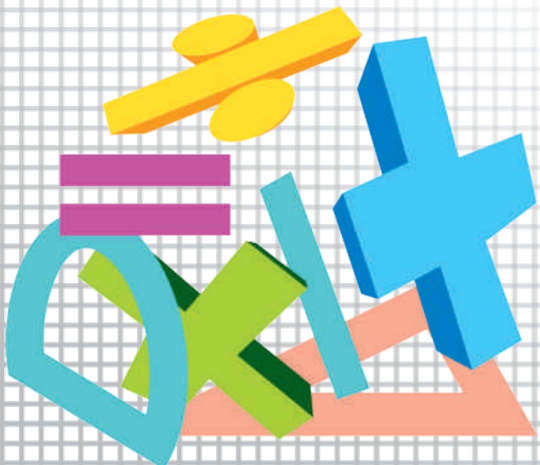
PRIMARY LEARNER'S

MATHEMATICS

P4

FOR RWANDA SCHOOLS

Kigali, January 2019



PREFACE

Primary Learner's Mathematics for Rwanda Schools has been written to provide the content of P4 Learner's book in 'Competence-Based Curriculum'.

This book emphasises a shift from 'teacher-centred' to a 'learner-centred' way of learning. Pupils learn by doing (hands-on activities), so as to develop logical reasoning skills, critical thinking skills, problem solving skills and generate curiosity and competence through mathematical applications in real life situations.

The book consists of the following key icons:

- **Example:** Fully worked examples to enable learners grasp concepts of mathematics effectively.
- **Class Activity:** Innovative exercises to engage learners in numerous cooperative learning manipulations. This will strengthen teamwork among learners while developing positive, ethical, moral and values as far as the respect for the rights, feelings and views of others in them.
- **Mind Game:** Additional inputs to enhance the mental ability of the gifted learners.
- **Think!!!:** Numerous intriguing mathematical problems based on real life situations. It requires the learners to think critically and find solutions to problems.
- **Exercise:** Various exercises for learners to work in a systematic way to develop clear, logical, coherent and creative mathematical reasoning.
- **Assessment Exercise:** Exhaustive recapitulation questions on the topics covered in the exercise to enhance the problem solving capacities in learners.
- **Internet Resource:** Icon indicators aimed at directing the learners to additional resources on the internet.

  Access to the listed websites will allow learners to explore unlimited learning activities, games, puzzles, brain teasers, demonstrations, animations and various other online resources.

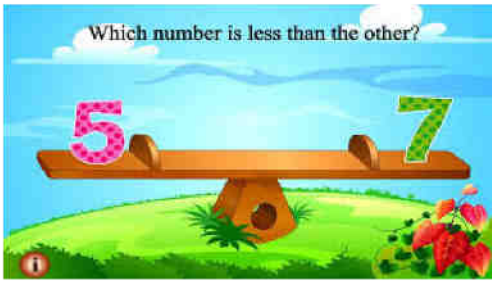
The topics and units are arranged in a very orderly manner that will facilitate a smooth transition from one unit to the next.

Enjoy Mathematics.

CONTENTS

UNIT 1

Mathematical Operations on Whole Numbers up to 100,000



Key unit competence

By the end of this unit, a learner should be able to write, compare and calculate whole numbers up to 100,000.

Attitude and Values

- develop personal confidence in the use of numbers.
- appreciate the importance of addition, subtraction, division and multiplication of numbers in real life.
- appreciate the need for manipulating numbers.

1.0 Introduction to the Number Systems

A number is a mathematical way of representing how many, how far, how long or how much a quantity is.

A number (numeral) system or system of numeration is a writing system for expressing numbers using digits or other symbols in a consistent manner.

Three of the most commonly used number systems are:

1. The Hindu-Arabic Numeral System.
2. The Roman Numeral System.
3. The Chinese Numeral System.

We generally use arabic numeral system.

The Hindu-Arabic Numeral System

This numeration system uses ten digits; 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. These digits can be used to form any number. For example, the digits 3, 9, 7 can be used to form numbers 397, 379, 973, 937, 793 and 739.

Natural Numbers (Counting Numbers)

When a child is learning to count, he/she says “one, two, three, four... .” This set of numbers is called **natural numbers** or **counting numbers**.

Counting (natural) numbers are 1, 2, 3, 4, 5, 6, 7, 8, 9 ...

Whole numbers

Whole numbers is a set of counting (natural) numbers including zero.

Whole numbers are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 ...

Forming numerals from digits

The digits 0 to 9 are used to form different numbers depending on how you arrange the digits.

Example 1.1

Write down any 2-digit number formed by the digits 4, 6, 7, 0, 1.

Solution

Pick any two digits given above.
For example
First number = 46
Second number = 67
Other numbers are 40, 10, 70, 71, 76, 61, etc.

Example 1.2

Discuss and give the smallest number or numeral that can be obtained from the digits 8, 9, 6, 1.

Solution

First, arrange the digits in ascending order (from smallest to biggest).
In ascending order we get 1, 6, 8, 9.
Therefore, the smallest number is 1 689.

Example 1.3

Find the biggest number that can be formed from the digits 1, 3, 5, 9, 4?

Solution

Arrange the digits in descending order (from biggest to smallest).
In descending order, we get 9, 5, 4, 3, 1.
Therefore, the biggest number formed is 95 431.

Activity 1.1

In this class activity, you will form numbers from given digits.

(i) Arrange five blank flash cards provided on your table.
(ii) Write the digits 5, 2, 4, 1 and 3 on each flash card.
(iii) Form a 5-digit number starting with 5.
(iv) Form a 5-digit number starting with 2.
(v) Form a 5-digit number starting with 4.
(vi) Form a 5-digit number starting with 1.
(vii) Form a 5-digit number starting with 3.
(viii) Arrange the formed numbers in ascending order.

Exercise 1.1

Given the 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

You can use a digit only once while answering the questions below:

(a) Use the digits above to form all 3-digit numbers beginning with 3 and ending with 9. {An example is 329}.
(b) What is the largest 2-digit number that can be formed from these digits?
(c) What is the smallest 2-digit number that can be formed from these digits?

1.1 Reading and writing numbers in words and in figures

Use one zero '0' to write a ten, two zeroes '00' to write a hundred, three zeroes '000' to write a thousand. For example:

10 = Ten.
30 = Thirty.
100 = One hundred.
370 = Three hundred seventy.
1 000 = One thousand.
8 900 = Eight thousand nine hundred.
50 000 = Fifty thousand.
99 990 = Ninety-nine thousand nine hundred ninety.
100 000 = One hundred thousand.

Activity 1.2

In this class activity, you will play a game of matching numbers.

(i) Divide yourselves into 2 groups: Group A and B.

(ii) Arrange yourselves in a straight line and sit in 2 groups by facing each other. The pupil seated opposite to you is your opponent.

(iii) Write one large number in words and one large number in figures on the two manila cards.

(iv) Take turns in playing the game by showing your opponent the numbers you have written on the cards. He/she should say the number aloud or write the number on the blackboard. The teacher together with the rest of the pupils will act as judges.

(v) Correct answer = 3 marks and wrong answer = 0 marks. Add up the marks for your group and see which group wins.

Example 1.4

Write the following numbers in words:

(a) 97 642

(b) 10 002

(c) 999

(d) 90 001

(e) 1 704

Solution

(a) 97 642 = Ninety-seven thousand six hundred forty-two.

(b) 10 002 = Ten thousand two.

(c) 999 = Nine hundred ninety-nine.

(d) 90 001 = Ninety thousand one.

(e) 1 704 = One thousand seven hundred four.

Example 1.5

Write the following in figures:

(a) Ninety-nine.

(b) One hundred ninety-nine.

(c) Seven hundred five.

(d) Six hundred fifty.

(e) Twelve thousand five hundred.

(f) Eighty thousand.

(g) Forty thousand one.

(h) One hundred thousand.

(i) Nine hundred ninety-seven.

(j) Eleven thousand one hundred eleven.

Solution

(a) Ninety-nine.

Ninety	=		9	0
Nine	= +			9
			9	9

(b) One hundred ninety-nine.

One hundred	=	1	0	0
Ninety	=		9	0
Nine	= +			9
		1	9	9

(c) Seven hundred five.

Seven hundred	=	7	0	0
Five	= +			5
		7	0	5

(d) Six hundred fifty.

Six hundred	=	6	0	0
Fifty	= +		5	0
		6	5	0

(e) Twelve thousand five hundred.

Twelve thousand	=		1	2	0	0	0
Five hundred	=	+			5	0	0
			1	2	5	0	0

(f) Eighty thousand. = 8 0 0 0 0

(g) Forty thousand one.

Forty thousand	=		4	0	0	0	0
One	=	+					1
			4	0	0	0	1

(h) One hundred thousand = 100 000

(i) Nine hundred ninety-seven.

Nine hundred	=		9	0	0
Ninety	=			9	0
Seven	=	+			7
			9	9	7

(j) Eleven thousand one hundred eleven.

Eleven thousand	=		1	1	0	0	0
One hundred	=				1	0	0
Eleven	=	+				1	1
			1	1	1	1	1

Exercise 1.2

1. Read and write the following numbers in words:
   (a) 111 (b) 1 011 (c) 54 700
   (d) 1 000 (e) 78 999 (f) 15 000
2. Write the following numbers in figures.
   (a) Nineteen (b) Ninety (c) Ninety-nine
   (d) Nine hundred ninety-nine. (e) Five hundred one.
   (f) Three thousand one.

1.2. Place Values of Whole Numbers

Place values help us to show the position of a given digit in a number.

Example 1.6

Find the value of each digit in 79 846.

Solution

7 9 8 4 6

- 6 ones = 6 × 1 = 6
- 4 tens = 4 × 10 = 40
- 8 hundreds = 8 × 100 = 800
- 9 thousands = 9 × 1 000 = 9 000
- 7 ten thousands = 7 × 10 000 = 70 000

Example 1.7

Use the table below to work out the value of each digit in the number 43 275.

Solution

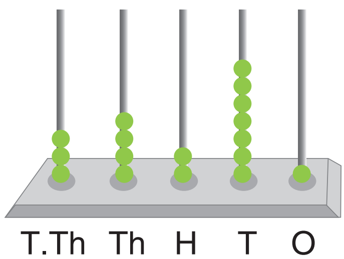
Number	Place Value	Value		
4 3 2 7 5				
5 →	Ones	5 × 1	=	5
7 →	Tens	7 × 10	=	70
2 →	Hundreds	2 × 100	=	200
3 →	Thousands	3 × 1 000	=	3 000
4 →	Ten Thousands	4 × 10 000	=	40 000

Activity 1.3

Get an abacus frame

(i) Place 3 beads on the ten thousand's spike, 4 on the thousand's spike, 2 on the hundreds spike, 7 on the ten's spike and 1 on the ones spike.

(ii) Read the number you have formed.



Exercise 1.3

Write down the place values of the underlined digits in the given numbers:

1. 3 $\underline{2}$89
2. 94 $\underline{4}$83
3. 8$\underline{7}$ 204
4. 8 7$\underline{2}$4
5. 89 $\underline{4}$34
6. $\underline{4}$ 927
7. 22 $\underline{3}$43
8. 88 28$\underline{7}$
9. 29 3$\underline{2}$1

Expanding whole numbers using place values

Example 1.8

Expand the following numbers:

(a) 82 645 (b) 98 067

Solution

(a) 82 645 = 80 000 + 2 000 + 600 + 40 + 5

(b) 98 067 = 90 000 + 8 000 + 60 + 7

Writing expanded numbers in short form

Example 1.9

Write the following expanded numbers in short form:

(a) 10 + 9 (b) 30 000 + 5 000

(c) 30 000 + 400 + 40 + 4 (d) 90 000 + 1

Solution

(a) 10 + 9

$$\begin{array}{rr} 1 & 0 \\ + & 9 \\ \hline 1 & 9 \\ \hline \end{array}$$

(b) 30 000 + 5 000

$$\begin{array}{rrrrr} 3 & 0 & 0 & 0 & 0 \\ + & 5 & 0 & 0 & 0 \\ \hline 3 & 5 & 0 & 0 & 0 \\ \hline \end{array}$$

(c) 30 000 + 400 + 40 + 4

$$\begin{array}{rrrrr} 3 & 0 & 0 & 0 & 0 \\ & & 4 & 0 & 0 \\ & & & 4 & 0 \\ + & & & & 4 \\ \hline 3 & 0 & 4 & 4 & 4 \\ \hline \end{array}$$

(d) 90 000 + 1

$$\begin{array}{rrrrr} 9 & 0 & 0 & 0 & 0 \\ & + & & & 1 \\ \hline 9 & 0 & 0 & 0 & 1 \\ \hline \end{array}$$

Activity 1.4

- Make cards like the ones given below.

5 Tens	7 hundreds	3 × 1000	3 × 1
5 × 10	3 ones	3 Thousands	7 × 100

- Pair the cards which have same value.

Exercise 1.4

1. Write the following numbers in expanded form.
   (a) 4 624 (b) 984 (c) 44 484
   (d) 93 428 (e) 76 709
2. Write the following in short form.
   (a) $(7 \times 1\,000) + (3 \times 100) + (8 \times 10) + (3 \times 1)$
   (b) $(9 \times 10\,000) + (8 \times 1\,000) + (3 \times 100) + (7 \times 10) + (6 \times 1)$
   (c) $(3 \times 10\,000) + (9 \times 1\,000) + (8 \times 100) + (6 \times 10) + (7 \times 1)$

1.3 Comparing Numbers

When comparing two numbers, we count the number of digits in each number.

- The number with more number of digits is greater than the one with few digits.
- The number with fewer digits is smaller than the other.
- If the two numbers have equal number of digits, then we can consider the value of each digit. The number which has greater value is greater than the other.

The following notations are used while comparing numbers:

$<$ denotes **'less than'**

$>$ denotes **'greater than'** and

$=$ denotes **'equal to'**.

Activity 1.5

In this class activity, you will write down the biggest number you know.

(i) Form yourselves in groups of 5 learners each.

(ii) Write down the greatest number you know on a flash card.

(iii) Compare the number you have written with the numbers your classmates have written.

Example 1.10

Use the symbol <, >, or = to compare the following numbers and items:

(a) Four thousand and 4×1000 (b) 10 000 and 1 000

(c) 500 Frw and 550 Frw (d) 400 bottles and 400 bottles

Solution

(a) Four thousand is equal to 4×1000, because four thousand $= 4 \times 1000 = 4000$.

(b) $10\,000 > 1\,000$ because 10 000 has more digits than 1 000.

(c) 500 and 550 have the same number of digits. The first digit in both numbers is 5. So, we now compare the next digits which are 0 and 5. Since 5 > 0, therefore, 500 Frw < 550 Frw.

(d) 400 bottles = 400 bottles. The two numbers are exactly the same so they are equal.

Think!!!

There is a three-digit number. The second digit is four times as big as the third digit, while the first digit is three less than the second digit. What is the number?

Exercise 1.5

1. Use the correct sign <, > or =

(a) 2 000 ☐ 20 000

(b) 3 214 ☐ 3 241

(c) 99 999 ☐ 9 999

(d) 70 001 ☐ 71 000

(e) 624 ☐ 642

(f) 881 ☐ 818

(g) 440 ☐ 404

2. Bakure and Mbonimana are farmers in a village. Bakure has 120 acres of land and Mbonimana has 102 acres of land. Who has more acres of land?

1.4 Operation of numbers

1.4.1 Addition of Whole Numbers

When adding numbers, we arrange the numbers so that the **ones** are on the same vertical line, the **tens** are also on the same vertical line and so on.

Addition of Whole Numbers Without Carrying

Example 1.11

1. Evaluate

$$\begin{array}{r} 34\,907 \\ +\ 54\,091 \\ \hline \\ \hline \end{array}$$

Solution

	T. TH	TH	H	T	O
	3	4	9	0	7
+	5	4	0	9	1
	8	8	9	9	8

2. Add 375 and 8 201.

Solution

Numbers can be easily added by using an addition grid as shown below:

	TH	H	T	O
		3	7	5
+	8	2	0	1
	8	5	7	6

Exercise 1.6

1. Add the following numbers and write your answers in words:

(a)

	TH	H	T	O
	3	4	5	5
+	1	3	0	4

(b)

	TH	H	T	O
		4	5	8
+	9	3	0	1

(c)

	TH	H	T	O
	2	6	2	5
+	1	3	4	0

(d)

	TH	H	T	O
	1	0	0	0
+				9

2. Add the following numbers together:
   (a) 230 and 230
   (b) 21 650 and 32 146
   (c) 5 and 21 454
   (d) 160 and 610
3. I have three thousand Rwandan Francs and my brother has seven thousand five hundred Rwandan Francs. How much do I and my brother have altogether?
4. Town A has 242 cars and Town B has 424 cars. How many cars are there in the two towns?

Addition with Carrying

When the sum of two or more numbers is more than 9, we carry as we do the addition as shown in the example given on the next page:

▸ Example 1.12

Add 4 999 and 8 294.

Solution

		1	1	1		
		4	**9**	**9**	**9**	**9 + 4 = 13,**
+		**8**	**2**	**9**	**4**	**9 + 9 = 18**
=	**1**	**3**	**2**	**9**	**3**	**9 + 2 = 11**
			12	19	13	**4 + 8 = 12**

- Add downwards starting from the place of ones on your right.
- A number where the sum above is a two-digit number, write the ones and carry the tens to the next digit to the left.
- So, 4 999 + 8 294 = 13 293.

Exercise 1.7

1. Add the following numbers together:
   (a) 53 250 and 32 488
   (b) 738 and 262
   (c) 1 354 and 9 999
   (d) 999 and 111
   (e) 999 and 1 110
2. The data below shows the monthly amount of rainfall received by a certain country for a whole year;

Months	Rainfall amount (mm)
January	174
February	2 417
March	1 814
April	2 161
May	2 410
June	2 147

Months	Rainfall amount (mm)
July	1 400
August	2 435
September	1 823
October	700
November	946
December	304

   (a) How much total rainfall was received between November and December?
   (b) How much rainfall was received in the first three months?
   (c) Write down in words, the amount of rainfall received in the month of May.
   (d) Calculate the sum of the least and greatest amount of rainfall during the year.

Think!!!

Using only addition, how do you add eight 8s and get the number 1 000?

1.4.2 Subtraction

Subtraction without Borrowing

Just like we did with addition of numbers, we arrange numbers so that the Ones, Tens, ... etc. are all aligned.

Example 1.13

Evaluate: 6 989 – 3 453

Solution

	TH	H	T	O
	6	9	8	9
–	3	4	5	3
	3	5	3	6

Subtraction with Borrowing

Example 1.14

Evaluate: 2 573 – 1 395

	TH	H	T	O
	2	4	16	13
	2	~~5~~	~~7~~	~~3~~
–	1	3	9	5
	1	1	7	8

- Arrange the two numbers as we did for addition.
- In ones, 3 – 5 is not possible because 3 is less than 5. We then borrow 1 from the next digit under the tens.
- So, we borrow 1 from 7 tens and remain with 6. The one we have borrowed becomes 10 and 10 + 3 = 13.
- Now, we subtract 5 from 13 to get 8.
- Now, in tens 6 – 9 is also impossible. So, we borrow 1 from 5 hundreds, so, 16 – 9 = 7.
- In the hundreds column, we have 4 – 3 = 1 and in the thousands column, we have 2 – 1 = 1.
- So, 2 573 – 1 395 = 1 178.

Example 1.15

Subtract:

$$\begin{array}{rccc} & \overset{6}{} & \overset{18}{} & \\ & 7 & 8 & 4 \\ - & 6 & 9 & 0 \\ \hline & & 9 & 4 \\ \hline \end{array}$$

We do not write the zero in such a position. We write 94 not 094.

Example 1.16

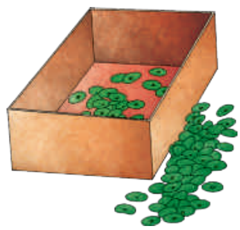
Eina has 73 567 Frw in her account and Awiza has 89 504 Frw in his account. What is the difference between the money in Eina's account and in Awiza's account.

Solution

$$\begin{array}{lcrrrrr} \text{Money in Awiza's account} & = & 8 & 9 & 5 & 0 & 4 \\ \text{Money in Eina's account} & = & -7 & 3 & 5 & 6 & 7 \\ \hline \text{Difference} & = & 1 & 5 & 9 & 3 & 7 \\ \hline \end{array}$$

Activity 1.6

- Put 256 bean seeds in a tin box.
- Remove 75 bean seeds from the tin box.
- Count the number of seeds which remained in the tin.
- How many seeds are left?



Exercise 1.8

1. Evaluate:
   (a) 15 789 – 11 000 (b) 86 786 – 63 524
   (c) 99 999 – 29 999 (d) 863 – 489
   (e) 45 567 – 12 540 (f) 48 487 – 32 450
   (g) 32 450 – 16 360 (h) 54 000 – 543
   (i) 65 009 – 222 (j) 90 000 – 1
2. A shirt costs 3 000 Frw and another shirt costs 1999 Frw. What is the difference in cost of two shirts?
3. I had 304 eggs in a box, out of which 70 got broken. How many eggs were not broken?

4. One metre of cloth costs 1 250 Frw and another cloth of 1 metre costs 2600 Frw. How much more does the another cloth cost?
5. Kayongo went to the market with 550 Frw and bought mangoes. He was left with a balance of 120 Frw. How much did he use to buy the mangoes?
6. By how much is 67 015 more than 67 010?
7. The distance between London City in the U.K and New York City in USA is 5 546 km. A plane travelling from London to New York has covered a distance of 4 509 km. What distance has to be covered by the plane to reach New York?
8. A district had a population of 30 845 in a national census. Of these, 19 678 were females. How many males were in the district?
9. The following people had the given amounts of money on their bank accounts.

Matsiko	Peter	Lina	Mwiza	Maniraho
24 672	53 765	80 000	87 450	23 908

   (a) What is the difference between the money in Matsiko's account and in Lina's account?
   (b) What is the difference of money in Mwiza's and Peter's accounts?
10. A town has 98 500 buildings. 70 005 of these buildings are shops. Find the number of other types of buildings in the town.

1.4.3 Multiplication of Whole Numbers

The Multiplication Table

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

▸ Example 1.17

Evaluate:

1. 23×2
2. 45×7
3. 21×13
4. 38×85
5. 782×3
6. 476×25
7. 450×25
8. 620×25

Solution

1. 23×2

$$= \begin{array}{r} 2\ 3 \\ \times\ \ 2 \\ \hline 4\ 6 \\ \hline \end{array}$$

$3 \times 2 = 6$ and $2 \times 2 = 4$

So, $23 \times 2 = 46$.

2. 45×7

$$= \begin{array}{r} 4\ 5 \\ \times\ \ 7 \\ \hline 3\ 1\ 5 \\ \hline \end{array}$$

$7 \times 5 = 35$. We write 5 and carry 3 which we shall add on to the product of 7 and 4, $7 \times 4 = 28$, $28 + 3 = 31$

So, $45 \times 7 = 315$.

3. 21×13

$$\begin{array}{r} 2\ 1 \\ \times\ 1\ 3 \\ \hline 6\ 3 \\ +\ 2\ 1\ \downarrow \\ \hline 2\ 7\ 3 \\ \hline \end{array}$$

$21 \times 3 = 63$

$21 \times 1 = 21$

So, $21 \times 13 = 273$.

4. 38×85

$$\begin{array}{r} 3\ 8 \\ \times\ 8\ 5 \\ \hline 1\ 9\ 0 \\ +\ 3\ 0\ 4\ \downarrow \\ \hline 3\ 2\ 3\ 0 \\ \hline \end{array}$$

$38 \times 5 = 190$

$38 \times 8 = 304$

So, $38 \times 85 = 3\ 230$.

5. 782×3

$$\begin{array}{r} 7\ 8\ 2 \\ \times\ 3 \\ \hline 2\ 3\ 4\ 6 \\ \hline \end{array}$$

So, $782 \times 3 = 2\ 346$.

6. 476×25

$$\begin{array}{r} 4\ 7\ 6 \\ \times\ 2\ 5 \\ \hline 2\ 3\ 8\ 0 \\ +\ 9\ 5\ 2\ \downarrow \\ \hline 1\ 1\ 9\ 0\ 0 \\ \hline \end{array}$$

$476 \times 5 = 2\ 380$

$476 \times 2 = 952$

So, $476 \times 25 = 11\ 900$.

7. 450×25

$$\begin{array}{r} 4\ 5\ 0 \\ \times\ 2\ 5 \\ \hline 2\ 2\ 5\ 0 \\ +\ 9\ 0\ 0\ \downarrow \\ \hline 1\ 1\ 2\ 5\ 0 \\ \hline \end{array}$$

$450 \times 5 = 2\ 250$

$450 \times 2 = 900$

So, $450 \times 25 = 11\ 250$

8. 620×25

$$\begin{array}{r} 6\ 2\ 0 \\ \times\ 2\ 5 \\ \hline 3\ 1\ 0\ 0 \\ +\ 1\ 2\ 4\ 0\ \downarrow \\ \hline 1\ 5\ 5\ 0\ 0 \\ \hline \end{array}$$

$620 \times 5 = 3\ 100$

$620 \times 2 = 1\ 240$

So, $620 \times 25 = 15\ 500$.

Multiplication of whole numbers by 10, 100, 1 000, 10 000.

When multiplying a whole number by:

- 10, we add a zero (0) at the right hand side of end of the last digit of the number.
- 100, we add two zeroes at the right hand side of the last digit of the number.
- 1 000, we add three zeroes at the right hand side of the last digit of the number.
- 10 000, we add four zeroes at the right hand side of the last digit of the number.

This is shown in the cases below:

(a) $27 \times 10 = 270$

(b) $4 \times 10 = 40$

(c) $2\,376 \times 10 = 23\,760$

(d) $24 \times 100 = 2\,400$

(e) $457 \times 100 = 45\,700$

(f) $34 \times 1\,000 = 34\,000$

(g) $6 \times 10\,000 = 60\,000$

Quick Multiplication by 5:

In order to multiply a whole number by 5, you have to multiply it by 10, then divide the product by 2.

Therefore, $280 \times 5 = (280 \times 10) \div 2$

$= 2800 \div 2 = 1400$

Quick Multiplication by 100 and 1000:

In order to multiply a whole number by 100, we put two zeros on the right hand side of that number.

Therefore, $82 \times 100 = 8200$.

In order to multiply a whole number by 1000, we put three zeros on the right hand side of that number.

Therefore, $46 \times 1000 = 46000$.

Example 1.18

A square floor of classroom is completely covered with tiles. The length of square room is covered by 26 tiles. Also number of tiles along its each boundary is 26. How many tiles are there in the class room.

Solution

Number of tiles along one boundary (length) = 26

Number of tiles along another boundary (width) = 26

Total titles = 26×26

So,

$$
\begin{array}{rrrr}
 & & 2 & 6 \\
 & \times & 2 & 6 \\
\hline
 & 1 & 5 & 6 \\
+ & 5 & 2 & \downarrow \\
\hline
= & 6 & 7 & 6 \\
\hline
\end{array}
$$

Exercise 1.9

1. Complete the multiplication table below and learn them by heart.

×	1	2	3	4	5	6	7	8	9	10	11	12	13
1													
2						12			18				
3													
4													
5					25								
6													
7			21										
8													
9													
10		20						80					
11				44									
12	12												

2. Complete the table below.

1 × 25 =	1 × 45 =	1 × 5 000 =	200 × 500 =
2 × 25 =	2 × 45 =	15 × 15 =	250 × 250 =
8 × 25 =	8 × 45 =	500 × 50 =	34 × 50 =
5 × 15 =	80 × 15 =	100 × 340 =	50 × 10 × 10 =
24 × 10	150 × 8 =	480 × 2 =	20 × 3 × 10 =
24 × 15 =	1 350 × 4 =	899 × 3 =	9 000 × 10 =
12 × 25 =	45 × 2 × 5 =	216 × 4 =	5 002 × 2 =
20 × 30 =	2 × 4 × 60 =	278 × 3 =	11 × 1 000 =

3. Work out:

(a) 164 × 6 (b) 40 × 9 (c) 78 × 7 (d) 217 × 5
(e) 450 × 5 (f) 897 × 5 (g) 575 × 3 (h) 349 × 8
(i) 999 × 9 (j) 35 × 21 (k) 34 × 12 (l) 56 × 23
(m) 75 × 25 (n) 55 × 60 (o) 39 × 13

Exercise 1.10

1. A rectangular floor is completely covered with tiles. There are 26 tiles along its length and 15 tiles along its width. How many tiles are there altogether in the room?
2. There are 10 rows of students at a school assembly. Each row has 28 students. How many students are there altogether?

3. Each box contains 500 nails. How many nails are contained in 80 boxes?
4. Kigali Chalk Factory produces 90 cartons of chalk in a day. Each carton contains 36 boxes of chalk. How many boxes of chalk does the factory produce per day?
5. The table below shows part of Mr. and Mrs. Bitega's wedding budget.

   The cost of the items is in dollars.

Item	Price per unit	Quantity needed	Total cost for item
Chicken	\$ 40	10	
Soda	\$ 65	15 crates	
Wedding cake	\$ 305	1 piece	
Wedding gown	\$ 850	2	
Shoes	\$ 370	2 pairs	

Complete the table and find the total cost for the different items.

1.4.4 Division

Division without A Remainder

Example 1.19

Work out the following:

(a) $48 \div 2$ (b) $245 \div 5$ (c) $90 \div 5$

(d) $2\,170 \div 7$ (e) $54\,000 \div 45$ (f) $108 \div 6$

Solution

(a) $48 \div 2 =$

$$\begin{array}{r}
24 \\
2\overline{)\,48} \\
-4 \\
\hline
08 \\
-8 \\
\hline
0 \\
\hline
\end{array}$$

$48 \div 2 = 24$

So, the answer is 24.

(b) $245 \div 5 =$

$$\begin{array}{r}
49 \\
5\overline{)\,245} \\
-20 \\
\hline
45 \\
-45 \\
\hline
00 \\
\hline
\end{array}$$

$245 \div 5 = 49$

So, the answer is 49.

(c) $90 \div 5 =$

$$\begin{array}{r}
18 \\
5\overline{)\,90} \\
-5 \\
\hline
40 \\
-40 \\
\hline
00 \\
\hline
\end{array}$$

$90 \div 5 = 18$

So, the answer is 18.

(d) $2\,170 \div 7 =$

$$\begin{array}{r}
310 \\
7\overline{)\,2170} \\
-21 \\
\hline
007 \\
-7 \\
\hline
00 \\
0 \\
\hline
0 \\
\hline
\end{array}$$

$2\,170 \div 7 = 310$

So, the answer is 310.

(e) 54 000 ÷ 45

$$
\begin{array}{r}
1\,2\,0\,0 \\
45\,\overline{)\,5\,4\,0\,0\,0} \\
-\,4\,5\downarrow\downarrow\downarrow \\
\hline
9\,0\,0\,0 \\
-\,9\,0\downarrow\downarrow \\
\hline
0\,0 \\
\hline
\end{array}
$$

54 000 ÷ 45 = 1 200

So, the answer is 1 200.

(f) 108 ÷ 6 =

$$
\begin{array}{r}
1\,8 \\
6\,\overline{)\,1\,0\,8} \\
-\,6\downarrow \\
\hline
4\,8 \\
-\,4\,8 \\
\hline
0\,0 \\
\hline
\end{array}
$$

108 ÷ 6 = 18

So, the answer is 18.

Example 1.20

Divide 5000 pens equally among 5 children.

Solution

Divide 5000 by 5

$$
\begin{array}{r}
1\,0\,0\,0 \\
5\,\overline{)\,5\,0\,0\,0} \\
-\,5\downarrow\downarrow\downarrow \\
\hline
0\,0\,0 \\
\hline
\end{array}
$$

Each child will get 1000 pens.

Exercise 1.11

1. Work out the following:

(a) 14 ÷ 7	(b) 180 ÷ 4	(c) 330 ÷ 11	(d) 900 ÷ 6
(e) 840 ÷ 10	(f) 2 718 ÷ 6	(g) 2 247 ÷ 7	(h) 5 106 ÷ 6
(i) 4 077 ÷ 9	(j) 1 242 ÷ 54	(k) 1 380 ÷ 60	(l) 9 450 ÷ 15

2. Answer the following questions:

   (a) There are 340 bags of cement to be unloaded off from a lorry by 5 men working at the same rate. How many bags will each man unload?

(b) Divide 450 sweets equally among 10 pupils.

(c) The District Agriculture Officer plans to distribute 1 080 Friesian cows to 10 farmers' groups. How many cows will each farmers' group get?

(d) A butcher supplies 10 kg of meat to each school. If he has 1 000 kg of meat, how many schools does he supply?

Division with a Remainder

Example 1.21

Evaluate the following:

(a) $25 \div 4$ (b) $398 \div 5$ (c) $1\,478 \div 12$

Solution

(a) $25 \div 4 =$

$$\begin{array}{r|rr} & & 6 \\ \hline 4 & 2 & 5 \\ - & 2 & 4 \\ \hline & & 1 \\ \hline \end{array}$$

So, $25 \div 4 = 6$, remainder $= 1$

(b) $398 \div 5 =$

$$\begin{array}{r|rrr} & & 7 & 9 \\ \hline 5 & 3 & 9 & 8 \\ - & 3 & 5 & \downarrow \\ \hline & & 4 & 8 \\ & - & 4 & 5 \\ \hline & & & 3 \\ \hline \end{array}$$

So, $398 \div 5 = 79$, remainder $= 3$

(c) $1\,478 \div 12 =$

$$\begin{array}{r|rrrr} & & 1 & 2 & 3 \\ \hline 12 & 1 & 4 & 7 & 8 \\ - & 1 & 2 & \downarrow & \downarrow \\ \hline & & 2 & 7 & \\ & - & 2 & 4 & \\ \hline & & & 3 & 8 \\ & & - & 3 & 6 \\ \hline & & & & 2 \\ \hline \end{array}$$

So, $1\,478 \div 12 = 123$, remainder $= 2$

Assessment Exercise

1. What is the largest 5-digit number that can be formed from the digits 0, 3, 2, 4, 1, 5?
2. Write the following numbers in figures:
   (a) Twenty-four thousand seven hundred seven.
   (b) One hundred twenty-four thousand seven hundred seventy.
   (c) Thirty-four thousand seven hundred seventy-seven.
3. Write the following in short form.
   (a) $(4 \times 1\,000) + (2 \times 100) + (7 \times 10) + (3 \times 1)$
   (b) $(5 \times 10\,000) + (5 \times 100) + (3 \times 10) + (2 \times 1)$
4. In a school with 888 pupils, three girls were voted for the post of head girl of the school. The number of votes obtained by each girl is given below:

Girl	Number of votes
Umuhoza Bianca	323
Ineza Rebecca	233
Uwimana Christa	332

   Which girl obtained the greatest number of votes?
5. On a certain school trip to Akagera National Game Park, we counted 123 zebras, 10 buffaloes, 21 wild pigs and 14 giraffes.
   (a) How many giraffes and zebras did we count?
   (b) How many wild animals did we count altogether in the park?
6. Fill the missing digits in the addition grids below:

(a)

	TH	H	T	O
	2	3	2	1
+	4		0	3
	6	3		4

(b)

	TH	H	T	O
	3	0	0	0
+				
	7	7	7	7

(c)

	TH	H	T	O
	4	4	4	4
+	2	2	1	3
	9	9	9	9

(d)

	TH	H	T	O
			1	1
	3	2	0	
	3	7	5	4
	8	9		6

7. A shopkeeper in Kimironko main market in Kigali had the following daily records of sales:

Monday	24 750 Frw
Tuesday	24 450 Frw
Wednesday	24 900 Frw
Thursday	40 765 Frw
Friday	24 000 Frw

   (a) What was the value of goods sold on Monday?
   (b) What was the value of goods sold on Thursday and Friday?
   (c) How much did the shopkeeper get from Monday to Wednesday?
8. A school water tank holds 100 000 litres of water. P5 pupils use 12 500 litres and P6 pupils use 67 500 litres. How much water remains in the tank?
9. By how much is 67 999 greater than 45 908?
10. Work out:
    (a) 217×11 (b) 234×90 (c) 805×30 (d) 565×20
    (e) 680×26 (f) 615×10 (g) 575×33 (h) 465×40
    (i) 500×100 (j) 895×100 (k) 65×456
11. Each tray of eggs contain 30 eggs. How many eggs are in 22 trays?
12. Work out;
    (a) $3\overline{)\,27}$ (b) $6\overline{)\,345}$ (c) $12\overline{)\,16\,798}$ (d) $2\overline{)\,679}$
    (e) $8\overline{)\,176}$ (f) $10\overline{)\,1\,257}$ (g) $9\overline{)\,38\,148}$
13. A father had 23 sweets and decided to give the sweets to his four children equally.
    (a) How many sweets did each child get?
    (b) How many sweets did he remain with?
14. A class has 67 pupils. A teacher wants to form groups of 4 pupils each.
    (a) How many groups were formed in the class?
    (b) How many students remain without a group?

Think!!!

Which 3 numbers have the same answer whether they are added or multiplied together?

UNIT 2

Positive and Negative Integers

Key Unit Competence

A learner should be able to solve problems related to comparing, ordering and finding distance between negative and positive integers.

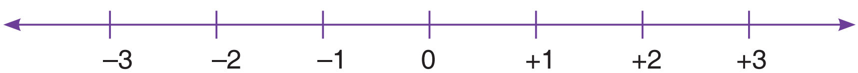
Attitudes and values

Appreciate the importance of using positive and negative numbers in practical contexts.

2.1 Integer

An integer is a number with no fractional part. Integer include all the whole numbers along with negative numbers.

We represent the integers on a number line as follows:



A set of integers includes:

1. All counting numbers (1, 2, 3, 4, 5, 6, 7, ………. 100, ..)
2. Zero {0}
3. And the negatives of all the counting numbers (–1,–2,–3,–4,–5….)

Therefore, the set of integers is (……, –3, –2, –1, 0, +1, +2, +3, …..)

Integers are made up of negative numbers, zero and positive numbers. ‘Zero’ is neither positive nor negative.

Activity 2.1

In this class activity, you will discuss positive and negative numbers with your group members.

You should discuss positive and negative numbers in relation to the following:

(i) Falling into a hole and climbing a tree, what can be the position of zero?

(ii) Profit and loss in business, what is negative and what is positive?

(iii) Sinking into water and rising above earth, what is the position of zero?

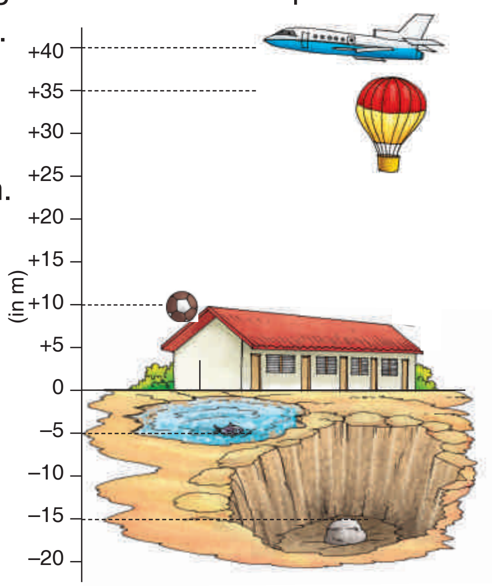
(iv) Promotion and demotion at work place, what is compared to positive event?

2.2 Explaining Integers

- If I have no money at all, then I can say that I have '0' money.
- If I have been given some 50 Frw, then I can say I have some money.
- If I have lost 100, then I can say that I have a shortage of 100 Frw.
- If a stone is dropped into a pit which is 10 metres deep, then from the ground level the stone is at –10 m from the earth surface.
- A plane flying above our school at a height of 500 m is +500 m above the school.

Example 2.1

Study the diagram below and use integers to estimate the position of the following objects from the earth surface.



Solution

(a) The position of the plane is +40 m.

(b) The position of the balloon is +35 m.

(c) The position of the ball is +10 m.

(d) The position of the ground is 0 m.

(e) The position of the fish is –5 m.

(f) The position of the stone is –15 m.

Exercise 2.1

Explain and illustrate these expressions using integers:

(a) A pupil got no mark in a Mathematics test __________.

(b) A team scored two points in a game __________ .

(c) A pupil climbed a tree 10 m tall __________ .

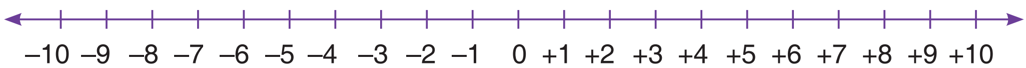
(d) My coin fell to the bottom of a swimming pool 2 m deep _______ .

(e) A shopkeeper made a profit of 2 000 Frw ________ .

(f) A shoeseller made a loss of 300 Frw________ .

2.3 Number Line

A number line is a horizontal line drawn with integers marked along its length. Positive numbers are marked and written on the right hand side of zero and negative numbers are marked and written on the left hand side of the zero mark as shown below:



- Positive numbers are written with a plus (+) sign in front of them. They may also be written without any sign in front, e.g. +5 = 5.
- Negative numbers are written with a minus (–) sign in front of them, e.g. –4.

The Temperature Scale

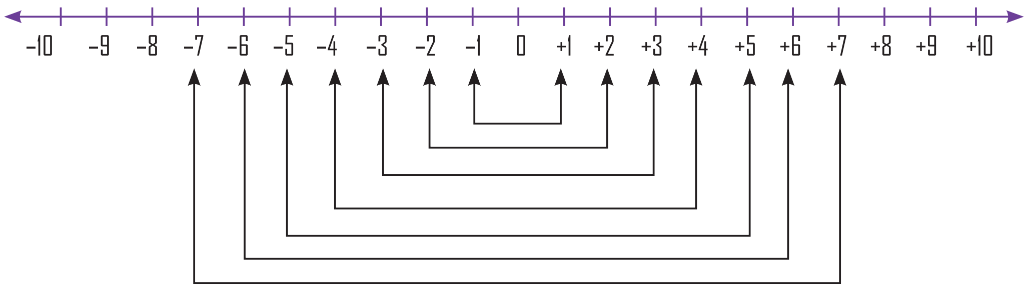
The temperature is a degree of hotness or coldness of an object. The temperature of an object is measured using a thermometer.

- The temperature of freezing water is 0°C.
- The temperature of boiling water is 100°C.
- The temperature of a normal person is about 37°C.

The temperature of an object below 0°C is negative. For instance, temperature in the Antarctica can reach as low as –89.2˚C.

2.4 The inverse or opposite of an integer

The opposite or inverse of an integer has the same absolute value but with an opposite sign.



The inverse of +1 is –1.
The inverse of –2 is +2.
The inverse of –3 is +3.
The inverse of +5 is –5.
The inverse of –6 is +6.
The inverse of +7 is –7 and so on.

The inverse property of an integer

The inverse property of integers states that any number added to its inverse equals to zero. **Example**: +5 +(-5) = 0

Exercise 2.2

1. Draw a number line. Mark all the integers from –10 to +10.
   (a) Which integer is 4 steps to the right of +4?
   (b) Which integer is 5 steps to the left of 0?
   (c) An integer is 6 steps to the left of 1. What is this integer?
   (d) If you are at zero (0) and you move 9 steps in the negative direction, where will you be on the number line?
   (e) An insect moves from -6 to +6. How many steps has it moved?
2. Verify the following:
   (a) (+1) + (–1) = 0 (b) (–88) + (+88) = 0
   (c) (+100) + (–100) = 0 (d) (+6) + (–6) = 0
3. Name the inverse of each of the following integers:
   (a) +12 (b) +45 (c) –34 (d) –20 (e) –240 (f) –500

2.5 Position of Integers on the Number Line

When locating integers on the number line, we need to take great care of the direction in which we are moving. We need to establish a system that we will follow whenever we are locating positions of integers on the number line.

- Our reference point is the zero (0) mark.
- An addition (+) operation means we move towards the right of 0.
- A subtraction (–) operation means we move towards the left of 0.
- We can imagine our face to represent the positive and the back of our heads to represent the negative.
- For positive integers, we move forwards.
- For negative integers, we move backwards.

Activity 2.2

In this activity, you will need the following materials for your class:

Long string (about 10 m), cotton thread, manila paper of different colours (red, green and yellow), a pair of scissor, two 6 cm nails, hammer, large cardboard box and a black marker pen.

(i) Using a hammer, fix two nails into the opposite walls of the classroom.

(ii) Make loops on the string and tie the string on the nails across the classroom.

(iii) Cut about 10 pieces of red manila papers, 10 pieces of green manila papers and 1 piece of yellow manila paper (each paper should be about 15 cm by 15 cm).

(iv) The teacher will guide you to write integers from –10 to +10 on the 21 pieces of manila papers. The red papers should be used for negative integers, yellow for zero and green for positive integers.

(v) Each pupil picks a cardboard from the box at random, makes a small hole in the paper and ties it with about 30 cm of cotton thread.

(vi) The pupils will stand in groups according to the colour of papers they have picked. There is only one pupil with a yellow paper on which 0 is written.

(vii) The pupil with the yellow paper ties his/her paper to hang exactly in the middle of the string.

(viii) The other pupils also hang their papers on the correct side of the yellow paper and at the correct positions.

Activity 2.3

(i) Your teacher will take you to a large play area such as a field.

(ii) Using dry sand, ash or any suitable material, draw a number line on the ground and mark integers on it so that each pupil has a point to stand on the number line. The distance between the integers can be about 60 cm.

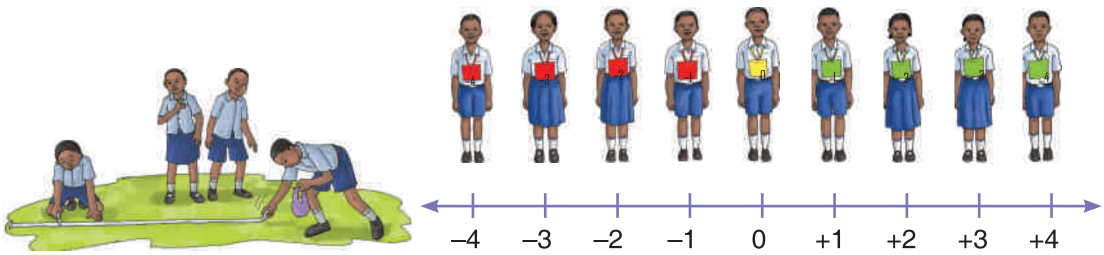
(iii) Write negative integers on the red papers, 0 on the yellow paper and positive on the green papers.

(iv) Pick the papers at random and tie a loop on the paper so that you are able to wear it around your neck.

(v) Move to the position on the number line which has the same number on your card.

(vi) During this activity, your name is the number that you are wearing on your neck. Listen carefully as the teacher calls your “name” and follow the instructions well.

(vii) Everyone should be able to know how far he/she has moved and in which direction (positive or negative) he/she has moved.

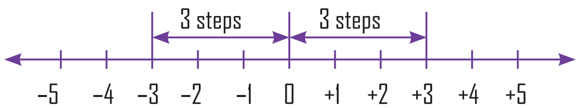


2.6 Distance between two integers

1. Two integers on the same side of zero:

   The magnitude of –3 is 3 and the magnitude of +3 is also 3.

   Magnitude of a number is the distance from 0 to that number.



   If two numbers are on the same side of zero, the difference between them is the difference of their magnitudes.

Example 2.2

What is the distance between the following integers on the number line?

(a) + 2 and +10 (b) 0 and +15 (c) –3 and –6 (d) –7 and –2

Solution

(a) Magnitude of +2 = 2 and magnitude of +10 = 10.

so, distance between +2 and +10 = 10 – 2 = 8 steps

(b) In the same way, distance between 0 and +15 = 15 – 0 = 15 steps.

(c) Magnitude of –3 = 3 and magnitude of –6 = 6. So the distance between –3 and –6 = 6 – 3 = 3 steps.

(d) Distance between –7 and –2 = 7 – 2 = 5 steps.

2. Two integers on opposite sides of 0 on the number line:

   If two numbers are on opposite sides of 0 on the number line, the distance between them is the sum of the magnitudes of the two numbers.

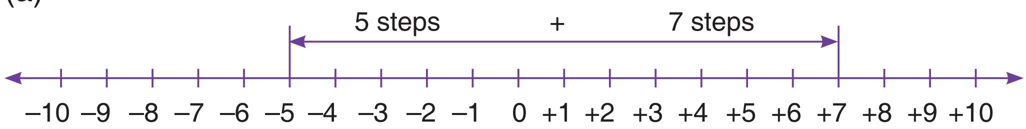
▸ Example 2.3

What is the distance between the following points on the number line?

(a) –5 and +7 (b) –10 and +10

Solution

(a)



Distance between – 5 and +7 = 5 steps + 7 steps = 12 steps.

(b) Two numbers on opposite side of zero

magnitude of –10 is 10 and the magnitude of +10 is also 10.

So, the distance between –10 and +10 = 10 + 10 = 20 steps.

Exercise 2.3

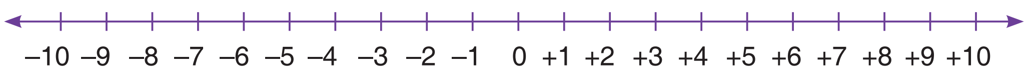
Without drawing a number line, state the distance between the following points on the number line;

(a) 0 and +3 (b) 0 and –3 (c) –2 and +2 (d) –1 and +1

2.7 Comparing integers and Ordering integers

- On a number line integers are always in order from the smallest to the biggest.
- If you touch two integers at a time, the one to the left is always smaller and the one to the right is always bigger.
- Any integer is always bigger than the one to its left on the number line.
- Any integer is always smaller than the one to its right on the number line.

▸ Example 2.4



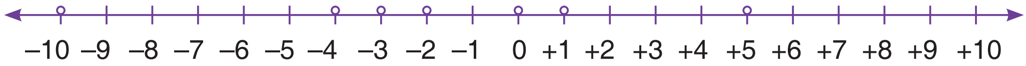
–10 is less than –9	–7 is less than –4	–2 is less than 0
1 is less than 6	+6 is less than +10	0 is greater than –4
+3 is greater than –10	+1 is greater than –1	

▸ Example 2.5

Arrange +1, –3, –10, –2, –4, 0, +5 in order starting with the smallest to the biggest (ascending order).

Solution

We draw the number line and show the positions of the integers.

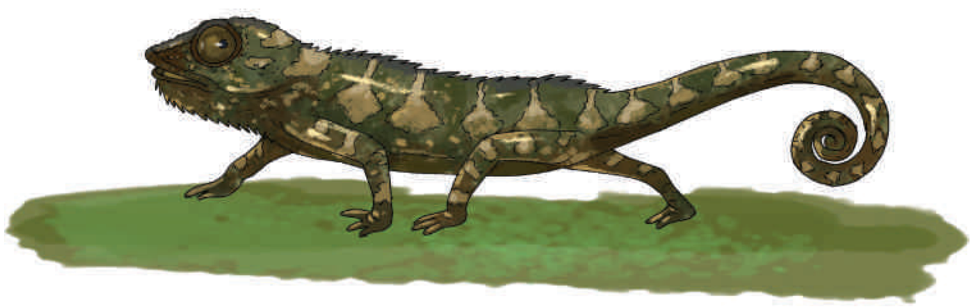


Order from the smallest to biggest = –10, –4, –3, –2, 0, +1, +5.

Assessment Exercise

1. Show these expressions using integers:
   (a) 3 metres below the ground __________ .
   (b) 5 steps forward _________ .
   (c) 10 steps backward _________ .
2. Name the inverse of each of the following integers:
   (a) –5 890 (b) +100 000 (c) –20 000
3. Without drawing a number line, state the distance between the following points on the number line;
   (a) +3 and –1 (b) –2 and +10 (c) –10 and +10
   (d) –10 and –6
4. Arrange these integers from biggest to smallest (descending order)
   –3, –7, 0, +4, –13, –31, +13, +31, –301, +310, +301.
5. Arrange these integers from the smallest to biggest (ascending order)
   –8, –5, 3, 2, 0, +5, 6, 8, 1

Think!!!



A chameleon wants to move from point A to point B, 10 metres apart. It walks in a very funny way such that within 1 minute, it moves 3 metres forward followed by 1 metre backward. How long does the chameleon take to complete its journey to point B?

UNIT 3

Classifying Numbers by their Properties

Key Unit Competence

A learner should be able to classify numbers and appreciate that one number may belong to various families of numbers.

Attitude and Values

Appreciate the importance of using square roots, being cooperative and displaying a teamwork spirit.

3.1 Natural and whole Numbers

The counting numbers starting from 1 are called natural numbers.

Natural numbers = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, ...}

Whole Numbers

Natural numbers together with 0 are called whole numbers.

Whole numbers = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, ...}

3.2 Odd Numbers

Odd numbers are natural numbers which are not exactly divisible by 2. When divided by 2 it always has a remainder of 1.

The following are examples of odd numbers less than 20.

Odd numbers = {1, 3, 5 ,7, 9, 11, 13, 15, 17, 19}

3.3 Even Numbers

Even numbers are natural numbers which are exactly divisible by 2. When divided by 2 it leaves no remainder.

The following are the even numbers found between 0 and 20.

Even numbers = {2, 4, 6, 8, 10, 12, 14, 16, 18}.

[Note: 20 is not included in this set of numbers and yet it is an even number. This is because we were asked to list even numbers between 0 and 20 and not 0 to 20.]

Activity 3.1

In this class activity, you are going to play a game which will help you to learn how to classify numbers as whole, natural, odd and even numbers.

- The teacher will give you a flashcard with a number written on it.
- Look at your number carefully and remember it throughout this activity (game).
- When the teacher calls out the class to which your number belongs, you will run and stand on the line drawn: Class of odd numbers, even numbers, whole numbers and natural numbers.

Exercise 3.1

1. List all the odd numbers between 0 and 100.
2. List all the even numbers from 0 up to 100.

Think!!!

I am an odd number. Take away one letter and I become even. What number am I?

3.4 Square Numbers

This is the number obtained when one number is multiplied by itself.

Study the multiplication table below and use it to identify all the square numbers less than 60.

x	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
2	2	4	6	8	10	12	14
3	3	6	9	12	15	18	21
4	4	8	12	16	20	24	28
5	5	10	15	20	25	30	35
6	6	12	18	24	30	36	42
7	7	14	21	28	35	42	49

From the table we can see that;

$1 \times 1 = 1$ | $6 \times 6 = 36$

$2 \times 2 = 4$ | $7 \times 7 = 49$

$3 \times 3 = 9$ | $8 \times 8 = 64$

$4 \times 4 = 16$ | $9 \times 9 = 81$

$5 \times 5 = 25$ | $10 \times 10 = 100$

So the set of square numbers up to 100 = {1, 4, 9, 16, 25, 36, 49, 64, 81, 100}.

Activity 3.2

Work together in groups and list all the square numbers between 0 and 410.

3.5 Square root of a number

Finding the square root of a number is the inverse operation of squaring the number.

The symbol used for the square root of an unknown number x is $\sqrt{x}$.

Number	Square of the number	Square root of the number
3	$3^2 = 3 \times 3 = 9$	$\sqrt{9} = 3$
5	$5^2 = 5 \times 5 = 25$	$\sqrt{25} = 5$
6	$6^2 = 6 \times 6 = 36$	$\sqrt{36} = 6$
9	$9^2 = 9 \times 9 = 81$	$\sqrt{81} = 9$
10	$10^2 = 10 \times 10 = 100$	$\sqrt{100} = 10$

Exercise 3.2

Evaluate the following by finding the square root.

(a) $\sqrt{1}$

(b) $\sqrt{16}$

(c) $\sqrt{49}$

(d) $\sqrt{81}$

(e) $\sqrt{64}$

(f) $\sqrt{100}$

(g) $\sqrt{8 \times 8}$

(h) $\sqrt{5 \times 5}$

Exercise 3.3

Complete the multiplication table below and use it to list all the square numbers less than 100.

X	1	2	3	4	5	6	7	8	9	10
1										
2					10					
3										
4										
5										
6										
7										
8			24							
9										
10									90	

3.6 Prime Numbers

A prime number is any number with only two factors; one factor being 1 and the other one being itself.

Examples of prime numbers are: 2, 3, 5, 7, 11, 13, 17, 19, 23, ...

Activity 3.3

List all the prime numbers between 100 and 150.

3.7 Composite Numbers

This is a natural number greater than one which has more than two factors. In fact a composite number is a natural number greater than 1 which is not a prime number.

The following are examples of composite numbers: 4, 6, 8, 9, 10, 12, 14, 15, 16, ...

Exercise 3.4

1. What is the smallest prime number?
2. What is the smallest even number which is a prime number?
3. What is the smallest odd number which is prime?
4. List the first 10 composite numbers.

Mind Game

I am an even number. I am a counting number and I am a prime number too. Who am I and what is my square?

3.8 Multiples of a Number

The multiples of a whole number are found by taking the product of any counting number and that whole number.

For example:

5×1 = 5	5×6 = 30
5×2 = 10	5×7 = 35
5×3 = 15	5×8 = 40
5×4 = 20	5×9 = 45
5×5 = 25	5×10 = 50

So, the multiples of 5 are 5, 10,15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, ...

Exercise 3.5

List the first 10 multiples of the following numbers:

(a) 4 (b) 6 (c) 7 (d) 8 (e) 9

(f) 11 (g) 12

3.9 Factors of a Number

The factors of a number are all those whole numbers that can divide evenly to the number and leave no remainder.

The greatest factor of a number is the number itself and the smallest factor of a number is 1.

Activity 3.4

Work together in groups and list all the numbers between 1 and 30. Which numbers are not multiple of 3?

Example 3.1

List all the factors of 18.

Solution

- We already have two factors of 18 namely 1 and 18. 1 is the smallest factor and 18 is the biggest factor.
- Try dividing 18 by numbers 2, 3, 4, 5 ...
- $18 \div 2 = 9$ and so 2 is the second smallest factor and 9 is the second biggest factor.
- Continue dividing with different numbers until you get all the factors.

$1 \times 18 = 18$ $2 \times 9 = 18$ $3 \times 6 = 18$	$18 \div 1 = 18$ $18 \div 2 = 9$ $18 \div 3 = 6$

- So, the factors of 18 arranged in ascending order are 1, 2, 3, 6, 9, 18.

Exercise 3.6

1. List all the factors of the following numbers:

(a) 8 (b) 12 (c) 24 (d) 36 (e) 48
(f) 64 (g) 45 (h) 23 (i) 96 (j) 100

2. I think of a number. When I multiply it by itself, the answer is 100. What is the number?

3.10 Lowest Common Multiple (LCM)

LCM means the Lowest Common Multiple. So, the LCM of two numbers is the smallest multiple which is common to both numbers.

Example 3.2

Find the LCM of the following numbers:

(a) 3 and 4 (b) 5 and 12
(c) 12 and 15 (d) 20 and 65

Solution

Method 1

(a) LCM of 3 and 4

Multiples of 3 = {3, 6, 9, 12, 15, 18, 21, 24, 27, ...}

Multiples of 4 = {4, 8, 12, 16, 20, 24, 28…}

The common multiples are 12, 24, ...

The smallest common multiple is 12 and so the LCM of 3 and 4 = 12.

(b) LCM of 5 and 12

Multiples of 5 = {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, ...}

Multiples of 12 = {12, 24, 36, 48, 60, 72, 84, 96, 108, ...}

The lowest common multiple is 60.

So, the LCM of 5 and 12 = 60.

(c) LCM of 12 and 15

Multiples of 12 = {12, 24, 36, 48, 60, 72, 84, 96, 108, ...}

Multiples of 15 = {15, 30, 45, 60, 75, 90, 105, 120, 135, ...}

The lowest common multiple is 60.

So, the LCM of 12 and 15 = 60

(d) LCM of 20 and 65

Multiples of 20 = {20, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, ...}

Multiples of 65 = {65, 130, 195, 260, 325, 390, ...}

The lowest common multiple is 260.

So, the LCM of 20 and 65 = 260.

Method 2

Another way of finding the LCM of two or more numbers is to first express them in terms of prime factors. Let's use this method to find the LCM of 12 and 15 and see whether we shall get 60.

Solution

Factorise 12 and 15 in terms of prime factors.

	12	15
2	6	15
2	3	15
3	1	5
5	1	1

The LCM can be got by multiplying all the prime factors of 12 and 15 in the first column on the left.

So, LCM of 12 and 15 = $2 \times 2 \times 3 \times 5 = 60$.

Assessment Exercise

1. Evaluate the following by finding its square root:

   (a) $\sqrt{4 \times 9}$ (b) $\sqrt{64}$ (c) $\sqrt{100}$ (d) $\sqrt{9}$

2. Find the first five multiple of the following numbers: 3, 6, 5, 9, 10
3. List the first 10 prime numbers.
   (a) Circle all the square numbers.
   (b) Using a pencil, tick all the composite numbers.
4. Find the highest common factor (HCF) and LCM of the following numbers:

   (a) 2 and 4 (b) 4 and 5 (c) 3 and 6 (d) 4 and 10

   (e) 12 and 14 (f) 23 and 46

Internet Resource

For more online support visit

https://www.superteacherworksheets.com/least-common-multiple.htm

UNIT 4

Fractions of the Same Denominator

Key Unit Competence

By the end of this unit, a learner should be able to explain the meaning of fractions, add and subtract same-denominator fractions, multiply and divide fractions accurately.

Attitude and Values

Appreciate the importance of accuracy in carrying out operations on fractions and develop the spirit of sharing with others.

4.1 Meaning of fractions

A fraction is a part of a whole number.

A fraction is made up of 2 numbers. The top number is called the **numerator** and the bottom number is called the **denominator**.

For example: In the fraction $\frac{3}{4}$, 3 is the **numerator** and 4 is the **denominator**.

How Fractions Arise?

Fractions are obtained when a whole number is divided into two or more than two parts. The figures below show an orange divided into 8 equal parts.

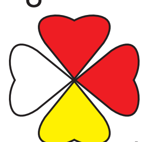
$\frac{1}{8}$.

$\frac{7}{8}$.

If one part is removed and eaten, then this is represented by the fraction $\frac{1}{8}$.

The part which has not yet been eaten is represented by the fraction $\frac{7}{8}$.

The figure aside shows a flower. The flower has four equal parts. 2 parts are coloured red, 1 yellow and 1 part is not coloured, *i.e.*, it is white. This can be represented using fractions:



The red part is represented by the fraction $\frac{2}{4}$, the yellow part is represented by the fraction $\frac{1}{4}$ and the white part is represented by the fraction $\frac{1}{4}$.

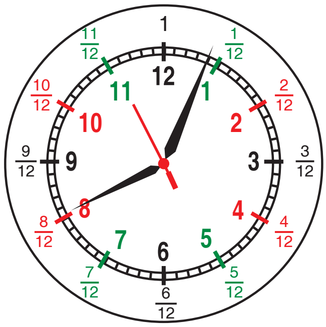
Mixed Fractions

$3\frac{1}{2}$ is an example of a mixed fraction. It can also be written as $\frac{7}{2}$.

So, $3\frac{1}{2} = \frac{7}{2}$.

Activity 4.1

In this class activity, you will identify the numerator and denominator in the following fractions. You will work in groups of 4.



- This is a clock face with so many numbers, some of which are fractions.
- Write down all the fractions shown on the clock face above.
- For each fraction you have written above, write down the numerator and denominator.
- Compare your results with other classmates in class.
- Present your answers to the teacher for marking.

Activity 4.2

In this class activity, you will write fractions when you are given the numerator and denominator. You will complete this activity in groups of 4. Complete the table in your note book, writing down the fraction.

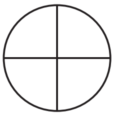
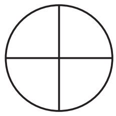
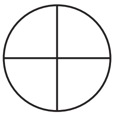
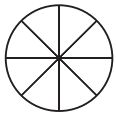
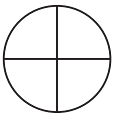
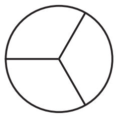
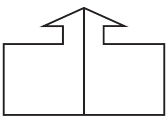
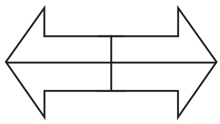
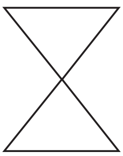
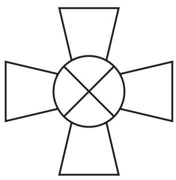
Numerator	One	Two	Three	Four	Five	Ninety	One hundred and twenty one	Seventy nine	Nine
Denominator	Three	Five	Seventy	Five	Three	Forty three	One hundred and twenty two	Seventy nine	Ninety nine
Fraction			$\frac{3}{70}$				$\frac{121}{122}$		

Think!!!

A farmer has a bag of popcorn, a hen and a fox. He wants to cross a river in a boat. The boat can only take him and only one of the three items he has. The problem is that the hen can eat popcorn and the fox can eat the hen. How does he cross the river without anything getting eaten up?

Activity 4.3

Look at the following figures. Use coloured pencils or crayons to colour or paint as instructed below:

	Colour $\frac{1}{4}$		Colour $\frac{2}{4}$
	Colour $\frac{4}{4}$		Colour $\frac{1}{8}$
	Shade $\frac{3}{4}$		Colour $\frac{1}{3}$
	Colour $\frac{1}{2}$		Colour $\frac{2}{4}$
	Colour $\frac{2}{2}$		Colour $\frac{1}{4}$

4.2 Reading a Fraction

Look at the following fraction: $\frac{2}{5}$

This fraction can be read as:

- Two-fifth or
- Two over five or
- Two divided by five.

$\frac{1}{2}$ is read as “half” or “one over two” or “one divided by two”.

$\frac{4}{5}$ is read as “four-fifths” or “four over five” or “four divided by five”.

$\frac{1}{10}$ is read as “one-tenth” or “one over ten” or “one divided by ten”

$\frac{7}{1000}$ is read as “seven-thousandths” or “seven over one thousand” or “seven divided by one thousand”

Activity 4.4

(a) In this class activity, you will work in groups of 6 learners.

(b) Three of them will write a half, a fifth and a third on their respective cards as shown below.

A Half	**A Fifth**	**A Third**

(c) Remaining three will write $\frac{1}{2}$, $\frac{1}{5}$ and $\frac{1}{3}$ on their respective cards as shown below.

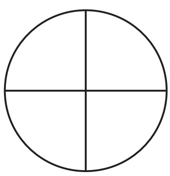
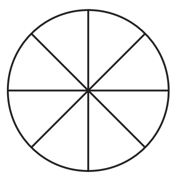
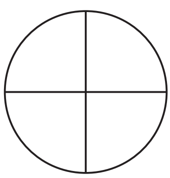
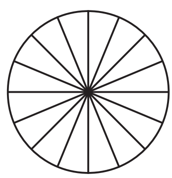
$\mathbf{\frac{1}{5}}$	$\mathbf{\frac{1}{3}}$	$\mathbf{\frac{1}{2}}$

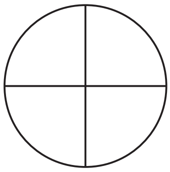
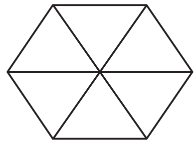
(d) Now, make pairs of similar values of cards.

(e) Ask your teacher to check the results.

Activity 4.5

Shade the parts represented by the given fraction.

 Shade one quarter	 Shade three eighths
 Shade two quarters	 Shade nine-sixteenths

 Shade three quarters	 Shade five-sixths

Exercise 4.1

Fill in "numerator" or "denominator" to complete the following.

1. Given $\frac{3}{4}$, 3 is the _________ and 4 is the _________ .
2. Given $\frac{5}{8}$, 8 is the _________ and 5 is the _________ .
3. In the fraction $\frac{10}{17}$, 17 is the _________ and 10 is the _________ .

4.3 Comparing fractions with the same denominator

Activity 4.6

In this class activity, you will work in groups of 5 learners.

(a) Cut the orange given to you into 4 equal parts. Each part shall be called a slice.

(b) Display the slices on a table and count them to be sure that they are 4.

(c) What fraction represents all the slices you have counted?

(d) Put the slices in 3 groups labelled A, B and C. In A put 1 slice, 2 slices in B and 1 slice in C.

(e) What fraction represents the number of slices in each group? Answer this question by completing the table below:

Group	A	B	C
Fraction			

(f) Which group has the greatest number of slices?

(g) Which group has the smallest number of slices?

(h) Compare the fractions $\frac{2}{4}$ and $\frac{1}{4}$: which one is bigger? Explain to your group why the fraction chosen is bigger.

When comparing fractions of the same denominator, we look at the numerators. The fraction with the bigger numerator is the greater fraction.

For example $\frac{10}{17}$ is greater than $\frac{8}{17}$.

Activity 4.7

In this activity, you will compare the given fractions using the correct comparison symbols; < (less than), > (greater than) or = (equal to).

(a) $\frac{6}{7} \ldots \frac{2}{7}$ (b) $\frac{7}{7} \ldots \frac{6}{7}$ (c) $\frac{8}{12} \ldots \frac{1}{12}$ (d) $\frac{6}{10} \ldots \frac{6}{10}$

(e) $\frac{2}{8} \ldots \frac{6}{8}$ (f) $\frac{4}{6} \ldots \frac{3}{6}$ (g) $\frac{5}{7} \ldots \frac{2}{7}$ (h) $\frac{3}{10} \ldots. \frac{10}{10}$

(i) $\frac{3}{5} \ldots. \frac{2}{5}$ (j) $\frac{30}{10} \ldots. \frac{49}{10}$ (k) $\frac{1}{3} \ldots. \frac{6}{3}$ (l) $\frac{2}{8} \ldots. \frac{8}{8}$

(m) $\frac{2}{11} \ldots.. \frac{7}{11}$ (n) $\frac{69}{96} \ldots.. \frac{96}{96}$ (o) $\frac{7}{18} \ldots.. \frac{6}{18}$ (p) $\frac{7}{11} \ldots.. \frac{10}{11}$

Example 4.1

Which one is greater?

(i) $\frac{2}{3}$ or $\frac{1}{3}$ (ii) $\frac{3}{4}$ or $\frac{1}{4}$

Solution

(i) $\frac{2}{3}$ is greater than $\frac{1}{3}$ or $\frac{1}{3}$ is less than $\frac{2}{3}$

(ii) $\frac{3}{4}$ is greater than $\frac{1}{4}$ or $\frac{1}{4}$ is less than $\frac{3}{4}$

Example 4.2

Which one is smaller?

(i) $\frac{1}{9}$ or $\frac{4}{9}$ (ii) $\frac{10}{11}$ or $\frac{5}{11}$

Solution

(i) $\frac{1}{9}$ is less than $\frac{4}{9}$ or $\frac{4}{9}$ is greater than $\frac{1}{9}$

(ii) $\frac{10}{11}$ is greater than $\frac{5}{11}$ or $\frac{5}{11}$ is less than $\frac{10}{11}$

Example 4.3

Are these pairs of fractions equal?

(i) $\frac{1}{3}$ and $\frac{3}{9}$ (ii) $\frac{2}{3}$ and $\frac{6}{9}$

Solution

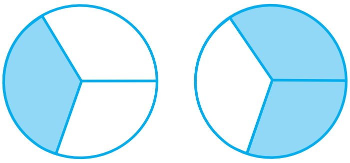
(i) $\frac{1}{3}$ is same as $\frac{3}{9}$; $\frac{1}{3}$ is the simplified fraction of $\frac{3}{9}$

(ii) $\frac{2}{3}$ is same as $\frac{6}{9}$; $\frac{2}{3}$ is the simplified fraction of $\frac{6}{9}$

Example 4.4

Compare $\frac{1}{3}$ and $\frac{2}{3}$

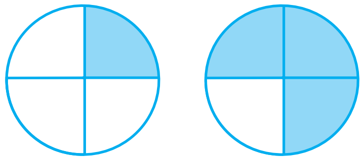
Solution



$\frac{1}{3} < \frac{2}{3}$

Example 4.5

Compare $\frac{1}{4}$ and $\frac{3}{4}$



$\frac{1}{4} < \frac{3}{4}$

Exercise 4.2

1. Fill in 'is greater than' or 'is less than' to complete the following statements.

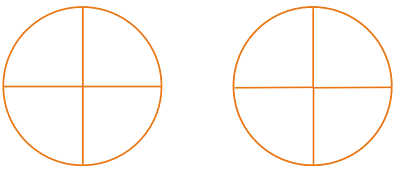
(a) $\frac{4}{5}$ .... $\frac{3}{5}$ (b) $\frac{1}{3}$ .... $\frac{2}{3}$ (c) $\frac{2}{4}$ .... $\frac{1}{4}$ (d) $\frac{4}{7}$ .... $\frac{1}{7}$

(e) $\frac{2}{9}$ .... $\frac{3}{9}$ (f) $\frac{9}{10}$ .... $\frac{4}{10}$ (g) $\frac{3}{7}$ .... $\frac{1}{7}$ (h) $\frac{2}{3}$ .... $\frac{8}{3}$

(i) $\frac{1}{7}$ .... $\frac{3}{7}$ (j) $\frac{3}{4}$ .... $\frac{2}{4}$ (k) $\frac{4}{11}$ .... $\frac{9}{11}$ (l) $\frac{5}{6}$ .... $\frac{1}{6}$

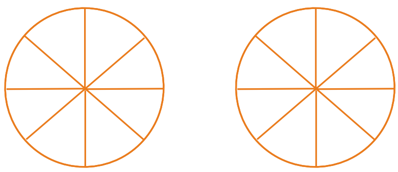
2. Shade the fraction given and use the symbols >, < or =.

(a)



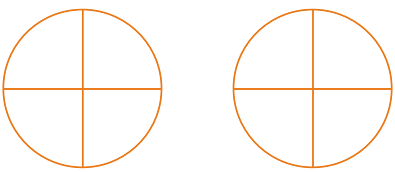
$\frac{1}{4}$ .... $\frac{2}{4}$

(b)



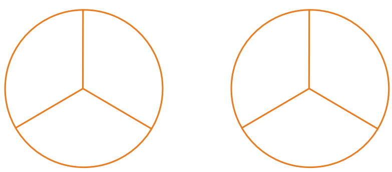
$\frac{2}{8}$ .... $\frac{1}{8}$

(c)



$\frac{3}{4}$ .... $\frac{1}{4}$

(d)



$\frac{1}{3}$ .... $\frac{2}{3}$

4.4 Addition of Fractions with the Same Denominator

Activity 4.8

In this class activity, we will learn and prove that $\frac{1}{4}+\frac{2}{4}=\frac{3}{4}$.

(a) Draw a circle of radius 10 cm on a manila paper.

(b) Mark the centre of the circle using letter O.

(c) Draw two lines through the centre of the circle to divide the circle into four equal parts. Each of these parts is called a sector.

(d) Label the three boxes A, B and C.

(e) Cut out the outline of the circle along the lines drawn.

(f) What fraction does each sector represent? Your answer should be $\frac{1}{4}$.

(g) In box A put one sector, put two sectors in B and one sector in C.

(h) What fraction is represented by the sectors in boxes A, B and C?

(i) Pick the sectors in box A and box B. Add them together. What total fraction do you get?

(j) Add the sectors in A and C together. What fraction do you get?

(k) Is $\frac{1}{4}+\frac{2}{4}=\frac{3}{4}$? Is $\frac{1}{4}+\frac{1}{4}=\frac{2}{4}$?

To add fractions of the same denominator add only the numerators and use the denominator once.

Example 4.6

Add: $\frac{1}{5}+\frac{2}{5}$

Solution

To add.....

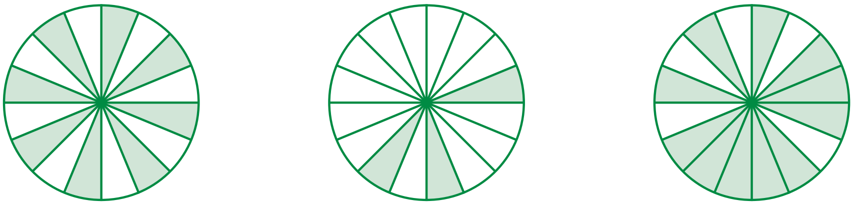
$\frac{1}{5}+\frac{2}{5}$, just add up the numerators since the denominators are exactly the same.

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

Example 4.7

Add: $\frac{8}{16}+\frac{3}{16}$

Solution



$$\frac{8}{16} \quad + \quad \frac{3}{16} = \frac{8+3}{16} = \frac{11}{16}$$

Think!!!

Mr. Kamanzi came back home from Kigali with 24 apples. He decided to share all the apples between his two sons Ted and Ronald. Ted was given a quarter of a half of the apples and Ronald was given a half of a quarter of the apples. Which son got more apples?

Exercise 4.3

Add the following fractions:

(a) $\frac{2}{4} + \frac{1}{4}$ (b) $\frac{3}{7} + \frac{3}{7}$ (c) $\frac{4}{12} + \frac{3}{12}$ (d) $\frac{2}{9} + \frac{3}{9}$

(e) $\frac{1}{10} + \frac{2}{10}$ (f) $\frac{2}{5} + \frac{2}{5}$ (g) $\frac{7}{9} + \frac{1}{9}$ (h) $\frac{2}{10} + \frac{5}{10}$

4.5 Subtraction of Fractions with the Same Denominator

Activity 4.9

In this class activity, we will learn and prove that $\frac{3}{4} - \frac{1}{4} = \frac{2}{4}$

(a) Draw a circle of radius 10 cm on a manila paper.
(b) Mark the centre of the circle using letter O.
(c) Draw two lines through the centre of the circle to divide the circle into four equal parts. Each of these parts is called a sector.
(d) Label the two boxes A and B.
(e) Cut out the outline of the circle along the lines drawn.
(f) What fraction does each sector represent? Your answer should be $\frac{1}{4}$.
(g) In box A, put 3 sectors and put 1 sector in box B.

When the denominator is common. Subtract only numerators and take the common denominator.

(h) What fraction is represented by the sectors in boxes A and B?

(i) Pick 1 sector from box A. Does this represent $\frac{3}{4} - \frac{1}{4}$?

(j) If yes, what fraction is represented by the sectors left in box A?

(k) Is $\frac{3}{4} - \frac{1}{4} = \frac{2}{4}$?

Example 4.8

Subtract the following:

(a) $\frac{4}{4} - \frac{3}{4}$

(b) $\frac{6}{7} - \frac{2}{7}$

(c) $\frac{5}{8} - \frac{2}{8}$

(d) $\frac{8}{11} - \frac{5}{11}$

Solution

(a) $\frac{4}{4} - \frac{3}{4} = \frac{4-3}{4} = \frac{1}{4}$

(b) $\frac{6}{7} - \frac{2}{7} = \frac{6-2}{7} = \frac{4}{7}$

(c) $\frac{5}{8} - \frac{2}{8} = \frac{5-2}{8} = \frac{3}{8}$

(d) $\frac{8}{11} - \frac{5}{11} = \frac{8-5}{11} = \frac{3}{11}$

Note: Remember always to reduce the answer to its simplest form.

Exercise 4.4

Subtract the following fractions:

(a) $\frac{5}{6} - \frac{2}{6}$ (b) $\frac{9}{10} - \frac{2}{10}$ (c) $\frac{3}{4} - \frac{2}{4}$ (d) $\frac{2}{3} - \frac{1}{3}$

(e) $\frac{42}{40} - \frac{32}{40}$ (f) $\frac{11}{12} - \frac{10}{12}$

Real Life Problems involving Fractions

Example 4.9

Jane ate $\frac{1}{3}$ of an apple in the morning and $\frac{1}{3}$ of it in the afternoon. Find the fraction of the apple that Jane ate.

Solution

Jane ate $\frac{1}{3}$ of an apple in the morning and $\frac{1}{3}$ in the evening.

Therefore, $\frac{1}{3} + \frac{1}{3} = \frac{1+1}{3} = \frac{2}{3}$

Jane ate $\frac{2}{3}$ of the apple.

Example 4.10

Namora had $\frac{11}{13}$ of the cake and he ate $\frac{7}{13}$ of the entire cake. What fraction of the cake remained?

Solution

$\frac{11}{13} - \frac{7}{13} = \frac{11-7}{13} = \frac{4}{13}$

$\frac{4}{13}$ of the cake remained.

Exercise 4.5

(a) A mother served her son with a half glass of "*ikivuguto*" (milk). The son drinks $\frac{1}{2}$ of the milk. What fraction of milk remains?

(b) Adults and children are seated in ONATRACOM bus from Kigali city to Kirehe. $\frac{2}{3}$ of the seats are filled by adults and children. What fraction of the seats is filled by children if $\frac{1}{3}$ are filled by adults?

(c) A father dies and leaves his land to be shared by three of his children; Marco, Jean and Bella. His land is divided into 8 equal portions. Marco takes 2 portions, Jean takes 4 portions and Bella takes the rest. What fraction of their father's land does Bella take?

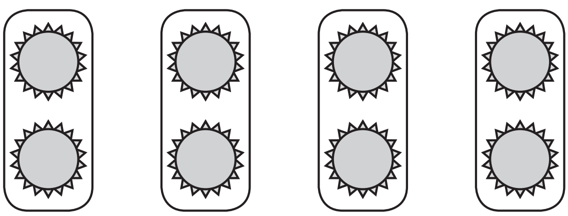
(d) A mother gave $\frac{1}{5}$ of her sugar cane to her daughter and $\frac{4}{5}$ of the sugar cane to her son. What fraction of the sugar cane did she gave to both?

4.6 Multiplication of Fractions by Whole Numbers

Activity 4.10

Get 8 bottle tops

Arrange them into four equal groups.



What is a quarter of eight bottle tops? Use your arrangement to get the quarter of 8.

Example 4.11

Find the value of $3 \times \frac{1}{4}$.

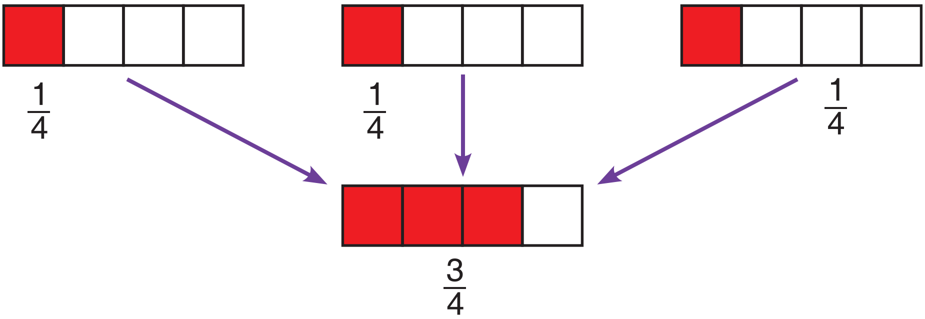
Solution

$3 \times \frac{1}{4}$ can also be written as $\frac{1}{4} \times 3$.

$3 \times \frac{1}{4} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$.

This is how we get the answer.

The box below is divided into four equal parts. The shaded part is $\frac{1}{4}$.



Example 4.12

What is the value of $3 \times \frac{1}{5}$?

Solution

$3 \times \frac{1}{5} = \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = \frac{(1+1+1)}{5} = \frac{3}{5}$. This method is called multiplication using repeated addition.

Example 4.13

Workout: $\frac{3}{8} \times 5$.

Solution

5 can be written as $\frac{5}{1}$. So, we multiply the numerators and denominators seperately as shown below:

$\frac{3}{8} \times 5 = \frac{3}{8} \times \frac{5}{1} = \frac{3 \times 5}{8} = \frac{15}{8}$.

Exercise 4.6

Multiply the following fractions by the given whole numbers:

(a) $\frac{8}{10} \times 5 =$ (b) $\frac{2}{3} \times 5 =$ (c) $\frac{3}{5} \times 10 =$ (d) $\frac{9}{10} \times 12 =$

(e) $\frac{1}{2} \times 2 =$ (f) $\frac{1}{2} \times 5 =$

4.7 Multiplication of Fractions by Fractions

Example 4.14

Multiply: $\frac{3}{7} \times \frac{4}{6}$

Solution

Multiply the numerators = 3 x 4 = 12

Multiply the denominators = 7 x 6 = 42. The answer is $\frac{12}{42}$

Reduce the fraction if necessary: $\frac{3}{7} \times \frac{4}{6} = \frac{\cancel{12}}{\cancel{42}} = \frac{6 \times 2}{6 \times 7} = \frac{2}{7}$

Example 4.15

Find $\frac{1}{2} \times \frac{1}{2}$

Solution

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

$\frac{3}{9}$

Example 4.16

Calculate $\frac{2}{3} \times \frac{3}{4}$

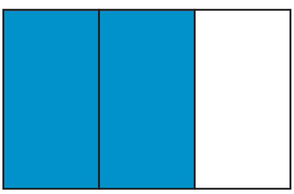
Solution

Two fractions can be multiplied together using a fraction grid.

(a) Draw a rectangle as shown below.

(b) Separate the rectangle into three equal parts using two vertical lines.

(c) Shade two of these parts. The shaded area (blue) represents the fraction $\frac{2}{3}$.



(d) Now divide the rectangle into four equal parts using three horizontal lines.

(e) Shade three of these parts to represent $\frac{3}{4}$.

(f) Now count the total number of parts in the rectangle. You will find 12 parts.

(g) Count the number of parts that have been double shaded. There are 6 out of 12 parts which are double shaded. (This is represented by the red parts)

(h) So, $\frac{2}{3} \times \frac{3}{4} = \frac{6}{12}$

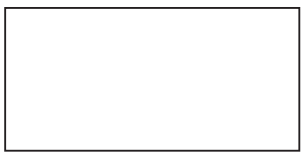
$\frac{6}{12}$ can be written as $\frac{1}{2}$ when simplified.

Example 4.17

Find the value of $\frac{2}{3} \times \frac{2}{5}$

Solution

Draw a rectangle as shown below.



Divide the rectangle into parts, shade to show the fractions $\frac{2}{3}$ and $\frac{2}{5}$. Count the number of parts that have been double shaded. We see that 4 out of 15 parts have been shaded.

So, $\frac{2}{3} \quad \times \quad \frac{2}{5} \quad = \quad \frac{4}{15}$

So since 4 parts are shaded twice, then the answer is $\frac{4}{15}$.

Exercise 4.7

Let us multiply the fractions below and reduce them to their simplest form:

(a) $\frac{1}{3} \times \frac{1}{4}$ (b) $\frac{2}{3} \times \frac{1}{3}$ (c) $\frac{4}{5} \times \frac{1}{7}$ (d) $\frac{2}{7} \times \frac{1}{5}$

(e) $\frac{3}{8} \times \frac{1}{2}$ (f) $\frac{2}{5} \times \frac{10}{11}$ (g) $\frac{3}{4} \times \frac{1}{6}$ (h) $\frac{8}{9} \times \frac{3}{5}$

(i) $\frac{7}{12} \times \frac{6}{7}$ (j) $\frac{2}{9} \times \frac{1}{3}$

4.8 Division of Fractions by Whole Numbers

To divide a fraction by a whole number:

Step 1: Multiply the denominator by the whole number.

Step 2: Simplify the fraction where necessary.

Example 4.18

$\frac{1}{2} \div 3$

Solution

Step 1: Multiply the bottom number of the fraction by the whole number:

$\frac{1}{2} \div 3 = \frac{1}{2 \times 3} = \frac{1}{6}$

Step 2: Fraction is already as simple as possible, so no need for step 2.

So, $\frac{1}{2} \div 3 = \frac{1}{6}$

Compare $\frac{1}{2}$ and $\frac{1}{6}$. Which one is smaller? $\frac{1}{6}$ is smaller than $\frac{1}{2}$.

So, when we divide a fraction by a whole number, the answer is smaller than the one we are dividing.

Exercise 4.8

Work out the following questions:

(a) $\frac{1}{6} \div 7$ (b) $\frac{2}{3} \div 7$ (c) $\frac{1}{6} \div 9$ (d) $\frac{4}{5} \div 2$

(e) $\frac{8}{9} \div 2$ (f) $\frac{1}{8} \div 5$ (g) $\frac{2}{3} \div 5$

Real Life Problems involving Fraction

Example 4.19

How many half litre bottles can be filled by a twenty litres jerrycan of water?

Solution

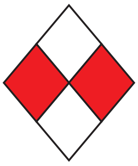
20 litres $\div \frac{1}{2}$ litre

$$\frac{20}{1} \div \frac{1}{2} = \frac{20}{1} \times \frac{2}{1} = 40 \text{ bottles}$$

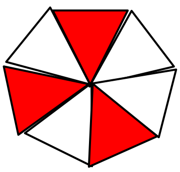
Assessment Exercise

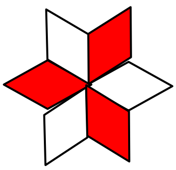
1. In the following diagrams, white parts are not shaded. The coloured parts are shaded. Count the shaded parts carefully and write down the fraction shown by the shaded part (s).

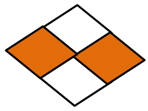
(i) 

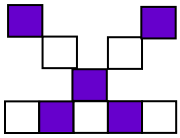
(ii) 

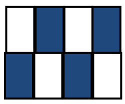
(iii) 

(iv) 

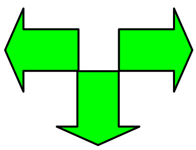
(v) 

(vi) 

(vii) 

(viii) 

(ix) 

(x) 

2. Given $\frac{21}{30}$, 30 is the __________ and 21 is the __________ .

3. Given $\frac{59}{60}$, 60 is the __________ and 59 is the __________ .

4. Arrange the fractions provided below in descending order (starting with the biggest to the smallest).

(a) $\frac{3}{8}, \frac{1}{8}, \frac{4}{8}$ (b) $\frac{2}{9}, \frac{4}{9}, \frac{5}{9}$ (c) $\frac{1}{12}, \frac{5}{12}, \frac{6}{12}$ (d) $\frac{3}{10}, \frac{7}{10}, \frac{5}{10}$

5. Add the following fractions:

   (a) $\frac{3}{10}+\frac{4}{10}$ (b) $\frac{1}{5}+\frac{3}{5}$ (c) $\frac{4}{9}+\frac{1}{9}$ (d) $\frac{22}{4}+\frac{18}{4}$

6. Subtract the following fractions:

   (a) $\frac{4}{5}-\frac{1}{5}$ (b) $\frac{4}{7}-\frac{3}{7}$ (c) $\frac{7}{15}-\frac{5}{15}$ (d) $\frac{125}{125}-\frac{120}{125}$

7. A day is made up of 24 hours. Jane spends $\frac{9}{24}$ of the day studying and $\frac{11}{24}$ of the day sleeping. What fraction of the day does he spend sleeping and studying altogether?

8. Manzi ate $\frac{1}{5}$ of a cake at breakfast and $\frac{3}{5}$ at lunch. What part of the cake did he eat?

9. Multiply the following fractions by the given whole numbers:

   (a) $\frac{5}{4}\times 3=$ (b) $\frac{1}{8}\times 3=$ (c) $\frac{1}{2}\times 9=$ (d) $\frac{1}{4}\times 8=$

10. What is $\frac{2}{5}$ of $\frac{4}{9}$?

11. Find the product of $\frac{13}{20}$ and $\frac{2}{3}$

12. Find the product of $\frac{13}{20}$ and $\frac{4}{5}$

13. Find $\frac{8}{9}$ of $\frac{3}{4}$

14. Work out: $\frac{4}{7}$ of 14

15. Multiply $\frac{9}{11}$ by $\frac{1}{3}$

16. Work out the following questions:

    (a) $\frac{3}{4}\div 28$ (b) $\frac{45}{100}\div 4$ (c) $\frac{65}{1000}\div 2\,000$

17. A mother has a cake. She decides to share it equally among her 5 children. What fraction does each child get?

18. Half of a pawpaw is shared equally by 2 people. What fraction of the pawpaw does each get?

19. In a class there are 30 students. Two-thirds of these are girls. How many girls are in the class?

20. A soccer stadium has 20 000 spectators. Half of the spectators are wearing red jerseys. How many spectators are wearing red jerseys?

21. Divide $\frac{9}{2}$ by 9.

22. My dad earns 250 000 Frw from the farm every month. He spends $\frac{1}{5}$ of this on food, $\frac{3}{5}$ on school fees and saves the rest.
    (a) How much money does he spend on food?
    (b) What fraction of his salary is saved?
    (c) How much does he save per month?
23. Ineza gave $\frac{3}{8}$ of her birthday cake to her brother and she kept $\frac{1}{8}$. Workout the part, how much more is given to his brother?
24. A plot of land in a certain town costs 100 000 Frw. Peter bought one-tenth of the plot. What amount of money did he pay for the plot?
25. In our school, a lesson lasts 40 minutes. We spend $\frac{1}{8}$ of the lesson revising the previous exercise. How long do we spend on revision per lesson?
26. A milk container can hold 15 litres of milk. The milk container falls so that one third of the milk pours out. How many litres of milk remains in the can?

Internet Resource

For more online support visit **www.math-play.com/fractions**

UNIT 5

Decimal Fractions/Numbers

Key unit competence

A learner should be able to add, subtract and compare decimal numbers using place values of decimals up to 2 decimal places.

Attitudes and values

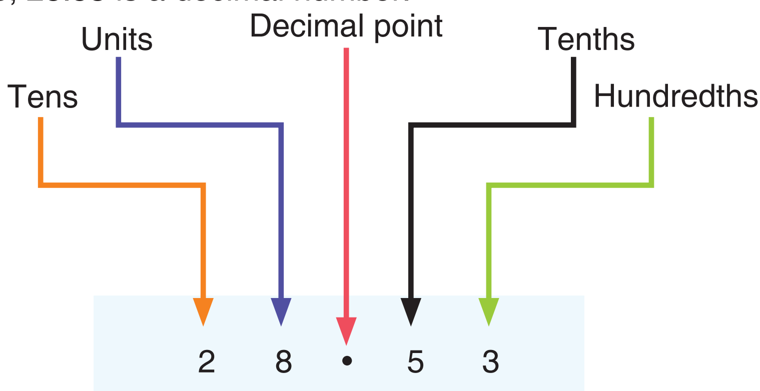
Develop personal confidence in the use of decimal numbers and appreciate the importance of decimal fractions in comparing and sharing.

5.1 The Concept of decimal number

A decimal number is any number which contains a decimal point.

A decimal number is a number which has a decimal part separated from the integer part using a decimal separator called the **decimal point**.

For example, 28.53 is a decimal number.



$$0.5 = 0 + \frac{5}{10},\ 0.03 = 0 + \frac{3}{100} \text{ and } 28.53 = 28 + \frac{53}{100}$$

Activity 5.1

i. Draw a horizontal line of about 12 cm on your notebook using a ruler and sharp pencil.

ii. Show the integers –4, –3, –2, –1, 0, +1, +2, +3 and +4 on the number line.

Activity 5.2

In this class activity, you will find some numbers:

(a) Divide the following numbers by 10:

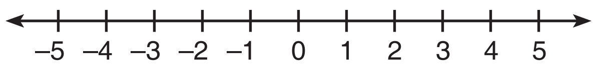
- 1400
- 140
- 14
- 1.4

(b) What number is exactly:

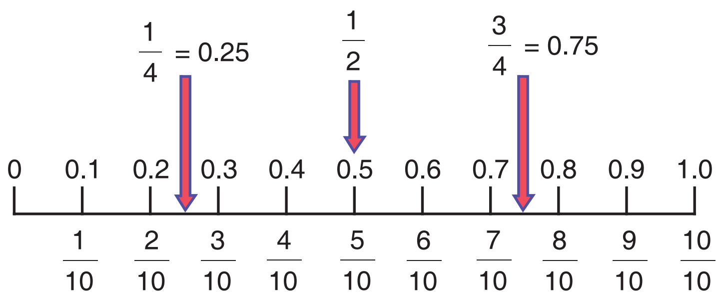
- between 0 and 100?
- between 0 and 10?
- between 0 and 1?

5.2 Decimals on a number line

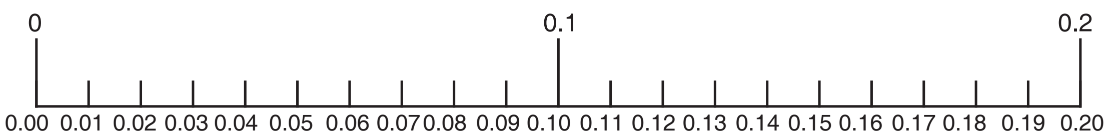
Consider the number line below. The number line shows negative and positive numbers from –5 to +5.



However, if we zoom into the space between 0 and 1, then we create new numbers which are not whole. The space between 0 and 1 is divided into 10 equal parts. The decimal numbers 0.1, 0.2, 0.3, 0.4, ... , 0.9 are produced. Decimals like 0.25 and 0.75 can easily be located as shown below.



By further zooming into the space between 0.1 and 0.2, we can form new decimal numbers as shown below.



Activity 5.3

In this class activity, you will divide the space between 2.0 and 3.0 into ten equal parts.

i. Draw a horizontal line of about 10 cm on your notebook using a ruler and sharp pencil.

ii. Mark the start of the line with the decimal number 2.0.

iii. Mark the end of the line with the decimal number 3.0.

iv. Mark the line drawn into 10 equal parts, each 1 cm long.

v. Show the decimal numbers 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 and 2.9 on the number line.

Activity 5.4

In this class activity, you will locate the positions of the given decimal numbers: 8.11, 8.16 and 8.19.

i. Draw a horizontal line in your notebook using a sharp pencil. Length of the line should be 10 cm.

ii. Mark the line at intervals of 1 cm so that the line has 10 equal parts.

iii. Write the decimal number 8.10 on the first mark and the decimal number 8.20 on the last mark.

iv. Carefully study the number line you have drawn and write the correct decimal numbers on the marks drawn.

v. Show the positions of the decimal numbers 8.11, 8.16 and 8.19.

vi. Present your work to the teacher for evaluation.

Exercise 5.1

Show the following on the number line:

(a) 0.6, 0.8, 0.3, 0.1

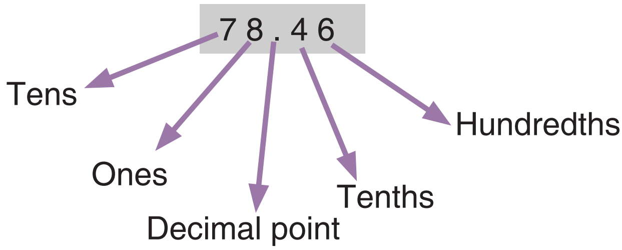
(b) 0.43, 0.48, 0.25, 0.15

(c) 0.3, 0.1, 0.5, 0.9, 0.2

(d) 0.51, 0.50, 0.48, 0.55

5.3 Place Value of decimals

Consider the decimal number 78.46



78.46 is read as **"seventy eight point four six"**.

It is wrong to say "seventy eight point forty six".

7 tens	=	7 x 10	=	7 0
8 ones	=	8 x 1	=	8
4 tenths	=	4 ÷ 10	=	0 . 4
6 hundredths	=	6 ÷ 100	=	0 . 0 6
		Total	=	7 8 . 4 6

We can see that the place value for 7 is 'tens', 8 is 'ones' or 'units', 4 is 'tenths', and 6 is 'hundredths'.

Value of 7 is $7 \times 10 = 70$

Value of 8 is $8 \times 1 = 8$

Value of 4 is $4 \times \frac{1}{10} = 0.4$

Value of 6 is $6 \times \frac{1}{100} = 0.06$

Activity 5.5

i. Let two pupils A and B stand to the right of a tree.
ii. Also, two pupils C and D should stand to the left of the tree.
iii. If we now consider the tree as a decimal point, let each pupil mention his/her place.

Example 5.1

Write the places of the underlined digits in the decimal numbers given below:

(a) $0.\underline{2}4$ (b) $\underline{5}.06$ (c) $\underline{1}3.56$

Solution

(a) Tenths (b) Ones (c) Tens

Exercise 5.2

1. Read the following decimal numbers and write them in words.
   (a) 87.09 (b) 12.2 (c) 0.03 (d) 23.56
   (e) 19.19 (f) 0.10 (g) 45.45
2. Write the following decimal numbers in figures:
   (a) One hundred forty-four point seven.
   (b) Twelve point one two.
   (c) Seven point seven.
   (d) Eighty point seven one.

5.4 Comparing decimals

When comparing decimal numbers, we may use =, < or >.

Example 5.2

Compare the decimal numbers 9.25 and 9.7.

Solution

1. Align the decimal points.
2. Fill in the empty place with zero.
3. Compare the digits from left to right until they are different.

9 . 2 5
9 . 7 0

Same Different

Since 2 < 7,
therefore, 9.25 < 9.7.

Example 5.3

Compare the two numbers: 452.78 and 452.21. Which one is greater?

Solution

Arrange the numbers in a table like this:

Hundreds	Tens	Ones		Tenths	Hundredths
4	5	2	.	7	8
4	5	2	.	2	1

The first three digits are the same in both decimal numbers. But in the tenths' column, 7 is greater than 2. So, 452.78 > 452.21.

Example 5.4

Arrange the following numbers in ascending order:
0.46, 0.64, 0.9, 0.09, 0.57, 0.75

Solution

- All these numbers begin with zero.
- Now we compare the second numbers.
- We can see that the smallest number is 0.09, followed by 0.46......
- 0.57 is smaller than 0.64.
- 0.75 is smaller than 0.9.

Therefore, Ascending order: 0.09, 0.46, 0.57, 0.64, 0.75, 0.9.

This can also be written as 0.09 < 0.46 < 0.57 < 0.64 < 0.75 < 0.9.

Example 5.5

Arrange the following numbers in descending order:

8.6, 7.66, 7.6, 0.76, 0.67, 0.86, 6.08.

Solution

Descending order: 8.6, 7.66, 7.6, 6.08, 0.86, 0.76, 0.67.

Alternatively, 8.6 > 7.66 > 7.6 > 6.08 > 0.86 > 0.76 > 0.67.

Exercise 5.3

1. Arrange the following decimal numbers from the smallest to the largest (Ascending order)
   (a) 3.5, 3.79, 3.42, 3.57, 3.7, 3.62.
   (b) 5.7, 5.64, 5.8, 5.4, 5.79, 5.72.
   (c) 5.0, 4.7, 4.8, 4.9, 4.3, 4.75
   (d) 1.02, 1.7, 1.12, 1.66, 1.71, 1.1
   (e) 3.1, 2.5, 2.49, 2.8, 3.48, 2.52
2. Arrange the following decimal numbers from the largest to the smallest (Descending order).
   (a) 8.1, 7.9, 7.92, 8.43, 7.89, 7.97
   (b) 6.8, 7.23, 7.32, 6.59, 6.92, 7.02
   (c) 2.01, 2.10, 2.63, 2.36, 1.4, 1.7
   (d) 3.8, 2.77, 2.75, 3.34, 2.9, 3.4
   (e) 6.4, 7.4, 4.7, 4.6, 4.06, 7.04

5.5 Addition and subtraction of decimal numbers

Adding decimal numbers works exactly the same way as adding whole numbers. You just line up the decimal points as shown below. For example,

Add 3.21 + 4.5

$$\begin{array}{r} 3.21 \\ +\,4.50 \\ \hline 7.71 \\ \hline \end{array}$$

$\longleftrightarrow$ add a zero (0) in this space.

Subtraction works well in the same way as subtracting whole numbers. For example, subtract 8.97 – 2.82

$$\begin{array}{r} 8.97 \\ -\,2.82 \\ \hline 6.15 \\ \hline \end{array}$$

$\longleftrightarrow$ align the decimal points.

Activity 5.6

In this class activity, you will find any two decimal numbers which add up to the given whole number:

(a) Find any 3 pairs of decimal numbers which add up to 10.
{e.g. 8.5 + 1.5, 5.5 + 4.5, and 3.55 + 6.45}

(b) Find any 3 pairs of decimal numbers which add up to 1.
{e.g. 0.25 + 0.75, 0.8 + 0.2 and 0.77 + 0.23}

Example 5.6

Add 528 + 7.49

Solution

We can write 528 as a decimal number by putting a decimal point after 8 and adding zeroes. So, 528 can be written as 528.00

$$\begin{array}{r} 528.00 \\ +\,7.49 \\ \hline 535.49 \\ \hline \end{array}$$

Example 5.7

Add the following decimal numbers:

(a) 206.1 + 223.9 (b) 404.1 + 247.4 (c) 665.2 + 567

(d) 435.7 + 65.1 (e) 299.72 + 0.08

Solution

(a) 206.1 + 223.9

$$\begin{array}{r} 206.1 \\ +\ 223.9 \\ \hline 430.0 \\ \hline \end{array}$$

(b) 404.1 + 247.4

$$\begin{array}{r} 404.1 \\ +\ 247.4 \\ \hline 651.5 \\ \hline \end{array}$$

(c) 665.2 + 567

$$\begin{array}{r} 665.2 \\ +\ 567.0 \\ \hline 1232.2 \\ \hline \end{array}$$

(d) 435.7 + 65.1

$$\begin{array}{r} 435.7 \\ +\ 65.1 \\ \hline 500.8 \\ \hline \end{array}$$

(e) 299.72 + 0.08

$$\begin{array}{r} 299.72 \\ +\ 0.08 \\ \hline 299.80 \\ \hline \end{array}$$

Example 5.8

Subtract: 3.8 – 1.26

Solution

3.8 – 1.26

$$\begin{array}{r} {\scriptstyle 7\ 10} \\ 3.80 \\ -\ 1.26 \\ \hline =2.54 \\ \hline \end{array}$$

zero is less than 6. So, we borrow 1 from 8 and proceed.

Exercise 5.4

Work out the following:

(a) 4.7 + 4.7	(b) 2.78 + 3.62	(c) 20.9 + 25.7
(d) 20.23 + 40	(e) 25.26 + 0.72	(f) 400.2 + 400
(g) 18.6 – 8.6	(h) 24.6 – 20.4	(i) 6.25 – 4.25
(j) 80.02 – 0.02	(k) 19.82 – 5.28	(l) 20.82 – 6.27
(m) 20.9 + 25.7	(n) 5.8 + 1.3	(o) 24.7 + 47.2

5.6 Real life problems involving decimals

Example 5.9

Ogolla ate 0.5 of his apple in the morning and 0.2 of it in the afternoon. How much of his apple did he ate altogether?

Solution

$$\begin{array}{r} 0.5 \\ +\ 0.2 \\ \hline 0.7 \\ \hline \end{array}$$

Therefore, he ate 0.7 of his apple.

Example 5.10

1. Opio bought 4 metres of cloth and used 2.3 metres for making shirts. Find the length of the remaining cloth.
2. Nankinga weighs 94.2 kg and his brother Hamidu, 87.5 kg.
   What is the difference between their weights?

Solution

1. Cloth bought by Opio ⟶ $\overset{3}{\cancel{4}}\,.\,\overset{10}{\cancel{0}}$ metres
   Cloth used in making shirts ⟶ $-\ 2\,.\,3$ metres
   Remaining cloth left with Opio ⟶ $1\,.\,7$ metres

$$\begin{array}{r} \overset{3}{\cancel{4}}\,.\,\overset{10}{\cancel{0}}\text{ metres} \\ -\ 2\,.\,3\text{ metres} \\ \hline 1\,.\,7\text{ metres} \\ \hline \end{array}$$

2. Weight of Nankinga ⟶ $\overset{8}{\cancel{9}}\,\overset{13}{\cancel{4}}\,.\,\overset{12}{\cancel{2}}$ kg
   Weight of Hamidu ⟶ $-\ 8\,7\,.\,5$ kg
   Difference between the weight of Nankinga and Hamidu ⟶ $6\,.\,7$ kg

$$\begin{array}{r} \overset{8}{\cancel{9}}\,\overset{13}{\cancel{4}}\,.\,\overset{12}{\cancel{2}}\text{ kg} \\ -\ 8\,7\,.\,5\text{ kg} \\ \hline 6\,.\,7\text{ kg} \\ \hline \end{array}$$

Assessment Exercise

1. Write the following decimal numbers in figures:
   (a) Three hundred ninety-nine point nine nine.
   (b) One thousand seventy point seven zero.
2. Compare the following decimal numbers by writing the symbols =, < or > in the box.

(a)	4.4	☐	0.44	(b)	5.65	☐	5.56
(c)	3.65	☐	3.56	(d)	6.78	☐	6.87
(e)	9.01	☐	9.01	(f)	4.28	☐	4.82
(g)	5.25	☐	5.25	(h)	9.05	☐	9.15
(i)	7.76	☐	7.67	(j)	2.58	☐	25.8
(k)	94.5	☐	9.45	(l)	8.83	☐	8.84
(m)	7.11	☐	7.18	(n)	5.14	☐	0.54
(o)	9.36	☐	9.36	(p)	0.74	☐	74.0
(q)	0.62	☐	6.21	(r)	1.19	☐	11.9
(s)	9.39	☐	3.99	(t)	3.66	☐	6.33

3. Work out the following:
   (a) 84.0 + 79.3 (b) 9.1 – 6.1 (c) 53.3 – 23.2
   (d) 92.7 – 20.7 (e) 8.9 – 0.9 (f) 689.6 – 609.8
   (g) 100.5 – 50.5

4. A boy walks 2.5 km to school and then 1.5 km to his friend's home. What is the total distance covered?
5. The masses of four children in our class are 34 kg, 43.4 kg, 36.3 kg and 38.2 kg. What is their total mass in kg?
6. A lesson starts at 8:30 a.m. and lasts for 50 minutes. At what time does it end?
7. The lengths of four rivers are 2.5 km, 4 km, 10.45 km and 0.95 km respectively. What is the total length of the four rivers? By how much is the longest river more than the shortest river?
8. In an athletics school race competition, the time taken to complete 100 m race is given below:

Name	Manzi	Deo	Gad	Karemera	John	Abdul
Time (seconds)	13.56	13.65	12.09	12.90	12.00	19.02

   (a) Who won the race? Explain why.
   (b) Who came last in the race? Explain why.
   (c) For how long did the first competitor wait for the last person to finish the race?
9. If x = 23.23 and y = 32.32, find the value of:
   (a) $x + x$
   (b) $x + y$
   (c) $y - x$.
10. By how much is 18.5 greater than 14.6?
11. I am 9 years old. My elder sister is 14.5 years old. My mother is 31.5 years older than me.
   (a) How old is my mother?
   (b) What is the total of all our ages?
12. My wrist watch displays time using figures. The time right now is shown as 8:15 a.m. What time will my watch show after 15 minutes from now?

UNIT 6

Length Measurements

Key unit competence

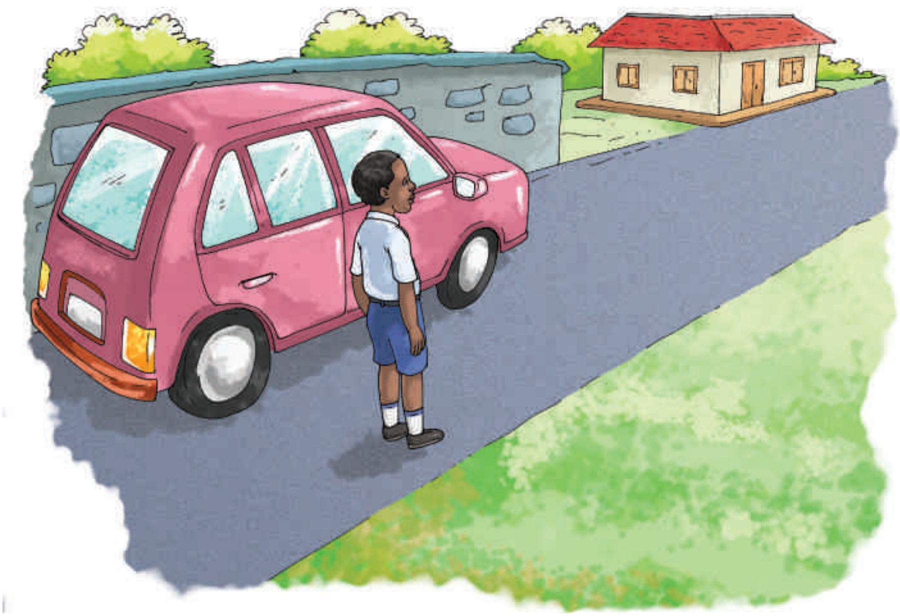
A learner should be able to know the meaning of length, conversion between units of length and apply them in solving mathematical problems related to daily life situations.

Attitudes and values

Learners should appreciate the importance of metric measures in daily life and recognise the importance of using, measuring tools correctly.

6.1 Meaning of length

Distance between two points is known as length.



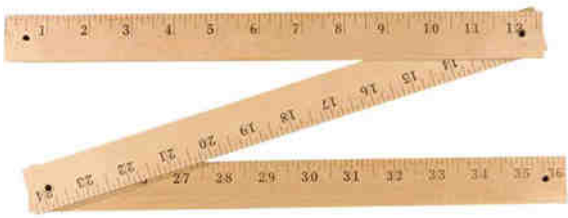
6.2 Instruments for Measuring Length

There are many instruments used for measuring length. These types of instruments are used depending on the size of the length to be measured. Some instruments used for measuring length/distances are shown below;

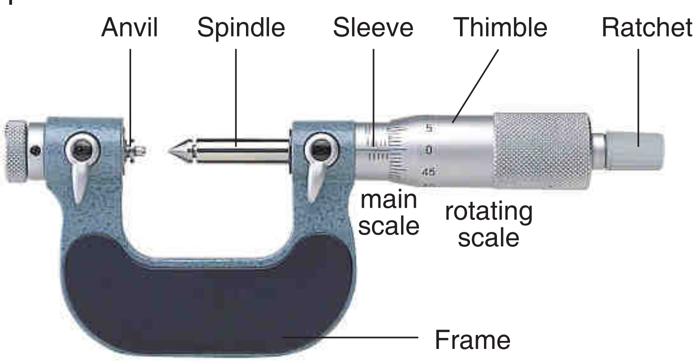
1. **Ruler:** It is used to measure short distances like length of a line in a book, length of a table, classroom, height of a door.

2. **Tape measure:** It is used for measuring longer distances like length of a field, height of a person, length of a cloth, etc.

3. **Yard stick:** It is a flat wooden board with markings at regular intervals. It is used for measuring small lengths.



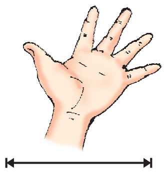
4. **Micrometer screw gauge:** It is used for measuring very small distances such as diameter of a pin or the thickness of a paper. A micrometer screw gauge appears like shown below:



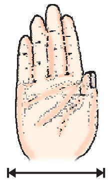
Other instruments used for measuring length are vernier calliper, Architect's scale, etc.

6.3 Units of Length

6.3.1 Non-standard Units

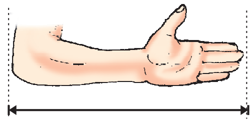


handspan

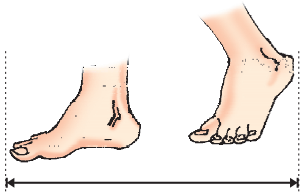


palm

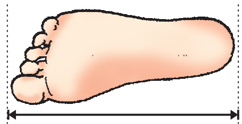
digit



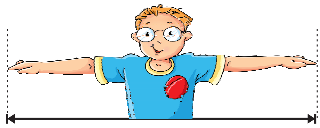
cubit



pace



foot span



arm span

We can measure the length using pace, handspan, foot span, cubit, etc. These units vary from persons to persons as they have different pace. This method is used by the same person to measure small distances.

For example, the length of a table is 6 hand spans, the length of a carpet is 8 foot spans.

Activity 6.1

- Stand straight up on the floor.
- Place the metre rule near your foot so that it is parallel to the side of your body.
- Mark a point on your body where the end of the metre rule touches.
- Now you have your own metre rule and be sure to tell the length of 1 metre.

- Cut the stick provided so that its length is 1m.
- How many times does your foot fit into a metre?
- You can now use your foot to measure the length of a classroom.

Activity 6.2

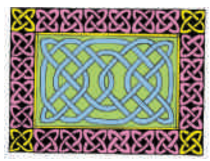
- Hold the metre rule as shown in the diagram. The zero mark of the metre rule must be at the tip of your finger.
- Mark a point on your arm/chest where the end of the metre rule touches.
- This is the length of 1m. Now you have your own metre rule.
- You can now use it to measure the length of your table.
- While at home, you can try to measure/estimate the height of a table, your brother, your sister, your parents/guardians, length of your bed.

Exercise 6.1

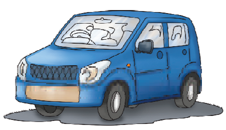
1. Check and write the lengths/heights of the following objects present in your home.

(a) 

_______ handspans

(b) 

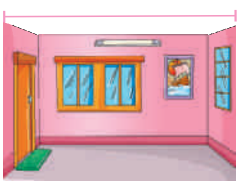
_______ foot spans

(c) 

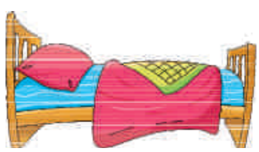
_______ paces

(d) 

_______ handspans

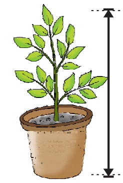
(e) 

_______ paces

(f) 

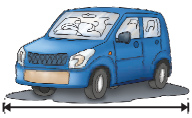
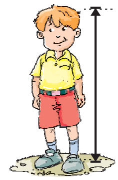
_______ foot spans

2. Check and write the length/height of the following.

Height of the plant is __________ handspans.

Length of the bicycle is __________ foot spans.

Height of your friend is __________ hand spans.

Length of the car is _________ pace.

6.3.2 Standard Units of Measuring Length

The standard unit for measuring length is **metre**. It is denoted by **'m'**.

The other units of length are the kilometre (km), hectometre (hm), decametre (dam), decimetre (dm), centimetre (cm) and millimetre (mm).

Metric-unit Prefixes

Metric prefixes are very useful in converting units of quantities. The main metric prefixes dealt with at this level are the kilo, hecto, deca, deci, centi and milli.

Prefix name	kilo	hecto	deca	Basic unit (one)	deci	centi	milli
Prefix symbol	k	h	da		d	c	m
Value	1000	100	10	1	0.1	0.01	0.001

Important mnemonic:

It is important to remember the order of the above prefixes:

Kigali Hotel Deserves One Delicious Chocolate Milk, where Kigali ⟶ kilo, Hotel ⟶ hecto, Deserves ⟶ deca, One ⟶ one (Unit), Delicious ⟶ deci, Chocolate ⟶ centi, and Milk ⟶ milli.

From the above table we can see that;

- One kilometre = 1 km = 1000 m.
- One hectometre = 1 hm = 100 m
- One decametre = 1 dam = 10 m
- One decimetre = 1 dm = 0.1 m (a tenth of a metre)
- One centimetre = 1 cm = 0.01 m = (hundredth part of a metre)
- One millimetre = 1 mm = 0.001 m = (a thousandth of a metre)

Activity 6.3

- Place the metre rule on your work table or desk.
- Identify the 0 cm and the 100 cm marks on the metre rule.
- Confirm that the metre rule is divided into 10 equal parts. How many decimetres make up a metre? {10 dm = 1 m}
- Look closely at 1 dm.You should be able to see that 1 dm is divided into 10 equal parts. Each part is a centimetre (cm). How many cm make up 1dm? {10 cm = 1 dm)
- Look closely at 1 cm. You should be able to see that 1 cm is divided into 10 equal parts. Each of these is called a millimetre (mm). How many mm make up a cm? {10 mm = 1 cm}.
- Now measure the length of your longest finger. Record your answer in dm, cm and mm.

Exercise 6.2

Estimate the length of the following in metres.

(a) length of a car.
(b) length of a bus.
(c) length/height of your handspan.
(d) length of your pace.

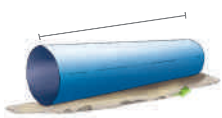
6.4 Estimation of Length

In this section, we will study to find the length of objects by observing them.

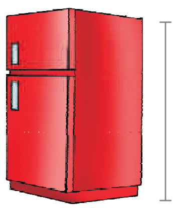
For example, the length of a notebook is about 12 cm, the length of a pencil is about 5 cm, etc.

Activity 6.4

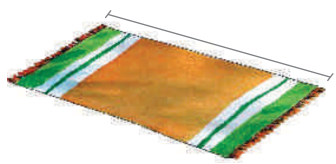
Estimate the length of the following in metres.

(a) 

Length = _______ m

(b) 

Height = _______ m

(c) 

Length = _________ m

Exercise 6.3

Since we have practically seen the length of a mm, cm, dm, m, dam, hm and km, it is now time to see how well you can estimate length.

Estimate the following lengths:

(a) Length of your foot (in cm).
(b) Length of your classroom (in m).
(c) Length of your pencil in mm (or cm).
(d) Width of your exercise book (in cm).
(e) Length of your table (in dm).
(f) Height of your best friend in class (in cm or m).

6.5 Conversion of Units

When converting from one unit of length to another, we can easily use a conversion table.

Conversion table for length

km	hm	dam	m	dm	cm	mm
kilometre	hectometre	decametre	metre	decimetre	centimetre	millimetre
1	0	0	0	0	0	0
			1	0	0	0

From the conversion table, you can see that;

- 1 km = 10 hm, 1 km = 100 dam, 1 km = 1000 m
- 1 m = 10 dm, 1 m = 100 cm, 1 m = 1000 mm,
- 1 hm = 0.1 km, 1 dam = 0.01 km, 1 m = 0.001 km
- 1 dm = 0.1 m, 1 cm = 0.01 m, 1 mm = 0.001 m.

Example 6.1

Convert the following units of length:

(a) 2 km to m (b) 2 km to hm (c) 10 cm to mm
(d) 3 dam to m (e) 40 m to mm (f) 50 dm to cm

Solution

(a) Use the conversion table

km	hm	dam	m
2	0	0	0

So, 2 km = 2 x 1 000 m = 2 000 m

(b) Use the conversion table

km	hm
2	0

So, 2 km = 2 x 10 hm = 20 hm

(c) Use the conversion table

dm	cm	mm
1	0	0

So, 10 cm = 10 x 10 mm = 100 mm

(d) Use the conversion table

dam	m
3	0

So, 3 dam = 30 m

(e) Use the conversion table

dam	m	dm	cm	mm
4	0	0	0	0

So, 40 m = 40 000 mm

(f) Use the conversion table

m	dm	cm	mm
5	0	0	

So, 50 dm = 50 x 10 = 500 cm

Example 6.2

Convert the following units of length:

(a) 2 000 m to km
(b) 30 000 mm to m
(c) 15 000 cm to m
(d) 200 dam to hm

Solution

(a) Use the conversion table:

km	hm	dam	m	dm	cm	mm
2	0	0	0			
	1	5	0			
		3	0	0	0	0
2	0	0				

(a) 2 000 m = 2 km
(c) 15 000 cm = 150 m
(b) 30 000 mm = 30 m
(d) 200 dam = 20 hm

Exercise 6.4

1. Complete the following:
   (a) 40 km = ... m
   (b) 350 cm = ... mm
   (c) 3 hm = ... m
   (d) 40 cm = ... dm
   (e) 1 m = ... mm
   (f) 2 900 mm = ... cm
   (g) 3 000 000 mm = ... m
   (h) 5 000 m = ... dam
2. Use the conversion table to convert the following units of length as instructed:
   (a) 2 m = ... cm
   (b) 3 km = ... dam
   (c) 2.5 m = ... cm
   (d) 46 cm = ... mm
   (e) 2 000 m = ... km
   (f) 50 mm = ... cm
   (g) 4500 dm = ... dam.

6.6 Addition and Subtraction of Length

The process of addition or subtraction of length is exactly similar to the addition or subtraction of ordinary numbers.

Example 6.3

Add the following:

(a) 3 km + 200 m = ... m

(b) 50 hm + 40 dm = ... dm

(c) 16 m + 14 dm = ... m

(d) 76 hm + 4 km = ... m

Solution

(a) Use the conversion table

	km	hm	dam	m
	3	0	0	0
		2	0	0
+	3	2	0	0

3 km + 200 m = 3 000 m + 200 m = 3 200 m

(b)

	km	hm	dam	m	dm
	5	0	0	0	0
+				4	0
	5	0	0	4	0

50 hm + 40 dm = 50 000 dm + 40 dm = 50 040 dm

(c

	dam	m	dm
		1	4
+	1	6	
	1	7	4

16 m + 14 dm = 16 m + 1.4 m = 17.4m = 174 dm

(d) 76 hm + 4 km = 7 600 m + 4 000 m = 11 600 m

Example 6.4

Subtract: 1) 226 cm – 105 cm

2) 3 m 15 cm – 1 m 35 cm

3) 125.2 mm – 87.6 mm

Solution

1. 226 cm – 105 cm = 121 cm

2. 3 m 15 cm $= 3 \times 100$ cm + 15 cm

= 300 cm + 15 cm

= 315 cm

1 m 35 cm = 100 cm + 35 cm

= 135 cm

Therefore, 315 cm – 135 cm = 180 cm

3. Follow steps as we follow in decimal subtraction.

$$
\begin{array}{rrrrrl}
 & 11 & 14 & & 12 & \\
1 & 2 & 5 & . & 2 & \text{mm} \\
- & 8 & 7 & . & 6 & \text{mm} \\
\hline
 & 3 & 7 & . & 6 & \text{mm} \\
\hline
\end{array}
$$

Exercise 6.5

Workout the following:

(a) 30 km + 4 000 m = ... m

(b) 3 600 m + 44 hm = ... km

(c) 65 hm – 25 dam = ... m

(d) 30 km – 4 000 m = ... hm

(e) 40 hm – 200 dam = ... dm

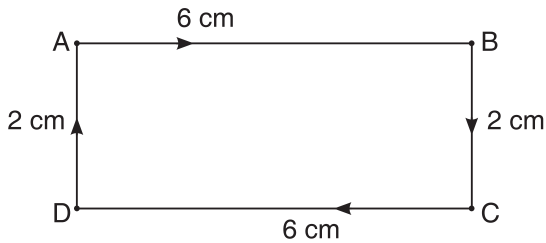
(f) 500 m + 28 000 dm = ... cm

6.7 The Perimeter

The perimeter of a closed figure is the distance around the figure. Since the standard unit of distance or length is the metre (m), then the unit of perimeter is the metre. However, perimeter can also be expressed in km, hm, dam, dm, cm or mm.

Example 6.5

The diagram below shows a piece of paper. Length AB = 6 cm, length BC = 2 cm, length CD = 6 cm and length DA = 2 cm. Calculate the distance all round the piece of paper.

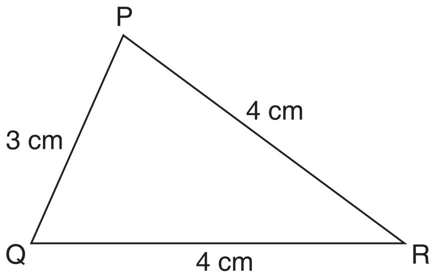


Solution

Perimeter = length of (AB + BC + CD + DA)
= 6 cm + 2 cm + 6 cm + 2 cm
= 16 cm.

Example 6.6

The diagram below shows an isosceles piece of cake PQR. The lengths of the sides of the cakes are shown on the diagram. What is the distance all round the figure PQR?

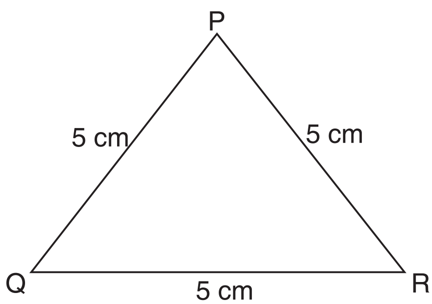


Solution

Perimeter = Distance around PQR = PQ + QR + RP = (3 cm + 4 cm + 4 cm)
= 11 cm.

Example 6.7

The diagram below shows a birthday card for my younger sister Cathy. The length of each side of the card is 5cm. What is the total distance all round the card?

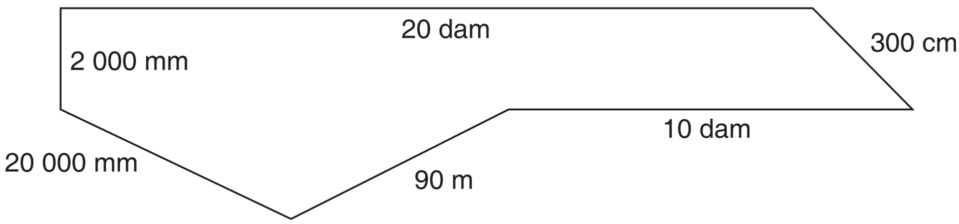


Solution

Perimeter = Length of (PQ + QR + PR)
= 5 cm + 5 cm + 5 cm
= 15 cm

Example 6.8

What is the total distance around this plot of land? Express your final answer in metres.



Solution

The sides are given in different units. We need to convert all units to metres using the conversion table.

km	hm	dam	m	dm	cm	mm
			2	0	0	0
	2	0	0			
			3	0	0	
	1	0	0			
		2	0	0	0	0

From the conversion table

2 000 mm = 2 m

20 dam = 200 m

300 cm = 3 m

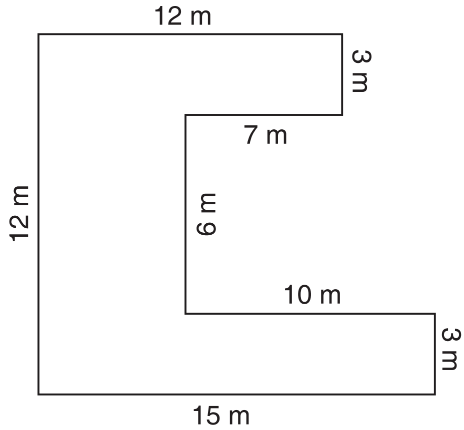
10 dam = 100 m

20 000 mm = 20 m

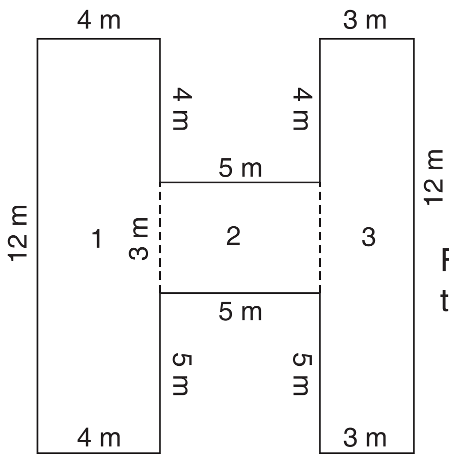
So the required distance = 2 m + 200 m + 3 m + 100 m + 20 m + 90 m = 415 m

Exercise 6.6

1. Calculate the perimeter of the figure shown below.



2. The figure below shows a composite shape. It is formed by joining rectangular shapes 1, 2 and 3.



Find the perimeter of the composite shape.

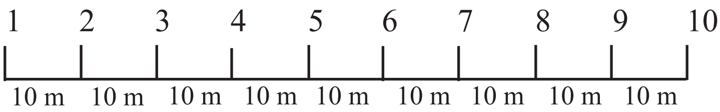
6.8 Application of Length

Sometimes, you find situations where you need to apply length in order to solve them. Study the following examples.

Example 6.9

Trees are planted at an intervals of 10 m. If ten trees are planted, find the distance from the first to the last tree.

Solution



First find the number of spaces

Number of spaces = Total number of trees – one tree = 10 – 1

= 9 spaces

1 space = 10 m

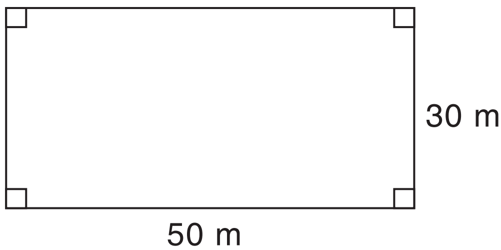
9 spaces = (10 × 9) m = 90 m

The distance is 90 metres.

Example 6.10

A rectangular garden 50 m by 30 m is to be fenced with poles placed at an interval of 5 m. Find the amount of money required to fence the garden at 3 000 Frw per pole.

Solution



Number of poles;

Along the length $= \dfrac{50}{5} =$ 10 poles

Along the width $= \dfrac{30}{5} =$ 6 poles

Total number of poles = (10 + 6) × 2 = 16 × 2 = 32 poles

Cost of 1 pole = 3 000 Frw

Cost of 32 poles = 32 × 3 000 Frw

= 96 000 Frw

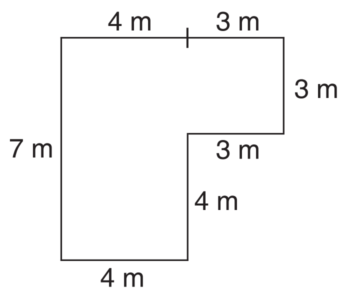
Note: Number of poles around a circular garden $= \dfrac{\text{Circumference}}{\text{Interval}}$

Activity 6.5

Eleven bundles of wires, each of 125 cm long were needed from Kabuye's house to the electric pole. How far was Kabuye's house from the electric pole?

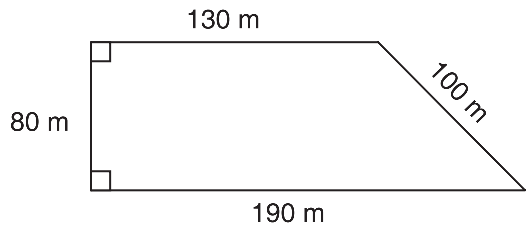
Assessment Exercise

1. Estimate the following lengths:
   (a) Height of your teacher (in m).
   (b) Length of your football field at school (in m).
   (c) Height of the tallest tree at your school (in m).
   (d) Length of your handspan (in cm).
2. Workout the following:
   (a) 1 100 mm + 1 100 cm = ... cm
   (b) 800 hm + 5 000 dam = ... km
   (c) 1 km + 1 hm + 1 dam + 1 m + 1 dm + 1 cm + 1 mm = ... mm
3. Find the perimeter of the shape shown in the diagram below:



4. Electric poles are fixed at intervals of 50 m apart. If 101 poles are fixed, find the distance from the first pole to the last pole.
5. How many poles are required to make a circular fence of 45 m if the poles are 5 m apart?
6. Othieno has to fence his rectangular garden of 45 m by 30 m.
   (a) Find the number of poles he will require if the poles are 5 m apart?
   (b) If each pole costs 4 500 Frw, how much does he require to buy the poles?
7. Find the number of trees required to plant around a circular pond of length 28 m at intervals of 4 m apart.

8. Luzige's land is in a shape of trapezium as shown:



He intends to fence it with poles 5 m apart. How many poles does he require?

9. Workout:

(a) 1.25 cm + 7.75 cm

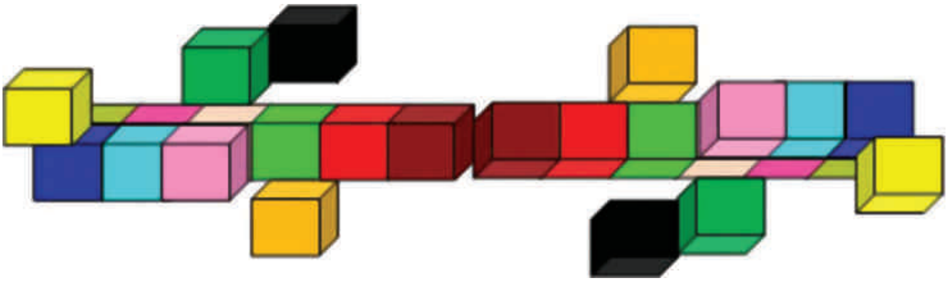
(b) 9.75 dm + 2.45 dm

Internet Resource

For more online support visit **www.kidsnumbers.com**

UNIT 7

Capacity Measurements



Key Unit Competence

A learner should be able to understand capacity, convert between units of capacity and apply them in solving mathematical problems related to daily life situations.

Attitudes and values

- Show an ability to properly use a range of materials to measure different liquids in daily life.
- Being honest and trustworthy when measuring different capacities.
- Being able to show respect for one another when working in groups.

7.1 Understanding Capacity

In our daily conversation, we usually make statements like:

- This is a small plane and that is a big plane.

- My cup is small but Dad's cup is big.

- An orange is smaller than a pineapple.

- A lion is smaller than an elephant.

All the above statements compares the volume or capacity of one object with another.

Volume is the space occupied by a given object.

Capacity, on the other hand, is the amount of liquid or solid an object can hold.

Activity 7.1

Collect empty containers and compare their capacities by filling water or any other liquid.

Exercise 7.1

Which has more capacity/volume?

1.

Cup

Glass

2.

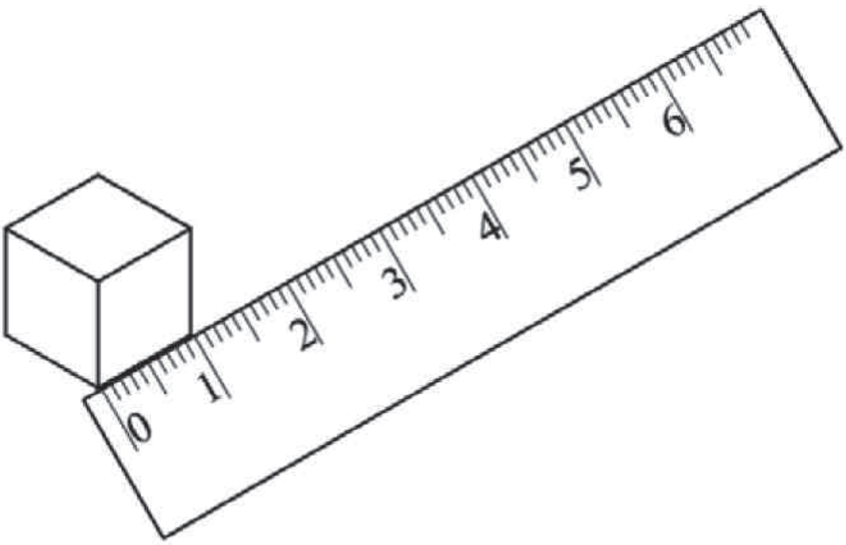
Jug

Can

7.2 Units of volume

Consider a container in the form of a cube as shown in the diagram below. Each side of the container is of length 1 cm.

Capacity of the container = length × width × height = 1 cm × 1 cm × 1 cm = 1 cm^3.



Activity 7.2

(a) Measure the length (l), width (w), and height (h) of the matchbox provided. Record your results in millimetres (mm).

(b) Calculate the volume of one matchbox using the formula;

$$V = l \times w \times h.$$

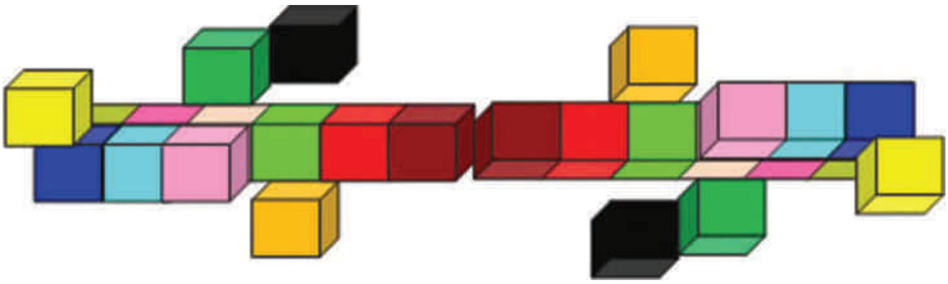
(c) Pile the matchboxes so as to form a big cuboid of matchboxes.

(d) What is the volume of the big box you have formed?

(e) Can you design other different big boxes using the same matchboxes?

Exercise 7.2

1. The figure below shows several small cubes of different colours joined together. Each small cube has a volume of 1 cm^3.

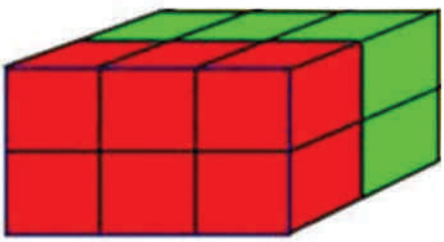


   (a) How many small cubes are there altogether?

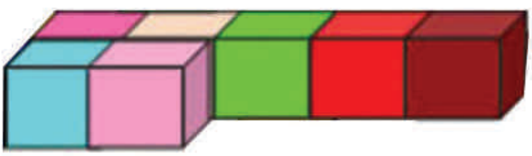
   (b) What is the total volume of all the cubes?

2. Find the volume of the solids if each cube has a volume of 1 m^3.

(a)



(b)



7.3 Estimating capacities of different containers

Activity 7.3

In this class activity, you are going to discuss the statements given with your classmates. State whether you agree or not. You may experiment (if possible) in your classroom.

(a) The capacity of a tea spoon is about 5 ml or 5 cm^3. The capacity of an ordinary glass for drinking water is about 300 ml or 300 cm^3 or 0.3 litre.

(b) The capacity of a mug is about 0.5 litre. The capacity of a water jug is about 2 litres.

Mug

Jug

(c) The capacity of a small jerrycan is about 5 litres. The capacity of a big jerrycan is about 20 litres.

5 litres

20 litres

(d) A large water tank has a capacity of about 1 000 litres.

Exercise 7.3

Estimate the capacities of the following containers:

A measuring cylinder

A feeding bottle

An ordinary bottle

A measuring jug

A milk can

Think!!!

What is full of holes and yet it holds lots of water?

7.4 Conversion of units for capacity

Conversion table for capacity

kl	hl	dal	l	dl	cl	ml
1	0	0	0			
	1	0	0			
		1	0			
			1	0		
			1	0	0	
			1	0	0	0

We can see that,

1kilolitre = 1 kl = 1 000 l

One hectolitre = 1 hl = 100 l

One decalitre = 1 dal = 10 l

One litre = 1 l = 10 dl

One decilitre = 1 dl = 0.1 l (a tenth of a litre)

One centilitre = 1 cl = 0.01 l (a hundredth of a litre), e.t.c.

Example 7.1

Change the following units of capacity as instructed below:

(a) 20 l to ml (b) 200 l to hl (c) 20 kl to l

(d) 50 kl to dal (e) 100 dl to ml (f) 35 hl to dal

(g) 7 800 cl to l (h) 60 000 ml to l

Solution

We construct a conversion table to enable us convert these units.

kl	hl	dal	l	dl	cl	ml
			1	0	0	0
1	0	0	0			

(a) 20 l = 20 000 ml (b) 200 l = 2 hl (c) 20 kl = 20 000 l

(d) 50 kl = 5 000 dal (e) 100 dl = 10 000 ml (f) 35 hl = 350 dal

(g) 7 800 cl = 78 l (h) 60 000 ml = 60 l

Activity 7.4

A cow produced milk as follows;

Monday - 2 litres

Tuesday - 5 litres

Wednesday - 3 litres

How much milk did it produce in three days? Write answer in ml.

Exercise 7.4

Express the following in millilitres:

(a) 3 litres (b) 5 litres (c) $2\frac{1}{2}$ litres

(d) $1\frac{1}{5}$ litres (e) 4.5 litres (f) 7.5 litres

7.5 Addition and Subtraction of Capacity

Activity 7.5

In groups, do the following:

- Measure the capacity of water in a jug.
- Change this into litres.
- Now, measure the capacity of a bucket by pouring water using 1 litre bottles.
- Compare the capacities. Which has more water? Obtain the total volume of water in litre.

Example 7.2

(a) Add: 900 decalitres + 400 litres

(b) Subtract: 24 litres – 2 400 centilitres

Solution

(a) +

kl	hl	dal	l	dl
9	0	0	0	
	4	0	0	
9	4	0	0	

900 dal + 400 l = 9 000 l + 400 l = 9 400 l

(b)

kl	hl	dal	l	dl	cl	ml
		2	4	0	0	
-		2	4	0	0	
		0	0	0	0	

24 l – 2 400 cl = 2 400 cl – 2 400 cl = 0.

Example 7.3

(a) 7.50 l + 3.50 l

(b) 6.30 l – 2.30 l

Solution

(a) 7.50 l + 3.50 l

$$\begin{array}{r} 7.50\ \text{l} \\ +\ 3.50\ \text{l} \\ \hline 11.00\ \text{l} \\ \hline \end{array}$$

(b) 6.30 l – 2.30 l

$$\begin{array}{r} 6.30\ \text{l} \\ -\ 2.30\ \text{l} \\ \hline 4.00\ \text{l} \\ \hline \end{array}$$

7.6 Application of Capacity

Example 7.4

1. A bottle of mineral water has a capacity of 300 ml. How many bottles of mineral water do I need to make 3 litres?
2. Mutoni sells 11 cans of milk to a milk depot every week. If each can of milk has a capacity of 20 litres, how much milk does she sell per month?

Solution

1. 3 l = 1 000 × 3 = 3 000 ml. Since 3 l = 3 000 ml, therefore, the number of mineral water bottles is given by:

   3000 ml ÷ 300 ml = 10
2. Number of cans sold per week = 11

   Number of cans sold per month = 11 × 4 = 44 cans (1 month = 4 weeks)

   Quantity of milk sold in 1 month = 44 × 20 litres = 880 litres.

Activity 7.6

Study the following figure and answer the given questions:

1. Find how much water should be added so as to fill up the tank fully.
2. How much water was there earlier in the tank. (Dimensions shown in figure are in centimetres)

Assessment Exercise

1. Add: (a) 3 l 500 ml + 5 l 700 ml (b) 3.25 l + 6.75 l
2. Subtract: (a) 5 l 400 ml – 3 l 250 ml (b) 10.5 l – 2.75 l
3. A restaurant sells 200 l of milk every day. How much milk is sold in 3 months? (assume 1 month = 30 days).
4. A school water tank contains 12 000 l of water. Pupils in the school used 40 hectolitres of water. What amount of water is remaining?
5. The capacity of a milk jug is 750 ml. By how much is this less than a litre?
6. The cost of milk is 150 Frw per mug (cup). Two such cups make up one litre of milk. How much will a person spend on 4 litres of milk?
7. On average, each pupil takes 1.5 litres of milk in our school. How much milk is taken by 100 pupils?
8. A Friesian cow in a certain farm produces 15 litres of milk in the morning and 10 litres of milk in the evening. How much milk does it produce in a week?

9. The price of petrol is 900 Frw per litre. A school bus requires 100 litres of petrol for a school trip. How much is spent on petrol?

Internet Resource

For more online support visit **www.math-play.com/capacity**

UNIT 8

Mass Measurements

Key unit competence

By the end of this unit, a learner should be able to convert between units of mass and apply them in solving mathematical problems related to daily life situations.

Attitudes and values

Appreciate the importance of mass measurement in daily life, show respect for one another, and appreciate difference in opinion while working with other people and show fairness while measuring mass.

8.1 Estimating Mass

In this section, you will study to estimate the mass of an object by observing it only.

Activity 8.1

- You will be provided with a stone of mass 500 g (0.5 kg) and another stone of mass 1 kg. Other alternative masses may be provided.
- Feel the mass of 500 g by holding the stone in your hand.
- Feel the mass of 1 kg by holding the stone in your hand.

- You should repeat the experiment a number of times because this will help you estimate masses of different objects.
- With the help of your teacher, measure the mass of a pen, small stone, a small exercise book, your shoes and a bottle top.

Activity 8.2

- With the help of your teacher, measure and record your mass in your exercise book.
- Compare your mass with the masses of your classmates.
- Record the least and the highest mass in the class.
- Use your imagination to estimate the mass of the teacher.
- Ask the teacher to tell the whole class his/her mass after all pupils have given their estimates.

Think!!!

A butcher at a butchery in Kigali City sells meat. He is 2 m tall, very fat and he puts on the biggest shoe size on market. What does he weigh?

Exercise 8.1

Estimate the mass of the following objects:

(a) mass of a bottle of soda.
(b) mass of a pawpaw fruit.
(c) mass of a goat.
(d) mass of a bull.
(e) mass of a small car.
(f) mass of a lorry.
(g) mass of a knife.
(h) mass of a mango leaf.
(i) mass of a 10 year old pupil.
(j) mass of 10 sheets of paper.

8.2 Measuring of Mass

Activity 8.3

Which unit would you use to measure the mass of the following? A kilogram or a gram?

(a) a tomato
(b) an egg
(c) a radio
(d) a baby
(e) an exercise book
(f) a school boy
(g) a chair
(h) an elephant
(i) a mathematical set

Mass is the quantity of matter contained in a substance. The more the matter, the greater the mass. A house brick and a piece of cotton of the same size have different masses. A house brick has more mass because it has more quantity of matter than the cotton.

1 litre of mineral water

1 kg of sugar

The standard unit for measuring and expressing mass is **kilogram.** The kilogram is represented by 'kg'.

However, mass can also be expressed in **ton,** denoted by 't' where,

1 ton = 1 000 kg.

Instruments for measuring mass

The following instruments can be used to measure mass:

Top pan balance, beam balance, triple beam balance, electronic balance, etc.

Top pan balance

Triple beam balance

Electronic balance

Beam balance

Exercise 8.2

Which units would you use to measure the following objects:

(a) mass of a pencil.
(b) mass of a ball.
(c) mass of a cycle.
(d) mass of a TV.

8.3 Conversion between units of Mass

Metric prefixes are very useful in converting units of quantities. The main metric prefixes dealt with at this level are the kilo, hecto, deca, deci, centi and milli.

kg	hg	dag	g	dg	cg	mg
1	0	0	0			
			1	0	0	0

From the above table we can see that;

- One kilogram = 1kg = 1000g.
- One hectogram = 1hg = 100g
- One decagram = 1 dag = 10g
- One decigram = 1 dg = 0.1g (a tenth of a gram)
- One centigram = 1cg = 0.01g = (hundredth part of a gram)
- One milligram = 1mg = 0.001g = (a thousandth of a gram)

Note:

The tonne is equal to one thousand kilograms.

1 tonne (1t) = 1 000kg

t	q	---------	kg
1	0	0	0
	1	0	0

1q = 100kg.

Read the following units of mass aloud:

(a) 20 t
(b) 250 kg
(c) 400 hg
(d) 680 dag
(e) 500 g
(f) 230 dg
(g) 100 cg
(h) 570 mg
(i) 45 cg

Example 8.1

Convert the following units of mass:

(a) 2 kg to g.
(b) 2 kg to hg.
(c) 10 kg to g.
(d) 3 dag to g.
(e) 40 g to mg.
(f) 50 dg to cg.

Solution

Conversion table

kg	hg	dag	g	dg	cg	mg
1	0	0	0			
			1	0	0	0

(a) 2kg = 2 000g
(b) 2kg = 20hg
(c) 10kg = 10 000 000mg
(d) 3 dag = 30g
(e) 40g = 40 000mg
(f) 50dg = 500cg

Example 8.2

Convert the following units of mass:

(a) 2 000 g to kg.
(b) 30 000 g to kg.
(c) 15 000 cg to g.
(d) 200 dag to hg.

Solution

kg	hg	dag	g	dg	cg	mg
2	0	0	0			
			1	0	0	
	1	5	0	0	0	

(a) 2000g = 2kg
(b) 30 000g = 30kg
(c) 15 000cg = 150g
(d) 200dag = 20hg

Exercise 8.3

1. Convert the following into grams.
   (a) 24 kg (b) 8 kg (c) 15 kg (d) 12 kg (e) 1.5 kg
   (f) 321 kg (g) 2.8 kg
2. Express the following in kilograms.
   (a) 15 000 g (b) 2 400 g (c) 7 000 g (d) 500 g
   (e) 912 g (f) 1 500 g

8.4 Addition and Subtraction of Masses

Example 8.3

(a) Add: 4kg + 3hg = ...kg
(b) Subtract: 29dg – 2.4cg = ...cg

(c) Subtract: 10t – 9 600kg = ...kg

Solution

T	q	-----	kg	hg	dag	g	dg	cg	mg
			1	0					
							1	0	
1	0	0	0						

(a) 4kg + 3hg = 4kg + 0.3kg = 4.3kg

(b) 29dg – 2.4cg = 290cg – 2.4cg = 287.6cg

(c) 10t – 9 600kg = 10 000kg – 9 600kg = 400kg

Exercise 8.4

(a) **Add:** 3.25 kg and 1.75 kg and express the answer in grams.

(b) **Subtract:** 5.25 kg from 25.65 kg and write answer in grams.

8.5 Application of Mass

In this section, we discuss the problems involving mass in real life situations.

Example 8.4

A school bought shields and cups for winners and runners-ups. There were 2 shields for the overall champions. If the weight of the smaller shield is 2 kg 120 g and bigger shield is 2 kg 865 g, then what is the difference in their masses.

Solution

The weight of the bigger shield = 2 kg 865 g = 2 865 g

The weight of the smaller shield = 2 kg 120 g = 2 120 g

∴ Difference in weight = 2 865 g – 2 120 g = 745 g

Assessment Exercise

1. Convert the following into grams.

   (a) 285 kg (b) 19 kg (c) 2.5 kg (d) 196 kg.

2. Convert the following into kilograms.

   (a) 2126 g (b) 9065 g (c) 850 g

3. There are 20 tins of biscuits in a shop. Each tin weighs 2 kg 500 g. What is the weight of all the tins in kg?

4. A car weighs 3 tons. Express this mass in kg.

5. An omnibus (taxi) is licensed to carry passengers with total mass not exceeding 1 140 kg. If 20 people each of mass 60 kg board the omnibus, find whether the omnibus is overloaded.
6. A truck carries 200 bags of cement. The total weight of all the bags in the truck is 10 tons. What is the mass of only 1 bag of cement?
7. Each book in a certain bookshop has a mass of 20 dg. How many of these books do I need to have 1 ton of books?
8. Yesterday, I bought 4 kg of mangoes and ate 2 000 g. How many grams of mangoes are left?

9. The mass of 1 chocolate bar is 100 g. What is the mass of 30 chocolate bars in kg?
10. The mass of 1 toy car is 600 g. What is the total mass of 60 toy cars?

11. Ms Annet packed 24 kg of sugar equally into 8 bags. How many grams of sugar did she pack in each bag?
12. Peter has a mass of 82 kg. John is 5 kg heavier than Peter. What is the mass of John?
13. John weighs 80 kg, Peter weighs 70 kg and Eric weighs 90 kg. How much do the three people weigh altogether?

Internet Resource

For more online support visit **www.kidsnumbers.com**

UNIT 9

Area and Land Measurements

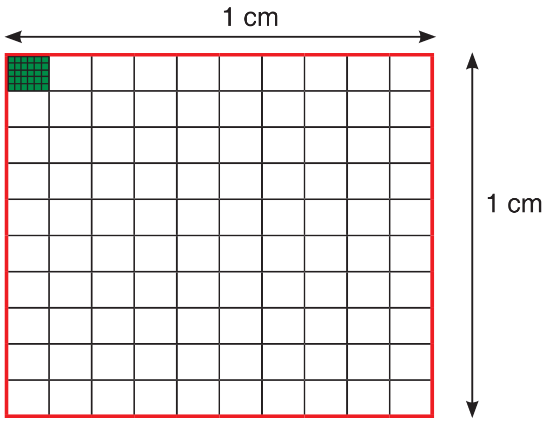
Key unit competence

By the end of this unit, a learner should be able to understand area as a two dimensional (2D) space enclosed by a boundary. The learner should also use square and land units in solving mathematical problems.

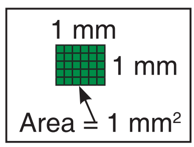
Attitudes and values

Appreciate the need to properly and accurately use different area and land measurements in daily life situations.

9.1 Understanding Area



Area = 1 cm^2.



In the preceding figure, the shaded part (green) is a square of length 1 mm and width 1 mm. The area of this part is 1 mm × 1 mm = 1 mm^2.

Now, consider the big square (red). There are 10 small squares along its length and 10 squares along its width.

So, the area of the big square = 10 mm × 10 mm = 100 mm^2.

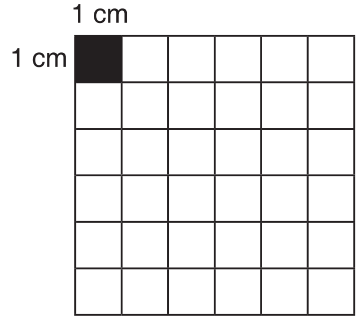
Important point

If area = 100 mm^2, then there are 100 squares each of area 1 mm^2.

Activity 9.1

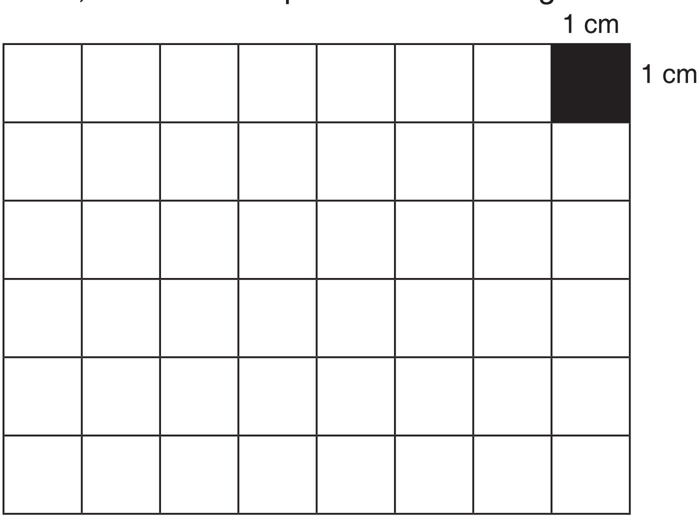
Refer to the area grid shown:

- What is the area of 1 small square?
- What is the area of the big square?
- Count the number of small squares in the big square.



Exercise 9.1

In the figure below, each small square has both length and width of 1 cm.



(a) What is the area of one small square?

(b) How many small squares are in the figure?

(c) What is the area of the whole figure?

9.2 Units of Area

The standard unit of area is the **square metre**. It is written as $\mathbf{m^2}$. However, other units for measuring area are km^2, hm^2, dam^2, dm^2, cm^2 and mm^2.

km^2	$1\ km^2 = 1\ km \times 1\ km$	One kilometre squared
hm^2	$1\ hm^2 = 1\ hm \times 1\ hm$	One square hectometre
dam^2	$1\ dam^2 = 1\ dam \times 1\ dam$	One decametre squared
m^2	$1\ m^2 = 1\ m \times 1\ m$	One metre squared or one square metre
dm^2	$1\ dm^2 = 1\ dm \times 1\ dm$	One square decimetre
cm^2	$1\ cm^2 = 1\ cm \times 1\ cm$	One square centimetre
mm^2	$1\ mm^2 = 1\ mm \times 1\ mm$	One square millimetre

Conversion table for units of area

km^2		hm^2		dam^2		m^2		dm^2		cm^2		mm^2	
	1	0	0	0	0	0	0						
			1	0	0	0	0						
					1	0	0						
							1	0	0	0	0	0	0
									1	0	0	0	0
											1	0	0

From the conversion table above, we can see that:

$1km^2 = 1\ 000\ 000\ m^2$

$1hm^2 = 10\ 000\ m^2$

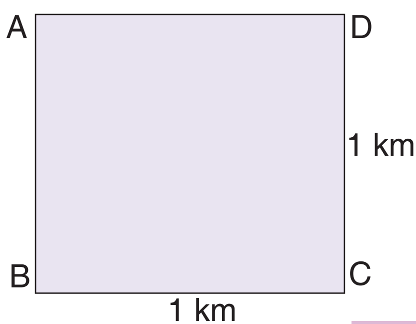
$1dam^2 = 100\ m^2$

$1\ m^2 = 1\ 000\ 000\ mm^2$

$1dam^2 = 10\ 000\ dm^2$

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

The meaning of 1 km^2



Consider a square plot of land ABCD such that BC is 1 km long and CD is also 1 km long as shown.

Area of the plot ABCD = length of side BC x length of side CD = 1 km x 1 km = 1 km^2.

The area of this plot of land is 1 km^2, which is read as “one kilometre squared” or “one square kilometre”.

NOTE:

Since 1 km^2 = 1 km x 1 km, then we can easily change 1 km^2 in to other units of area such as m^2.

1 km^2 = 1 km x 1 km = 10 hm x 10 hm = 100 hm^2.

Read the following areas aloud:

(a) 50 km^2 (b) 600 hectares (c) 40 acres

(d) Our school football field has an area of 7 000 m^2

(e) My study table is 320 cm^2 (f) The size of my wall photo is 300 mm^2.

Exercise 9.2

Change the following units of area as instructed:

(a) 1 km^2 = ________ m^2

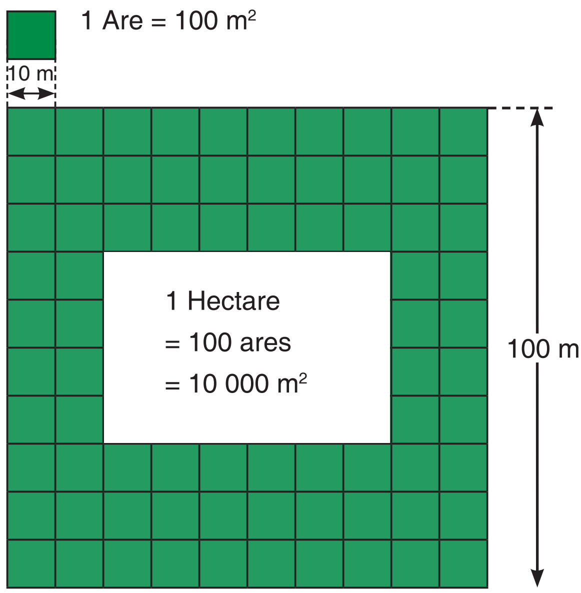
(b) 10 m^2 = ________ cm^2

(c) 25 dam^2= ___________ m^2

9.3 Relationship Between Land Measurement and Area

Land area is measured in a larger unit called the **hectare**. It is written in short as **ha**. Other units of area include; are, acre and hectare.

- A plot of land measuring 100 m by 100 m has an area of 1 hectare. So, 1 hectare (1 ha) = 100 m × 100 m = 10 000 m^2.
- A plot of land measuring 10 m by 10 m has an area of 1 are. So, 1 are = 100 m^2.
- 1 ca = 1 m^2, i.e. 1 centiare = 1 square metre.
- 1 acre = 0.40 hectare and 1 hectare = 2.47 acre.



Hectare (ha)		Are (a)		Centare (ca)	
	1	0	0	0	0
	1	0	0		
			1	0	1

1ha = 100a

1a = 100 ca

1 ha = 10 000ca

1ca = $1m^2$

hm^2		dam^2		m^2		dm^2		cm^2		mm^2	
Ha		a		ca							
	1	0	0	0	0						
			1	0	0						
					1	0	0	0	0	0	0
							1	0	0	0	0
									1	0	0

1 hm^2 = 1ha, 1dam^2 = 1a, 1m^2 = 1ca.

Activity

Study the conversion table above. Discuss with your group members and answer the following questions:

- 1a = ...ca
- 1dm^2 = ...ca
- 10a = ...ha
- 20ca = ...cm^2
- 5dam^2 = ...dm^2
- 25m^2 = ...ca
- 25ca = ...a
- 5 000 m^2 = ...ha

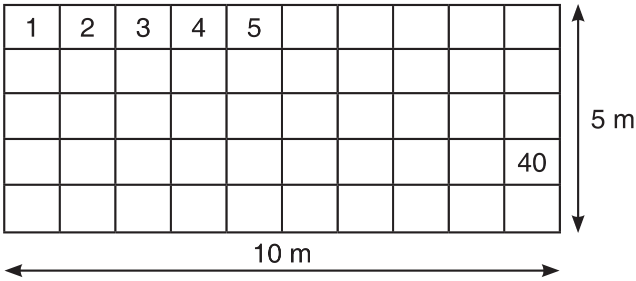
Activity 9.2

In this class activity, you will find the area of a plot of land of length 10 m and width 5 m by counting the number of square metres in it.

(a) 10 m can not fit into your book, so you will use a scale of 1 cm to represent 1 m. Draw a rectangle of length 10 cm and width 5 cm in your book.

(b) Divide the length into 10 equal parts using vertical lines. Each part should be equal to 1 cm.

(c) Divide the width into 5 equal parts using horizontal lines as shown in the diagram below:



(d) Count the number of small squares formed by the lines you have drawn. You can do this by numbering all the small squares.

(e) Each small square represents an area of 1 m^2.

(f) Now answer this question: What is the area of the plot of land?

Example 9.1

Convert the following units of area:

(a) 3 m^2 to cm^2

(b) 5 km^2 to dam^2

(c) 2.5 hectares to m^2

Solution

Km^2		hm^2		dam^2		m^2		dm^2		cm^2	
		ha		a		ca					
							3	0	0	0	0
	5	0	0	0	0						
			2	5	0	0	0				

(a) $3m^2 = 30\,000cm^2$

(b) $5km^2 = 50\,000dam^2$

(c) 2.5 ha $= 25\,000m^2$

Exercise 9.3

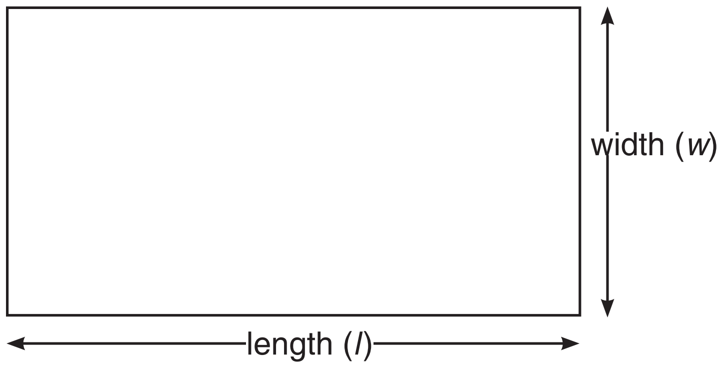
Convert the following units:

(a) 5 km^2 in m^2.

(b) 1 hectare in m^2.

(c) 10 are in m^2.

9.4 Area of Rectangular Piece of Land



Area of a rectangular piece of land = length × width.

mathematically, $A = l \times w$

or $l = \dfrac{A}{w}$

$\boxed{w = \dfrac{A}{l}}$

where A = Area

l = length

w = width

Example 9.2

Find the area of a rectangular piece of land whose length and width are:

(a) 80 m and 20 m.   (b) 100 m and 40 m.

Solution

(a) Area = length × width = 80 m × 20 m = 1 600 m^2.

(b) Area = 100 m × 40 m = 4 000 m^2.

Exercise 9.4

1. The length of a house floor is 10 m and its width is 8 m. What is the area of the floor?
2. The area of the floor of our classroom is 40 m^2. How long is the classroom if it is 5 m wide?

9.5 Addition and Subtraction of the Area of Land

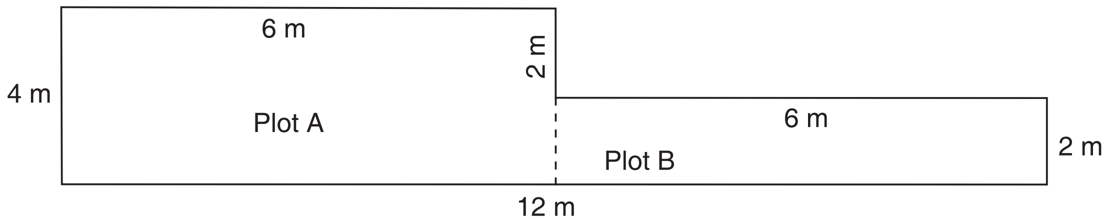
Activity 9.3

In groups, do the following:

- Measure the length and width of your classroom.
- Also, measure the length and width of another classroom.
- What is the total area? What is the difference between the areas of two rooms? Write the answers in m^2.

Activity 9.4

In this class activity, you are going to work in groups and find the area of the plot of land shown below. Divide the land in two parts. Find the areas of plot separately. Add the area of the two plots and express in m^2.



Example 9.3

1. **Add:**

   (a) $17.25\ m^2$ and $5.05\ m^2$. (b) 57.03 are and 10.07 are.

2. **Subtract:**

   (a) 15.27 are from 24.09 are. (b) $9.23\ m^2$ from $16.67\ m^2$.

Solution

1. (a)
$$\begin{array}{r} 17.25\ m^2 \\ +\ \ 5.05\ m^2 \\ \hline 22.30\ m^2 \\ \hline \end{array}$$
(b)
$$\begin{array}{r} 57.03\ \text{are} \\ +\ 10.07\ \text{are} \\ \hline 67.10\ \text{are} \\ \hline \end{array}$$

2. (a)
$$\begin{array}{r} 24.09\ \text{are} \\ -\ 15.27\ \text{are} \\ \hline 8.82\ \text{are} \\ \hline \end{array}$$
(b)
$$\begin{array}{r} 16.67\ m^2 \\ -\ \ 9.23\ m^2 \\ \hline 7.44\ m^2 \\ \hline \end{array}$$

Assessment Exercise

1. Change the following units of area as instructed.

   (a) 2 500 cm^2 = _________ m^2

   (b) 8 000 m^2= ______________ hm^2

   (c) 6.5 km^2 = ______________ dam^2

2. A piece of paper has an area of 6 cm^2. If it is 3 cm long, then how wide is the paper?

3. (a) Add 25.32 m^2 and 62.28 m^2.

   (b) Subtract 4.25 ha from 6.75 ha.

4. School A is built on 1 are of land and school B is built on 100 m^2 of land. Which of the two schools has bigger area?

5. On a fruit farm, 1 are of land produces 2 tons of oranges. How many kilograms of oranges will be produced by 300 m^2 of the same farm land?

6. Kenia has a plot of land measuring 100 m by 100 m. Peter's land has an area of 3 hectares and Kwame has an area of 200 ares. Who has the largest land? What is the total Land area in hectares?

7. The total land area of our country Rwanda is 26 338 km^2. Lake Victoria has an area of 69 484 km^2. By how much is Lake Victoria bigger than Rwanda?

Internet Resource

Internet Resource **www.mathplace.com**

UNIT 10

Time

Key unit competence

The learner should be able to tell, write and convert time appropriately.

Fun Corner

"Who has two hands but can't wave?"

Ans: Eeeehhhh.....ahahaha....Am I not Mr. Clock?

"You are my friend, I am your friend. You can wait for me but I can never wait for you!" Who am I?

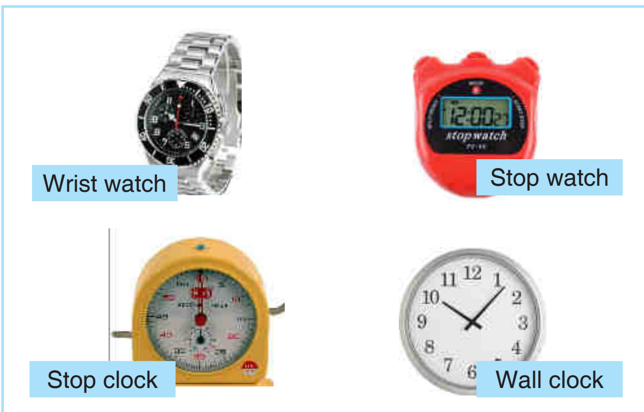
Ans: Ahahaha...... I am Mr. Time.

Attitudes and values

Appreciate the value of time management in daily situations.

9.1 Reading and Telling Time

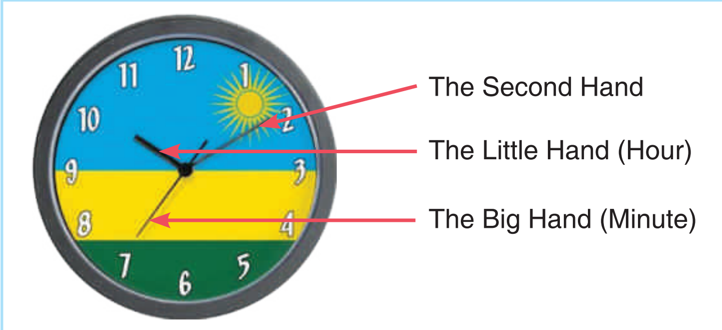
Time is a measure of durations of events and the intervals between them.



The short hand of the clock is called the **hour hand**. It measures time in hours. If it rotates once round the clock face, then the time taken is 12 hours.

The long hand of the clock is the **minute hand** and it measures time in minutes. One full rotation equals 60 minutes.

The thinnest hand is the **second hand**. Of the three, it rotates the fastest. Its full rotation equals 60 seconds.



There are two common ways of telling time:

(i) Say the hour first and then the minutes e.g.

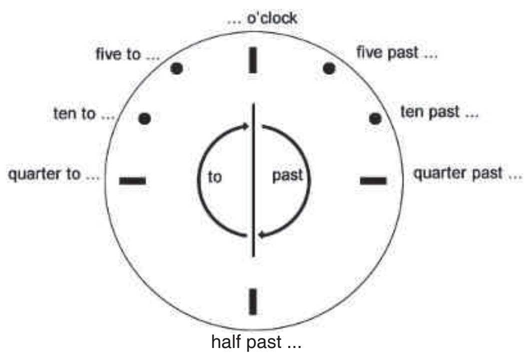
- 6:25 = It is six twenty-five
- 8:05 = It is eight O-five (O is said like letter O)
- 9:11 = It is nine eleven
- 2:45 = It is two forty-five

(ii) Say the minutes first and then the hour e.g.

- 2:16 = It is sixteen past two
- 11:20 = It is twenty past eleven or it is eleven twenty
- 8:30 = It is half past thirty or it is eight thirty
- 8:40 = It is twenty to nine or it is eight forty
- 11:59 = It is one to twelve or it is eleven fifty-nine
- 8:51 = It is nine to nine or it is eight fifty-one.

Use of the words 'past' and 'to'

- If it is 30 minutes or less after the hour, we use the word "past". For example, if it is 1:16, we can say that the time is sixteen past one.
- If it is more than 30 minutes after the hour, we use the word "to". For example, if the time is 3:55, we see that it is only 5 minutes remaining to reach 4 o'clock. So we can say that the time is 5 to four o'clock.



Quarter past/to and half past

15 minutes is a quarter of 60 minutes and 30 minutes is half of 60 minutes.

- When it is 15 minutes past the hour we use the words "quarter past" e.g. 6:15 = a quarter past six, 9:15 = a quarter past nine etc.

- When it is 15 minutes to the hour, we use the word “a quarter to”, e.g. 10:45 = a quarter to eleven, 4:45 = a quarter to five etc.
- When it is 30 minutes past the hour, we use the words “half past” not “half to”. e.g. 7:30 = half past seven, 12:30 = it is half past twelve etc.

O’clock

We use o’clock, when there are no minutes. We use o’clock when the time is exact. For example; 2:00 = two o’clock, 11:00 = eleven o’clock etc.

12:00

When it is exactly 12:00, we say it is twelve o’clock. There are 2 twelve o’clocks in a day namely:

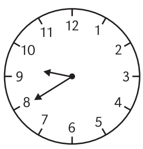
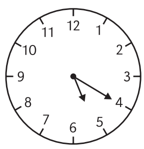
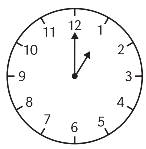
- Twelve o’clock midday. This is also referred to as noon.
- Twelve o’clock midnight.

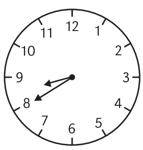
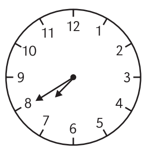
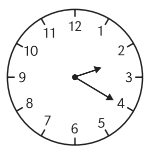
Activity 10.1

Read and tell the time in the clocks shown below:

Example 10.1

Read and tell the time shown by the clock faces below:

(a)  (b)  (c) 

(d)  (e)  (f) 

Solution

(a) The time is 9:40. This may be 9:40 a.m. or 9:40 p.m.

(b) The time is 5:20. It may be 5:20 a.m. early morning or 5:20 p.m. in the evening.

(c) It is one o’clock.

(d) The time is 8:40

(e) The time is 7:40

(f) The time is 2:20

Exercise 10.1

1. Match the digital and analogue clocks which show the same time. You may use an arrow.

Digital clock | **Wall clock**

A. 

B. 

C. 

D. 

E. 

(a) 

(b) 

(c) 

(d) 

(e) 

2. Read and tell the time indicated by the following clock faces:

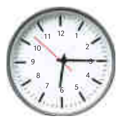
(a) 

(b) 

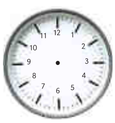
(c) 

(d) 

(e) 

(f) 

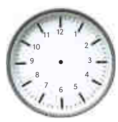
3. Draw the hour and minute hands on the following clock faces to show the correct times indicated:

(a) 

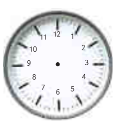
03:20

(b) 

06:45

(c) 

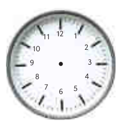
10:50

(d) 

07:10

(e) 

10:37

(f) 

01:25

10.2 Writing Time Using a.m. and p.m.

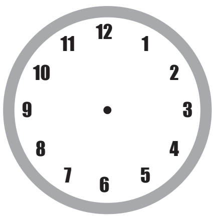
Time using a.m. is ***ante meridian,*** means before midday.

Time using p.m. is ***post meridian,*** means after midday.

a.m. starts at exactly midnight at a time called 12:00 o'clock up to just before midday (12 noon). **p.m.** starts at midday at a time called 12 noon and ends just before midnight.

Activity 10.2

Use a manilla card and plastics to form a model clock as shown below. Your teacher will help you. Use it to show the time mentioned below.



minute hand

hour hand

8.10

4.45

Example 10.2

Express 9 o'clock in the morning using a.m. or p.m.

Solution

9 o'clock in the morning is 9:00 a.m.

Example 10.3

What time is a half past 5 o'clock in the evening?

Solution

A half past 5 o'clock in the evening is 5:30 p.m.

Exercise 10.2

1. Write the time using 'a.m.' or 'p.m.': 10 o'clock in the morning?
2. Express 6 o'clock in the morning as a.m. or p.m.
3. What time is half past 11 o'clock in the morning?
4. Express 2 o'clock in the afternoon using a.m. or p.m.
5. My father left Moroto at a quarter to 7 o'clock in the morning. Write this time using a.m. or p.m.

10.3 Units of Time and Their Conversion

The standard unit of time is the **second**. The second is written in short as **'s'**. Other units used to express time are minute, hour, day, week, fortnight, month, year, decade, century and millennium, where

1 minute	=	60 second(s).
1 hour	=	60 minutes.
1 day	=	24 hours.
1 week	=	7 days.
1 fortnight	=	2 weeks.
1 month	=	4 weeks.
1 year	=	12 months (365 days).
1 decade	=	10 years.
1 century	=	100 years.
1 millennium	=	1000 years.

- An ordinary (common) year has 365 days and February ends on 28th.
- A leap year is a year which has 366 days and its February ends on 29th.
- 2004, 2008, 2012 were leap years and the next leap year is 2016.
- A full day has both daytime and night time, each of which lasts 12 hours.

Activity 10.3

In this class activity, you will work in groups and find out the number of seconds that are found in:

(a) 1 minute (b) 1 hour (c) 1 day
(d) 1 week

Example 10.4

Change 4 hours to minutes.

Solution

1 hour = 60 minutes

4 hours = (4×60) minutes = 240 minutes.

Example 10.5

Change 180 minutes to hours.

Solution

60 minutes = 1 hour

180 minutes = $180 \div 60$ = 3 hours

Therefore, 180 minutes = 3 hours

$$\begin{array}{r|l} & \ \ 3 \\ 60 & \ 180 \\ & -180 \\ \hline & \quad 0 \end{array}$$

Exercise 10.3

1. Change the following hours into minutes and seconds.

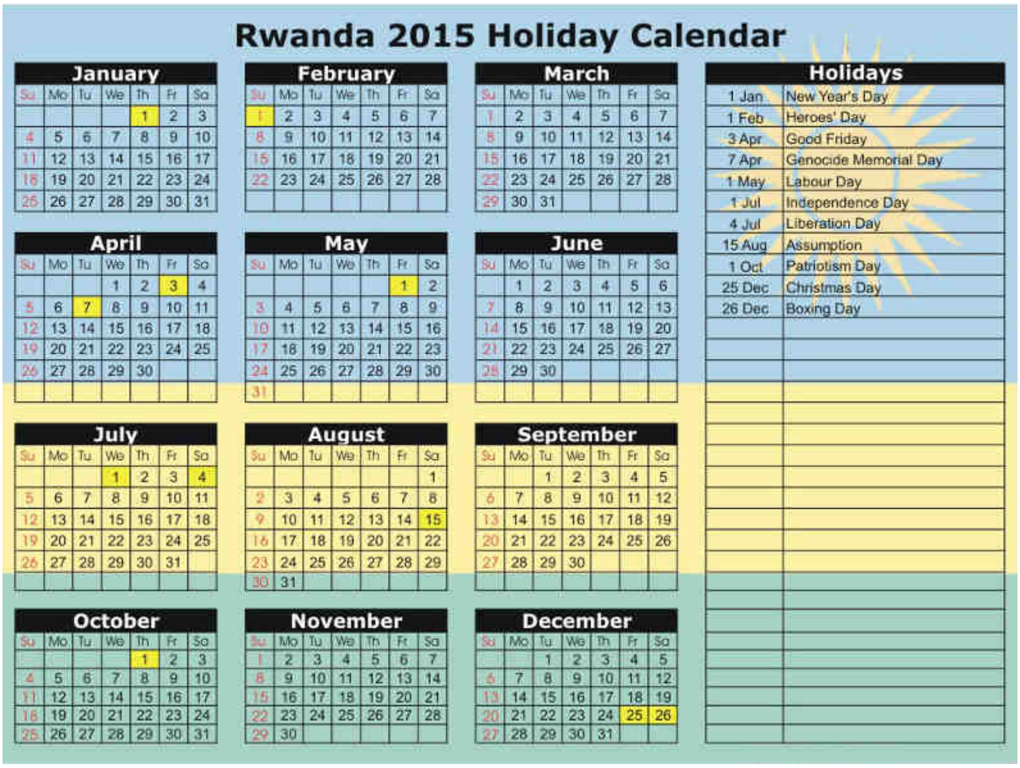
(a) 1 hour (d) 5 hours (g) 6 hours

(b) 3 hours (e) 8 hours (h) $1\frac{1}{2}$ hours

(c) 2 hours (f) 11 hours (i) $4\frac{1}{2}$ hours

10.4 The Calendar

A calendar is a chart showing days, weeks and months of a particular year. A calendar helps us to identify days and be informed of special days like Christmas, Independence Day, school term opening and closing days, birthdays, etc.



Example 10.6

Name the days of a week.

Solution

Days are: Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday.

Example 10.7

Name the months of the year.

Solution

Months are: January, February, March, April, May, June, July, August, September, October, November, December.

Activity 10.4

In this activity, you will list down all the activities you do in a day right from the time you wake up till you go to sleep.

Activity 10.5

You will work in small groups with your classmates to finish this activity. Carefully follow the teacher's instructions.

Study the calendar below and answer the following questions:

July 2015

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

(a) For which year does the calendar belong?

(b) For which month of the year is the calendar?

(c) What does 'Mo' stand for in the calendar?

(d) On what day does the month begin?

(e) On what day does it end?

(f) How many week days does the month have?

(g) Ineza played football for 30 minutes on each weekend days of the month. How many seconds did he spend playing football in the whole month?

(h) How many days are there in the month?

(i) On what date is the last Sunday of the month?

(j) A certain conference started on the first Monday at 9:00 a.m. and ended at 9:00 a.m. on 29th of the same month. How long (in days) did the conference last?

Activity 10.6

Form yourselves into groups of 4 learners each. Study the calendar and discuss the questions below:

(a) For which year does this calendar belong?

(b) How many months are found in a year?

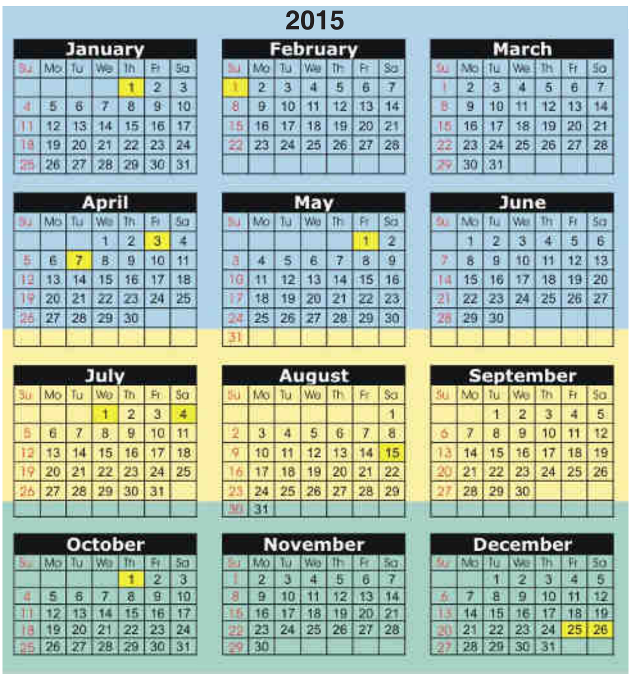
(c) Which months have 30 days?

(d) Which months have 31 days?

(e) What is the last month of the year?

(f) In which month were you born?

(g) In which month does Rwanda celebrate independence?



Think!!!

Charles' mum has three children. The first is called June. The second child is called July. What is the name of the third child?

Exercise 10.4

Using the given calendar, answer the following:

1. How many days are there in the months of January, February (not a leap year) and March?
2. List down all months with 30 days.
3. Write down all months of the year with 31 days.

10.5 Problems Involving Time

Example 10.8

Kato, is a brick layer. He makes 120 bricks every day. How many bricks does he make in the month of January, if he works every day?

Solution

In one day, he makes 120 bricks. But, January has 31 days.

Therefore, in 31 days, he makes = $120 \times 31 = 3720$ bricks

Therefore, he will make 3 720 bricks.

Example 10.9

Dorah is a mother of 3 children. She has a job in town and this job enables her to take care of her children. She goes to town everyday except on Sundays. How many times does she go to town in the month of September, if there are 4 Sundays in September?

Solution

September has 30 days and there are 4 Sundays.

$(30 - 4)$ days = 26 days

Therefore, she goes to town 26 times in the month of September.

Example 10.10

It takes Aminyo 2 hours 30 minutes to travel from Kampala to her village in Luwero. If she walks from Luwero town to her village for 1 hour 10 minutes, how much time does she spend moving from Kampala to Luwero town?

Solution

	Hours	Minutes
Total time taken	2	30
Time taken from Luwero to village =	–1	10
Time taken from Kampala to Luwero =	1 hours	20 minutes

Subtract hours;
2 hours – 1 hour = 1 hr

Subtract minutes;
30 min – 10 min = 20 minutes

Activity 10.7

1. In groups, study the following class time table and answer the questions given below:

Gihugu community primary school P4 Time-table

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00-8:40 am	Maths	Science	Maths	Maths	Library
8:40-9:20 am	Maths	P.E.	Maths	Maths	Maths
9:20-10:00 am	Kinyarwanda	French	French	Science	English
10:00-10:30 am	B	R	E	A	K
10:30-11:10 am	SST	Kinyarwanda	Science	SST	Music
11:10-11:50 pm	Science	English	English	English	SST
11:50-12:30 pm	Kiswahili	English	English	P.E	Science
12:30-1:30 pm	L	U	N	C	H
1:30-2:10 pm	English	SST	SST	Kinyarwanda	Kinyarwanda
2:10-2:50 pm	Drama	Library	Debate	General Assembly	General Assembly
2:50-3:30 pm	Sports	Sports	Sports	Sports	Community service

(a) How many periods are there before break on Monday?

(b) On which day is the school's general assembly held?

(c) How long is planned for P.E. in the whole week?

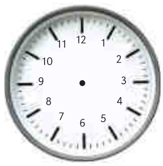
(d) Which subject is given biggest amount of time and how long?

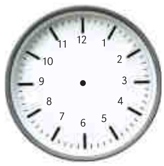
(e) On Wednesday, the Science teacher came to class at 10:30. He conducted an experiment in our class for 15 minutes. We then used the remaining part of the lesson for doing a test. How long was the test?

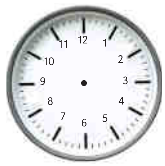
(f) Last Friday, the community service was extended by 55 minutes because of rain. At what time did it end?

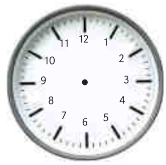
Assessment Exercise

1. Draw the hour and minute hands on the following clock faces to show the correct times indicated:

(a)  5:30

(b)  1:55

(c)  7:00

(d)  12:00

2. Our school timekeeper always rings the bell at half past 10 o'clock in the morning. Write this time using a.m. or p.m.
3. A match between Arsenal and Everton started at a quarter past 6 o'clock in the evening on Saturday. Write this time in a.m. or p.m.
4. Express the following as minutes:

(a) 80 seconds	(d) 150 seconds	(g) 240 seconds	(j) 360 seconds
(b) 70 seconds	(e) 130 seconds	(h) 180 seconds	(k) 720 seconds
(c) 120 seconds	(f) 480 seconds	(i) 300 seconds	(l) 540 seconds

5. Gloria sold pancakes every day for 2 months as follows:

   September, 200 pancakes every day.

   October, 100 pancakes every day.

   (a) How many pancakes did she sell in September?
   (b) How many pancakes did she sell in October?
   (c) Find the total number of pancakes Gloria sold in the two months.
6. Bwire started washing clothes at 6:30 a.m. and stopped at 7:45 a.m. How much time did he take to wash clothes?

Internet Resource

For more online support visit **www.mathplayground.com**

UNIT 11

Money and Its Financial Applications

Key unit competence

A learner should be able to understand what money is and know its applications in our daily life.

Attitudes and values

Appreciate the importance of money in daily life situations and show concern and the need for honesty in spending money.

11.1 What is money?

Money is a piece of paper or metal which is legally accepted to be used for buying goods and services within a country.

A service is something you cannot hold in your hand **e.g.** education, internet, advice.

National Bank of Rwanda makes money for use in Rwanda.

Characteristics of money:

- It cannot be easily damaged.
- It is very scarce. That means it is hard to get money.
- It is easy to carry.
- It is hard to forge.
- It should be easily divisible into smaller denominations.
- It is accepted by everyone.

Uses of money:

- It is used for buying goods like books, cars, food, mobile phones.
- It is used for buying services like education (school fees), medical

treatment, airtime, insurance, etc.

- It is used to keep wealth.
- It is used to pay debts.

11.2 Rwandan Currency

The money used in our country (Rwanda) is known as **Rwandan francs**. It is usually denoted by ‘’. FRW

In Rwanda, we use both notes (paper money) and coins (metallic money).

Rwandan Currency Coins:

1 Frw, 5 Frw, 10 Frw, 20 Frw, 50 Frw 100 Frw

Activity 11.1

In this class activity, you are provided with 6 different Rwandan coins.

a) Identify the 1, 5, 10, 20, 50 and 100 Frw coins.

b) Discuss with your friends what item can be bought by each coin denomination.

Rwandan Currency Notes:

Activity 11.2

In this class activity you are provided with four Rwandan currency notes.

a) Identify the following notes: 500 Frw, 1 000 Frw, 2 000 Frw and 5 000 Frw.

b) Discuss with your friends what item each currency note can buy in Rwanda.

c) Is there any other currency note whose picture is not shown above?

Example 11.1

My mother gave me money to buy a new school uniform. It was 5 150 Frw in an envelope. In the envelope, there was only one note and two coins. Identify the note and the coins my mother gave me.

Solution

Total money = 5 150 Frw.

Since there was only one note, it must have been the 5 000 Frw note. There is no coin for 150 Frw, so the two coins are 100 Frw and 50 Frw.

Example 11.2

Paul bought sweets from a shopkeeper. He paid the shopkeeper 550 Frw using only coins of 50 Frw each. How many coins did he gave to the shopkeeper?

Solution

Number of coins = $\frac{550\text{ Frw}}{50\text{ Frw}}$ = 11 coins.

Exercise 11.1

1. What do we call the national currency used in Rwanda?
2. Which Rwanda note has the highest value?
3. A mother gave three notes of 1 000 Frw and five coins of 50 Frw to her son to buy school uniform. What was the total amount of money given by the mother?
4. Three men shared 15 000 Frw equally. How much money did each man get?

Sample Currency Notes from Other Countries

Uganda

Tanzania

Kenya

Burundi

11.3 Planning According to Needs and Wants

A **need** is something you cannot live without. A need is something you must have for you to survive. Examples of needs are food, shelter, clothing and medical care.

A **want** is something you would like to have but you can live without it. It is not absolutely necessary but it would be a good thing to have. Examples of wants are music, TV, computer, car, toys, mobile phone, radio, electricity.

Scarcity and Budgeting

Those in towns and cities buy most of their needs and wants including food, clothes, etc. Those in villages may get food from their gardens and also live in their own houses for free. However, everyone needs money to buy salt, sugar, medicine, airtime, soda, bicycle, clothes etc. One of the biggest problems that we all have is **scarcity** of money. We don't always have money for everything that we need or want.

Therefore, every time we have money, we need to plan carefully for the money so that we buy only the most important things. This planning is called **budgeting**.

Activity 11.3

a) Identify the basic needs from the below list.

Needs / wants	Price
Buying food	5 000 Frw
Ice cream	3 000 Frw
Toy car	3 000 Frw
Malaria treatment	1 550 Frw
Blanket	1 450 Frw
Shelter	25 000 Frw
Watching football match	5 000 Frw
School fees	6 500 Frw
Watching wild animals in a zoo	10 000 Frw

b) Plan your budget according to your priorities. How will you spend 5 000 Frw?

11.4 Buying and Selling

A person who buys goods or services and sells to others is called a trader or businessman or businesswoman.

Selling is the act of giving out goods to someone in order to get money.

Buying is the act of giving money to someone in order to get goods that you need.

Cost Price and Selling Price

A shop keeper goes to a factory and buys 1 crate of soda at 4 500 Frw. If he sells the crate to a customer at 6 500 Frw, then **the cost price is 4 500 Frw** and **the selling price is 6 500 Frw**.

11.5 Profit and Loss

- If the selling price is more than the cost price, then the shopkeeper makes a **profit**. This means he gets extra money and he becomes richer.
- If the selling price is less than the cost price, then the shopkeeper suffers a **loss**. This means he loses some money and he becomes poorer.

Example 11.3

Manzi was given 3 000 Frw by his father as pocket money for school use. He bought a pen at 200 Frw, a book at 500 and geometry set at 900 Frw. How much money is left with him?

Solution

Cost of a pen	=	200 Frw
Cost of a book	=	500 Frw
Cost of a geometry set	=	900 Frw
Total amount of money spent by Manzi	=	(200 + 500 + 900) Frw
	=	1 600 Frw
Pocket money given to Manzi by his father	=	3 000 Frw
Money left with Manzi	=	(3 000 – 1 600) Frw
	=	1 400 Frw

Example 11.4

A trader went to the market and bought a goat at 20 000 Frw, a sheep at 15 500 Frw and a cock at 5 000 Frw. How much money did he spend in the market?

Solution

Price of a goat	=	20 000 Frw
Price of a sheep	=	15 500 Frw
Price of a cock	=	5 000 Frw

Total amount of money spent by the trader = (20 000 + 15 500 + 5 000) Frw

= 40 500 Frw

Example 11.5

Christa bought a tray of eggs at 2 000 Frw and sold it to Sandra at 2 200c Frw. Sandra sold it to James at 3 000 Frw and James also sold it to Alex at 2 500 Frw.

a) What profit did Sandra get?

b) What loss did James bear?

Solution

a) Sandra:

Cost price = 2 200 Frw

Selling price = 3 000 Frw

Sandra's profit = Selling price – Cost price

= (3 000 – 2 200) Frw

= 800 Frw

b) James:

Cost price = 3 000 Frw

Selling price = 2 500 Frw

James' loss = Cost price – Selling price

= (3 000 – 2 500) Frw

= 500 Frw

Activity 11.4

(a) You will do this activity in pairs, suppose a shopkeeper purchases goods at 2 500 Frw and sells the goods at 3 000 Frw. What extra money does the shopkeeper get? Discuss with your teacher.

(b) Shina went to the market and bought a dress at 5 000 Frw. The dress was too big and so she decided to sell it at 6 000 Frw. Did she gain from the sale of her dress? Discuss with your friend.

Assessment Exercise

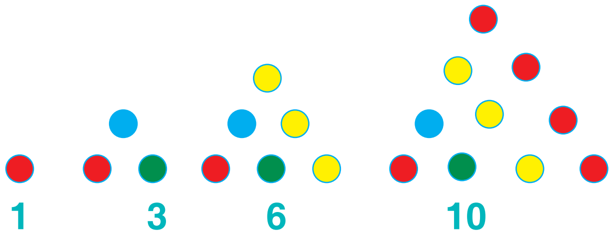
1. If the cost of one pen is 500 Frw, then what will be the cost of 4 pens?
2. Keza has 450 Frw. She buys an eraser at 250 Frw and a sweet at 125 Frw. How much does she remain with?
3. One metre of cloth costs 2 600 Frw. Maria went with one 5 000 Frw and one 2 000 Frw note. She bought two metres of cloth. How much balance was she given?
4. A plot of land was sold at 30 000 Kenyan shillings. This resulted in a profit of 4 500 Kenyan shillings. What was the cost price of the land?
5. The bus fare from Kigali to Kampala is 12 000 Frw. How much does one spend from Kigali to Kampala and back to Kigali?
6. The price of a litre of petrol is 1 200 Frw. A car fuel tank has a storage capacity of 100 litres. How much does it cost to fill up the tank?
7. MTN charges 60 Frw per minute on calls to Kenya. How long do I speak to a friend in Kenya if I have 1 200 Frw airtime in my phone?
8. A Samsung TV costs \$ 340. How much will be charged for 2 similar TV sets?
9. The price of a mobile phone is marked as 79 500 Frw. The trader sells it to me and makes a loss of 3 500 Frw. How much do I pay for the phone?
10. A refrigerator costs 80 500 Frw. Kamanda wants to buy the refrigerator and he has 76 900 Frw. How much more money does he need to buy the refrigerator?
11. A group of students are on a school trip to Gisenyi to tour the Methane Gas Plant on Lake Kivu. The fare for each student is 6 250 Frw. There are 40 students in the bus. How much does the conductor of the bus collect from the students?

Internet Resource

For more online support visit www.math-play.com/fractions

UNIT 12

Number Patterns



Key unit competence

A learner should be able to describe and generate number patterns.

Attitudes and values

Appreciate the importance of orderliness in daily life. Learners should be made to realise the need for orderliness in places such as bus, park, banks, markets, schools, hospitals and other places in daily life situations.

12.1 What is a Number Pattern?

A list of numbers which form a sequence is called a number pattern.

Ascending order (increasing order)

The term ascending means ‘going up’. While ordering integers in ascending order, we arrange integers from smallest to the largest.

For example: 1, 3, 6, 8, 9, 23, 56, 400, ...are arranged in ascending order.

Descending order (decreasing order)

The term descending means coming down. While ordering integers in descending order, we arrange them from largest to smallest.

For example: 45 000, 340, 34, 20, 6, 2, –3, –567, ...,.....,... are arranged in descending order.

Importance of orderliness in daily life situations

Arranging numbers in order of size helps us to compare numbers easily from a given set of numbers.

Example 12.1

The list shown below shows the size (area) of some selected countries in the world. (Source: www.simple.wikipedia.org)

Country	**Land area (in km²)**
Seychelles	455
Belgium	32 542
Rwanda	26 338
Israel	26 990
Singapore	692
Vatican City	0.44
Burundi	27 830
Jamaica	10 990
Haiti	27 750

Arrange the land areas of the different countries in

(a) ascending order

(b) descending order

Hence tell the 4th smallest country from this list.

Solution

(a) Ascending order: 0.44, 455, 692, 10 990, 26 338, 26 990, 27 750, 27 830, 32 542.

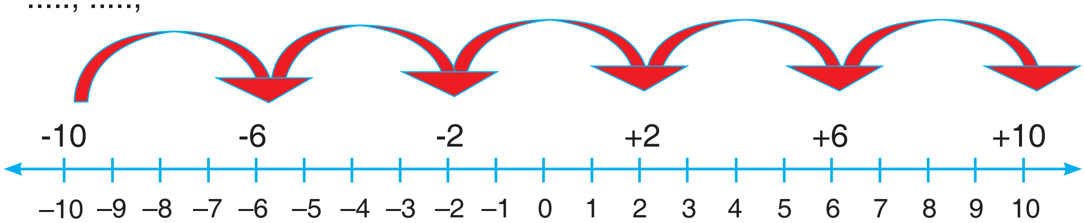
(b) Descending order: 32 542, 27 830, 27 750, 26 990, 26 338, 10 990, 692, 455, 0.44.

The 4th smallest country has an area of 10 990 km^2. It is the 4th from the left on the ascending list and it is the 4th from the right on the descending list.

So the answer is **Jamaica**.

Example 12.2

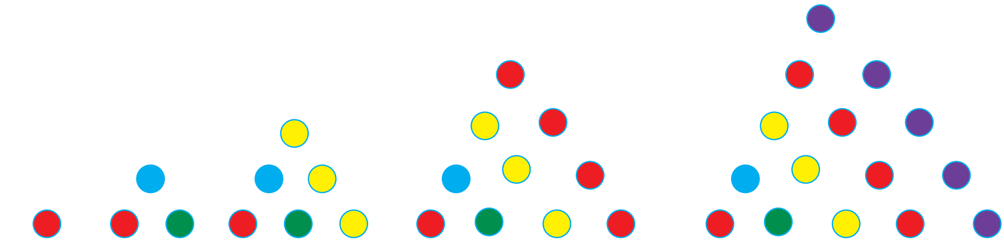
For example, the figure below shows the number pattern –10, –6, –2, ..., ..., ...,



This pattern starts with – 10 and jumps by 4 every time.

▸ Example 12.3

Dots like these ones below can also be used to show number patterns.



1 dot   3 dots   6 dots   10 dots   15 dots

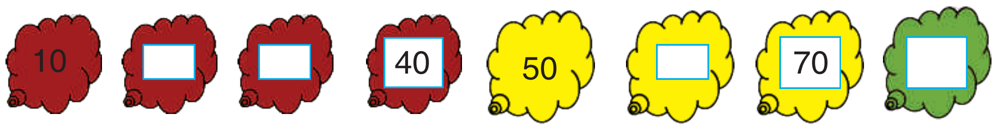
The number pattern formed is 1, 3, 6, 10, 15,.......

This pattern starts with 1 and then you add 2, 3, 4, 5 and so on.

Activity 12.1

Each picture has a number on its face.

Can you workout the number patterns and fill the missing numbers?

(a) 

(b) 

Compare your answers with the answers of your classmates from the other groups.

Exercise 12.1

1. Complete the number pattern.
   (a) 4, 8, 12, 16, 20, 24, __________
   (b) 1, 4, 8, 13, __________
   (c) 50, 42, 35, 29, __________
   (d) 100, 105, 115, 130, 150, __________
   (e) 1, 2, 4, 7, __________, 16
2. The list shown below shows the marks obtained (out of 100) by the students of class 4 in a maths test:

   59, 56, 79, 82, 90, 53, 19, 54, 65, 88, 93, 58, 63, 52, 75.

   Arrange the data in the ascending order and find out the third highest mark.

12.2 Progression or Series

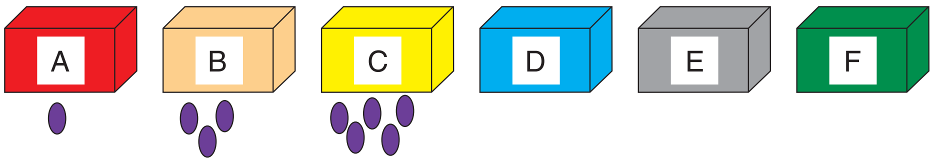
There are two types of series or progressions namely; Arithmetic series and Geometric series.

12.2.1 Arithmetic Progression

In an arithmetic progression or arithmetic series, the sequence of numbers are such that the difference between the consecutive terms is constant.

For example: The sequence 3, 5, 7, 9, 11, 13, 15 is an arithmetic progression with a common difference of 2.

Activity 12.2



What you need

- 6 empty chalk boxes, labelled A, B, C, D, E and F.
- At least 100 bean seeds.
- Marker pens.
- Manila paper.

What to do

(i) Place one bean seed in box A.
(ii) Record the number of bean seeds in box A on a manila paper.
(iii) Remove the bean seed in box A and transfer it to box B. Add two more bean seeds in box B.
(iv) Count the number of bean seeds in box B and record the number on the manila paper.
(v) Remove all the bean seeds in box B and place them in box C. Add two more bean seeds in box C.
(vi) Count the number of bean seeds in box C and record the number on a manila paper.
(vii) By adding two bean seeds each time, repeat the procedures for boxes D, E and F. Record the number of beans in the boxes D, E and F on the manila paper.

The numbers on the manila paper forms an Arithmetic progression with a first term of 1 and common difference of 2.

Use the bean seeds to form other Arithmetic Progressions.

Exercise 12.2

Rewrite the numbers as shown in your exercise book and write down the next two numbers in the following sequences:

(a) 70, 69, 68, 67, 66, 65, 64, 63,......,.......,

(b) 20, 17, 14, 11, 8, 5,......,........,

(c) 10, 20, 30, 40, 50, 60,.......,........,

(d) 10, 13, 16, 19, 22, 25,......,........,

12.2.2 Geometric Progression

A geometric progression is a sequence of numbers in which the next number is obtained by multiplying or dividing the previous number by a fixed number.

Examples of a geometric progression :

40, 20, 10, 5. The first number is 40. The next number of the sequence is got by dividing by 2 or multiplying by $\frac{1}{2}$.

1, 2, 4, 8, 16, 32, 64, 128,....... The first number is 1 and the next number is got by multiplying the previous number by 2.

Assessment Exercise

1. Complete the number pattern:

   (a) 4, 7, 12, 19, 28, __________ (b) 20, 23, 28, 35, __________

   (c) 1, 7, 18, 34, __________

2. Rewrite the numbers as shown in your exercise book and write down the next two numbers in the following sequences:

   (a) +12, +10, +8, +6, +4, ..., ..., (b) 0, 40, 80, 120, 160, ..., ...,

3. On a modern art painting, there are 4 green dots in the first row, 12 green dots in the second row, 36 green dots in the third row, 108 green dots in the fourth row, and 324 green dots in the fifth row. If this pattern continues, how many green dots will there be in the sixth row?

4. A restaurant used 2 onions on Friday, 4 onions on Saturday, 6 onions on Sunday, 8 onions on Monday, and 10 onions on Tuesday. If this sequence continues, how many onions will the restaurant use on Wednesday?

5. While at work, Mimi is putting papers into folders. She puts 3 papers in the first folder, 6 papers in the second folder, 9 papers in the third folder, 12 papers in the fourth folder, and 15 papers in the fifth folder. If this sequence continues, how many papers will Mimi put in the sixth folder?

Internet Resource

For more online support visit **www.kidsites.com**

UNIT 13

Filling in the Missing Numbers

Key unit competence

By the end of this unit, a learner should be able to solve missing number problems involving addition and subtraction.

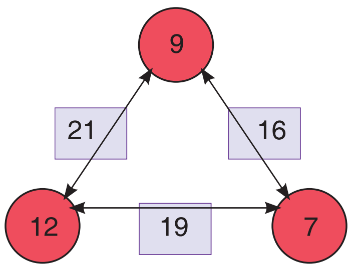
Attitudes and values

Appreciate the importance of inverse operations when solving missing number problems and checking answers.

Arithmagon

An arithmagon is a polygon with numbers at its vertices and sum of these numbers determine the numbers written on its edges.

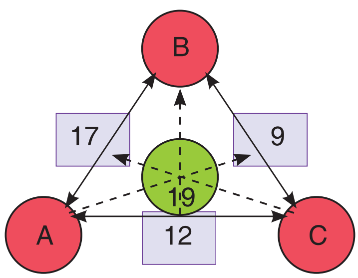
Example:



Here, the numbers 7, 9 and 12 are at the vertices of the Arithmagon and the numbers 16, 21 and 19 are at the edges.

You can see that 12 + 9 = 21, 12 + 7 = 19 and 9 + 7 = 16.

So, add the numbers at the vertex to get the number on the edge. This rule applies to this arithmagon only. Other arithmagons have different rules. You can study them carefully and discover the rules by yourself.



In the arithmagon shown above

A = 19 – 9 = 10

B = 19 – 12 = 7

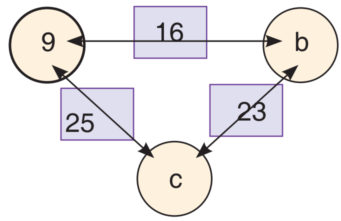
C = 19 – 17 = 2

Activity 13.1

You will complete this task in groups of 5 learners.

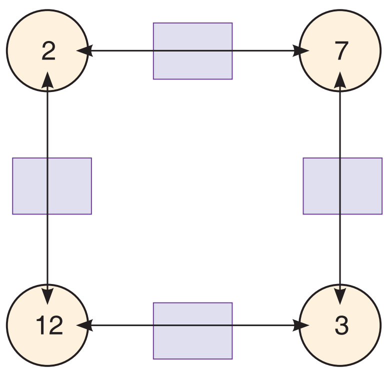
(a) Find the value of b

(b) Find the value of c



Example 13.1

Fill in the missing number.



Solution

In the arithmagon above, there are 4 numbers at the vertices namely 2, 7, 3 and 12. You can see that 2 + 7 = 9, 7 + 3 = 10, 3 + 12 = 15 and 12 + 2 = 14.

Example 13.2

What number should be there in the box?

(a) $9 + \boxed{} = 16$ (b) $18 - 9 = \boxed{}$

(c) $36 \div \boxed{} = 9$ (d) $5 \times \boxed{} = 30$

Solution

(a) $9 + \boxed{} = 16$

Here, 16 – 9 = 7

So, 9 + 7 = 16

(b) $18 - 9 = \boxed{}$

Here, 18 – 9 = 9

so, 18 – 9 = 9

(c) $36 \div \square = 9$

Here, $\frac{36}{9} = 4$

So, $36 \div 4 = 9$

(d) $5 \times \square = 30$

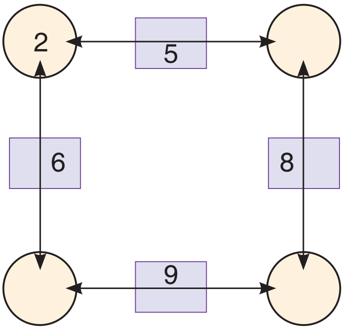
Here, $\frac{30}{5} = 6$

so, $5 \times 6 = 30$

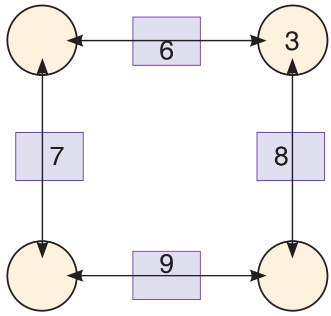
Assessment Exercise

1. Study the arithmagons below and complete them by inserting appropriate numbers:

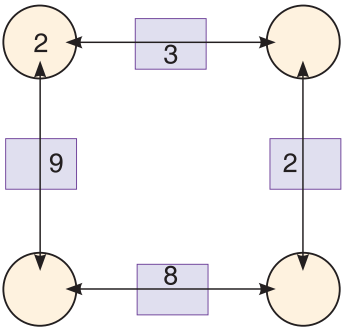
(a)



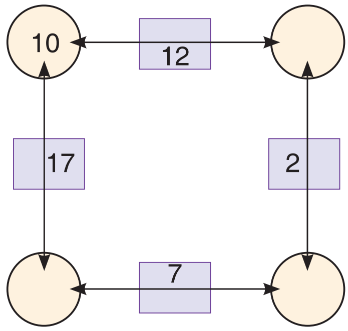
(b)



(c)

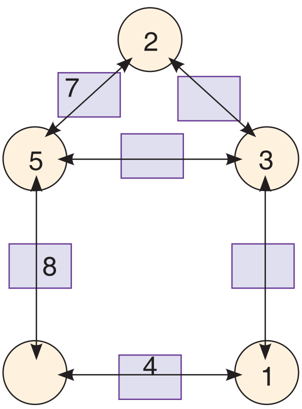


(d)

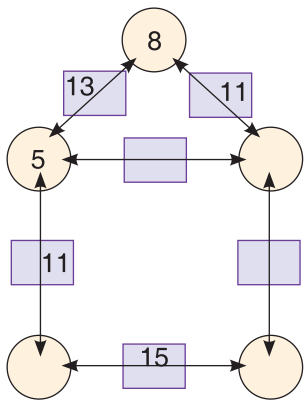


2. Complete the Arithmagon below by inserting correct numbers.

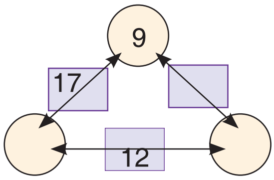
(a)



(b)

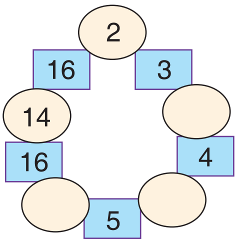


3. Fill in the missing numbers to make the arithmagon correct.

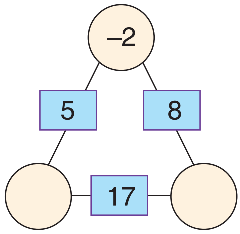


4. Complete the arithmagons below by filling in the right numbers in the circles.

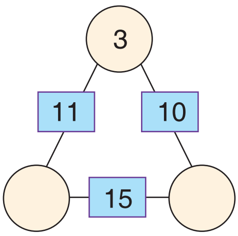
(a)



(b)



(c)



5. If a number is multiplied by 6, the answer will be 24. What will be the value of the number.
6. If 'X' is added to 6. The number obtained is 19. What is the value of 'X'.

Think!!!

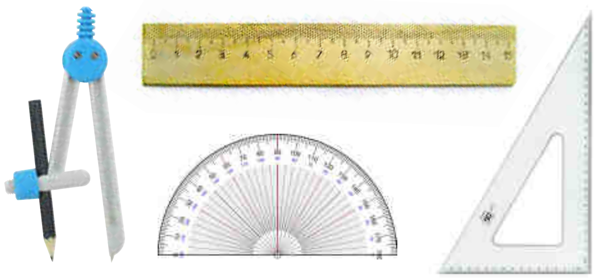
If you were running a race and you run past the one in second position, what position would you be in now?

Internet Resource

For more online support visit: **http://www.sheppardsoftware.com/math.htm**

UNIT 14

Types of Lines and Angles



Key unit competence

By the end of this topic, a learner should be able to identify types of lines and angles and use a protractor to measure angles.

Geometry is a branch of mathematics which deals with the measurement of shape and size of different figures.

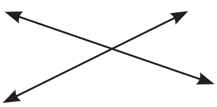
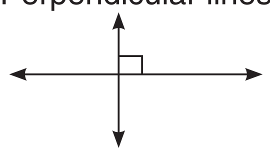
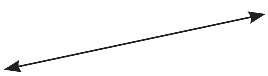
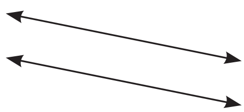
Attitudes and values

Appreciate the importance of lines and angles in daily activities, being confident and accurate when measuring lines and angles.

14.1 Lines

A line is a long straight mark which joins any two points. It has no end points. A line has no thickness and extends forever.

Types of lines: Observe and define the following lines

Intersecting lines	Perpendicular lines	Horizontal line
		
Vertical line	Oblique line	Parallel lines
		

- Parallel lines do not meet at all.
- Intersecting lines are lines which meet at a point.
- Perpendicular lines make an angle of 90˚.

Activity 14.1

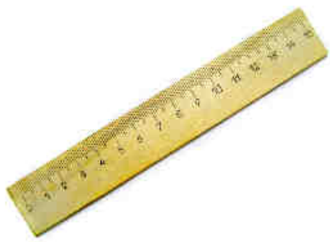
Using a geometry set, draw the following lines on a manila paper.

- 2 horizontal lines
- 2 vertical lines
- 2 intersecting lines
- 2 perpendicular lines
- 2 oblique lines not cutting each other
- 3 parallel lines

Label the lines according to their names.

14.2 Measuring the length of a line segment

A pair of compass and a ruler can be used to measure the length of line segment.



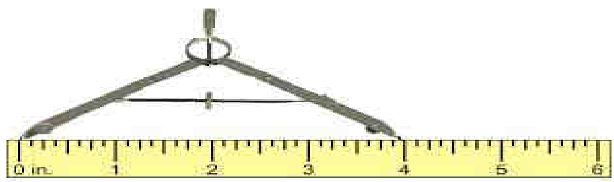
Activity: Consider the line segment AB shown in the diagram below.

Place one arm of the compass at point A.

Extend the second arm of the compass up to point B.

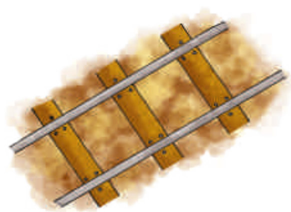
Transfer the compass on to a ruler as shown below.

The length of the line segment can be read from the ruler.

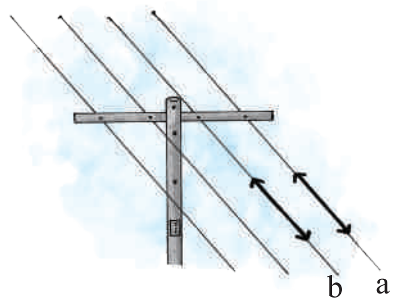


Example 14.1

(a) Railway track is an example of parallel lines.



(b) Aluminium wires in electric poles are examples of parallel lines.



a // b

Exercise 14.1

1. Measure the length of the following line segments by the help of a ruler.

   (a)

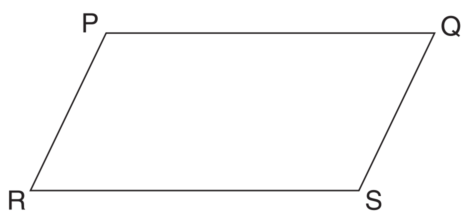
   (b)

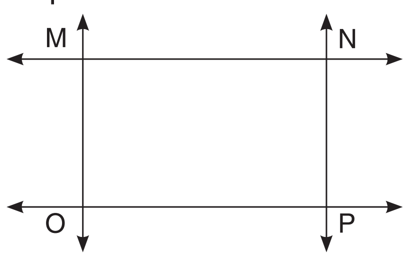
   (c)

   (d)

   (e)

2. In each diagram below, name the pairs of parallel lines that exist.





PQ || ______

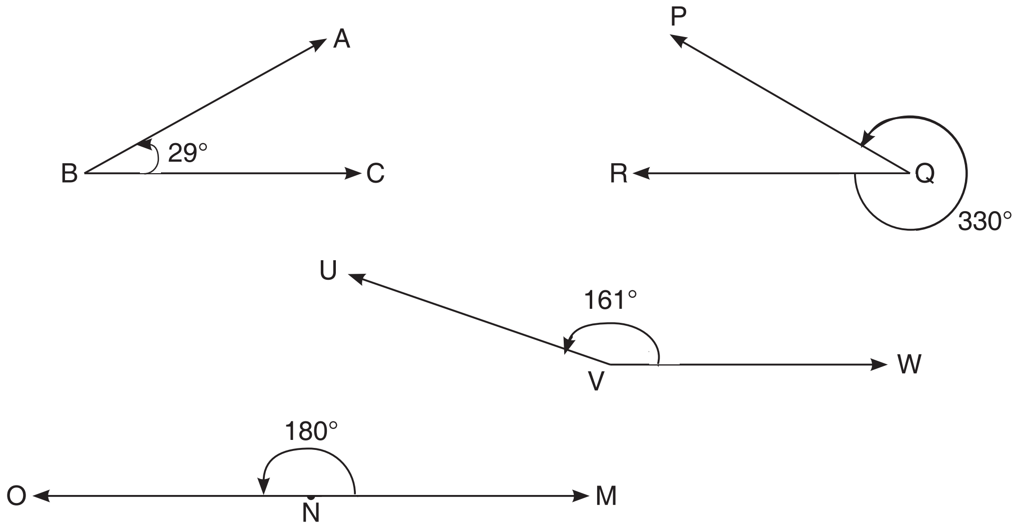
______ || QS

MN || ______

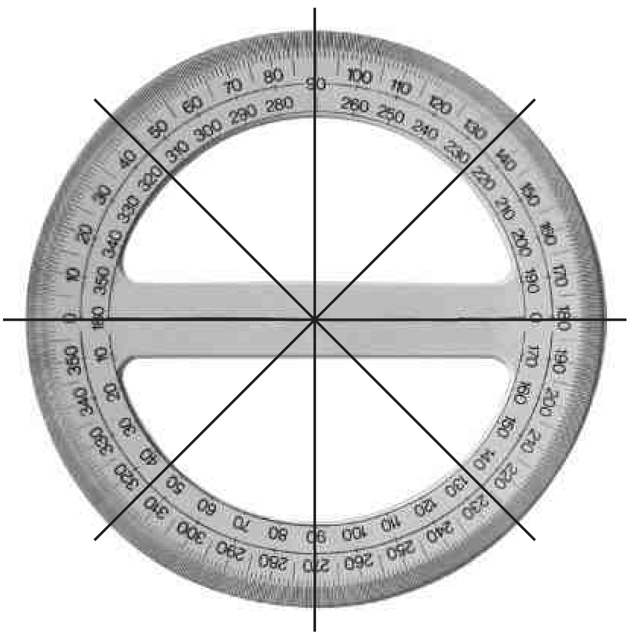
MO || ______

14.3 Angles

An angle is the measure of the amount of turn from one direction to another. An angle is the measure of the space between two intersecting lines. We use an anticlockwise direction.

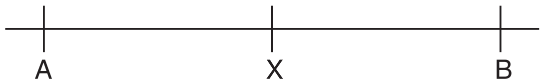


The unit for measuring an angle is known as '**degree**'. A degree is written in short as (°). If you draw a circle and divide the circle into equal parts using 180 diameters, then the amount of turn from one diameter to the other diameter is 1 degree or 1˚.



Activity 14.2

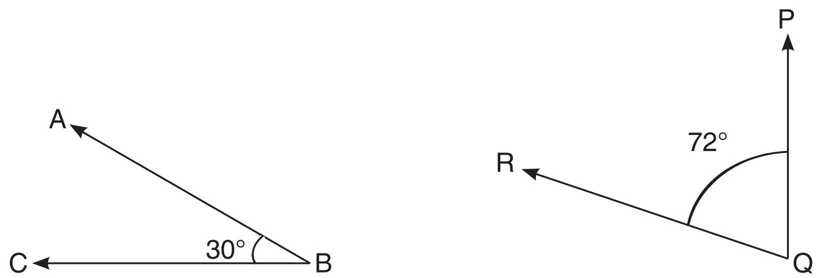
Draw a straight line AB



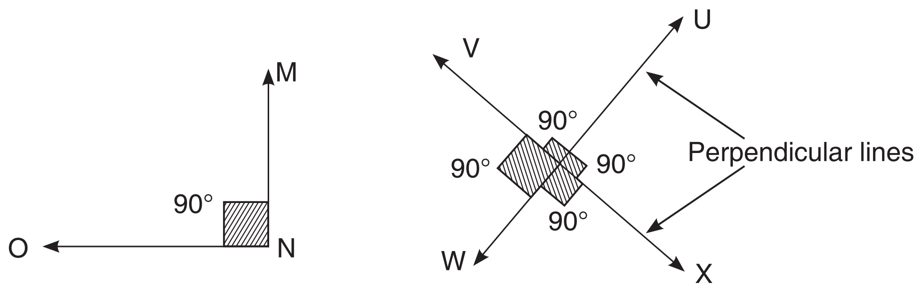
Mark a point 'X' at the centre of the line segment AB. Use a protractor to measure AXB. What will be the size of angle AXB?

14.4. Types of angles

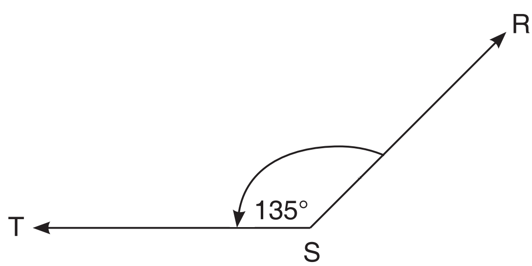
(a) Acute angle: This is an angle which is greater than 0˚ but less than 90˚. Examples of acute angles are 30˚ and 72˚.



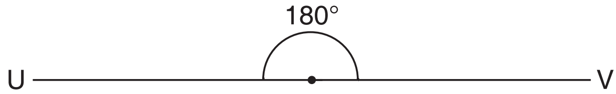
(b) Right angle: This is an angle which is formed by intersection of two straight perpendicular lines. The measure of a right angle is 90˚.



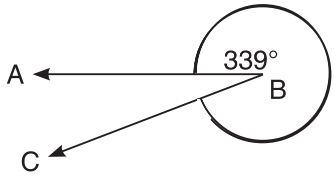
(c) Obtuse angle: This is an angle which is greater than 90˚ but less than 180˚. Example of obtuse angle is 135˚.

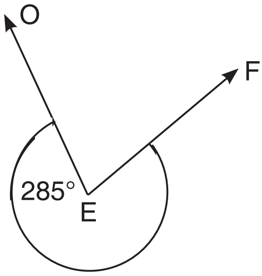


(d) Straight angle: This is the angle whose value is exactly 180˚. A straight angle is formed when two straight lines meet end to end and form one straight line.

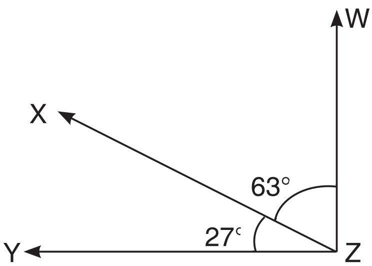


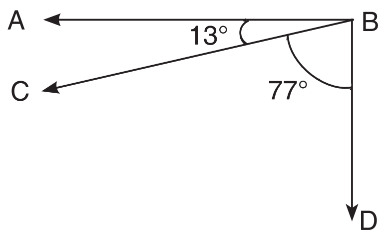
(e) Reflex angle: This is an angle whose value is greater than 180˚ but less than 360˚. Examples of reflex angles are 339˚ and 285˚.



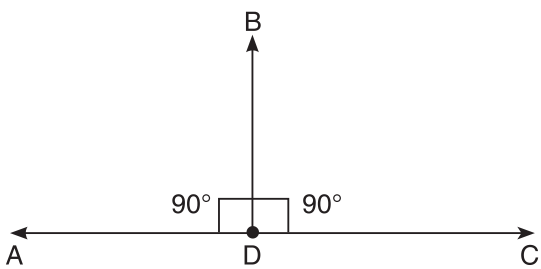


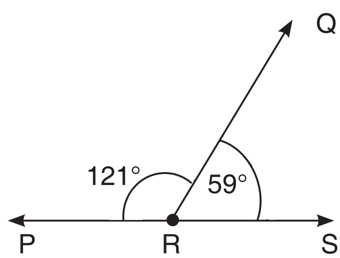
(f) Complementary angles: These are two angles which add up to 90˚. For example 27˚ and 63˚ are complementary angles as 27˚ + 63˚ = 90˚. We can say, the complement of 27˚ is 63˚ and the complement of 63˚ is 27˚.

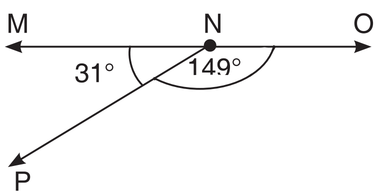




(g) Supplementary angles: These are the angles which add up to 180˚. For example 90˚ and 90˚ have a sum of 180˚. So, they are supplementary angles. Other examples of supplementary angles are 121˚ and 59˚, 31˚ and 149˚.







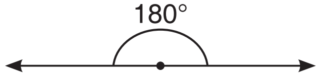
Activity 14.3

1. Do you see any objects that form right angles in your classroom? Name them.
2. Compare your list with your classmates.

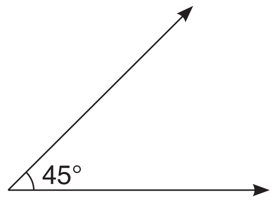
Exercise 14.2

1. Name the following angles.

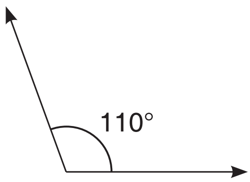
(a)



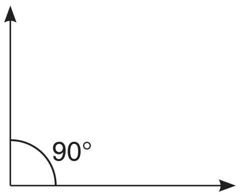
(b)



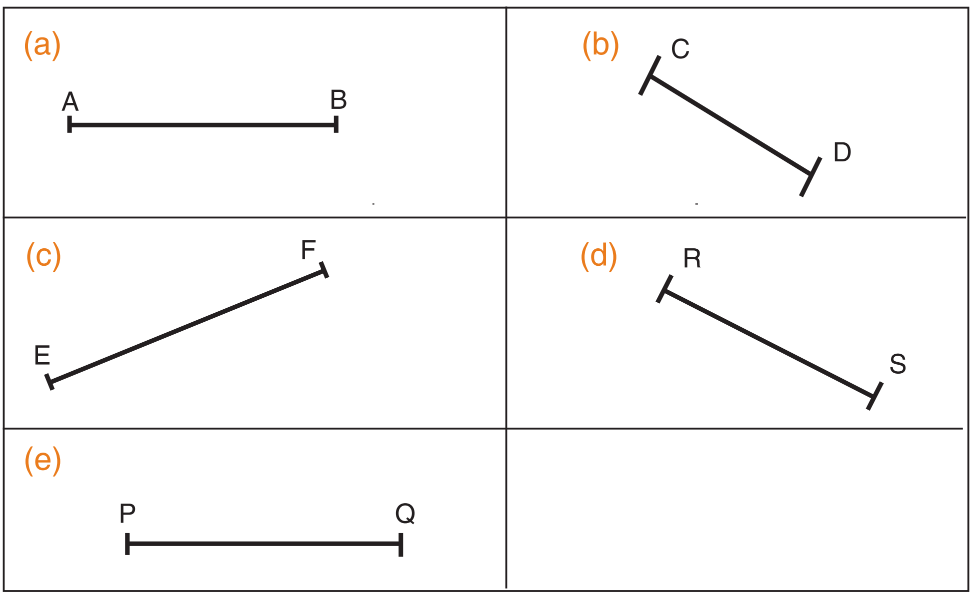
(c)



(d)

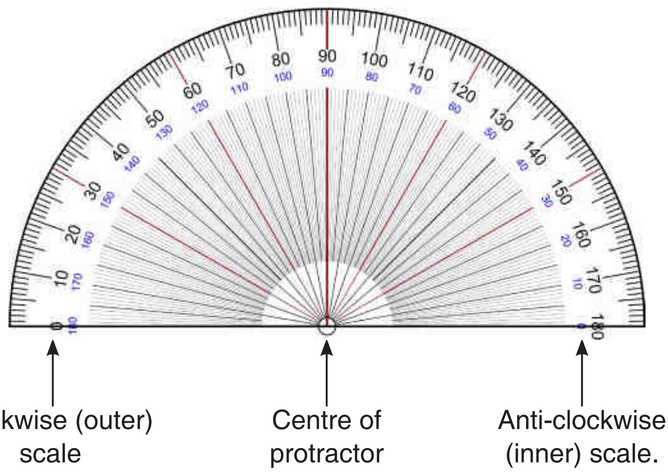


2. Using Set squares and a Ruler, draw perpendicular lines to the given lines below.



14.5 Measuring Angles

The instrument used for measuring an angle is called a **protractor**.

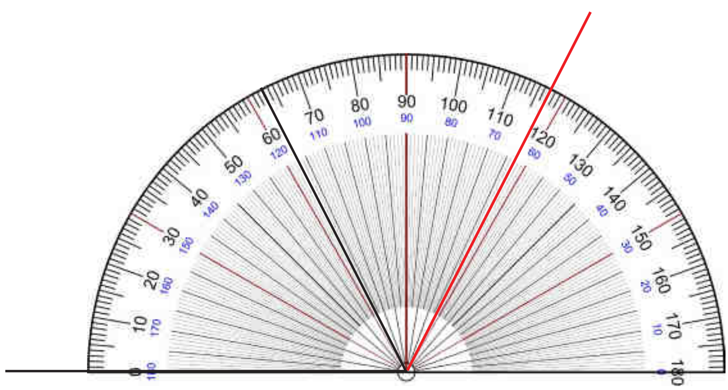


The above protractor can be used to measure angles from 0° up to 180°. Angles can be measured either in a clockwise sense or anti-clockwise sense depending on where the angle is drawn.

- When measuring the angle between two intersecting lines, we place the protractor so that its centre is at the point of intersection of the two lines.
- We adjust the protractor so that the horizontal line on it runs along one of the lines.
- We measure the angle by counting the number of degrees from one line to the next line.

Measure the following angles with the help of Protractor

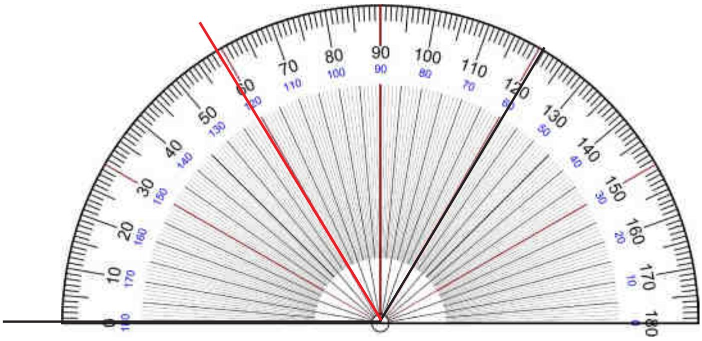
▸ **Example 14.2**



Solution

The acute angle between the two lines = 63˚.

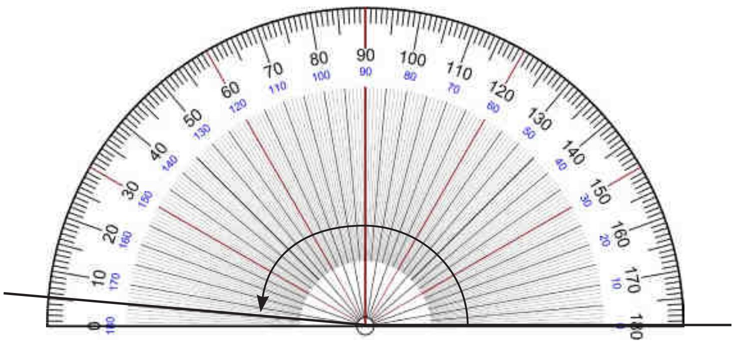
Example 14.3



Solution

The angle between the two lines is obtuse. We measure it by using the anticlockwise scale of the protractor. The size of this angle is 121˚.

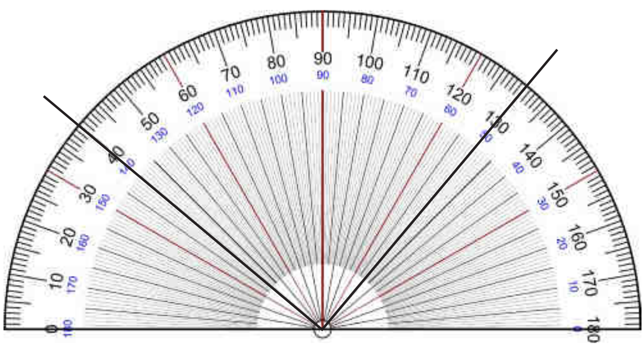
Example 14.4



Solution

The angle between the two lines is measured using the anti-clockwise scale and its value is 175˚.

Example 14.5



Solution

The angle between the two lines = 130° – 40° = 90°.

Alternatively, the angle = 140° – 50° = 90°.

Activity 14.4

In this activity you will make your own protractor.

You will need the following materials:

- Manila paper
- Pencil
- Markers
- Pair of scissors
- Math set
- Paper glue
- Blackboard protractor

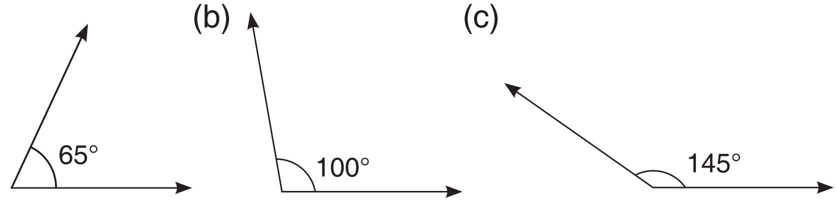
1. Place the Manila paper on a large table and spread it flat on the table.
2. Place the blackboard protractor in the middle of the Manila paper.
3. Trace the outline of the protractor on the Manila paper using a pencil.
4. Draw short marks on the manila paper corresponding to the following angles: 0°, 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°, 100°, 110°, 120°, 130°, 140°, 150°, 160°, 170° and 180°.
5. Remove the protractor and mark a point which represents the point where all lines meet on a protractor.
6. Redraw the lines using a marker.
7. Carefully cut out your Manila protractor using a pair of scissor or any other useful tool.
8. Cut another piece of Manila paper which is identical to your Manila protractor. Use paper glue to attach this Manila paper under your Manila protractor.

   You now have a strong Manila protractor.
9. Use your Manila paper to measure different angles in your class room including the angles at the edges of your table, book etc.

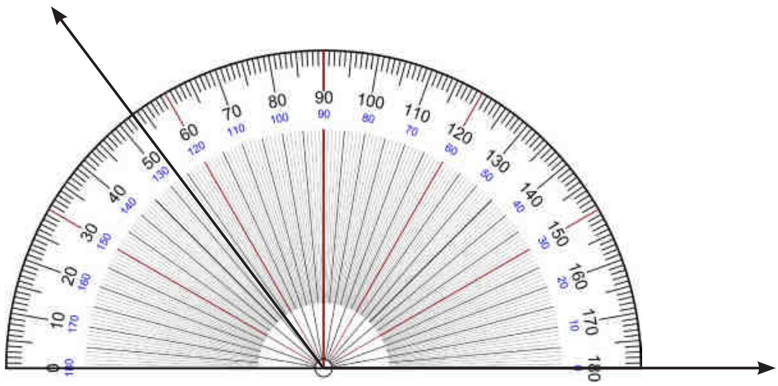
Assessment Exercise

1. Name the following angles:

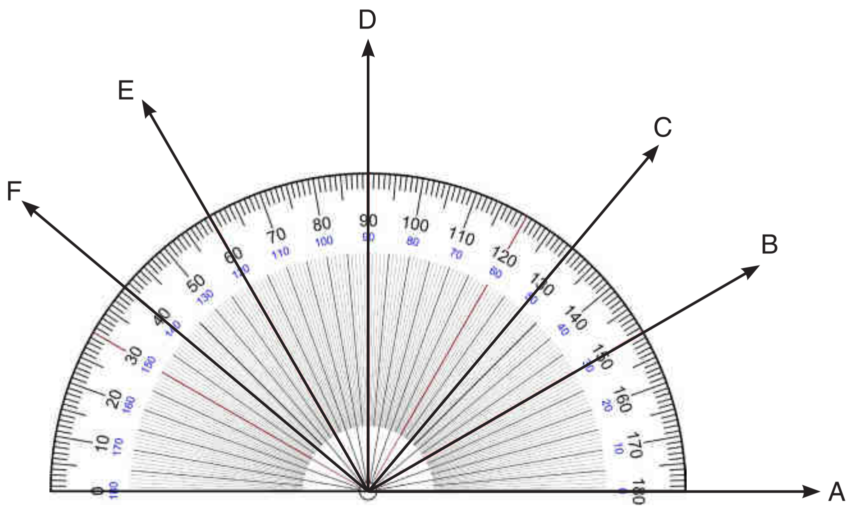
(a) (b) (c)



2. What is the value of the angle shown below in anticlockwise direction?



3. In the figure below, the protractor is used to measure many angles at once. Find the angle between;



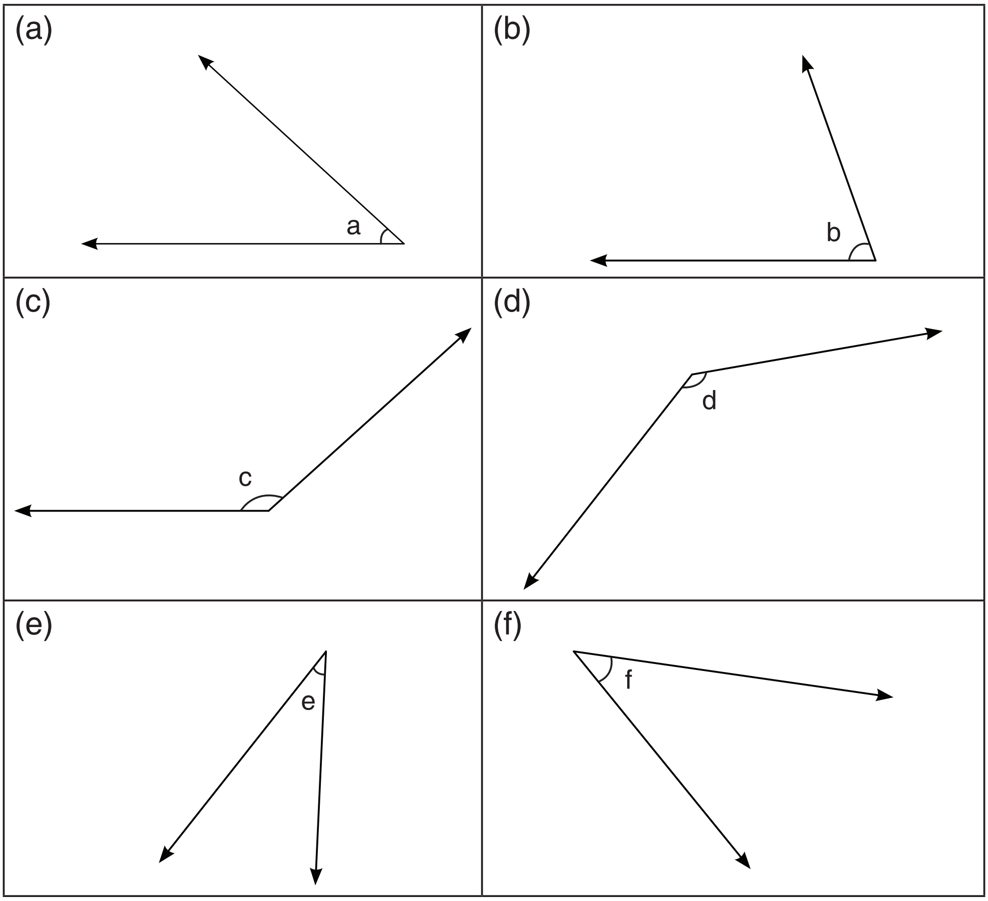
(a) Line A and line F

(b) Line B and line C

(c) Line D and line A

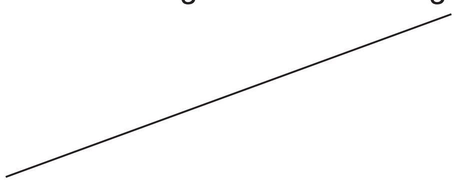
(d) Line B and line E

4. Here are some angles marked using letters a, b, c, d, e and f. Using a protractor, measure and record the angles in degrees.



5. Measure the length of the following line segments by the help of ruler.

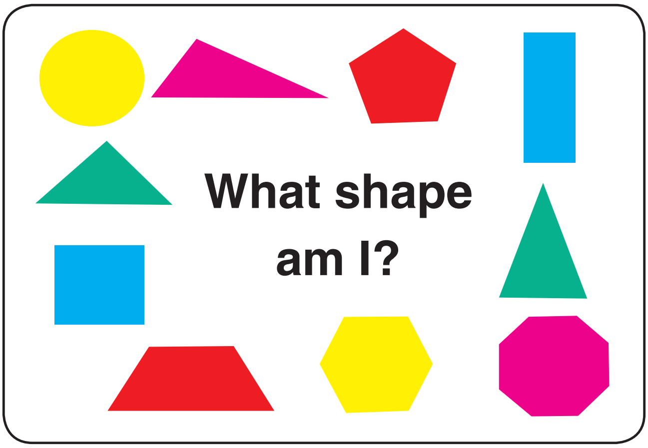
(a)



(b)

UNIT 15

2D Shapes and their Properties



Key Unit Competency

A learner should be able to use geometric properties to classify shapes.

Attitudes and values

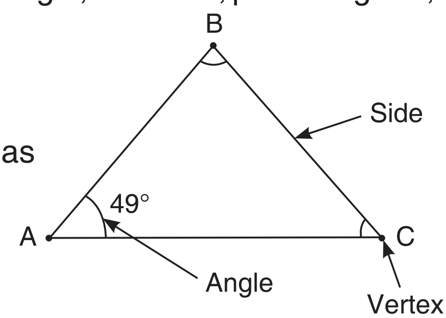
Appreciate the use of properties to distinguish shapes and recognise that special quadrilaterals are a subset of all quadrilaterals.

15.1 2D Shapes

2D shapes/figures are two dimensional shapes or figures. These shapes have only two dimensions, i.e., length and width. They do not have thickness. Examples of 2D shapes are triangle, square, rectangle, rhombus, parallelogram, kite, trapezium, pentagon, etc.

15.2 Triangle

A triangle is a closed three sided figure. It has three angles and three sides.



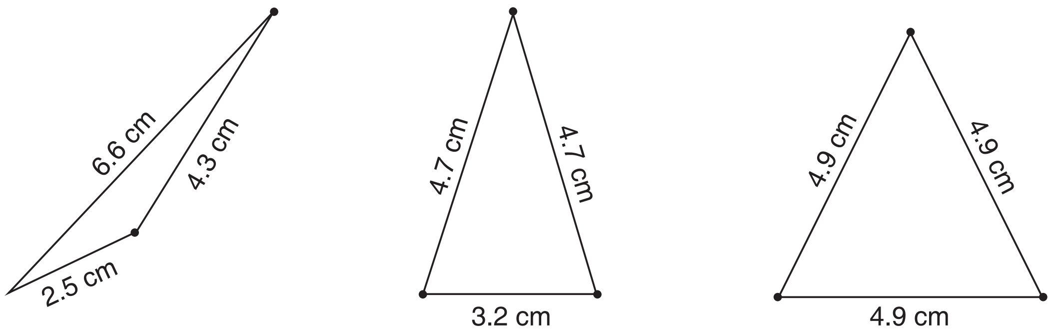
Vertex

A vertex is a point where any two sides meet. The plural of vertex is vertices. So, a triangle has 3 sides, 3 vertices and 3 angles.

Types of triangles

Triangles can be classified according to their sides or angles.

Triangles in terms of sides



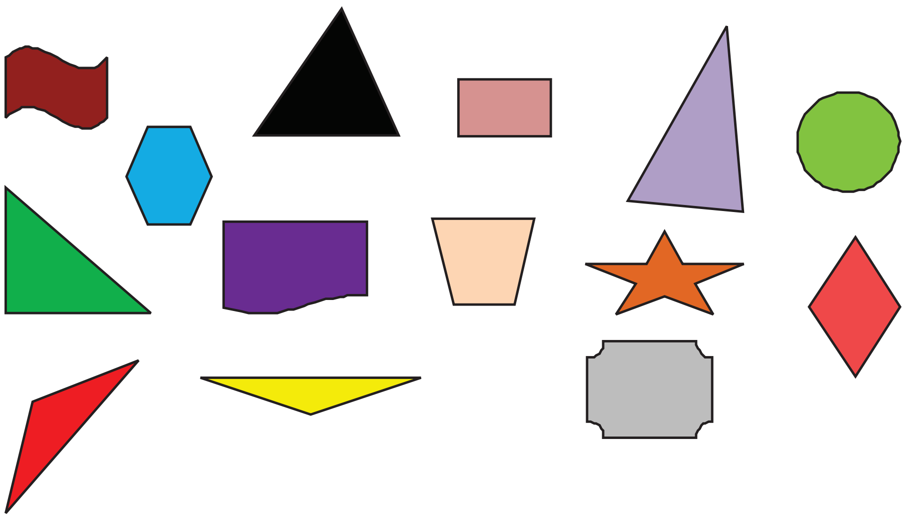
Scalene triangle **Isosceles triangle** **Equilateral triangle**

- A scalene triangle is a triangle in which all sides are unequal.
- An isosceles triangle is a triangle in which two sides are equal.
- An equilateral triangle is a triangle in which all sides are equal.

Activity 15.1

Complete this activity in groups of 5 learners

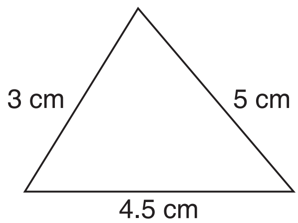
- You are provided with the following paper/card objects:

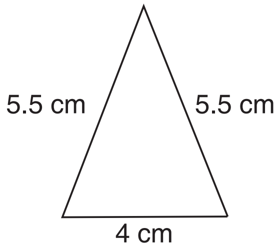


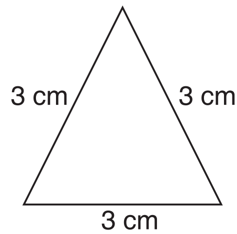
- Identify the triangles by putting them separately from the other paper objects.
- How many sides does a triangle have?
- How many angles does a triangle have?
- How many vertices does a triangle have?

Example 15.1

Write the names of the triangles in terms of their sides.

(a) 

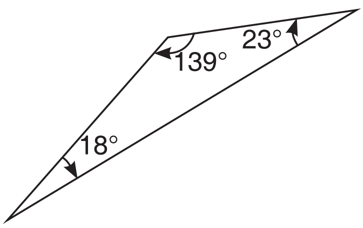
(b) 

(c) 

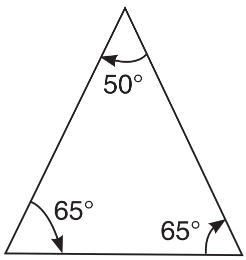
Solution

(a) Scalene triangle (b) Isosceles triangle (c) Equilateral triangle

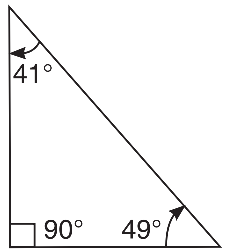
Triangles in terms of angles



Obtuse angled triangle



Acute angled triangle

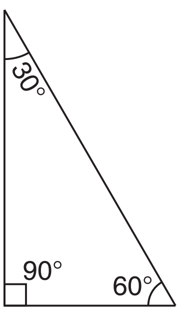


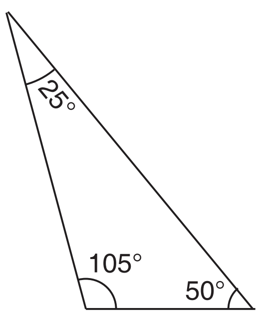
Right angled triangle

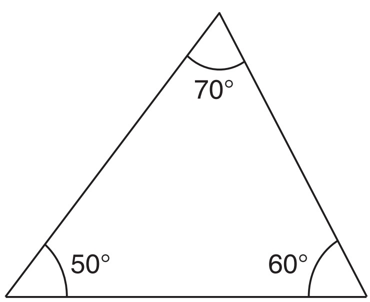
- Obtuse angled triangle is a triangle in which one angle is obtuse, i.e., more than 90°.
- Acute angled triangle is a triangle in which all the angles are acute, i.e., less than 90˚.
- Right angled triangle is a triangle in which one angle is a right angle (90°).

Example 15.2

Write the names of the triangles in terms of their angles.

(a) 

(b) 

(c) 

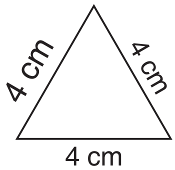
Solution

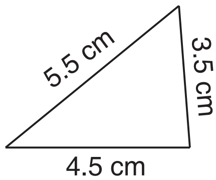
(a) Right angled triangle (b) Obtuse angled triangle

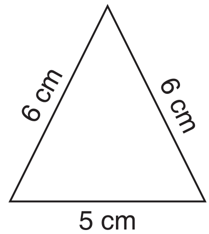
(c) Acute angled triangle

Exercise 15.1

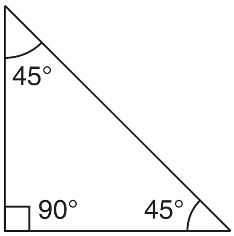
1. Write the names of the triangles in terms of their sides.

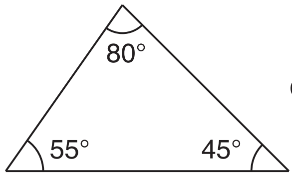
(a) 

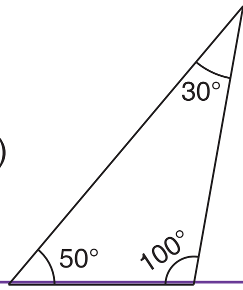
(b) 

(c) 

2. Write the names of the triangles in terms of their angles.

(a) 

(b) 

c) 

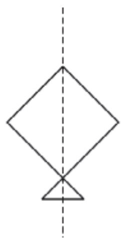
15.3 Quadrilaterals

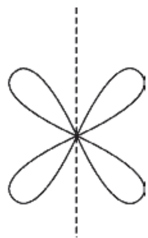
A closed plane figure bounded by line-segment is called a polygon. The line segments are called its sides and the points of intersection of consecutive sides are called vertices. Line segments joining non-consecutive vertices are called diagonals.

Activity 15.2

(a) Look at the following plane figures:


(a)

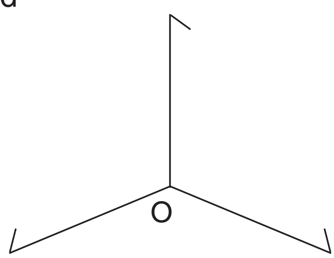

(b)


(c)

From the above figures we observe that if these figures are folded along a specific line (dotted line). Each figure on the left hand of the dotted line fits exactly on the figure on the right hand side of dotted line.

Therefore, if a figure is divided into two coincident parts (mirror images) by a line, then the figure is called symmetrical about that line and the line is called the **line of symmetry.**

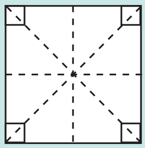
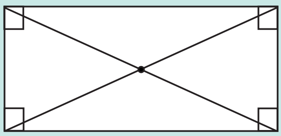
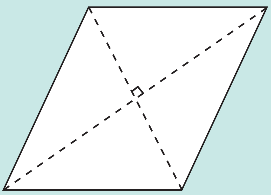
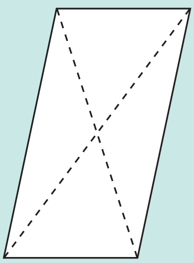
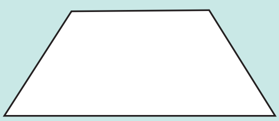
(b) Look at the following figure:

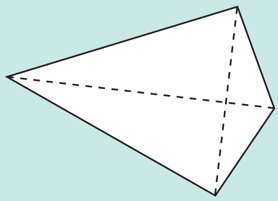


The figure shown above does not have any lines of symmetry or point of symmetry. Yet it seems balanced and has regularity of shape.

Let this figure be rotated through one complete turn (clockwise or anticlockwise) about a point O. These are three occasions when it looks the same as it did in its starting positions these are when it has been rotated through 120°, 240° and 360°. We say that this figure has a rotational symmetry of order 3.

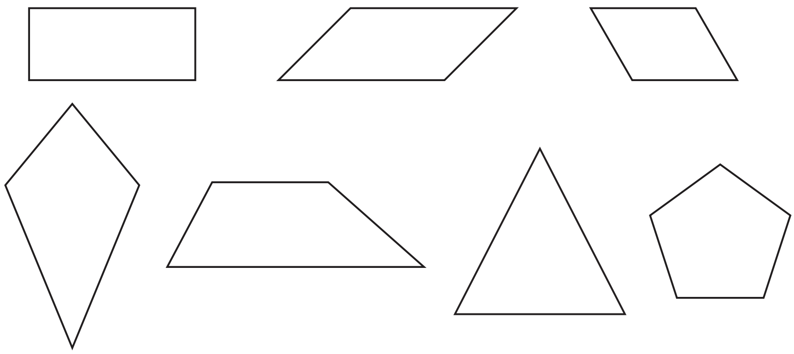
Definition: A quadrilateral is a 4 sided, closed and 2 dimensional figure.

Quadrilateral	Appearance	Sides and diagonals	Lines of symmetry	Order of Rotational symmetry
Square		All sides are equal. All angles are 90°. Diagonals are equal and bisect at right angles.	It has 4 lines of symmetry	4
Rectangle		The opposite sides are equal. All angles are 90°. Diagonals are equal. They bisect but not at right angles.	It has 2 lines of symmetry	2
Rhombus		Two angles are obtuse and the other two are acute. All sides are equal. Diagonals bisect each other at 90°.	2 lines of symmetry.	2
Parallelogram		Two opposite sides are equal. Diagonals are not equal. They bisect each other.	No line of symmetry	2
Trapezium		Two opposite sides are parallel but the other two aren't. Diagonals do not bisect.	None	None

Kite		Diagonals aren't equal in length but they intersect at 90°.	One line of symmetry	None

Activity 15.3

Identify the 2D shapes given below by writing their names on each shape:



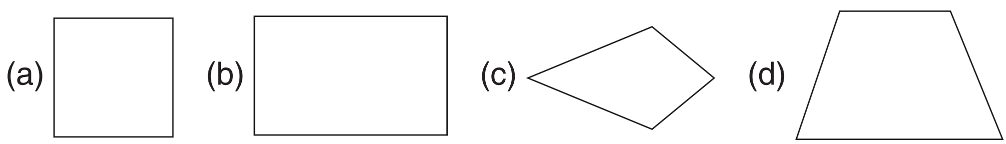
Activity 15.4

(a) Move around your classroom, library and the whole school compound. Identify atleast 10 objects which have two dimensional (2D) shapes.

(b) With reasons, explain to your classmates whether the object is a square, rectangle, rhombus, trapezium, triangle, etc.

Example 15.3

How many lines of symmetry are there in the following shapes?

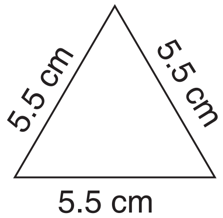


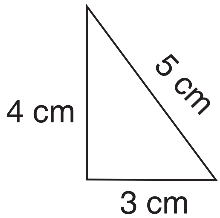
Solution

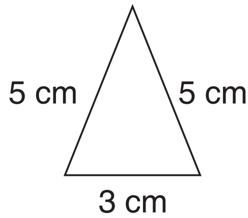
(a) 4 (b) 2 (c) 1 (d) None

Assessment Exercise

1. Name the triangle in terms of their sides.

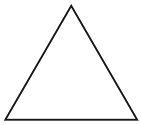
(a) 

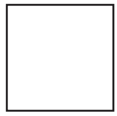
(b) 

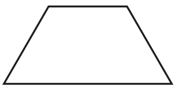
(c) 

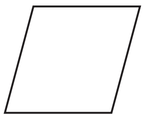
2. Which of the following shapes are: triangle, square, rectangle, rhombus, parallelogram, kite, trapezium or pentagon.

(a) 

(b) 

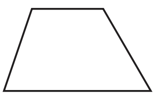
(c) 

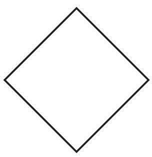
(d) 

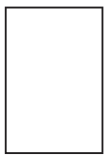
(e) 

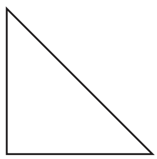
(f) 

3. How many lines of symmetry are there in the following shapes:

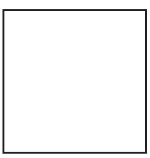
(a) 

(b) 

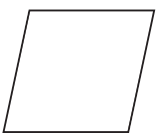
(c) 

(d) 

4. Write the order of rotational symmetry in the following figures.

(a) 

(b) 

(c) 

(d) 

UNIT 16 Area and Perimeter of 2D Shapes

Key unit competence

By the end of this unit, a learner should be able to use area of rectangle to determine the area of a triangle and other shapes.

Attitudes and values

Appreciate that the relationship between area and perimeter.

16.1 Area

Area is defined as the amount of space inside the boundary of a flat (2-Dimensional) object such as triangle, square, circle etc.

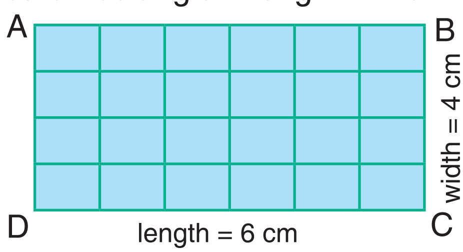
The area of a closed figure is the measure of the surface enclosed by it.

16.2 Area of Rectangle

Activity 16.1

In this class activity, you will determine the area of a rectangle by counting the number of square grids in the rectangle.

1. Draw a rectangle of length 6 cm and width 4 cm on a graph paper.
2. Divide the rectangle into grids by dividing the length into 6 equal parts and width into 4 equal parts.
3. Count the total number of squares formed in the rectangle, *i.e.*, 24. This is equal to the area of the rectangle.
4. Now, $6 \times 4 = 24$ which is equal to the area of rectangle.
5. Thus, we find the area of rectangle = length × width



Area of rectangle = length x width

Example 16.1

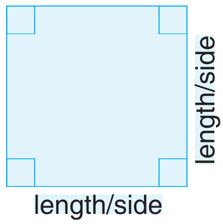
A rectangular football field measures 100 m by 70 m. What is the area of the field?

Solution

Area = length x width = 100 m x 70 m = 7 000 m^2.

16.3 Area of a Square

As we have seen in above activity that area of rectangle is length × width. Area of square is defined as, the number of square units it takes to completely fill a square. In square all four sides are equal. So, area of square is length × length.



Area of a square = length × length or side × side

Example 16.2

A piece of land is in the form of a square. Its side is 200 m long. What is its area?

Solution

Area of square= side x side

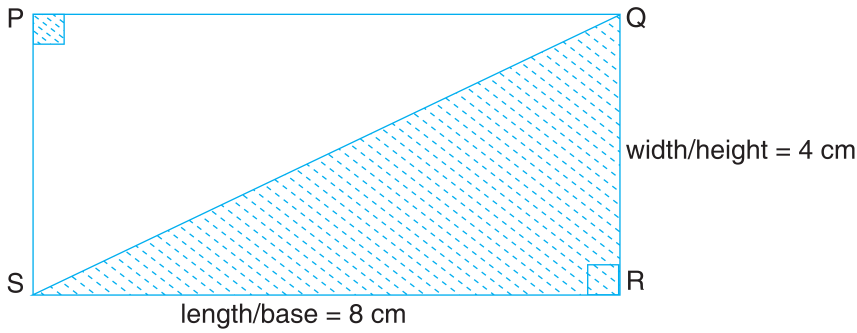
Area of square= 200 m x 200 m= 40 000 m^2

16.4 Area of Triangle

Activity 16.2

In this class activity, you are going to find the area of a triangle from a rectangle.

1. Draw a rectangle of length 8 cm by 4 cm on a graph paper.
2. Divide this rectangle into thirty two 1 cm^2 grids. The area of this rectangle is 32 cm^2.
3. Cut out this rectangle using a pair of scissors along one of its diagonal.
4. This forms two equal triangles.
5. What is the area of each triangle?
6. How does the area of the triangle relate to the area of the rectangle? Now, let's look at the formula.



In the figure above, PSRQ is a rectangle with length 8 cm and width 4 cm. SQR is a triangle with base 8 cm and height 4 cm.

$$\text{Area of rectangle PSRQ} = (\text{length} \times \text{width}) = 8 \text{ cm} \times 4 \text{ cm}$$
$$= 32 \text{ cm}^2$$

The shaded part is a triangle. The area of the triangle is half the area of the rectangle.

$$\text{Area of triangle SRQ} = \frac{1}{2} \times (\text{length x width})$$
$$\text{Area of triangle SRQ} = \frac{1}{2} \times 8 \text{ cm x } 4 \text{ cm}$$
$$= \frac{1}{2} \times 32 = 16 \text{ cm}^2$$

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

The height of a triangle makes an angle of 90° with the base.

Example 16.3

A triangle has an area of 100 cm^2 and a base of 10 cm. What is the height of the triangle?

Solution

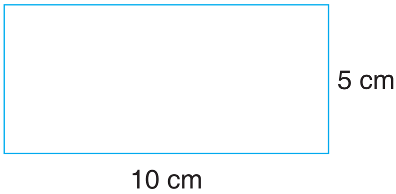
$$\text{Area} = 100 \text{ cm}^2 \text{ and base} = 10 \text{ cm}$$
$$\text{Area of triangle (A)} = \frac{1}{2} \times \text{base} \times \text{height},$$
$$\text{height} = \frac{2A}{\text{base}} = \frac{2 \times 100}{10} = 20 \text{ cm}$$

So, the height of the triangle = 20 cm

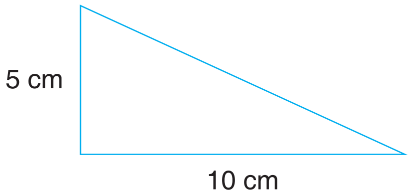
Exercise 16.1

Calculate the area of the following 2D shapes:

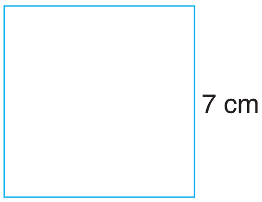
(a)



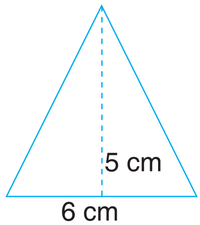
(b)



(c)



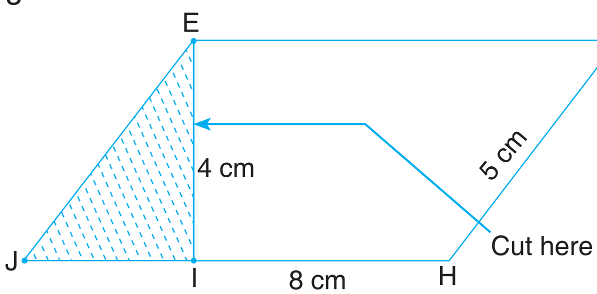
(d)



16.6 Area of Parallelogram

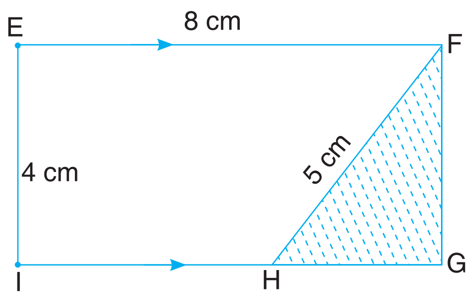
Activity 16.3

Consider the parallelogram JHFE of base 8 cm, height 4 cm and width 5 cm as shown in the diagram below:



If we cut the parallelogram along the height, we get the shaded part EJI. We can paste the shaded part to the right hand side of HF.

The new figure formed is EIGF as shown in the figure below:



The figure EIGF is a rectangle of length 8 cm and width 4 cm.

So, the area of the parallelogram EJHF = area of rectangle EIGF.

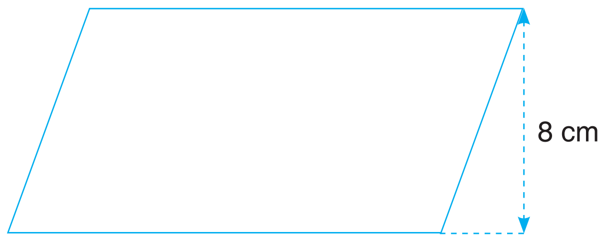
Area of parallelogram = base x height

Note: The height of the parallelogram is perpendicular to the base.

Area of the given parallelogram = 8 cm x 4 cm = 32 cm^2

Example 16.4

Find the area of the parallelogram given below:



Solution

$$\begin{aligned}
\text{Area of the parallelogram} &= \text{base} \times \text{height} \\
\text{Base of the parallelogram} &= 20 \text{ cm} \\
\text{Height of the parallelogram} &= 8 \text{ cm} \\
&= 20 \times 8 \\
&= 160 \text{ cm}^2
\end{aligned}$$

Activity 16.4

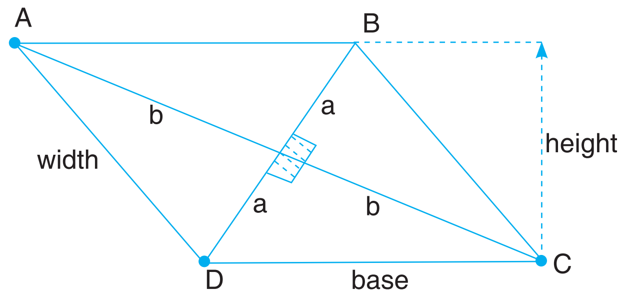
In pairs,

- Draw a triangle and a rhombus whose perimeter is 36cm.
- Draw a triangle and a rhombus whose area is 36cm^2.

16.7 Area of a Rhombus

A rhombus is a special type of parallelogram in which all the sides are equal and the diagonals bisect each other at right angle. The area of a rhombus can be given by the formula:

Area of rhombus = base x height



AC and DB are diagonals. AC = 2b and DB = 2a. The two diagonals divide the rhombus into four equal right angled triangles. Each right angled triangle has a base **b** and height **a**.

$$\text{Area of rhombus} = 4 \times \text{area of one right angled triangle}$$

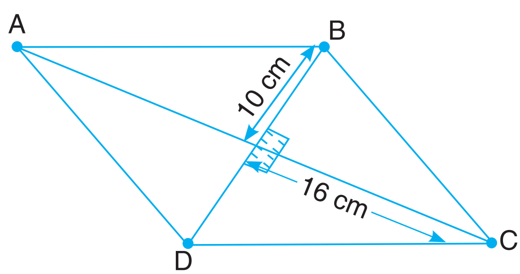
$$\text{Area of rhombus} = 4 \times (\frac{1}{2} \times \text{base} \times \text{height}) = 2 \times (b \times a)$$

$$= \frac{1}{2} \times 2b \times 2a = \frac{1}{2} \times AC \times BD$$

$$\boxed{\textbf{Area of rhombus} = \frac{1}{2} \times \textbf{product of diagonals}}$$

Example 16.5

A rhombus has diagonals of lengths 20 cm and 32 cm as shown below. Calculate the area of the rhombus.



Solution

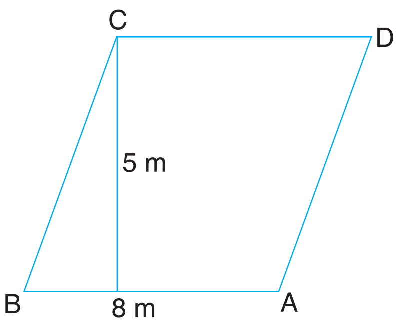
$$\text{Area of rhombus} = \frac{1}{2} \times \text{product of diagonals} = \frac{1}{2} \times 20 \times 32$$

$$= 320 \text{ cm}^2$$

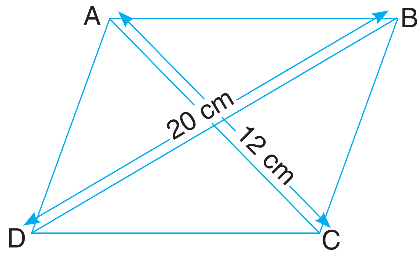
Exercise 16.2

Calculate the area of the figures given below.

(a)



(b)

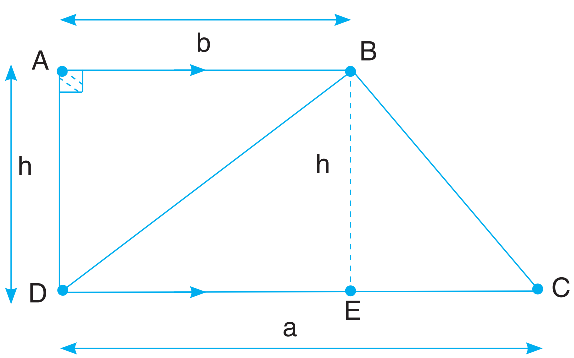


Activity 16.5

- Use a squared paper to draw a rectangle of length 6 units and height 4 units.
- Use a squared paper to draw a right angled triangle of base 3cm and height 4cm.
- By counting the number of squares, find the area of the rectangle and the area of the triangle.
- Join the two shapes together to form one figure. What is the name of this new figure formed?
- By counting the number of squares, find the area of the new figure formed.
- What have you learnt from this activity? Discuss your finding with your teacher.

16.8 Area of a Trapezium

A trapezium can be divided into two triangles. This makes it easy for the area to be calculated.



ADCB is a trapezium. Line DB is a diagonal of the trapezium. It divides the trapezium into two triangles namely ADB and DCB.

Area of trapezium = Area of triangle ADB + Area of triangle DCB

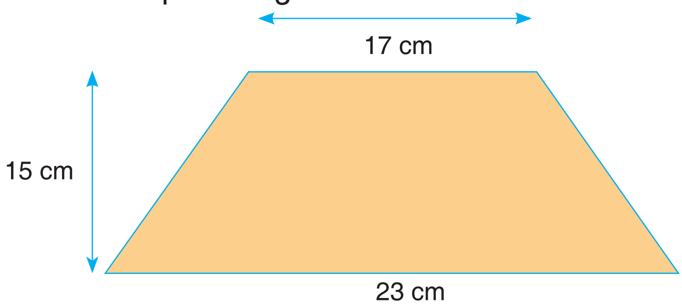
$$= \frac{1}{2}(b \times h) + \frac{1}{2}(a \times h)$$

$$\text{Area of trapezium} = \frac{1}{2} \times h\,(a + b)$$

$$\boxed{\textbf{Area of trapezium} = \frac{1}{2} \times \textbf{(sum of parallel sides)} \times \textbf{height}}$$

Example 16.6

Find the area of the trapezium given below.



Solution

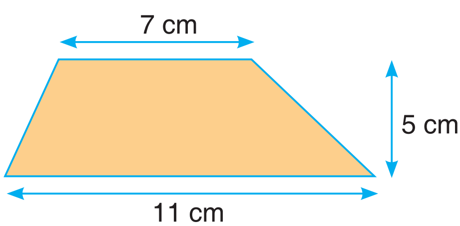
$$\text{Area of trapezium} = \frac{1}{2} \times (a + b) \times h$$

$$= \frac{1}{2} \times (23 + 17) \times 15 = 300 \text{ cm}^2.$$

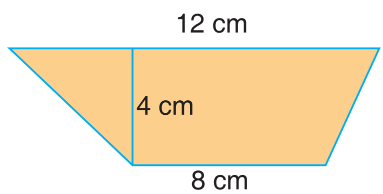
Exercise 16.3

What is the area of the trapezium given below?

(a)



(b)

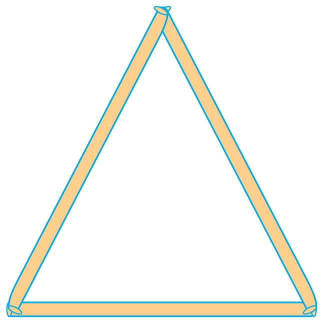


16.9 Perimeter

The perimeter of a closed figure is the total distance around the given figure.

Activity 16.6

In this class activity, you will use straws to draw a triangle and you will find its perimeter.



(a) You are provided with ordinary drinking straws.

(b) Cut three straws such that each one has a length of 8 cm.

(c) Join these straws to form a triangle.

(d) What is the perimeter of the triangle?

Activity 16.7

In this activity, you are going to design a square, rectangle, rhombus, parallelogram and trapezium whose perimeter is 24 cm. You can use straws to design these shapes.

To design a rectangle or parallelogram, you need

- 2 straws each of 4 cm long and
- 2 straws each of 8 cm long

$$\begin{aligned} \text{So, perimeter} &= 2 \times 4 + 2 \times 8 \\ &= 2\,(4 + 8) \\ &= 2 \times 12 \\ &= 24 \text{ cm} \end{aligned}$$

Therefore, Perimeter of rectangle = 2 (length + width)

Perimeter of parallelogram = 2 (length + width)

Now, to design a square or rhombus, you need

- 4 straws each of 6 cm long

$$\text{So, Perimeter} = 6 + 6 + 6 + 6$$

$= 4 \times 6 = 24$ cm

Therefore, Perimeter of square $= 4 \times$ side

Perimeter of rhombus $= 4 \times$ side

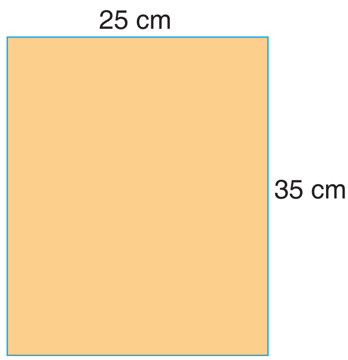
Since, the sides of a trapezium are different in length.

Therefore, Perimeter of trapezium = sum of all the sides.

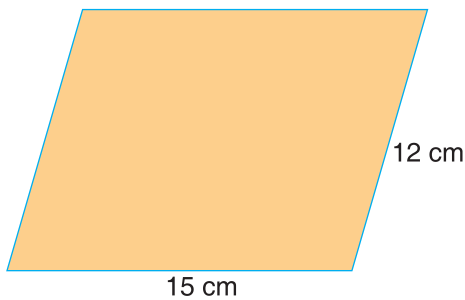
Example 16.7

Find the perimeter of the rectangle and parallelogram given below:

(a)



(b)



Solution

(a) Perimeter of rectangle $= 2(25 + 35)$

$= 120$ cm

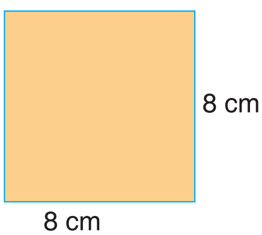
(b) Perimeter of parallelogram $= 2\ (15 + 12)$

$= 54$ cm

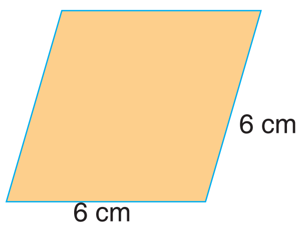
Example 16.8

Find the perimeter of the square and rhombus given below.

(a)



(b)



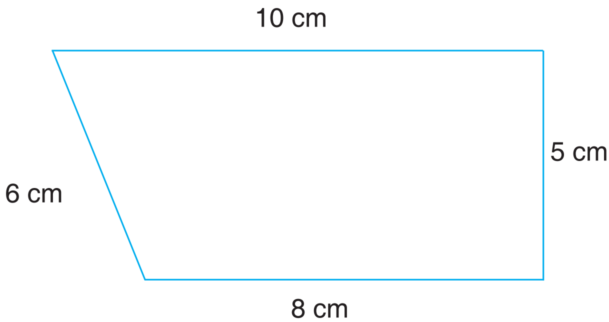
Solution

(a) Perimeter of square $= 4 \times$ side $= 4 \times 8 = 32$ cm

(b) Perimeter of rhombus $= 4 \times$ side $= 4 \times 6 = 24$ cm

Example 16.9

Find the perimeter of the given trapezium.

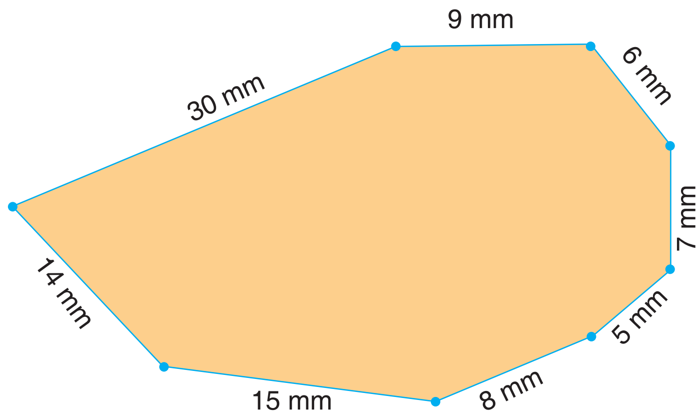


Solution

Perimeter of trapezium = 10 + 5 + 8 + 6 = 29 cm

Example 16.10

Calculate the perimeter of the shape given below.

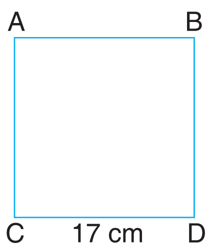


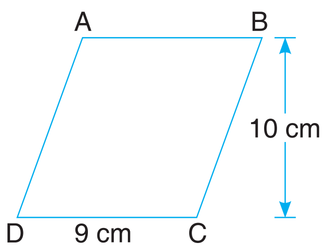
Solution

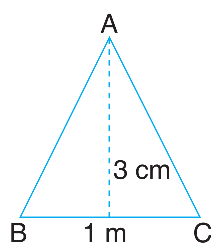
Perimeter = 30 mm + 9 mm + 6 mm + 7 mm + 5 mm + 8 mm + 15 mm + 14 mm = 94 mm

Assessment Exercise

1. Find the area of the following shapes.

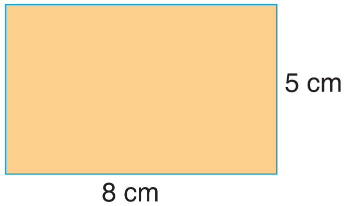
(a) 

(b) 

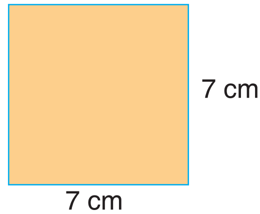
(c) 

2. Calculate the perimeter of the shapes given below.

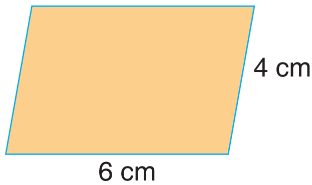
(a)



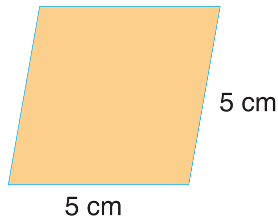
(b)



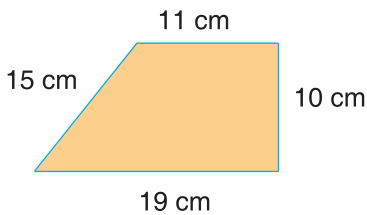
(c)



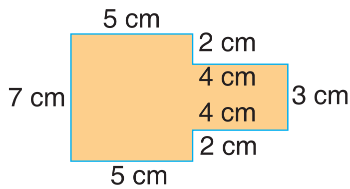
(d)



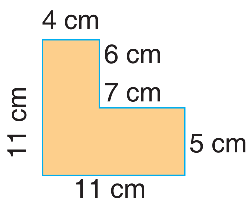
(e)



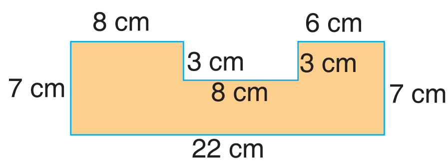
(f)



(g)



(h)



Internet Resource

Visit http://www.sheppardsoftware.com/math.htm

UNIT 17

Elementary Statistics

Key unit competence

By the end of this unit, you should be able to collect, represent and interpret data.

Attitudes and values

- Appreciate the importance of data collection in daily life situations.
- Appreciate the importance of interpreting and extracting information from tables.
- Appreciate the importance of statistics tables and graphs in daily life situations

17.1 Statistics and data

It is the branch of mathematics which deals with collection, representation, interpretation and retrieval of data.

Meaning of data

A collection of information in the form of numerical figures is called data. Examples of data are:

- Ages of pupils in P4 in our class.
- Heights of all pupils in our school.
- Masses of goats in a market.
- Prices of milk in different markets.
- Number of children born in Rwanda per day.

17.2 Qualitative and Quantitative data

Quantitative data is the type of data which can be expressed in terms of numbers. For example:

- Number of cars that pass through a certain town per day.
- Number of pregnant cows in a kraal.
- Marks obtained by pupils in a Math test.
- Ages of people in a market

Qualitative data is a type of data which cannot be expressed in terms of numbers. In other words, it cannot be quantified. We use other attributes other than numbers to describe qualitative data.

Examples of qualitative data

- A person's skin colour; I am black, brown or white.
- A person's sex; I am either a male or female.
- Someone's nationality; I am a Rwandan, my friend is a Ugandan and our neighbour is Congolese.
- My favourite soda; the answer can be coca cola, fanta orange or pepsi.

17.3 Ways of collecting data

There are many ways of collecting data which may include the following:

1. Questionnaire

A questionnaire is a written set of questions that are given to people in order to collect facts or opinions (data) about something.

2. Census

A census is a study that obtains data from every member of a population. A census is very expensive because it is very hard to reach everybody. A national population is carried out to determine the number of people in a country.

In Rwanda, the last Housing and Population census was carried out in August 2012.

3. Sample survey

A sample survey is a study that obtains data from a very small group of a population. The result of the sample survey is used to make conclusion for the whole population.

4. Observation

This is where the person collecting the data makes observations and compiles his/her data accordingly. For instance, a person can simply observe and count the number of girls in a class without necessarily talking to anyone.

5. Interview

In this method of collecting data, people are asked some questions directly.

17.4 Presentation of Data

Presentation of data is a method of displaying data in a very simple way so that the data collected can be easily understood. Data can be displayed in many forms namely:

- Table
- Bar graph
- Pie chart
- Line graph
- Pictograph

However, at this level, we shall look at table and bar graph only.

17.4.1 Table

This is a very simple way of presenting data. The data is presented in columns and rows.

Example 17.1

The data below shows the results of football matches by three teams in a football league:

Kanombe United: Win = 6, Draw = 3, Loss = 1

Kigali Stars: Win = 6, Draw = 0, Loss = 4

Gisenyi Boys: Win = 4, Draw = 2, Loss = 4

(a) Present the information on a table.

(b) If a win is worth 3 points, a draw 1 point and a loss is worth 0 point, which team has got the highest points?

Solution

(a) Let us arrange our data in a table like the one below:

Team	Win	Draw	Loss
Kanombe United	6	3	1
Kigali Stars	6	0	4
Gisenyi Boys	4	2	4

(b) Total points:

Kanombe United = $(6 \times 3) + (3 \times 1) + (1 \times 0) = 18 + 3 + 0 = 21$ points.

Kigali Stars = $(6 \times 3) + (0 \times 1) + (4 \times 0) = 18 + 0 + 0 = 18$ points.

Gisenyi Boys = (4 × 3) + (2 × 1) + (4 × 0) = 12 + 2 + 0 = 14 points.

Kanombe United has the highest points = 21 points.

Activity 17.1

In this class activity, each pupil will ask the age of all the pupils of the class and represent this data in a table.

Example 17.2

The data below shows the marks obtained (out of 100) by some pupils in a Maths test:

56 56 76 23 09 89 90 43 23 12 64 88

43 54 76 23 22 43 12 54 29 66 74 50

(a) Represent this data in a table.

(b) How many pupils did appear for the test?

(c) How many pupils scored 76% marks?

(d) How many pupils got less than 50% marks?

(e) What was the highest marks scored?

Solution

(a)

Marks	Number of pupils
09	1
12	2
22	1
23	3
29	1
43	3
50	1
54	2
56	2
64	1
66	1
74	1
76	2
88	1
89	1
90	1
Total	24

(b) Total number of pupils who appeared for the test = 24 pupils.

(c) 2 pupils scored 76% marks.

(d) Number of students who got less than 50%

$$= 1 + 2 + 1 + 3 + 1 + 3 = 11 \text{ pupils.}$$

(e) The highest mark scored was 90%.

Exercise 17.1

20 pupils are asked for their favourite colour. The answers are as follows:

Red, Red, Blue, Black, Yellow, Green, Green, Black, Pink, Pink, Pink, Blue, Blue, Yellow, Green, Red, Black, Red, Red, Pink

(a) Represent this data in a table.

(b) Which colour is liked by the most number of pupils?

(c) Which colour is liked by the least number of pupils?

17.4.2 Bar graph

A bar graph is drawn by representing the data on two perpendicular axis. The vertical axis is called the **y-axis** and the horizontal axis is called the **x-axis**.

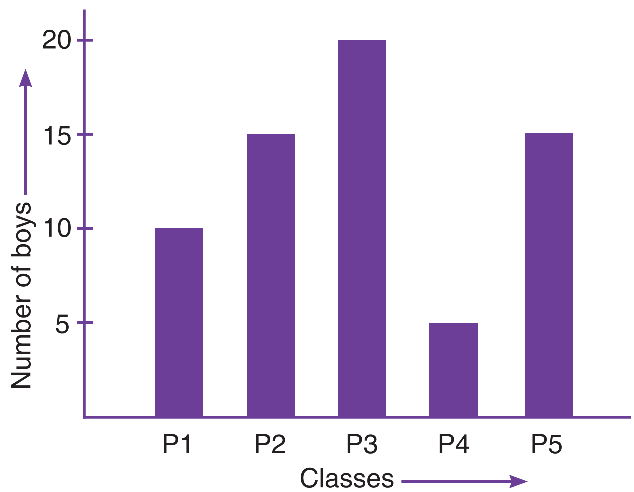
Example 17.3

The data below shows the number of boys from P1 to P5 in GS Gisozi.

Classes	P1	P2	P3	P4	P5
Number of boys	10	15	20	05	15

Represent this data on a bar graph.

Solution



The vertical axis shows the number of boys and the horizontal axis represents the classes. The height of a bar correspond to the number of boys on the Y- axis.

From the graph we can see that;

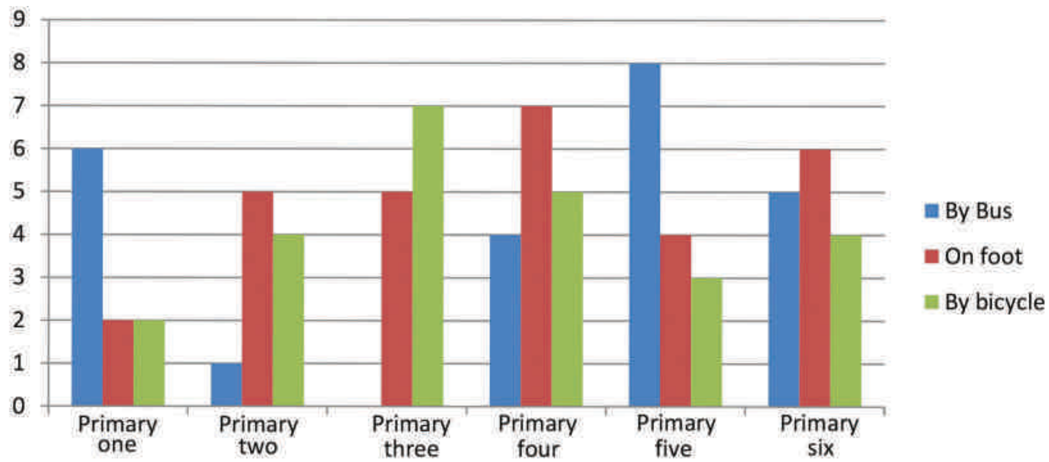
- P1 has 10 boys, P2 has 15 boys, P3 has 20 boys, P4 has 5 boys and P5 has 15 boys.
- P3 has the most number of boys and P4 has the least number of boys.
- Total number of boys from P1 to P5 = 10 +15 + 20 + 5 + 15 = 65 boys.

Activity 17.2

Ask each pupil about their favourite fruit. Write the number of pupils of each fruit, and collect the data in a table. Represent this data by a bar graph.

Example 17.4

A survey was carried out in a certain school to find out the means of transport used by pupils to go to school. It was found out that each pupil go to school by bus, on foot or by bicycle. The data is shown in the bar graph below:



(a) What quantity is represented on the vertical axis?
(b) What quantity is represented on the horizontal axis?
(c) How many pupils go to school by bus in P4?
(d) How many pupils go to school by bus in P3?
(e) How many pupils go to school by bicycle in the whole school?
(f) Which class has the largest number of pupils?

Solution

(a) "Number of pupils" is represented on the vertical axis.
(b) "Classes" is represented on the horizontal axis.

(c) 4 pupils go to school by bus in P4.

(d) There is no bar for the bus in P3. This means no pupil in P3 goes to school by bus.

(e) Total number of pupils who go to school by bicycle = 2 + 4 + 7 + 5 + 3 + 4 = 25 pupils.

(f) There are 16 pupils in P4. So P4 has the largest number of pupils in the school.

Assessment Exercise

1. The birth rate per thousand of five countries over a period of time is shown below:

Countries	China	India	Germany	UK	Sweden
Birth rate per thousand	42	35	14	28	21

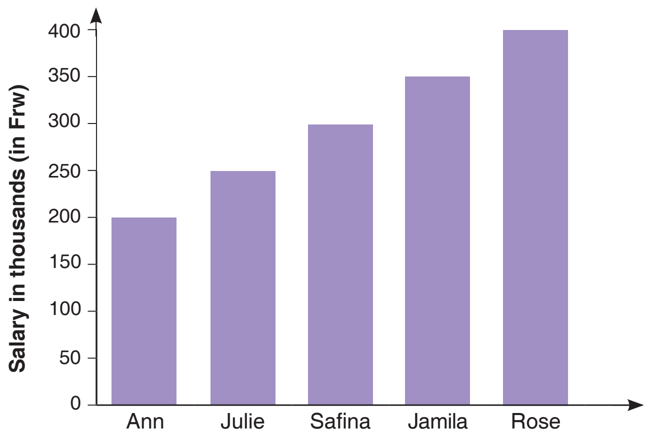
Represent above data in a bar graph.

2. The table given below shows the monthly expenditure (in percentage) on various items, in a family.

Items	Rent	Food	Education	Clothing	Misc
Expenditure (in percentage)	24%	36%	16%	20%	4%

Represent the above data in a bar graph.

3. The graph below shows the salary of five ladies who work in a certain factory. Use it to answer the questions that follow.



(a) How much money does each lady get?

(b) Find the sum of Safina's and Ann's salary.

(c) Find the average of Julie's, Safina's and Rose's salary.

UNIT 18 Introduction to Probability

Key unit competence

By the end of this unit, a learner should be able to play games based on the probability.

Attitudes and values

Appreciate the importance of following rules and taking turns when playing games of cards and coins, throwing dice, snakes and ladders and bingo with probability.

Meaning of Probability

Probability is a branch of Mathematics which deals with the possibility of something happening. The possibility of something happening is also called the ***chance*** or ***likelihood*** of something happening.

Games such as tossing a coin, cards, throwing dice, snakes and ladders and bingo etc. are played based on probability.

Activity 18.1

Tossing a coin

- Pair up with one of your classmates.
- Together with your friend, you will decide which side of the coin is the head and which one is the tail. Confirm with the teacher which side is the head (H) or tail (T).

- Each one of you will draw a table like the one shown below in your book.

Number of throws	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Side facing up										

- You will toss the coin, allow it to fall on the floor and note the side facing up. If the head is facing up in the 1st toss, then write H in the table. Otherwise, write T for a tail facing up.
- Repeat the experiment 9 more times and record your results as honestly as possible in the table.
- Let your friend also repeat what you have done and help him/her record his/her results in a table.
- Compare your results and see who has more heads than the other.

Activity 18.2

Tossing 3 coins at once

- In this activity, you will pair up with a classmate.
- Carefully observe the coin faces and decide which the heads are.
- You will be required to toss all the three coins at the same time and note the sides of the coin facing up. It is good to decide on a winning combination before starting the game. For instance, the winning combination may be getting 2 heads and 1 tail (HHT). If you get anything else, then you have lost.
- Toss the three coins at once and note the sides facing up. Record your result as a win or a loss.
- Give the three coins to your friend and let him/her toss.
- Repeat the experiment several times and see who gets 10 wins first.

Activity 18.3

In this class activity, you will play a game of cards and discover how lucky you are!!!!

(a) Open the pack of playing cards. Count the total number of cards and record your answer.
(b) Group the cards of the same type together. You should have 5 groups of cards namely; hearts, spades, clubs, diamonds and jokers.
(c) Count and record the number of each suit of cards.
(d) How many picture cards are there altogether?
(e) Shuffle the pack of playing cards very well. Deal 5 cards to your neighbour.
(f) Open the cards so that everybody can see. Count the number of aces he/she has got and record the number down.
(g) Repeat the shuffling and dealing for everybody in the group.
(h) Play the game for a number of times, each time recording the number of aces each pupil has got.
(i) The pupil who gets 10 aces first is the winner of this game.
(j) Is the game fair? If you think it is unfair, discuss how you could make it fair for everyone.

Assessment Exercise

1. Discuss the following questions: (Refer Activity 18.1)
   (a) Was the game fair?
   (b) Are there some winning strategies for getting a head up?
   (c) Some people believe that girls will get more "heads" up than "tails". Do you agree?
   (d) Some people think that tossing the coin first makes you get "tails" only. Is this true?
2. Discuss the following questions: (Refer Activity 18.2)
   (a) Were we very sincere while doing the experiment?
   (b) Is it possible to get 2 heads and a tail?
   (c) Some people believe that small coins show heads only and big coins show tails only. Do you agree with this?

Internet Resource

For more online support visit **http://www.sheppardsoftware.com**

GLOSSARY

Abacus: a table or frame used for performing arithmetical calculations.

Acre: a unit of land measure equivalent to 4046 square metres.

Addends: the numbers being added together.

Angle: circular measure of the space between two intersecting lines.

Acute angle: Angle less than 90˚.

A.M. : Ante Meridian, time before mid-day.

Architect: Stet person who designs and constructs buildings.

Area: measure of the 2D space surrounded by lines.

Arithmagon: a polygon with numbers at its vertices which determine the numbers written on its edges.

Arithmetic: branch of mathematics that deals with calculations.

Calculator: instrument used to help adding, subtracting, multiplying and dividing numbers.

Calendar: an arrangement of dates, days and months of the year.

Capacity: the amount of liquid a given container can carry.

Circle: closed figure with all points at equal distance from the centre.

Circumference: distance around a circle.

Cube: closed figure with six equal faces.

Coin: metallic money in the form of a small disc.

Compass: device for telling the direction.

Data: any information collected for statistics.

Denominator: the lower number in a fraction.

Diagonal: a line (which is not a side) joining any two vertices of a polygon.

Diameter: distance from one point on a circumference to the other through the centre. It is twice the radius of a circle.

Digit: a numeral or number.

Edge: the boundary line of a surface.

Even number: a number which is divisible by 2.

Equivalent fractions: two fractions which have the same numerical value.

Estimate: to approximate something.

Face: any of the flat surface of a solid figure.

Factors: any two numbers multiplied together to form another number.

Fraction: ratio of two numbers; the numerator and the denominator.

Gram: a unit of mass equivalent to 0.001 kg.

Graph: a diagram displaying data showing the relation between two quantities.

G.C.F. : Greatest Common Factor.

H.C.F. : Highest Common Factor.

Intersect: for lines, to meet at a point.

L.C.M.: Lowest Common Multiple.

Line: a straight path through two or more points.

Litre: the unit of capacity equivalent to 1000 cm^3.

Multiple: a number that may be divided by another number with no remainder.

Numerator: the lower number of a fraction.

Oblique line: a line which is neither horizontal nor vertical. It is a sloping/slanting line.

Pair of compasses: a tool consisting of two arms used to draw circles.

Parallel lines: these are lines which do not meet at all.

Pentagon: a 5-sided closed figure.

Perimeter: the distance around a given figure.

Perpendicular lines: two or more lines which intersect at an angle of 90°.

Plane: a flat surface.

Point: a small dot used to represent the location of something.

Polygon: a closed figure bounded by straight or curved edges.

Prime number: a number with only two factors. One factor being 1 and the other one is itself.

Probability: this is the chance or likelihood of something happening.

Protractor: This is a geometrical instrument used for measuring angles.

Quadrilateral: This is any 4-sided closed figure.

Radius: this is the distance from the centre of a circle to any point on the circumference of the circle. It is half the diameter.

Range: this is the difference between the largest and smallest numbers in a data.

Ratio: it refers to the division of two numbers.

Remainder: a number which is left when two numbers are divided.

Right angle: an angle which is equal to 90°.

Square: a closed 4-sided figure with all sides equal.

Symmetrical shape: a shape that can be separated into two exactly equal parts which can overlap.

Tossing a coin: throwing a coin in air so that it falls with one side facing upwards.

Triangle: a closed figure with three sides, three angles and three vertices.

Vertex: a point on a polygon where two lines meet.

Volume: the space occupied by an object.

X-axis: the horizontal line on the Cartesian plane.

Y-axis: the vertical line on the Cartesian plane.