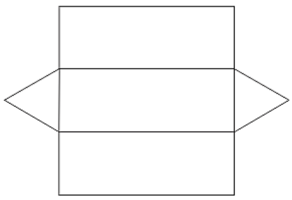


The net is folded to form a solid. How many edges will the solid have?

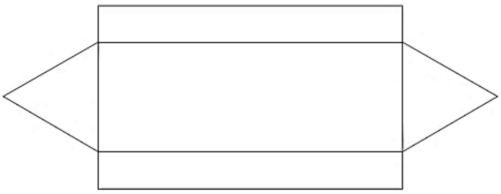
Is it a pyramid or prism?

5. Which one of the following figures is the net of a triangular prism?

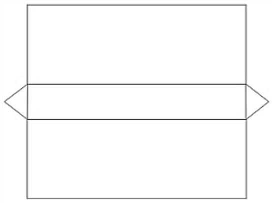
A.



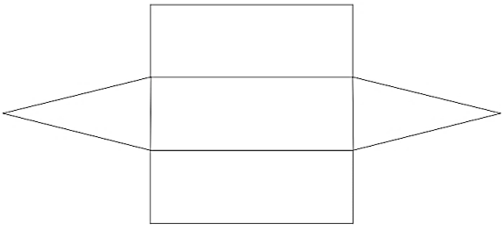
B.



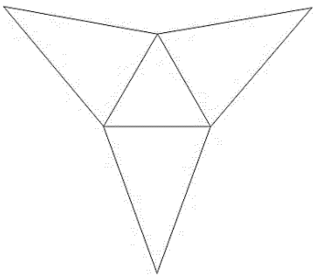
C.



D.



6. The figure represents the net of a solid



The net is folded to form the solid. How many vertices will the solid have?

3.3 Scale

Scale is the ratio of the length in a drawing (or model) to the length of the real things.

Real Horse
1500 mm high
2000 mm long

Drawn Horse
150 mm high
200 mm long

In the drawing anything with the size of "1" would have a size of "10" in the real world, so a measurement of 150mm on the drawing would be 1500mm on real life.

Example 3.

A road 3km is represented by a line 8cm long. What is the length of a road 12cm long?

$$8cm = 3km$$
$$8cm = 3000m$$
$$\therefore 1cm = ?$$

Cross multiply $\frac{1 \times 3000}{8}$

$\therefore 1cm$ is $375m$

1cm rep 0.375km

$\therefore 12cm$ Will be 0.375×12

$\underline{\underline{= \mathbf{4.4km}}}$

Activity 5:

In groups measure the following and use the scale 1:100 to draw them on a paper.

a. School Compound.
b. Class room.
c. Playing ground.

Exercise 4.

In groups, work out problems involving scale drawings.

1. A section of a tarmac road measures 8.5km, if it is drawn on a map it measures 17cm. What was the scale used?

2. A river measuring 5cm on a map has a length of 75km. What is the scale used on the map?

3. A map whose scale was 1:100000, an actual length of a right-angled plot of land measures 70m by 50m. What was the area of the triangular plot on the map?

4. On a map, 7.5cm represents 90km of the border of a certain county. What is the scale used?

5. A map is drawn to a scale of 1:15000. What is the distance in kilometres of a road which is 13.5cm on a map?

6. In scale drawing 1cm on a map represents an actual length of 25m. What area in the drawing will represent an actual area of 1 hectare?

7. A road is represented on a map by 3cm. What is the actual length of the road in kilometres if the scale used is 1:125000?

8. On a map of a scale of 1:100000, a rectangular shaped estate in town measures 9cm by 4cm. What is the actual length of the plot in kilometres?

9. A map is drawn to a scale of 1:800. What is the distance in metres of a road which is 17cm on the map?

10. A distance of 72km is represented on a scale drawing by a line measuring 18cm. What is the scale used in ratio form?

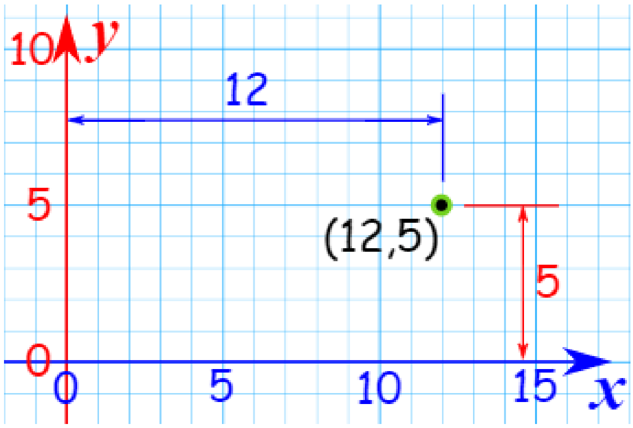
3.4 Coordinates

Coordinates are a set of values that show an exact position.

On graphs it is common to have a pair of numbers to show where a point is: the first number shows the distance along and the second number shows the distance up or down.

Example 4.

The point (12,5) is 12 units along, and 5 units up.



On maps the two coordinates often mean how far North/South and East/West.

There are other types of coordinates, too, such as polar coordinates and 3 dimensional coordinates.

Plotting points on a Cartesian plane

Just like with the Number Line, we can also have negative values.

Negative: start at zero and head in the opposite direction:

Negative x goes to the left, negative y goes down

For example (-6,4) means:
go back along the x axis 6 then go up 4.

And (-6,-4) means:
go back along the x axis 6 then go down 4.

Four Quadrants

When we include negative values, the x and y axes divide the space up into 4 pieces: Quadrants I, II, III and IV

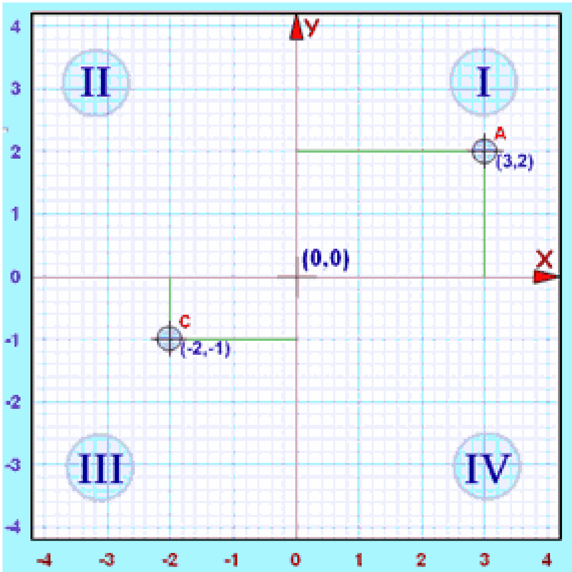
In Quadrant I both x and y are positive, but in Quadrant II x is negative (y is still positive), in Quadrant III both x and y are negative, and in Quadrant IV x is positive again, while y is negative.

Like this:

Quadrant	X (horizontal)	Y (vertical)	Example
I	Positive	Positive	(3,2)
II	Negative	Positive	
III	Negative	Negative	(-2,-1)
IV	Positive	Negative	

(They are numbered in a counterclockwise direction)

Example 5.



The point "A" (3,2) is 3 units along, and 2 units up.

Both x and y are positive, so that point is in "Quadrant I"

Example: The point "C" (-2,-1) is 2 units along in the negative direction, and 1 unit down (i.e. negative direction).

Both x and y are negative, so that point is in "Quadrant III"

Note: The word Quadrant comes from ***quad*** meaning four. For example, four babies born at one birth are called ***quadruplets*** and a ***quadrilateral*** is a four-sided ***polygon***.

UNIT 4: ALGEBRA

In algebra, we use letters to represent to represent unknown numbers.

4.1 Simplifying algebraic expressions

Put like terms together. A letter or a number with a letter in algebra is known as a term.

Example 1.

i. $y + y + y + y + y$ is put together as $5 \times y = 5y$.
ii. $m + m + m + m + m + m = 6 \times m = 6m$

When simplifying algebraic expressions, similar letters should be put together.

1. The operation sign (+ or –) placed before a term is for that term and determines the operation to be performed.
   i. + 7n means add 7n; - 9a means subtract 9a.
   ii. 12a – 7a means subtract 7a from 12a which results to 5a.
   $= 13y - 4y = 9y$
   iii. $p + 2p + 3p - 4p = 2p$
   iv. $3n + 7m + 15n - 4m - 11n$
   Putting like terms together we get;
   $$= (3n + 15n - 11n) + (7m - 4m) = 7n + 3m$$
   $$= 2\frac{1}{2}p + 4\frac{1}{4}q - \frac{3}{4}p - 2\frac{1}{2}q$$
   Putting like terms together
   $$= (2\frac{1}{2}p - \frac{3}{4}p) + (4\frac{1}{4}q - 2\frac{1}{2}q)$$
   $$= 1\frac{3}{4}p + 2q$$
   v. $\frac{1}{2}(5x + 7y) + \frac{1}{4}(3x - 6y)$

Multiply every term in the brackets by the value outside the bracket.

$$= \frac{5}{2}x + \frac{7}{2}y + 3/4x - 6/4y$$

Putting like terms together

$$= \frac{5}{2}x + \frac{3}{4}x + \frac{7}{2}y - \frac{3}{2}y = \frac{13}{4}x + \frac{4}{2}y$$

$$= \frac{13}{4}x + 2y$$

vi. $\frac{15a + 12b - 6a + 8b}{4(3a - 2b) + 13b}$

$$= \frac{15a - 6a + 12b + 8b}{12a - 8b + 13b}$$

$$= \frac{9a + 20b}{12a + 13b - 8b}$$

$$= \frac{9a + 20b}{12a + 5b}$$

Activity 1:

Simplify the algebraic expressions below:

i. $d + 3d - 5d + 7d$

ii. $\frac{1}{2}(18x + 24y) - \frac{1}{4}(20x + 16y)$

iii. $\frac{\frac{3}{5}(15a + 20b) - \frac{2}{3}(9a - 6b)}{\frac{3}{4}(8a - 12b) + 16b}$

iv. $2.5m + 7 - 1.45m + 13$

v. $\frac{5}{8}(32p - 16q) + \frac{3}{7}(14 + 21q)$

vi. $36(\frac{3}{4}x + \frac{5}{6}y - \frac{3}{8}x) - \frac{4}{5}(10x + 20y)$

vii. $(6 + 3)w + 11w - 6$

4.2 Word statements into algebraic expressions

We simplify algebraic expressions to find the unknown numbers.

Steps

i. Identify the unknown quantity and give it a letter to represent it.

ii. Identify the operations to be used.

Example 2.

1. A father is five times the age of his daughter. If the sum of their ages is 42 years, find the age of the daughter.

   Solution

   Let the age of the daughter be y.

$$y + 5y = 42$$
$$6y = 42$$
$$y = \frac{42}{6} = 7$$

Example 3.

Maryanne has n mangoes, Winnie has half Maryanne's mangoes while Debborah has twice Maryanne's mangoes. If they have 28 mangoes all together, how many mangoes does each have?

Solution.

Let the number of maryanne's mangoes be n.

Winnie has $\frac{n}{2}$ mangoes

Debborah has $2n$ mangoes

$$n + \frac{n}{2} + 2n = 28$$
$$3n + \frac{n}{2} = 28$$

Multiplying both sides by 2

$$6n + n = 56$$
$$7n = 56$$
$$n = \frac{56}{7} \qquad n = 8$$

Example 4.

The length of a rectangle is greater than its width by 12cm. If the perimeter of the rectangle is 64cm, find its length and area.

Solution.

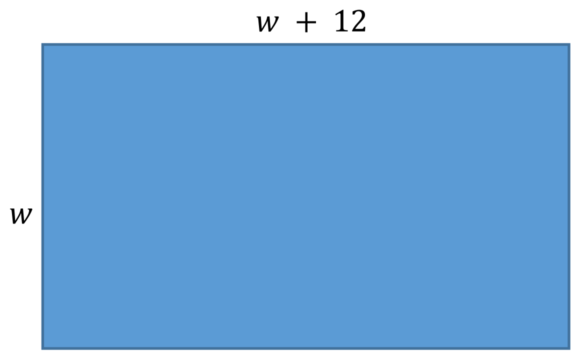
$P=2(l+b)$

Where $b=w$

$l=w+12$

Let the width be w.

Length = w + 12



$P = 2(l + l)$

$64 = 2\,(w + 12 + w)$

$64 = 2(2w + 12)$

$64 = 4w + 48$

$4w = 64 - 48$

$4w = 16$

$w = \frac{16}{4}$ $\qquad w = 4\ cm$

Length $(l) = w + 12$

$= 4 + 12 \quad = \mathbf{16\ cm}$

Area $= l \times w$

$= 16 \times 4 \quad = \mathbf{64cm^2}$

Activity 2:

1. A mother is 6 times older than her son. The sum of their ages is 63 years, determine the age of the mother.

2. The perimeter of a square is 36 cm. Find the length of its sides.

3. David's age divided by 3 is equal to David's age minus 14. Find David's age.

4.3 Sets

What is a Set?

A set is a well-defined collection of distinct objects.

Example 4.

$A = \{1, 2, 3, 4, 5\}$

What is an element of a Set?

The objects in a set are called its elements.

So in case of the above Set A, the elements would be 1, 2, 3, 4, and 5. We can say, $1 \in A$, $2 \in A$

Usually we denote Sets by CAPITAL LETTERs like A, B, C, etc. while their elements are denoted in small letters like x, y, z

If x is an element of A, then we say x belongs to A and we represent it as $x \in A$

If x is not an element of A, then we say that x does not belong to A and we represent it as $x \notin A$

How to describe a Set?

Sets of Numbers

Natural Numbers ($\mathbb{N}$)

$\mathbb{N} = \{1, 2, 3,4 ,5\ 6, 7, \ldots\}$

Integers (Z)

$\mathbb{Z} = \{\ldots, -3, -2, -1, 0, 1, 2, 3, 4, \ldots\}$

Whole Numbers ($\mathbb{Z}_0^+$)

$\mathbb{Z}_0^+ = \{0, 1, 2, 3\ 4, 5, 6\ldots\}$

Rational Numbers ($\mathbb{Q}$)

$\{\frac{p}{q}: p \in \mathbb{Z}, q \in \mathbb{Z}, q \neq 0\}$

Exercise 1.

List the elements of the following sets.

(a) A = The set of all even numbers less than 12
(b) B = The set of all prime numbers greater than 1 but less than 29
(c) C = The set of integers lying between -2 and 2
(d) D = The set of letters in the word LOYAL
(e) E = The set of vowels in the word CHOICE
(f) F = The set of all factors of 36
(g) G = {x : x ∈ N, 5 < x < 12}
(h) H = {x : x is a multiple of 3 and x < 21}
(i) I = {x : x is perfect cube 27 < x < 216}
(j) J = {x : x = 5n - 3,n ∈ W, and n < 3}
(k) M = {x : x is a positive integer and x2 < 40}
(l) N = {x : x is a positive integer and is a divisor of 18}
(m) P = {x : x is an integer and x + 1 = 1}
(n) Q = {x : x is a color in the rainbow}

4. Write each of the following sets.

(a) A = {5, 10, 15, 20}
(b) B = {l, 2, 3, 6, 9, 18}
(c) C = {P, R, I, N, C, A, L}
(d) D = {0}
(e) E = { }
(f) F = {0, 1, 2, 3, ..., 19}
(g) G = {—8, —6, —4, —2}
(h) H = {Jan, June, July}
(i) I = {a, e, i, 0, u}
(j) J = {a, b, c, d, ..., z}
(k) K = {1/1, 1/2, 1/3, 1/4, 1/5, 1/6}
(l) L = {1, 3, 5, 7, 9}

4.4 Finite Sets & Infinite Sets

Finite Set: A set where the process of counting the elements of the set would surely come to an end is called finite set.

Example 7.

All natural numbers less than 50
All factors of the number 36

Infinite Set: A set that consists of uncountable number of distinct elements is called infinite set.

Example 8.

Set containing all natural numbers $\{x : x \in \mathbb{N}, x > 100\}$

Cardinal number of Finite Set

The number of distinct elements contained in a finite set A is called the cardinal number of A and is denoted by n(A)

Example 9.

$A = \{1, 2, 3, 4\}$ then $n(A) = 4$

$A = \{x : x$ is a letter in the word 'APPLE'$\}$. Therefore $A = \{A, P, L, E\}$ and $n(A) = 4$

$A = \{x : x$ is the factor of $36\}$, Therefore $A = \{1, 2, 3, 4, 6, 9, 12, 18, 36\}$ and $n(A) = 9$

Empty Set

A set containing no elements at all is called an empty set or a null set or a void set.

It is denoted by ϕ

Also $n(\phi) = 0$

Example 10.

$\{x : x \in N, 3 < x < 4\} = \phi$

$\{x : x \text{ is an even prime number}, x > 5\} = \phi$

Non Empty Set

A set which has at least one element is called a non-empty set

Example 11.

A = {1, 2, 3} or B = {1}

Equal Sets

Two set A and B are said to be equal sets and written as A = B if every element of A is in B and every element of B is in A

Example 12.

A = {1, 2, 3, 4} and B = {4, 2, 3, 1}

It is not about the number of elements. It is the elements themselves.

If the sets are not equal, then we write as $A \neq B$

Universal Set

If there are some sets in consideration, then there happens to be a set which is a super set of each one of the given sets. Such a set is known as universal set, to be denoted by U.

i.e. if A = {1, 2}, B = {3, 4}, and C = {1, 5}, then U = {1, 2, 3, 4, 5}

What is a Venn diagram?

A Venn diagram uses overlapping circles to illustrate the relationships between two or more sets of items. Often, they serve to graphically organize things, highlighting how the items are similar and different.

What are Venn diagrams?

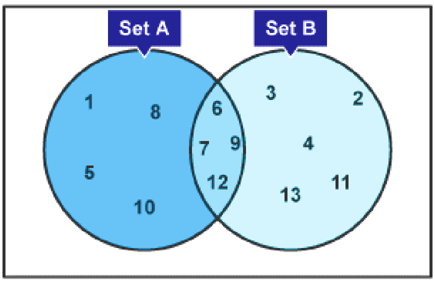
A Venn diagram is a way of grouping different items. These groups are known as sets.

We have a set of golf clubs or a set of dishes – these are just groups of those items.

We write a set using a special type of brackets. You could have a set of friends, eg {tom, lucy, marie}. Notice you **don't** use capitals within the brackets.

A Venn diagram begins with a box called our **universal set**, which is denoted by the symbol ε (epsilon).

The universal set contains everything we are interested in at that particular time. There'll be circles inside the box which we use to group the items within the universal set. Items in the circles form different subsets.



Subsets

Set A is the numbers in the circle labelled Set A.

Set A = {1, 5, 6, 7, 8, 9, 10, 12}

Set B is the numbers in the circle labelled Set B.

Set B = {2, 3, 4, 6, 7, 9, 11, 12, 13}

These are the subsets of the universal.

Intersection

The intersection is where we have items from Set A and Set B, these can be found in the section that overlaps.

We write it as $A \cap B$. In the example above $A \cap B = \{6, 7, 9, 12\}$.

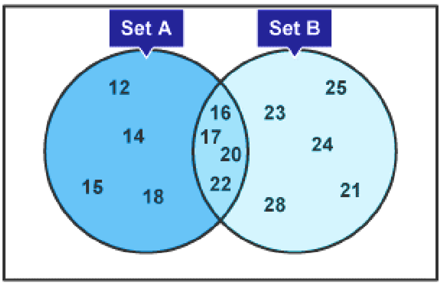
Union

The union of a Venn diagram is the numbers that are in either Set A or Set B.
The union of the above example is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 as it's the numbers that appear in either of the circles.

We write it as $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$

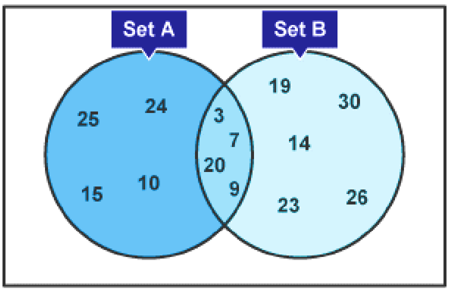
Exercise 3.

1. Look at the venn diagram below.



List the items in:
Set A
Set B

2. List the intersection and union of the following Venn diagram:



Activity 3:

Work in groups;

There are 150 Learners in primary 8 sitting some examination, if not all, of the following examinations: English, Maths and Science.

15 pupils are sitting both English and Maths but not Science

20 pupils are sitting Science and Maths but not English

18 pupils are sitting Science and English but not Maths

8 pupils are sitting all three exams

65 are sitting Science in total

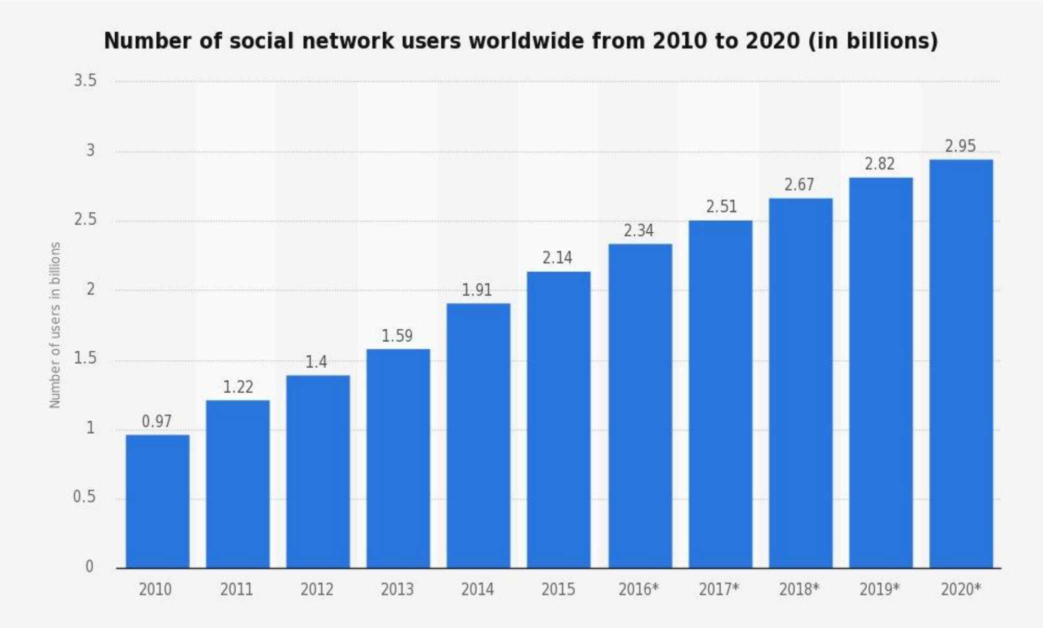
55 are sitting English in total

72 are sitting Maths in total

Using a venn diagram, how many pupils did not sit any of these examinations?

UNIT 5: STATISTICS

Look at the graph below.



In pairs, discuss what you can see in the graph. Do you see any difference in the year 2010 and 2020.

5.1 Data collection Process

Step 1: Identify issues for collecting data

The first step is to identify issues for collecting data and to decide what next steps to take.

To do this, it may be helpful to conduct a quick assessment to understand what is happening around the area you want to collect data from.

Step 2: Select issue(s) and set goals

The focus of Step 2 is choosing a priority issue(s) for collecting data, and then setting goals and objectives.

Select some of the questions to consider when deciding to prioritize an issue for gathering data.

Step 3: Plan an approach and methods

In Step 3, we make decisions about how data will be collected, the sources of data that will be used, and the duration of the data collection will take, among other questions.

The methods and approaches will flow from the goals set in Step 2, and will vary significantly depending on the purpose and complexity of the issue(s) selected.

Step 4: Collect data

When planning on how best to collect data in Step 4, it is important to be aware of the practical considerations and best practices for addressing logistical challenges people often face at this stage. Like transport and communication

Step 5: Analyze and interpret data

Step 5 involves analyzing and interpreting the data collected. Whether quantitative and/or qualitative methods of gathering data are used, the analysis can be complex, depending on the methods used and the amount of data collected.

Step 6: Act on results

Once we analyze and interprete the results of the data collected, we can decide to act on the data, collect more of the same type of data or modify its approach.

5.2 Reading and interpreting tables and graphs

This is the fifth step where we already have the data collected.

Example 1.

The table below shows the class attendance in a school. All pupils were present on Friday. Which day had the highest number of absentees?

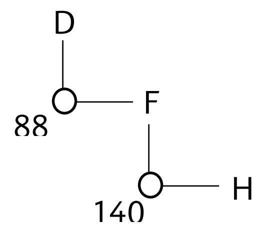
DAYS	PRESENT
Monday	48
Tuesday	49
Wednesday	47
Thursday	48
Friday	50

∴ The highest number of absentees was on Wednesday

Example 2.

Mercy and Juma travelled from D to H via F. How many kilometres did they travel if they used the table below?

D				
80	**E**			
88	70	**F**		
100	90	60	**G**	
200	160	140	70	**H**



$$88 + 140 = 228km$$

Activity 1:

1. The table below shows the fare in South Sudanese Pounds for a bus travelling to different towns.

A					
50	**B**				
80	60	**C**			
100	80	40	**D**		
150	100	120	50	**E**	
200	150	130	90	60	**F**

A teacher and 3 pupils left town A for town F. They stopped at town C and then continued with the journey to town F in another bus. If the bus fare for children is half that of adults, how much did they pay altogether?

Exercise 1.

1. The table below shows the number of times football teams Team A, Team B and Team C won, drew or lost in a competition. Three points were awarded for each game won, one point for each game drawn and no point for a game lost.

	Team A	**Team B**	**Team C**
WON	2	3	4
DRAWN	2	4	3
LOST	5	2	5

Arrange in order the 1st, 2nd and 3rd team in the score. Which two teams tied?

2. The table below shows the number of tonnes of sugar produced and sold by a factory in 7 days.

Days	**MON**	**TUE**	**WED**	**THUR**	**FRI**	**SAT**	**SUN**
Tonnes produced	500	700	800	400	900	250	250
Tonnes sold	300	400	200	700	500	150	180

On which day was the number of tonnes of sugar sold one and three quarter times the number of tonnes produced?

3. A trader sold loaves of bread for all the days of the week. The table below shows the number of loaves the trader sold in 6 days of the week.

DAYS	**MON**	**TUE**	**WED**	**THUR**	**FRI**	**SAT**	**SUN**
No. of loaves of bread	150	95	105	80	40	91	70

One loaf of bread was sold at SSP100. How much did the trader get on Monday than on Saturday?

4. The table below shows the number of people who attended an agricultural show.

Female Adults	**Male Adults**	**Children**
1909	3918	3449

How many more adults than children attended the show?

5. The table below represents arrival and departure times of buses from a company serving towns J, K, L, M, N, P, Q and R.

Towns	**Arrival Time**	**Departure Time**
J		6.00 am
K	8.30 am	9.30 am

L	10.20 am	10.30 am
M	11.45 am	12.00 noon
N	12.45 pm	1.00 pm
P	2.05 pm	2.20 pm
Q	3.15 pm	3.30 pm
R	4.45 pm	

How long does it take the bus to travel from town K to town Q?

6. The table below shows the number of pupils who were present from Monday to Friday.

DAYS	**MON**	**TUE**	**WED**	**THUR**	**FRI**
No. of pupils	63	57	65	67	69

If the class has a total of 70 pupils. How many pupils were absent on Tuesday?

7. The table below represents the sales of milk in litres by a milkman in five days. The sale for Friday is not shown.

DAYS	Monday	Tuesday	Wednesday	Thursday	Friday
NUMBER OF LITRES	24	20	20	25	____

One litre of milk was sold at SSP 50. The milkman got a total of SSP 5,850 for the sale of milk during the five days. How many more litres of milk did the milkman sell on Friday than on Tuesday?

8. The table below shows the number of pupils who were in standard 5–8 in a certain school from 2011- 2014.

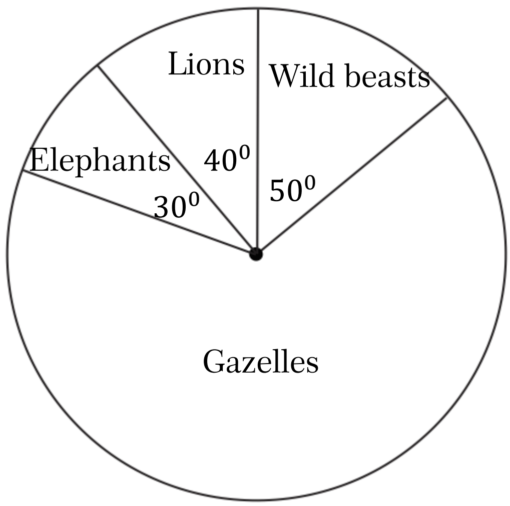
	Primary 5	**Primary 6**	**Primary 7**	**Primary 8**
2011	81	75	61	57
2012	85	79	73	59
2013	88	82	76	70
2014	91	85	79	73

How many pupils of the class which was in Primary 5 in 2011 had dropped out of that class by 2014?

Working out problems involving pie charts

Example 3.

The pie chart below shows the population of 10800 wild animals in a certain part.



How many more Gazelles than wild beasts are there in the park?

Solution

A circle has 360˚ which represent 10800 animals

$1^\circ = \frac{10800}{360^\circ}$

Angle representing gazelles is 360 - (30˚ + 40˚ + 50˚)

$= 360^\circ - 120^\circ$

$= 240^\circ$

$1^\circ = \frac{10800}{360^\circ}$

$240^\circ = \frac{\overset{30}{\cancel{10800}}}{\cancel{360^\circ}} \times 240^\circ \qquad = 7200$ Gazelles

$1^\circ = \frac{\overset{30}{\cancel{10800}}}{\cancel{360^\circ}} \times 50^0 \qquad = 1500$ Wild beasts

How many more gazelles than wild beasts?

7200 - 1500= 5700

There are 5700 more gazelles than wild beasts in the park.

Activity 2:

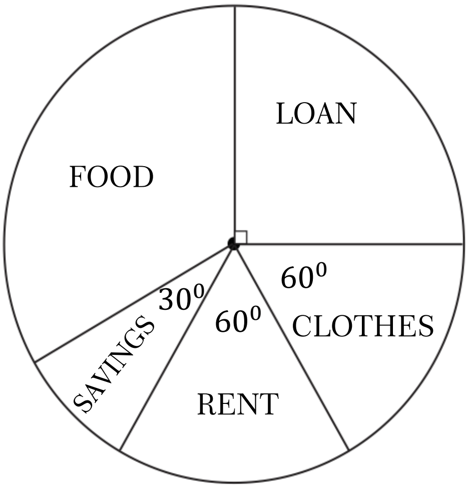
In groups, work out the activities and present to the class.

1. The table below represents different colours and the number of pupils who like each colour.

Colours	**Red**	**Blue**	**White**	**Yellow**	**Green**
Number of pupils	14	16	12	26	22

Draw a pie chart to represent the information given above, what will be the difference in angles of pupils who liked blue colour compared to those who like colour green?

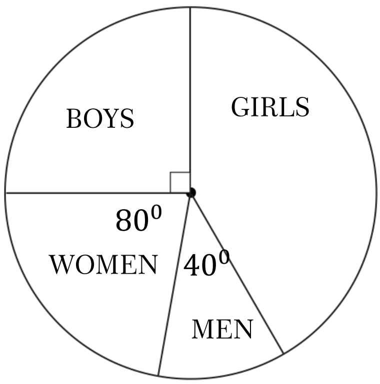
2. The pie-chart below shows how Taban spent his salary.



How much more did he spend on loan than on rent, if he spent SSP8000 on food?

3. The population of an estate in a town is represented by the pie chart below.

If there were 600 girls, how many more boys than men were there?



Exercise 2.

1. The table below shows the number of exercise books each pupil was given

Exercise books	Nene	Maundu	Ann	Mustafa	Asha
Number of pupils	16	14	15	18	27

Draw a pie chart to represent this information.

2. There were 210 girls, 168 boys, 336 men and 126 women in a meeting. If a pie chart was drawn to represent this information. What angle would represent the boys?

3. The table below shows Kenyi's score in topical tests in mathematics. The tests were marked out of 20 marks.

Tests	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}	7^{th}
Score	18	17	20	16	15	19	15

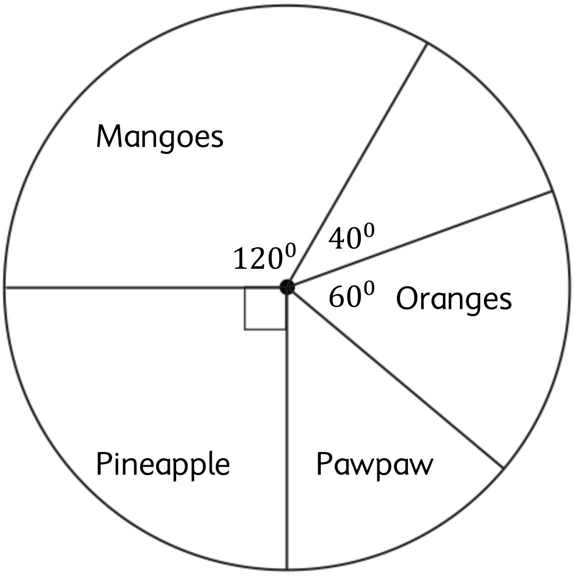
If a pie chart is to be drawn to represent the information given in the table above, what would be the sum of angles representing 2^{nd} and 5^{th} tests?

4. The table below shows Nyandeng's income from the sale of farm produce during a certain year. The information on the income of vegetables is not given.

Produce	**Cabbages**	**Coffee**	**Maize**	**Wheat**
Income	________	SSP 72 000	SSP 42 000	SSP 90 000

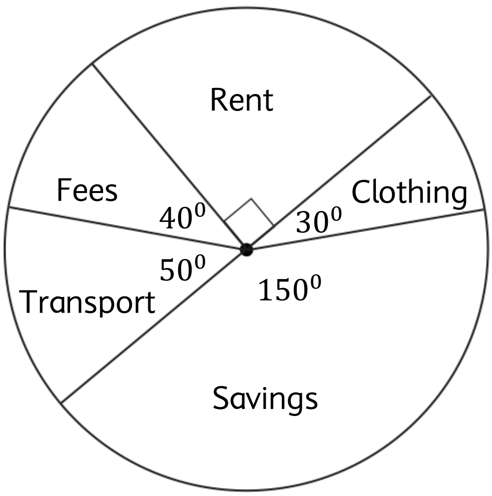
In groups, draw pie chart was drawn to represent the information above. If the angle representing the income from maize was 72°, what was the income from cabbages?

5. The circle graph below shows 432 fruits sold by a trader in one day.



How many more oranges than pawpaw did the seller sell that day?

6. The pie chart below shows how Eunice spent her June salary.



If she spends SSP 2,400 on clothing every month, how much less does she spend on transport than on rent?

Activity 3:

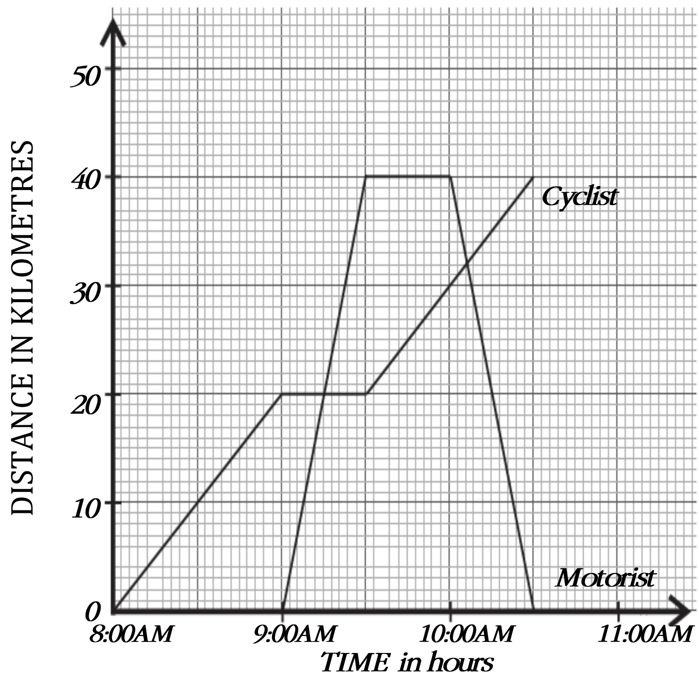
2. The table below shows how Akello utilizes his piece of land.

Purpose	Homestead	Tea cultivation	Maize cultivation	Grazing
Number of hectares	$\frac{1}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$

Using a graph paper, plot the data on a bar graph.

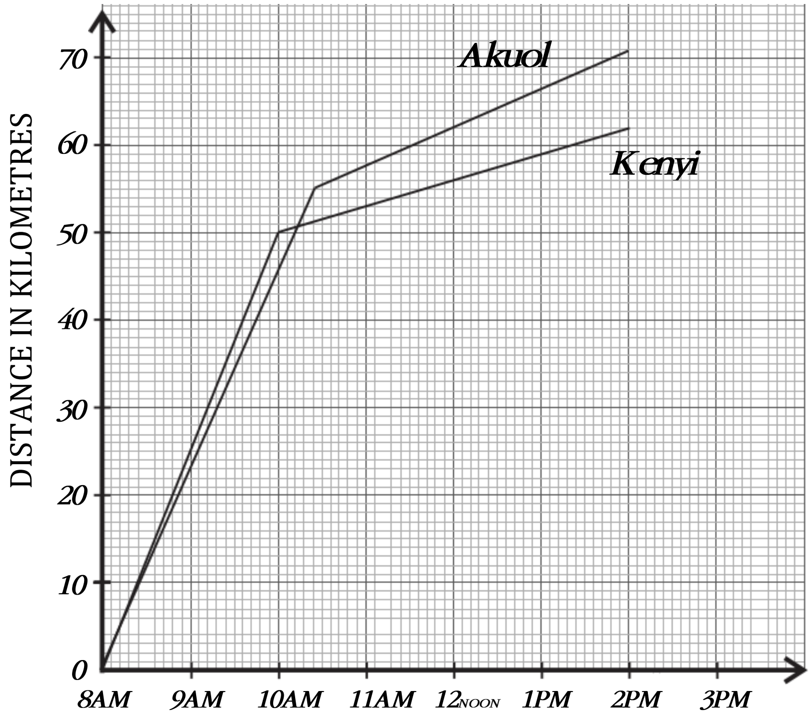
Exercise 3.

1. Below is a travel graph showing the journey of a motorist travelling from town R to town S and back, and that of a cyclist travelling from town R to town S.



How far from R was the cyclist when she met the motorist travelling back to town R?

6. The graph below shows journeys of two motorists, Akuol and Kenyi.



How far away from starting point did the two motorists meet?

a) How far had Kenyi travelled at 10.00AM?

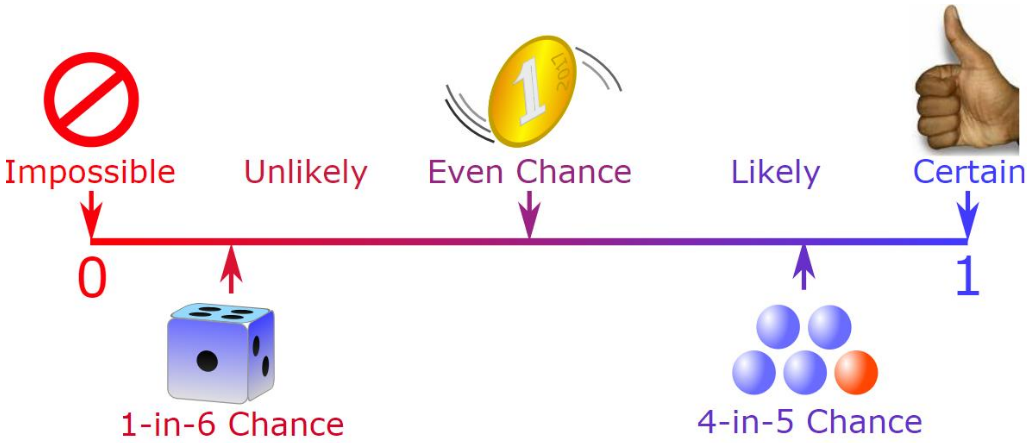
5.3 Probability

Probability is the measure of the likelihood that an event will occur.

To show random events have different likelihood of occurring.

Use vocabulary of chance e.g. impossible, certain, equally likely, even chance, unlikely, likely etc. to answer the questions.

Create a set of statements in your group that another group has to agree or disagree with.



Example 4.

If you draw a card from a standard deck of cards, what is the probability of not drawing a spade?

Solution

There are 13 spades, so that means that there are 52 – 13 = 39 cards that are not spades.

$$\frac{39}{52} = \frac{3}{4} = 75\%$$

Example 5.

If you roll two dice, what is the probability that the sum of the two is odd?

Solution

there are 18 combinations that result in an odd sum. There are still 36 different combinations, so:

$$\frac{18}{36} = \frac{1}{2} = 50\%$$

Example 4.

Jermain and Tremain both calculate the predicted probability of getting heads if they flip a coin 10 times. Then they each flip a coin 10 times.

a. Will they get the same number when they calculate the predicted probability?

b. When they actually flip the coin 10 times, will they get as many as the probability predicted, for sure, no matter what?

c. When they actually flip the coin 10 times, will Jermain absolutely, positively get the same number of heads as the Tremain?

Solution

a. Since they're using the same formula to find the predicted probability, they will get the same number:

b. The number of heads they flip is all up to chance. They should flip about 5 heads out of their 10 flips, but there's no promise, no absolute way of knowing. The answer is no, there is no guarantee that they'll flip 5 heads.

c. Because what they actually flip is up to chance, there is also no guarantee that Jermain will flip the same number of heads and the same number of tails as Tremain. It's just flippin' up to chance.

Activity 4:

In pairs toss a coin 20times and record the outcome in a table.

Heads	
Tails	

Record the class result

1. What are the chances of getting a head?
2. What are the chances of getting a tail?
3. Does the coin know what had happened on the last throw?
4. Is it more or less likely to get a head or a tail?
5. Is getting an even score on a head as likely as getting a tail an odd score?

Activity 5:

In pairs roll a die 48 times and record the outcome e.g. 5, 4, 3, 3etc. Count the total number of each score and make a table and a bar chart.

Create a table of the class results and make a bar chart. Using a bar graph answer these questions

a. What are the chances of getting a particular score?
b. Is it possible to have a draw in this game?
c. Is getting an even score on a dice as likely as getting an odd score?
d. Is each outcome equally likely?
e. Is this game fair or unfair? Explain to the rest of your classmates.

Activity 6:

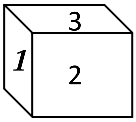
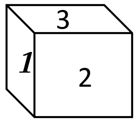
In pairs toss a bottle top 20times and record the outcome in a table. Fill in the data in a table.

a. Does the bottle top behave in the same way as the coin? If not, why?
b. Is it possible to have a draw in the outcome?
c. What are the chances of getting a particular score?
d. Make a list of possible outcomes?

Activity 7:

In pairs make 2 cubes and number their faces 1- 6.

Roll two number cubes, if the product is odd, player x wins. If the product is even player y wins. Play 20 times of this game. Record the result in a table.

Player X	Player Y
	

a. How many different outcomes are possible?
b. How likely is the product even?
c. Is it equally likely to have a draw in in this game?
d. How many ways can player y win?
e. How many ways can player x win?
f. Is this game fair or unfair?

Exercise 4.

Find the probability. Write your answer as a fraction in the simplest form:

1. There are 6 green marbles and 2 red marbles in a jar. What the probability of picking a red marble.
2. There are 5 lollipops and 4 candies marbles in a Jar. What is the probability of picking a lollipop?
3. There are 6 maize grains and 2 beans in a bag. What is the probability of picking a bean?
4. There are 10 black and 9 white crayons in a box. What is the probability of picking a white crayon?
5. A glass jar contains 15 red and 11 blue marbles. What is the probability of picking a blue marble?

UNIT 6: BUSINESS ACCOUNTING

Look at the picture. In pairs, discuss what you can see.

6.1 Commissions in South Sudanese Pounds

Commission is the money given to a sales person after the sale of goods on behalf of the employer.

To calculate the commission in South Sudanese Pounds we multiply R% by value of goods sold.

Example 1.

Deng sold goods worth SSP 25 000 for a certain company. He was given a commission of 15% of the value of the goods sold. How much was his commission?

Solution

$$Value\ of\ goods\ sold = Sh\ 25{,}000$$

$$Percentage\ commission\ rate = 15\%$$

$$Commission\ in\ South\ Sudanese\ Pounds = R\% \times Value\ of\ goods\ sold$$

$$= \frac{15}{1\cancel{00}} \times 25{,}0\cancel{00}$$

$$= SSP\ 3{,}750$$

Exercise 1.

1. Nadia was paid a salary of SSP 25 200 per month. She is also paid a commission of 9% on the value of goods sold. In one month she sold goods worth SSP150 000. What was the total money she got at the end of that month?

2. Michael was paid a salary of SSP 27 000 per month and commission at $6\frac{1}{2}\%$ for the value of the goods sold. Above SSP10 000. In June he sold goods worth SSP140 000, what was his total money he received at the end of the month?

3. George is paid a commission of 12.5% on the value of goods sold above SSP 25 000. In one month she sold goods valued at SSP175,000. What was her commission that month?

4. A salesperson is paid a commission on the value of goods sold. In one month she sold 600 items each at SSP1 500. If she was paid a commission at the rate of 5%, how much commission in South Sudanese Pounds did she earn?

5. Khamis is paid a monthly salary of SSP 30,000 and a 3% commission on goods he sold above SSP150 000. In December he sold goods worth SSP125 000, how much was his total earnings at the end of that month?

6.2 Discounts in South Sudanese Pounds

Discount involves reducing the prices of items to attract customers into buying them.

Example 2.

Angelo bought a bed whose marked price was SSP15,000. If he bought it for SSP13,910, what discount was he allowed for the bed?

Solution

$Marked\ price\ =\ SSP15{,}000$

$Selling\ price\ =\ SSP13{,}910$

$$Discount\ =\ SSP15{,}000 - SSP13{,}910\ = SSP1{,}090$$

$$Discount\ =\ Marked\ price - Selling\ price$$

Activity 1:

1. Pricilla bought a dress for SSP650, the marked price was SSP810. How much discount was Pricilla given?
2. Adil paid SSP2 750.50 for a wardrobe. If the marked price of the wardrobe was SSP3 600, how much was the discount?
3. A customer bought an item for SSP 750, after he was given a discount of SSP150. What was the marked price of the item?
4. Solomon paid SSP8 500 for a radio after getting a discount of SSP95. How much less would he have paid had he been given a discount of SSP115?

6.3 Hire purchase in South Sudanese Pounds

This is a method of buying items over a period of time. Deposit is the amount of money paid first. Instalment is the amount paid thereafter over the given period of time.

$$Hire\ purchase\ =\ Deposit + Total\ instalment$$

Example 3.

The hire purchase of a bicycle is SSP 7 500. Francis paid SSP 1 000 as deposit and the balance was paid in 10 equal monthly instalments. How much was each monthly instalment?

Hire purchase = SSP 7,500
Deposit = SSP 1,000

$$\text{Total instalment} = \text{Hire purchase} - \text{Deposit}$$

$$\text{Total instalment} = 7500 - 1000$$

$$\text{Total instalment} = 6500$$

Monthly instalment =,650~~0~~-10 = SSP 650

Exercise 2.

1. The hire purchase price of a sewing machine was 125% of the cash price. Luka bought the sewing machine at hire purchase terms by paying a deposit of SSP13 500 plus 9 months installments of SSP1,500. What was the cash price of the sewing machine?
2. Noah bought a radio cassette on hire purchase price. He paid a deposit of SSP 45 000 and 18 equal monthly installments of SSP 850. The total amount paid was 25% more than the cash price. What was the price of the radio cassette?
3. Gabriel bought a laptop on hire purchase terms. He paid a deposit of SSP 20 000. The remaining amount was paid in 8 equal monthly installments. He paid a total of SSP27680. How much was each monthly installment?
4. The hire purchase price of a dining table is 120% of the marked price. The hire purchase price is a deposit of SSP 8 000 and an instalment of SSP 5 000 each. By how much is the hire purchase more than the marked price?

5. Philip bought a TV set on hire purchase items. She paid a deposit of SSP120 000 and 12 equal monthly installments of SSP 850 each. The hire purchase price was 20% more than the cash price. Sylvia bought the same TV set on cash. How much more did Alai pay for the TV set?
6. The hire purchase price of an electric cooker was 10% more than the cash price. The cash was SSP150 000. Antony paid SSP 90,000 as deposit and the rest in equal monthly instalments for 18 months. How much was his monthly instalment?
7. The marked price of a motorcycle was SSP 300 000 but a discount of 8% was allowed for cash payment. Ryan bought the motorcycle on hire purchase by paying a deposit of SSP12 000 followed by 8 equal monthly instalment of SSP18 000 each. How much money would Ryan have saved had he bought it for cash?

6.4 Profit and loss in South Sudanese Pounds

Profit is realized when the selling price is higher than the buying price.

Example 4.

Lopir bought a basin for SSP175. He later sold it for SSP208. What profit did Lopir make?

Solution

Selling price = SSP208

Buying price = SSP172

Profit = SSP (208-172)

= SSP36

$$Profit = Selling\ price - Buying\ price$$

Loss is realized when the buying price is higher than the selling price.

Example 5.

Worija bought a radio for SSP 720. He later sold it at SSP 630. What loss did Worija make?

Solution

Buying price = SSP720

Selling price = SSP630

Loss = SSP(720-630)

= SSP90

$$Loss = Buying\ price - Selling\ price$$

Exercise 3.

1. A trader bought 8 trays of eggs at SSP 240 per tray, eight eggs broke and he sold the rest at SSP8 per egg. If a tray holds 30 eggs, how much loss did he get?

2. Jacob bought 250 chicken whose average mass was $1\frac{1}{2}$kg. The buying price per kilogram was SSP150. He then sold each chicken for SSP 215, what profit did Jacob make?

3. Jacinta bought 15 bags of fruits at SSP 450 per bag. She spent SSP 500 on transport, $1\frac{1}{2}$ bags of the fruits got spoilt and she sold the rest at SSP 400 per bag. What was her loss?

4. Saida bought 9 trays of eggs @ SSP 200. All eggs in one of the trays broke and he sold the remaining trays @ SSP 205. What loss did he make?

6.5 Simple interest in South Sudanese Pounds

This type of interest usually applies to automobile loans or short-term loans, although some mortgages use this calculation method.

Terms used in Simple Interest and Compound Interest:

Principal: This is the money borrowed or lent out for a certain period of time is called the principal or sum.

Interest: Interest is payment from a borrower to a lender of an amount above repayment of the principal sum.

Amount: The total money paid back by the borrower to the lender is called the amount.

Amount = Principal + Interest

Rate: The interest on SSP100 for a unit time is called the rate of interest. It is expressed in percentage (%). The interest on SSP100 for 1 year is called rate per annum (abbreviated as rate % p. a.)

Simple interest is calculated only on the principal amount, or on that portion of the principal amount that remains. It excludes the effect of compounding. It is denoted by **S.I.**

The simple interest is calculated uniformly only on the original principal throughout the loan period.

$$\text{SIMPLE INTEREST} = \frac{Principal \times Rate \times Time}{100}$$

$$S.I = \frac{PRT}{100}$$

Where P = Principal, R = Rate and T = Time in years.

While calculating the time period between two given dates, the day on which the money is borrowed is not counted for interest calculations while the day on which the money is returned, is counted for interest calculations.

For converting the time in days into years, we always divide by 365, whether it is an ordinary year or a leap year.

Example 6.

Juma borrowed SSP15,000 from a financial institution for $2\frac{1}{2}$ years at simple interest of 12% P.a. How much interest did he pay?

Abbreviations	Words
I	Interest(money earned)
P	Principal(money borrowed or deposited)
R	Rate always represented as percentage
T	Time expressed in years
A	Amount = Interest plus principle

Formula $I = P \times \frac{R}{100} \times T$

Solution

P = SSP15,000

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

R = 12%

$$I = 15{,}0\cancel{00} \times \frac{\overset{6}{\cancel{12}}}{\cancel{100}} \times \frac{5}{\cancel{2}}$$

Juma paid an interest of SSP 4,500

Interest paid was SSP 4,500
Amount Juma paid after $2\frac{1}{2}$ years was $P + I = A$

SSP 15,000 + SSP 4,500 = SSP19,500

Example 7.

Winfrey was issued a loan of SSP 500000 on simple interest. After 6 months, she paid back an interest of SSP 25000. At what interest rate was the loan issued?

Solution

$$S.I = \frac{PRT}{100}$$

$$25000 = \frac{500000 \times R \text{ X } 0.5}{100}$$

$$2500000 = 500000 \times R \times 0.5$$

$$R = \frac{2500000}{500000 \times 0.5}$$

$$= 10\% \text{ p.a}$$

Exercise 4.

1. Maryanne was issued with a loan of SSP 325,000 from a bank on simple interest at a rate of 18.5% p.a. how much money is she expected to pay the bank after 5 years?

2. David took a loan of SSP200,500 from a financial institution at a rate of 12.5% p.a. after what duration is he expected to pay an interest of SSP 100250?

To find Rate when Principal Interest and Time are given the rules are.

Interest = (Principal × Rate × Time)÷100

Rate = (100 × Interest) ÷ (Principal × Time)

Activity 2:

1. Find Rate, when Principal = SSP 3000; Interest = SSP 400; Time = 3 years.

2. Find Principal when Time = 4 years, Interest = SSP 400; Rate = 5% p.a.

3. Richard deposits 5400 and got back an amount of 6000 after 2 years. Find Richard's interest rate.

4. A farmer borrowed SSP 45,000 from a bank for buying a water pump. If she was charged a simple interest rate of 9%P.a. How much;

   a) Interest did she pay at the end of 18 months?

   b) Amount did she pay at the end of 18 months

5. Martin deposited SSP 90,000 in a bank account, which paid a simple interest rate at 10%. How much interest did he earn after 3 years?

6. Jemma borrowed SSP120,000 from a bank that charged simple interest at the rate of 15%. How much should she pay back the bank at the end of two years?

7. Shahin deposited SSP10,000 for a period of two years. She was charged simple interest at the rate of 15% per year. How much interest did she get?

8. Hussein deposited SSP100,000 in a financial institution that offered simple interest at the rate of 5% per annum. How much interest had Hussein's money earned after $1\frac{1}{2}$ years?

6.6 Compound interest in South Sudanese Pounds

Compound interest is the interest paid on the original principal and on the accumulated past interest.

When you borrow money from a bank, you pay interest. Interest is a fee charged for borrowing the money, it is a percentage charged on the principal amount for a period of a year.

Compound Interest (C.I.) = Final Amount – Original Principal

When calculating compound interest, the amount for the first year is used as principal for the second year. The time (T) is always 1.

Example 8.

Calculate the amount and the compound interest on SSP 12000 for 2 years at 5% per annum compounded annually.

Solution

For 1st year: P = SSP 12000; R=5% and T=1 year

Therefore; Interest $= \frac{PRT}{100}$

$= \frac{12000 \times 5 \times 1}{100}$

$= 600$

Amount = 12000 + 600 = SSP 12600

For 2nd year: P = SSP12600; R=5% and T=1year

Therefore; Interest $= \frac{PRT}{100}$

$= \frac{12600 \times 5 \times 1}{100}$

$= 630$

Amount = 12600 + 630 = SSP 13230

Example 9.

Luka deposited SSP10,000 in a bank which paid a compound interest at the rate of 12% per annum. If he withdrew all the money after two years, how much money did he withdraw?

Solution

Method 1:

1st year interest $= P \times \frac{R}{100} \times T = Sh100\cancel{00} \times \frac{12}{\cancel{100}} \times 1 = Sh1200$

Principal 2nd year =SSP10,000 + SSP1,200 = SSP11,200

2nd year interest $= SSP11{,}200 \times \frac{12}{100} \times 1 = SSP1{,}344$

Total interest = SSP1,200 + SSP1,344 = SSP2,544

Total amount withdrawn = Deposit + Total Interest

Total amount withdrawn = SSP10,000 + SSP2,544 =SSP12,544
=SSP12,544

Method 2:

$$I = \frac{P \times R \times T}{100}$$

Where R_1 = 1st year

R_2 = 2nd year

C1 = Compound interest

T = Time

$$CI = P \times \frac{R_1}{100} \times \frac{R_2}{100} \times T$$

$$CI = 10{,}000 \times \frac{112}{100} \times \frac{112}{100} \times 1 = 12{,}544$$

The time (T) is multiplied by 1 since we are squaring the rate

∴ The compound interest for the two years is $SSP2{,}544 = 12{,}544 - 10{,}000$

Total amount withdrawn is SSP 2,544 (compound interest) plus initial deposit (principal) SSP 10,000.

The answer is SSP 12,544.

Exercise 5.

1. Susan borrowed SSP 200,000 from a money lender for a period of two years at a compound interest rate of 8% per year. How much did she pay all together?
2. Stephen borrowed SSP 250,000 from a bank for a duration of that charged a compound interest rate of $12\frac{1}{2}\%$ P.a. How much money should he pay the bank at the end of two years?
3. A trader deposited SSP18,000 for 2 years in a bank paying compound interest at the rate of 8% P.a. How much did she save in her account at the end of 3 years?
4. John borrowed SSP 40,000 from a bank which he paid a compound interest at the rate of $7\frac{1}{2}\%$ P.a. What was the total interest at the end of the second year?
5. Abdi deposited SSP 480,000 in a bank that paid a compound interest at the rate of 12% P.a. How much money did he pay back after $1\frac{1}{2}$ years?
6. Isaac deposited SSP100,000 in a financial institution that paid compound interest at the rate of 20%P.a. How much did he get at the end of the third year?
7. Stella deposited SSP 200,000 in a bank that paid a compound interest rate of 12% P.a. How much money was in her account at the end of two years?
8. Samuel borrowed SSP150,000 for a period of two years. He was charged compound interest at the rate of 12% per year. How much interest did he pay altogether?
9. Zachariah deposited his savings in a bank which paid a simple interest at a rate of 15% P.a. for a period of 3 years, while Oliver deposited the same amount of SSP 45,000 in saving account which pays a compound interest of 10%P.a. at the end of three years both withdrew the deposits with the interest, who was paid more than the other and by how much?

Activity 3:

With the guidance of a teacher, visit a local businessperson and listen to him/her to explain how they run their business and what sort of accounts they keep.

Example 10.

Calculate the amount and the compound interest on SSP 8000 for years at 10% per annum compounded yearly for 1 ½ years.

Solution

$$\text{Interest} = \frac{PRT}{100}$$

$$= \frac{8000 \times 10 \times 1}{100}$$

$$= 800$$

Amount = 8000 + 800 = SSP 8800

For 2nd year: P = SSP 8800; R=10% and T=0.5 year

$$\text{Interest} = \frac{PRT}{100}$$

$$= \frac{8800 \times 10 \times 0.5}{100}$$

$$= \text{SSP } 440$$

Amount = 8800 + 440 = SSP 9240

Compound interest = Amount – principal

= 9240 – 8000

= SSP1240

Exercise 6.

1. Racheal borrows SSP 12,000 at 10% per annum interest compounded half-yearly. Calculate the total amount she has to pay at the end of 30 months in order to clear the entire loan.
2. On a certain sum of money, invested at the rate of 10% per annum compounded annually, the interest for the first year plus the interest for the second year is SSP 2652. Find the sum.
3. A sum of money is lent at 8% per annum compound interest. If the interest for the second year exceeds that for the first year by SSP 96, find the sum of money.
4. A person invested SSP 8000 every year at the beginning of the year, at 10% per annum compounded interest. Calculate his total savings at the beginning of the third year.
5. A sum of SSP13500 is invested at 16% per annum compound interest for 5 years.

   Calculate:

   i. interest for the first year
   ii. the amount at the end of the first year
   iii. Interest for the second year.
6. Jackline borrowed SSP 7500 from Risper at 8% per annum compound interest. After 2 years she gave SSP 6248 back and a TV set to clear the debt. Find the value of the TV set.
7. It is estimated that every year, the value of the asset depreciates at 20% of its value at the beginning of the year. Calculate the original value of the asset if its value after two years is SSP 10240.
8. Find the sum that will amount to SSP 4928 in 2 years at compound interest, if the rates for the successive year are at 10% and 12% respectively.
9. Joan opens up a bank account on 1st Jan 2010 with SSP 24000. If the bank pays 10% per annum and the person deposits SSP 4000 at the end of each year, find the sum in the account on 1st Jan 2012.

6.7 Cash accounts

Example 10.

On 1st January 2017, Mark had a capital of SSP17000. On 5th January he bought pawpaws for SSP2400. On 7th January, he bought oranges for SSP 1000 and mangoes for SSP 2000.

By 10th January, he had sold pawpaws for SSP 5000, oranges for SSP 2400 and mangoes for SSP 4000.

On the same day (10th January) he paid SSP 700 for transport and SSP500 a market fee.

- Prepare mark's market cash account as at 11th January and balance it.
- What was his balance on 11th January 2017?
- What was his profit?

Solution

MARK'S MARKET CASH ACCOUNT

DATE	CASH IN			CASH OUT	
	Particulars	SSP	Date	Particulars	SSP
2017 Jan.1 Jan.10 Jan.10 Jan.10	Capital Pawpaws sale Oranges sale Mangoes sale	17000 5000 2400 4000	2017 Jan.5 Jan.7 Jan.7 Jan.10 Jan.10	Purchase Pawpaws Oranges Mangoes Transport Market fee Balance (cash in hand)	 2400 1000 2000 700 500 21800
		28400			28400
Jan.11	Balance	21800			

Profit = *Balance (cash in hand) - capital (or balance at the start of business)*

SSP21800 - SSP17000

=SSP4800

WORKING PROCEDURE

1. The layout is divided into two sides:
   - Left hand side (cash in) for all the money received.
   - Right hand side (cash out) for all money spent
2. Each of the sides has 3 columns:
   - Date
   - particulars
   - money (SSP)

a. **Date:** The year is written at the top of the date column .Each of the particulars goes with its date.
b. **Particulars:** These are written in short phrases e.g. orange sale.
c. **Money:** Do all calculations on a separate piece of paper.

How to balance a cash account.

Step 1: Find the sum in the left hand column.

(SSP17000+SSP5000+SSP2400+SSP4000) = SSP28400
Enter this sum in the left hand side as shown.

Step 2: Find the sum of the expenditure, on a separate piece of paper.

(SSP2400+SSP1000+SSP2000+SSP700+SSP500)=SSP6600.
Do not enter this sum.

Step3: Subtract the total expenditure.

(SSP6600) from the total cash in (SSP28400) to get the balance (cash in hand) SSP 21800.

Step 4: Enter the balance (cash in hand) SSP21800 in the right hand side as shown.

Step 5: Find the sum in the right hand side by adding the total expenditure (SSP6600) and the balance or cash in hand SSP21800.
i.e. SSP6600+SSP21800=SSP28400.

NOTE: the sum in the right hand side should be equal to the sum in the left hand side. If the sum in the left hand side and the right hand side are equal, you have balanced the account. If they are not equal, then you have not succeeded in balancing the account

Exercise 7.

In groups, prepare and balance cash account for the different accounts:

1. Shopkeepers account.
   On first April 2017, a shopkeeper had a cash balance of SSP 49500 in hand. On fifth April, a bill of SSP 5990 was paid to flour mills limited. He received SSP20000 for goods sold in week ending 17th April and SSP35850 in a week ending 14th April. On 22nd April he paid SSP45600 to a bread company and SSP12350 to seed company he received SSP62300 for goods sold in the week ending 22nd April and SSP53400 for goods sold in the week ending 29th April. On 30th April he paid SSP10000 rent, SSP850 for lighting and SSP4500 wages and deposited SSP 20000 in his bank account.

   a. Prepare this shopkeepers cash account and balance it.
   b. What was his balance in his cash account as at 1st may 2017?

2. Carpenters account:
   A carpenter had a balance in his hand of SSP17800. On 1st jan.2016, on 15th Jan, he spent SSP5900 on wood, SSP680 on nails and SSP8990 on tools. On 21st Jan. he sold 10 chairs at SSP2400 each and 6 tables at each SSP4000 .on 27th Jan. he spent SSP 11900 on nails. He transferred SSP9990 to his bank account and paid his labourers a total of SSP 7900 on 31st Jan.
   a. Prepare the carpenters cash account.
   b. What was the balance in his cash account as at 1st Feb 2016?

3. Poultry account.

A poultry farmer had a flock of 600 layers and a cash balance of SSP26000 on 1st June 2015. On 2nd June, he bought 3 sacks of layers marsh at SSP 2500 each on 5th June, he sold 90 trays of eggs at SSP 300 each and bought 6 sacks layers mash at SSP 2500 each.

On 21st June he sold 178 trays of eggs at SSP 300 a tray and bought 10 sacks of layers marsh at SSP 1500 a sack.

On 28th June he sold 100 trays of eggs at SSP 300 a tray.

On 29th June, he bought 80 egg trays at SSP50 each and paid his worker SSP 4600 on 30th June

a. Prepare and balance the poultry cash account.
b. If the farmer banked the balance, how much money did he bank?
c. How much money did he earn from his poultry farming during the month of June 2015?

South Sudan

Primary Mathematics 8

Primary Mathematics has been written and developed by Ministry of General Education and Instruction, Government of South Sudan in conjunction with Subjects experts. This course book provides a fun and practical approach to the subject of mathematics, and at the same time imparting life long skills to the pupils.

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