South Sudan

ALP
3

Mathematics

Learner's Book Level 3

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FOREWORD

I am delighted to write the foreword for this book. The Ministry of General Education and Instruction (MoGE&I) has developed the Accelerated Learning Programme (ALP) textbooks based on the National Curriculum of South Sudan.

The textbook was written to help learners develop the background knowledge and understanding in the subject. It is intended largely to serve as a source of knowledge and understanding of the subject concerned, but not to be considered as a summary of what learners ought to study.

The National Curriculum is a competency based and learner-centered that aims to meet the educational needs and aspirations of the people of South Sudan. Its aims are manifold: (a) Good citizenship (b) successful lifelong learners, (c) creative, active and productive individuals; and (d) Environmentally responsible members of our society.
This textbook was designed by subject panelists to promote the learners'attainment of the following competencies; critical and creative thinking, communication, cooperation, culture and identity.

No one can write a book of this kind without support from colleagues, friends and family. Therefore, I am pleased to register my thanks to Dr Kuyok Abol Kuyok, the Undersecretary of the Ministry, who emphasized the importance of Alternative Education System (AES) and approved the development of its textbooks.

I also want to record my thanks toUstaz Omot Okony Olok, the Director General for Curriculum Development Centre (CDC) and Ustaz Shadrack Chol Stephen, the Director General for Alternative Education Systems (AES) who worked tirelessly with thesubject panelists to develop the textbooks.

Lastly, but not least, my greatest thanks and appreciation must go to the Global Partnership for Education (GPE) and UNICEF-South Sudan for without their support and partnership this textbook would not have seen light.

Hon. Awut Deng Acuil, MP
Minister,
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TABLE OF CONTENTS

UNIT 1: NUMBERS

1.1 Reading, writing, ordering and comparing numbers up six digits

With the help of the teacher,

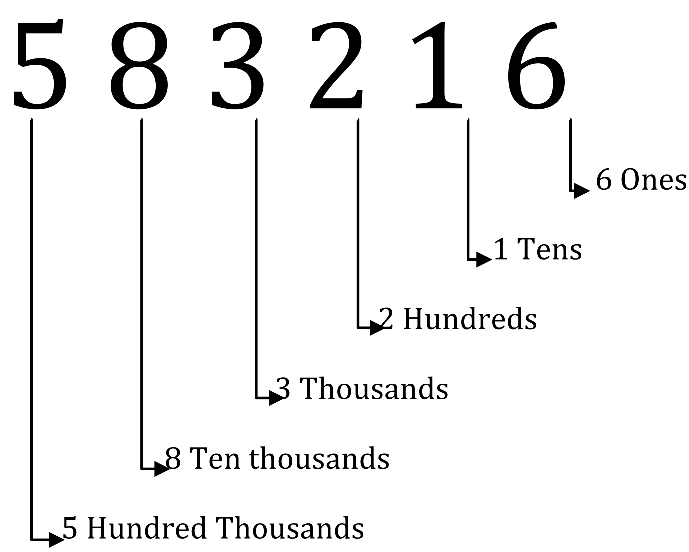
Tell your partner the biggest number you know.
Tell your partner the smallest number you saw.
Write them down in figures and in numbers.

In reading numbers with digits up six we have to identify the specific place value of each of the number.

To identify this, start from the first digit from the right hand side.

Example 1.

583216



Thus the number **583216** = Five hundred and eighty three thousand, two hundred and sixteen.

Activity 1:

In groups of 4, make a pack of 10 flash digit cards.

Shuffle the cards and take in in turns to draw 3 digits at a time. Place the cards in the middle of your group and then read aloud the number that you have made together.

Now place the cards back into the pile, shuffle and repeat the activity.

Once you are confident at making 3 digit numbers, move on to shuffle and make 4 digit numbers, then 5 digit number and finally 6 digit numbers.

Now go back to 3 digit numbers. Pull out 3 numbers to make one number, then make two more 3 digit numbers from the remaining cards. Read aloud the three numbers that you have made and then order them from smallest to largest number. Repeat this.

Now move into pulling out 2, 4 digit numbers. Say them aloud and order them so that you have a small and larger number.

Individually.

In your books, write these groups of numbers in ascending order.

a) 345, 628,951,729
b) 388,991,137,839
c) 441, 369,888,936
d) 4128, 5289, 3819, 0728
e) 4829, 4829,1893, 2893
f) 4782,7382, 9182, 6279
g) 27893, 28194, 27289, 99925
h) 38299, 93389, 37778, 38389
i) 345678, 123877, 378467, 444682
j) 1345,278,27819, 381926
k) 2671, 2678, 189267, 25711
l) 31111, 281290, 3677, 271

Exercise 1.

1. Look at the table below. What do the numbers tell you about the population in South Sudan and in each state?

STATE	POPULATION	AREA
Northern Bahr el Ghazal	820 834	30 543.30
Western Bahr el Ghazal	358 692	91 075.95
Lakes	782 504	43 595.08
Warrap	1 044 217	45 567.24
Western Equatoria	658 863	79 342.66
Central Equatoria	1 193 130	43 033.00
Eastern Equatoria	962,719	73 472.01
Jonglei	1 443 500	122 580.83
Unity	645 465	37 836.39
Upper Nile	1 013 629	77 283.42
TOTAL	**8 923 553**	**644 329.37**

Answer these questions together and then prepare some other questions to ask other pairs of learners in your class.

a. Which state has the largest population? b) Which state has the smallest population?
b. Which state is almost half the size of Central Equatoria?
c. Which state has an area of about 43 000

2. Look at the table below showing the number of people affected in each disease.

Number	Disease	Number of Cases
1	Malaria	170 000
2	HIV Aids	75 000
3	Typhoid	150 000
4	Tuberculosis (TB)	1 575
5	Cholera	49 100

a. What is the most common disease? Explain your answer.
b. What is the least common disease? Explain your answer.
c. Find the sum of the number of people affected by Malaria and Cholera. Show your working.
d. What is the total number of cases affected by the diseases?
e. Find the difference between the number of people affected by the most common and least common disease. What do you need to do first?
f. Find the total number of people affected by Typhoid, Cholera and Tuberculosis. Explain how you worked this out.

Activity 2:

In pairs visit the local grocery or shops and find out the cost of each of the items listed below.

Number	Item	Price (SSP)
1	Sugar 50kg	
2	Rice 50kg	
3	Wheat flour 50Kg	
4	Beans 50Kg	
5	Maize 50Kg	

a. What is the cost of the most expensive item? What is it?
b. What is the cost of the least expensive item? What is it?
c. What do you notice about the costs of items?

1.2 Read, write, compare and order numbers to a million

Kiden decided to count what grew in her garden. She found 867,440 carrots. Can you read that sentence aloud?

It's a tough one. But knowing how to read and write larger numbers is an essential math skill. So, let us explore how to read and write numbers with one to seven digits.

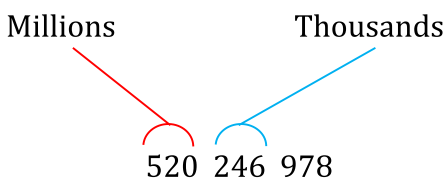
Reading Larger Numbers

All numbers are read from left to right. You can use place value, the value of a digit based on its position in the number, to help you read the number. Let's see how.

Reading and writing numbers to a million

In reading numbers up to six digits you have to identify the specific place value of each of the numbers.

Reading and writing whole numbers can be explained by using the following illustration.
Take a close look and carefully study it.



Recall that the place value for 2, 4, and 6 are the hundred-thousands, the ten-thousands, and the thousands respectively.

Again, the position occupied by 2 is the hundred-thousands and putting a 2 is this position means that there are 2 hundred-thousands or **two hundred** thousand.

In the same way, putting a 4 in the ten-thousands position means that there are 4 ten-thousands or **forty** thousand because 4 tens is forty.

Finally, putting a 6 in the thousands position means that there are 6 thousands or **six** thousand.

Putting it all together, we have;

(**two hundred**) thousand + (**forty**) thousand + (**six**) thousand =

(**two hundred** + **forty** + **six**)thousand =

(**two hundred and forty six**)thousand = **246** thousand

What gives us the right to just add **two hundred**, **forty**, and **six**?

Try to do the following:

two hundred cars + forty cars + six cars.

Would not you agree that it is equal to two hundred forty six cars?

The above is the same, except that instead of using cars, we are using thousand.

The group name, as shown in the illustration, is 'thousand'

In general, it is unnecessary to say it three times.

When reading whole numbers, always read the numeral first, which is **246** and then the group name from left to right.

Therefore, we read

(**two hundred**) thousand + (**forty**) thousand + (**six**) thousand as (**two hundred forty six**) thousand = **246** thousand.

The whole number can be read as:

(**two hundred thirty four**) billion (**five hundred twenty**) million (**two hundred forty six**) thousand nine hundred seventy-eight =

(**234** billion (**520** million (**246**)thousand 978

Example 2.

355 645 is read three hundred fifty five thousand, six hundred forty-five

16 006 006 is read sixteen millions, six thousand, six

Activity 3.

In pairs, Read this to your partner, does it make sense? Write the following numbers in figures or words.

1. Seven million, nine hundred and thirty thousand, two hundred and six.
2. Five million, three hundred and twenty thousand, one hundred and twelve.
3. Three million, five hundred and six thousand, four hundred and seventy two.
4. 4 789 652
5. 2 565 531
6. 9 578 123

Exercise 2:

Write the following in words or numbers.

1. 5 821 456
2. 1 235 847
3. Six million, five hundred and forty thousand, six hundred and seventy four.

4. Seven million, eight hundred and twenty one thousand three hundred and sixty five.

Compare and order numbers to a million

First we need to identify the place value of the numbers.

Activity 4.

In groups, Discuss and then write the following numbers from the smallest to the biggest.

Who can order these the fastest? Explain your answers to the class.

a. 12, 415, 62, 418, 3468, 1345
b. 65, 89, 45, 672, 456 , 196
c. 980, 768, 560, 356, 45, 120
d. 765, 980, 134, 1452, 698, 19 345

Exercise 3:

There are 645 465 people living in Unity while there are 962 716 people living in Eastern Equitoria.

Which state has greater population? Explain why it is so.

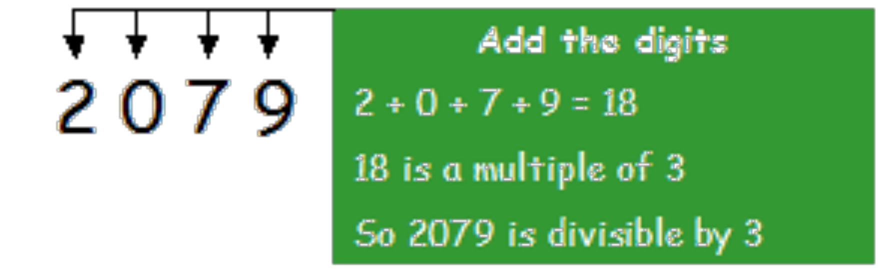
The size of Upper Nile is 77 283 square metres while Jonglei is 122 580 square miles.

Which state has a smaller area? Explain how you got it.

1.3 Divisibility tests of numbers 3, 4, 6 and 9

Divisibility test of 3

A number is divisible by 3 if the sum of its digits is divisible by 3.



Number	Divisible?	Why?
405	Yes	$4 + 0 + 5 = 9$ (9 is a multiple of 3)
381	Yes	$3 + 8 + 1 = 12$ (12 is a multiple of 3)
928	No	$9 + 2 + 8 = 19$ (19 is *not* a multiple of 3)
4,616	No	$4 + 6 + 1 + 6 = 17$ (17 is *not* a multiple of 3)

Example 3.

381 (3+8+1=12, and 12÷3 = 4) Yes

217 (2+1+7=10, and 10÷3 = $3\ ^{1}/_{3}$) No

This rule can be repeated if needed.

99996 (9+9+9+9+6 = 42, then 4+2=6) Yes

Activity 5:

In pairs;

1. Identify which of the following numbers are divisible by three.

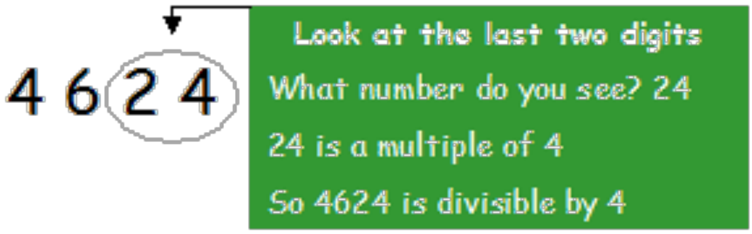
   a. 2916 b. 39 c. 1008 d. 927 e. 143,706

2. You have got 96 questions for homework and you have three days to do them. You want to do the same number of questions on each day.

Use the divisibility test of 3 to check if you can divide equally.

Divisibility test of 4

If the last two digits are a multiple of 4 or are divisible by 4 (or if the last two digits are 00).



Number	Divisible?	Why?
348	Yes	48 is a multiple of 4
27,616	Yes	16 is a multiple of 4
8,514	No	14 is *not* a multiple of 4
722	No	22 is *not* a multiple of 4
1,200	Yes	The last two digits are 00 (200 is a multiple of 4)

Example 4.

13**12** is (12÷4=3) Yes
70**19** is not (19÷4=4 $^3/_4$) No

Another way to identify if a number is divisible by 4 especially for small numbers.
Halve the last two digits of a number twice and if the result is still a whole then the number is divisible by 4.

$\frac{12}{2} = 6$, $\frac{6}{2} = 3$, 3 is a whole number. Yes

$\frac{30}{2} = 15$, $\frac{15}{2} = 7.5$ which is not a whole number. No

Activity 6:

1. Working in pairs, write down some even numbers that are between 300 and 436.
2. Four learners had 620 South Sudanese pounds. Use the divisibility test of 4 to check if they were able to divide equally.

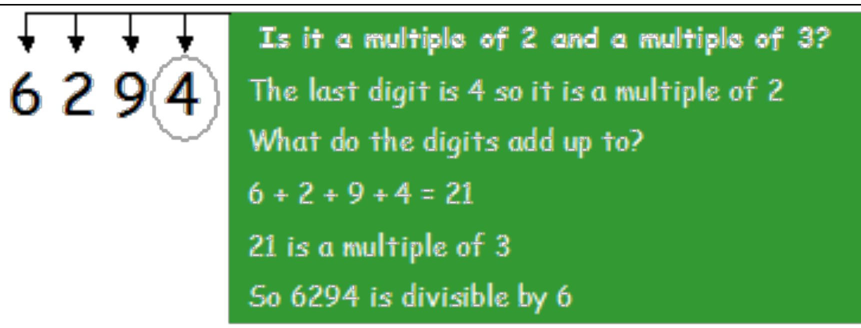
Divisibility test of 6

A number is divisible by 6 if it is divisible by both 2 and 3

Example 5.

114 (it is even, and 1+1+4=6 and 6÷3 = 2) Yes

308 (it is even, but 3+0+8=11 and 11÷3 = 3 $^{2}/_{3}$) No



Number	Divisible?	Why?
5,106	Yes	The last digit is a 2 (it is a multiple of 2) and... 5 + 1 + 0 + 6 = 12 (12 is a multiple of 3)
636	Yes	The last digit is a 6 (it is a multiple of 2) and... 6 + 3 + 6 = 15 (15 is a multiple of 3)
5,912	No	The last digit is a 2 (it is a multiple of 2) *but...* 5 + 9 + 1 + 2 = 17 (17 is *not* a multiple of 3)
508	No	The last digit is a 8 (it is a multiple of 2) *but...* 5 + 0 + 8 = 13 (13 is *not* a multiple of 3)

Activity 7:

1. In pairs, identify which of the following numbers are divisible by six. Explain how do you work it out.

a. 408 b. 1 364 c. 189 024 d. 103 e. 10 230

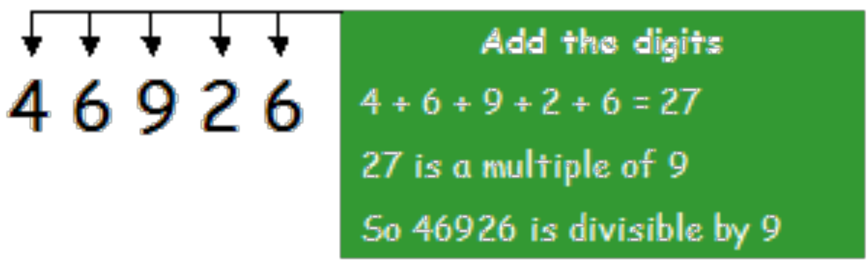
2. Our class teacher had 294 bottle tops and she wanted to share them equally to 6 learners. Use the divisibility test of 6 to check if she was able to share the bottle tops equally. Show your working out.

3. You and five friends have 294 mangoes and you want to share them equally. Use the divisibility test of 6 to check if you can share equally. Show your working out.

Divisibility test of 9

A number is divisible by 9 if the sum of its digits is divisible by 9 or are a multiple of 9.

Just like in the divisibility test for three, this rule may be repeated if needed.



Number	Divisible?	Why?
7,686	Yes	$7 + 6 + 8 + 6 = 27$ (27 is a multiple of 9)
252	Yes	$2 + 5 + 2 = 9$ (9 is a multiple of 9)
883	No	$8 + 8 + 3 = 19$ (19 is *not* a multiple of 9)

5,105	No	5 + 1 + 0 + 5 = 11 (11 is *not* a multiple of 9)

Example 5.

1629 (1+6+2+9=18, and again, 1+8=9) Yes

2013 (2+0+1+3=6) No

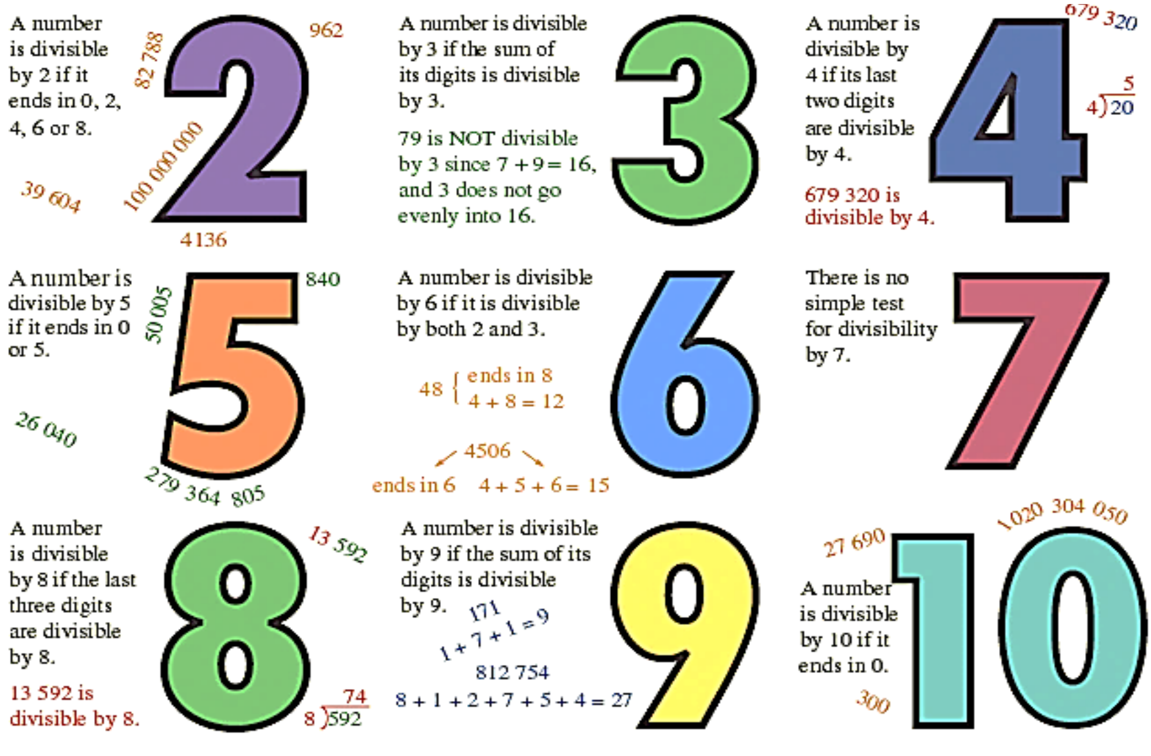
Activity 6:

1. In pairs, copy on a paper and check if they are divisible by 9 in your exercise book.

   a. 729   b.788   c. 913 680   d. 554 704

2. A farmer had 636 kg of animal feed and 9 cows. Use the divisibility test of 9 to check if the farmer can divide the animal feed equally.

3. What if you and 8 friends wanted to share 12 candies equally? Draw a picture showing how the candies can be shared.



Exercise 4.

Work in pairs;

1. Use 'Divisibility Rules' to test whether 8,712 is divisible by:

A 3 B 4 C 6 D 9

Ca you explain your answer to your partner

2. Using divisibility test identify which number is divisible by 3. How will you work this out?

A 5 994 B 5 996

C 5 992 D 5 990

3. Use 'Divisibility Rules' to determine which of the following numbers

1) 237 2) 833 3) 6 488 and 4) 3 528

is divisible by:

A 3 B 4 C 6 D 9

4. Check whether the following are divisible by 3

(a) 741 352 (b) 2 034 198 (c) 317 925 (d) 3 412 920

5. Check whether the following are divisible by 4

(a) 4 137 156 (b) 135 764 (c) 34 560 (d) 167 435

6. Check whether the following are divisible by 6

(a) 4 234 156 (b) 1 027 863 (c) 924 658 (d) 1 850 421

7. Check whether the following are divisible by 9

(a) 739 602 (b) 2 034 198 (c) 674 132 (d) 7 413 552

Tell your partner what you have leant about divisibility tests of numbers 3, 4, 6 and 9

1.4 Divisibility test of 8 and 11.

Divisibility of 8

A number is divisible by 8 if the last three numbers are divisible by 8.

Attempt in pairs if they are divisible by 8

a. 723 810 b. 456 791 824 c. 923 780

Is it easy? How was the experience?

Example 6.

a. 723 810

Take a look at the last two digits: 723 810. Does 4 divide evenly into 10? No. That means that 4 will not divide evenly into 723 810 and there will be a remainder.

The Rule for 8: If the last three digits of a whole number are divisible by 8, then the entire number is divisible by 8.

b. 456 791 824

Look at the last three digits of the number: 456 791 824. Does 8 divide evenly into 824? YES, 8 goes into 824, 103 times without anything left over. So this number is divisible by 8.

c. 923 780

Again, we will focus on the last three digits of the number: 923 780. Does 8 divide evenly into 780? NO, 8 goes into 780, 97 times with a remainder of 4.

So this number is not divisible by 8.

Activity 8.

1. Discuss and identify which number is divisible by eight. How do you check your answer?
   a) 23 751 b) 396 c) 506 d) 1 624

2. Discuss and identify which number is not divisible by eight. How did you work it out?
   a)56 816 b) 63 424 c) 31 326 d)6 832

Divisibility of 11

A number is divisible by 11 if the alternating sum of its digits is divisible by 11.

Example 7.

A.) 280 819:

$2 - 8 + 0 - 8 + 1 - 9 = -22$, so it is divisible by 11 (recall the definition of divisbility allows for negative numbers).

B.) 53:
$5 - 3 = 2$, so it is not divisible by 11.

To identify if a number is divisible by 11, add and subtract digits in an alternating pattern. (Add digit, subtract next digit, add next digit, etc...) Then check if that number is divisible by 11.

Example 8.

1364 $(+1 - 3 + 6 - 4 = 0)$ Yes

913 $(+9 - 1 + 3 = 11)$ Yes

3729 $(+3 - 7 + 2 - 9 = -11)$ Yes

987 $(+9 - 8 + 7 = 8)$ No

Activity 9.

1. Discuss and identify which number is not divisible by 11. How did you get your answer?
   a) 54 637 b) 7894 c) 891 d) 2494

2. Discuss and identify which number is divisible by 11. How did you get your answer?
   a) 69 859 b) 23 469 c) 38 929 d) 18 958

Exercise 5:

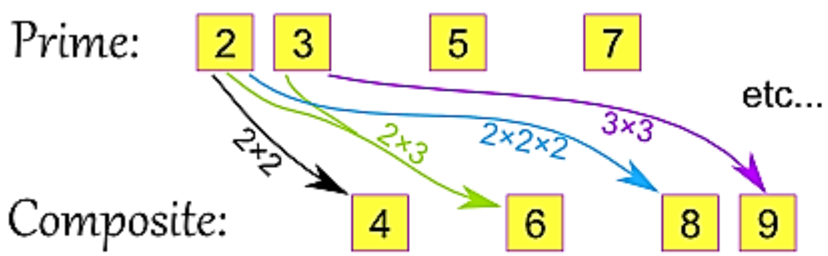
1. Which of the following numbers is not divisible by 11? Is there another way of working out the answer?
   a)2 547 039 b)10 604 c)31 415 d)292 215

2. Which of the following numbers is divisible by 8? How did you work it out?
   a)760 672 b)89612 c)93 732 d)65 432

3. Identify numbers divisible by 8 or 11. Which method will you use?
   a)3 624 b)2 728 c)28 182 d)7 120

1.5 Prime numbers

A prime number is any number that can be divided evenly by 1 or itself.

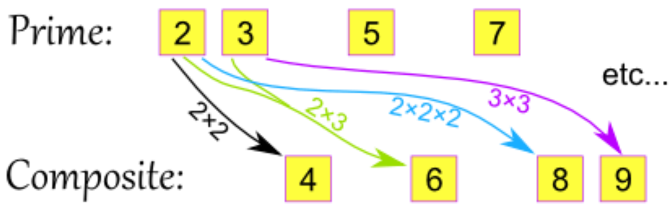


Example 9.

5 can only be divided evenly by 1 or 5, so it is a prime number.

But 6 can be divided evenly by 1, 2, 3 and 6 so it is NOT a prime number (it is a composite number).

A composite is a whole number that can be divided evenly by numbers other than 1 or itself.



Example 10.

9 can be divided evenly by 3 (as well as 1 and 9), so 9 is a composite number.

But 7 cannot be divided evenly (except by 1 and 7), so is NOT a composite number (it is a prime number).

Whole numbers above 1 are either prime or composite.

Exercise 6.

1. How many different prime factors does the number 252 have?

A 2	B 3
C 4	D 5

2. Which of the following numbers is not a prime number?

A 101	B 103
C 105	D 107

3. Which one of the following numbers is prime number?

A 18	B 19
C 20	D 21

4. From the following which number is not a prime?

A 67	B 69
C 71	D 73

1.6 Roman numbers and Hindu numbers up to 50

Roman Numbers

Roman numerals are based on the following symbols

1	5	10	50
I	V	X	L

Basic combination of numeral numbers is.

1	2	3	4	5	6	7	8	9	10
I	II	III	IV	V	VI	VII	VIII	IX	X
11	12	13	14	15	16	17	18	19	20
XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX
21	22	23	24	25	26	27	28	29	30
XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XXVIII	XXIX	XXX
31	32	33	34	35	36	37	38	39	40
XXXI	XXXII	XXXIII	XXXIV	XXXV	XXXVI	XXXVII	XXXVIII	XXXIX	XL
41	42	43	44	45	46	47	48	49	50
XLI	XLII	XLIII	XLIV	XLV	XLVI	XLVII	XLVIII	XLIX	L

Example 11.

VI = V + I = 5 + 1 = 6

When a symbol appears after a large symbol it is added.

IX = X - I = 10 - 1 = 9

If the symbol appears before a larger symbol it is subtracted.

Activity 10:

In groups, identify the equivalent Roman numeral notations to the following. How will you work it out?

A 31 B 43

C 49 D 27

Converting numbers into roman notations.

Break the number according to its specific order of adjectives, thousands, hundred, ten and ones.

Example 12.

Covert 34 to roman numerals.

Break 34 into 10, 5 and 1, then do each conversion

10 = X 10 X 3 = 30 = XXX

5 = V

1 = I

5-1=4 V-I =IV

34 = XXXIV

Exercise 7.

1. Convert 21 to roman numerals.

2. Convert to roman numbers.

(A) 26 (B) 24 (C) 25 (D) 27

3. Covert to roman numerals.

(A) 24 (B) 6 (C) 47 (D) 41

Hindu – Arabic notation

In pairs, count the numbers below. Write down a number and ask your partner to say it.

Numeral in English	
0	Zero
1	One
2	Two
3	Three

4	Four
5	Five
6	Six
7	Seven
8	Eight
9	Nine
10	Ten
11	Eleven
12	Twelve
13	Thirteen
14	Fourteen
15	Fifteen
16	Sixteen
17	Seventeen
18	Eighteen
19	Nineteen
20	Twenty
21	Twenty one
22	Twenty two
23	Twenty three
24	Twenty four
25	Twenty five
26	Twenty six
27	Twenty seven
28	Twenty eight
29	Twenty nine
30	Thirty
31	Thirty one
32	Thirty two
33	Thirty three
34	Thirty four
35	Thirty five
36	Thirty six
37	Thirty seven
38	Thirty eight
39	Thirty nine
40	Forty
41	Forty one
42	Forty two
43	Forty three
44	Forty four
45	Forty five

46	Forty six
47	Forty seven
48	Forty eight
49	Forty nine
50	Fifty

1.7 Factor of numbers and their multiples

Factors are numbers we multiple together to get another number.

Example 13.

$2 \times 3 = 6$ In this case 2 and 3 are factors of six.

A number can have many factors.

Like for instance the factors of 12 are 1, 2, 3, 4, 6 and 12 as well as -1,-2, -3, -4, -6 and -12.

Factors are usually positive or negative whole numbers. (No fractions)

Common factors of numbers

This is acquired after working out the factors of two or more different numbers.

Example 14.

Factors of 12 and 30.

Factors of 12 are 1, 2, 3, 4, 6 and 12.

Factors of 30 are 1, 2, 3, 5, 6, 10, 15 and 30.

The numbers that appear in both lists are the common numbers.

So, the common factors of 12 and 30 are: 1, 2, 3 and 6

Activity 11:

In groups of three identify the factors of the following

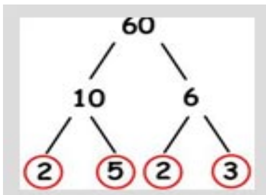
(A) 15 (B) 24
(C) 36 (D) 22

Explain how you worked it out.

1.8 How to find the HCF and the LCM of numbers

HCF also commonly known as highest common factor refers to a set of two or more numbers that can be divided exactly or by a common number.

HCF is also called GCD greatest common divisor or greatest common measure.



LCM or least common multiple refers to the smallest quantity of a number that can be divisibly by two or more quantities of a given number without a reminder.

HCF and LCM are calculated by either factorization or method or division method.

Factorization method: Express each of the numbers as products of prime numbers.

The product of highest powers of all prime factors gives LCF.

Exercise 8.

In groups, calculate the following.
Before you begin, discuss how you will solve the problem.

1. Ben has collected 6 T-shirts and 16 buttons from his favorite band. He wants to combine them into identical sets to sell, with no pieces left over. What is the greatest number of sets Ben can make?
2. Kamal has 6 cans of regular soda and 15 cans of diet soda. He wants to create some identical refreshment tables that will operate during the football game. He also doesn't want to have any sodas left over. What is the greatest number of refreshment tables that Kamal can stock?
3. At a family reunion, each of Sana's aunts and uncles is getting photographed once. The aunts are taking pictures in groups of 5 and the uncles are taking pictures in groups of 10.
   If Sana has the same total number of aunts and uncles, what is the minimum number of aunts that Sana must have?
4. Sapphire and Abe are shelving books at a public library. Sapphire shelves 5 books at a time, whereas Abe shelves 6 at a time.

   If they end up shelving the same number of books, what is the smallest number of books each could have shelved?
   What do you need to calculate? What method would you use and why?
   Can you estimate or predict the answer?

H.C.F.: We can use the H.C.F.

1. To split things into smaller sections?

2. To equally distribute 2 or more sets of items into their largest grouping?

3. To figure out how many people we can invite?

4. To arrange something into rows or groups?

Example 15.

Real life example:

Maya has two pieces of cloth. One piece is 36 inches wide and the other piece is 24 inches wide. She wants to cut both pieces into strips of equal width that are as wide as possible. How wide should she cut the strips?

Answer:

This problem can be solved using H.C.F. because we are cutting or "dividing" the strips of cloth into smaller pieces (Factor) of 36 and 24 (Common) and we are looking for the widest possible strips (Highest).

So

H.C.F. of 36 and 24 is 12

so we can say that Maya should cut each piece to be 12 inches wide.

L.C.M.: we can use the L.C.M.

1. To know an event that is or will be repeating over and over.

2. To purchase or get multiple items in order to have enough.

3. To figure out when something will happen again at the same time.

Example 16.

Real life example:

Mika exercises every 12 days and Nanu every 8 days. Mika and Nanu both exercised today. How many days will it be until they exercise together again?

So,
This problem can be solved using Least Common Multiple because we are trying to figure out when the soonest (Least) time will be that as the event of exercising continues (Multiple), it will occur at the same time (Common).

Answer: L.C.M. of 12 and 8 is 24.

1.9 Squares and square roots

Square

A square is the second power of a quantity. Simply means to multiply a number by itself.

Example 17.

What is the square of 3?

3 squared =

1	2	3
4	5	6
7	8	9

= $3\times3=9$

What is the square of 5?

5 squared =

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

= $5\times5=25$

Squared is usually written as a little 2 like this

This means "squared"

$4^2 = 16$

This says "4 squared equals 16"

(The little two says the number appears twice in multiplying)

Activity 12.

1. In groups, discuss and give the squares of the following numbers.

a) 9^2 b) 10^2 c) 14^2 d) 24^2

e) 19^2 f) 32^2 g) 13^2 h) 20^2

Square root

A square root is a value that can be multiplied by itself to give the original number.

Square root goes the other way of square.

9 is the square of 3

3 is the square root of 9

3 is the square root of 9 because when 3 is multiplied by itself it gives you 9.

This means square root $\sqrt{9}=3$

This says square root of 9 equals 3

Activity 13.

1. In groups, discuss and give the squares of the following numbers. Explain the steps in doing this.

a) 5^2 b) 12^2 c) 15^2 d) 8^2

2. Discuss and give the square roots of the following numbers. Explain the steps in doing this.

a) $\sqrt{169}$ b) $\sqrt{289}$ c) $\sqrt{16}$ d) $\sqrt{400}$

Exercise 9:

1. Write the squares and square roots of the following numbers. Explain to your partner the steps in working it out.
   a) 9^2 b) 11^2 c) 25^2 d) 6^2
2. What is the square root of the following numbers? Explain to your partner the steps in working it out
   a) $\sqrt{4}$ b) $\sqrt{196}$ c) $\sqrt{144}$ d) $\sqrt{100}$

1.10 Add and subtract fractions using LCM

Addition of fraction using L.C.M

Example 18.

Solve $\frac{1}{3} + \frac{1}{6} =$

Find the L.C.M of denominators 3 and 6.
L.C.M of 2 and 3 is 6.
Divide each denominator by the L.C.M (i.e.) 6÷3= 2 multiply 2 numerator by 1 = 2× 1= 2.
Record 2 above L.C.M 6 then divide 6 by denominator 6.
6 ÷ 6= 1.
Multiply 1 by numerator 1 = 1.
Record 1 above L.C.M 6 and then add.

$$\frac{2+1}{6} = \frac{3}{6} \text{ or } \frac{1}{2}$$

Exercise 10.

1. Use L.C.M to find the sum of the following fractions with different denominators. Show your working out.

a) $\frac{1}{6}+\frac{1}{7}=$ b) $\frac{2}{9}+\frac{1}{2}=$ c) $\frac{3}{7}+\frac{2}{6}=$

d) $\frac{2}{5}+\frac{1}{3}=$ e) $\frac{2}{4}+\frac{1}{3}=$ f) $\frac{1}{8}+\frac{1}{7}=$

g) $\frac{2}{11}+\frac{1}{3}=$ h) $\frac{1}{12}+\frac{1}{9}=$ i) $\frac{1}{4}+\frac{1}{2}=$

2. Gachire did $\frac{1}{3}$ of his mathematics homework and $\frac{2}{5}$ of his homework in English. What was his total homework done in both English and Mathematics? Show your working out.
3. Abdul had $\frac{3}{5}$ of his mathematics marked and $\frac{1}{4}$ of Science marked by the teacher. What fraction of his work in Mathematics and Science was marked? Show your working out.
4. Amondo spent $\frac{1}{12}$ of her savings in one month and $\frac{1}{5}$ the following month. What fraction in her savings did she spend in the 2 months? Show your working out.

Subtraction of fractions using L.C.M

Example 19.

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

Find the L.C.M of 2 and 3

2	2	3
3	1	3
	1	1

- L.C.M of 2 and 3 is $2\times3=6$.
- Divide each denominator with the L.C.M $6\div2=3$ then multiply the result by the numerator so, 3×1.
- Record it above the denominator 6.
- Repeat the same with denominator 3.

Exercise 11.

1. Use L.C.M to work out the following: Show your working out.

a) $\frac{2}{5} - \frac{1}{4} =$

b) $\frac{3}{4} - \frac{1}{5} - \frac{1}{8} =$

c) $\frac{1}{3} - \frac{2}{9} =$

d) $\frac{2}{3} - \frac{3}{10} - \frac{1}{5} =$

e) $\frac{3}{4} - \frac{5}{7} =$

f) $\frac{2}{3} - \frac{1}{5} - \frac{1}{4} =$

g) $\frac{5}{6} - \frac{1}{7} - \frac{1}{3} =$

h) $\frac{2}{3} - \frac{2}{4} =$ __ or __

i) $\frac{2}{5} - \frac{2}{7} =$

j) $\frac{2}{4} - \frac{2}{9} =$

2. Akiba saved $\frac{1}{4}$ of his salary in one month. He later spent $\frac{1}{9}$ of his saving in paying school fees for his son. What fraction of his saving did he remain with? Show your working out.
3. A carpenter had a $\frac{3}{4}$m piece of wood. He cut off $\frac{1}{3}$m of it to support a granary. How long was the piece of wood that he remained with?
4. Onjwere subtracted $\frac{3}{14}$ from $\frac{6}{7}$. What was the answer? Show your working out.

1.11 Fractions and decimals

Converting decimals into factions.

1) Write down the decimal divided by 1 $\left(\frac{0.5}{1}\right)$

2) Multiple both top and bottom by 10 for every digit after the decimal point. $\left(\frac{0.5 \times 10}{1 \times 10}\right)$

3) Simplify the fraction. $\left(\frac{5}{10} = \frac{1}{2}\right)$

Example 20.

Convert 0.75 to a fraction.

$$\frac{0.75}{1}$$

Multiple both top and bottom with a hundred because in this case there are two digits after the decimal point.

× 100

$$\frac{0.75}{1} = \frac{75}{100}$$

× 100

Simplify the fraction

Answer= $\frac{3}{4}$

÷5 ÷ 5

$$\frac{75}{100} = \frac{15}{20} = \frac{3}{4}$$

÷5 ÷ 5

Activity 14:

In pairs, convert the following to a fraction. Explain to your partner your working out.

1. 0.625   2. 2.35   3. 0.333

Exercise 12.

Convert the following decimals to fractions. How did you get your answer?

a) 0.2   b) 0.04   c) 0.27   d) 1.25   e) 5.62

f) 2.1   g) 0.75   h) 0.48   i) 1.7   j) 8.21

Convert fraction into a decimal

1. Find a number you can multiply by the bottom of the fraction to make it 10, 100 or 1,000.

2. Multiply both top and bottom by that number.

3. Then write down just the top number, putting the decimal point in the correct spot (one space from the right hand side for every zero in the bottom number).

Example 21.

Convert $\frac{3}{4}$ to a decimal

We can multiply 4 by 25 to become 100

Multiply top and bottom by 25:

$$\overset{\times 25}{\frac{3}{4} = \frac{75}{100}}$$

$$\times 25$$

Write down 75 with the decimal point 2 spaces from the right (because 100 has 2 zeros);

Answer = 0.75

Activity 15:

In pairs, convert the fractions to decimals. Explain to your partner your working out.

1. $\frac{3}{16}$ 2. $\frac{1}{3}$ 3. $\frac{5}{8}$

Exercise 13.

Convert the following fraction to decimals. How did you get your answer?

a) $\frac{3}{10}$ b) $\frac{13}{20}$ c) $\frac{7}{10}$ d) $\frac{9}{40}$ e) $\frac{9}{25}$ f) $\frac{1}{5}$

g) $\frac{7}{8}$ h) $\frac{18}{52}$ i) $\frac{12}{33}$ j) $\frac{8}{22}$ k) $\frac{9}{74}$ l) $\frac{10}{36}$

1.12 Decimals, fractions and percentage conversions

Converting from decimal to percent

To convert a number from a decimal to percent, you multiply by 100 and add the % sign.

The easiest way to multiply by 100 is to move the decimal point 2 places to the right.

Example 22.

Convert 0.125 to percentage.

$$0.125 \times 100 = 12.5\%$$

Activity 16.

In pairs, convert the following decimals to percentage. Can you explain to your partner, what you have done?

a) 0.81 b) 1.376 c) 2.586 d) 2.362

Exercise 14:

Express the following decimals to percentages.

a)1.563 b) 0.632 c) 3.485 d)12.3

Explain how you have worked it out.

Converting from percent to decimal

To convert from percent to decimal, divide by 100, then remove the % sign.

The easiest way to divide by 100 is to move the decimal point two places to the left

Example 23.

Convert 55% to decimal.

55%= 55÷100= 0.55

Activity 17.

In pairs, convert the following percentage to decimals. Can you explain to your partner, what you have done?

a) 20% b) 66% c) 30% d) 78%

Exercise 15:

Express the following percentages to decimals.

a) 65% b) 23% c) 48%

Explain how you have worked it out.

Converting fraction to percent

To convert fraction to percentage, you divide the top number by the bottom number then multiply by 100 and add the % sign.

Example 24.

Convert $\frac{3}{8}$ to a percentage

First divide 3 by 8: 3÷8= 0.375

Then multiply by 100: $0.375 \times 100 = 37.5$

Then add the % sign: 37.5%

Answer: 3/8 = 37.5%

Activity 18.

Individually, convert the following fractions to percentage. Compare your answers with your classmate.

a) $\frac{4}{5}$ b) $\frac{3}{4}$ c) $\frac{5}{6}$ d) $\frac{1}{3}$

Ask your partner how they got their answers

Exercise 16:

1. Convert the following fractions to percentage.

   a) $\frac{2}{5}$ b) $\frac{5}{7}$ c) $\frac{2}{3}$

   Explain how you have worked it out.

2. $\frac{17}{20}$ of the number of homeless children are boys. What is the percentage of the boys?

3. $\frac{5}{2}$ of the number of beds in a hospital are occupied by patients. What is the percentage of beds occupied by the patients?

Converting from percent to fraction

To convert from percent to fraction, first write the number as a fraction by (dividing by 100) then we simplify the fraction as shown below.

Example 25.

Convert 60% to a fraction.

Write 60% as a fraction: $60 \div 100 = \frac{60}{100}$

Simplify the fraction $\frac{6\not{0}}{10\not{0}}$

Every number after simplifying will be $\frac{6}{10}$

Simplify fraction further $\frac{3}{5}$

Activity 19.

In groups, discuss and convert the following percentages to fractions.

a) 45% b) 32% c) 40% d) 78%

Can you describe the method used?

Exercise 17:

1. Convert the following percentages to fractions.

   a) 55% b) 70% c) 36% d) 80%

   What did you notice when converting percentages to fractions?

2. Lobojo used of 45% of his land to plant sorghum. What fraction of the land did he use for sorghum?

3. In a church in Mapel, 58% are women. What is the fraction of women in that church?

Converting from fraction to decimal

To convert a fraction to a decimal simply divide the numerator with the denominator.

Example 26.

Convert $\frac{1}{3}$ to a decimal

$1 \div 3 = 0.3$

Therefore $\frac{1}{3}$ as a decimal is 0.3

Activity 20.

In pairs, convert the following fractions to decimals. Explain your thinking.

a) $\frac{4}{5}$ b) $\frac{2}{5}$ c) $\frac{5}{6}$

Exercise 18:

Convert the following fractions to decimals.

a) $\frac{7}{8}$ b) $\frac{3}{5}$ c) $\frac{12}{10}$ d) $\frac{15}{120}$

How did you arrive at your answer

Converting from decimal to fraction

To convert decimal to fraction requires a little more steps as shown in example 11.

Example 27.

Convert 0.55 to a fraction

First write the decimal over the number 1 $\frac{0.55}{1}$

Multiply top and bottom by 100 for every number after the decimal point
(10 for 1 decimal point, 100 for 2 decimal point etc.) $\frac{0.55 \times 100}{1 \times 100}$

(This makes a correct formed fraction) $\frac{55}{100} = \frac{11}{20}$

Simplify the fraction

Activity 21.

Work in pairs, discuss and convert the following decimals to fractions.

a) 2.5 b) 0.22 c) 1.35 d) 0.46

e) 1.48 f) 2.85 g) 0.65 h) 0.55

Exercise 19:

1. Convert the following decimals to fractions. Show your work out.
   a) 0.56 b) 0.26 c) 0.25 d) 0.45

1.13 Ratios and Proportion

Activity 122.

What is the ratio of boys to girls in your class?

Ratios

A ratio is a comparison between two quantities.

Example 28.

In a certain class there are three girls and six boys.

Therefore the ratio of girls to boys is 3:6 read as 3 is to 6.

This is to say the number of girls is $\frac{3}{6}$ of the number of boys.

Simplify the fraction $\frac{3}{6}$ which is $\frac{1}{2}$

Therefore 3:6 is 1:2

(The sign to show ratios is represented by ':')

Activity 23.

1. There are 80 tables and 160 chairs in a class, what is the ratio of desks to chairs? How did you get your answer?

2. A herd of 52 cows has 12 white and some black cows. What is the ratio of white to black cows? How are you going to tackle this?

Exercise 20:

In groups, solve the following questions.

1. Express the following ratios in the simplest form. Show your working
   a) 3:9 b) 72:16 c) 64:12 d) 36:15
2. Find out the ratio of boys to girls in your school.
3. Find out the ratio of teachers to learners in your class. Compare with other groups an find out if there is any difference.
4. In a school, there are 410 learners and 10 teachers. What is the ratio of learners to teachers in that school?
5. A pattern has 5 blue triangles to every 80 yellow triangles. What is the ratio of blue triangles to all triangles?
6. A pattern has 14 blue triangles to every 18 yellow triangles. What is the ratio of yellow triangles to blue triangles?

Proportion

Proportion is a pair of ratios equal to each other

Example 29.

1. Two learners had ten books. How many books do 5 learners have?

2 learners ⟶ 10 books
1 learner ⟶ $10 \div 2 = 5$ books

5 learners with equal number of books $5\times 5 =$ **25books**

2. A bottle has $\frac{1}{2}$ litres and another has 1 litre of water. How many $\frac{1}{2}$ litre bottles can fill 2 litre bottles?

$$2 \div \frac{1}{2}\text{l} = 2 \times \frac{2}{1}$$

$= \mathbf{4}$ **bottles**

Activity 24.

1. If the cost of 5kg of wheat is 180, what is the cost of 12kgs?
2. A shop sells 200 for every two bags of rice, how much will 5 bags of rice cost in the same shop?
3. One pen weighs 2kg, what is the mass of 8 such pens?
4. 41 kg of tomatoes cost SSP 8 200. How many kilograms of tomatoes can you get with 3 600?
5. 35 kg of onions cost SSP 3 500. How much would 16 kg cost?
6. A car can travel 180 Kilometres on 5 litres of petrol. How much petrol will it need to go 252 Kilometres?
7. A boat travels 365 kilometres in 5 hours (with a constant speed). How much time will it take traveling 454 kilometres?

Exercise 21:

1. A shopkeeper sells bags of maize and rice in the ration of 3:4, if in that period, he sells 108 bags of maize how many bags of rice did he sell in that period? How did you get your answer?
2. In a test, the ratio of the learners who passed to those who failed was 3:2 if the learners who failed were 4, how many learners passed? What did you notice when working out this question?
3. Express each of the ratios in the simplest form

   a) 14:16 b) 20:100 c) 60:140 d) 12:36

   e) 35:60 f) 9:45

UNIT 2: MEASUREMENT

2.1 Millimetres as units of length

When we use millimetres, it is more accurate and precise

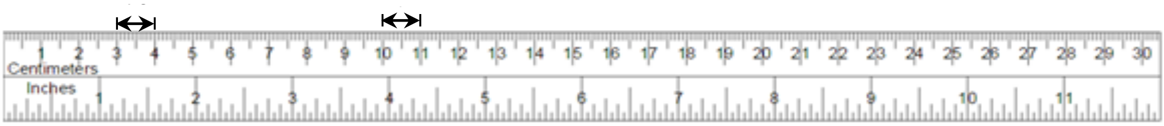
For example in the building industry we require accuracy and this can be achieved by using millimetres.

Activity 1.

In groups, discuss why we use millimetres and where do we use them.

When we are measuring the length, width or height of something, it is important that we choose the right unit. Therefore, we should choose either millimetres, centimetres or metres.

As a general rule, you should measure small objects in millimetres or centimetres and bigger lengths in metres.



Millimetres (mm)

A millimetre is about the width of a sewing needle. We can measure small items such as screws or lines on a house plan using mm.

There are 10 mm in a centimetre (cm). So if an object measures 12 mm then you could also write this measurement as 1 cm 2 mm.

Centimetres (cm)

A centimetre is roughly the width of a finger.

We can measure the length of our neck-size using cm.

A cm is the same as 10 mm. So if an object like a matchbox measures 6 cm in length then you can also write this as 60 mm.

Metres (m)

A metre is about the length of a person's stride.

We can measure longer things like a room or a garden using metres.

A metre is the same as 1,000 mm, although if things are big enough to be measured in metres then the measurement is not usually shown in millimetres.

10 mm = 1 cm
100 cm = 1 m
1000 m = 1 km

Example 1.

Express 5 810 millimetres in metres.
Solution:
1 metre = 1000 millimetres
Set up the conversion so the desired unit will be cancelled out. In this case, we want m to be the remaining unit.

$$Distance\ in\ m\ =\ (distance\ in\ mm) \times (\frac{1\ m}{1000\ mm}).$$

$$Distance\ in\ m\ =\ (\frac{5810}{1000})\ m.$$

$$Distance\ in\ m\ =\ 5.810\ m.$$

Answer:

5810 millimetres is 5.810 metres.

Activity 2.

Measure your mathematics textbook in centimetres (cm). What is the measurement in millimetres (mm).
Share your measurement with your classmates.
Convert the measurements to centimetres (cm).

Exercise 1:

In pairs, convert to the unit in brackets.

a. 3 cm =(mm)
b. 12 cm =(mm)
c. 285 cm =(mm)
d. 6 m =(cm)
e. 2.4 m =(cm)
f. 0.7 m = (cm)
g. 40 mm =(cm)
h. 250 mm = (cm)
i. 400 mm =(cm)
j. 500 cm =(m)
k. 750 cm = (m)
l. 20 cm = (m)

It is clear from the visual comparison of the lengths that a centimetre is a larger unit than a millimetre or conversely that a millimetre is a smaller unit than a centimetre.

Exercise 2:

1. In pairs, convert the following measurements.

   a. 8 cm to mm
   b. 6 m to cm
   c. 7 km to m

2. The length of the front of a car park is 2400cm. How long is it in metres?

3. A piece of string measures 1.4M. How long is this in centimetres/

2.2 Convert metres into kilometres and vice versa

Activity 3:

In groups, discuss the units we use to measure your desk, school compound and distance between towns.

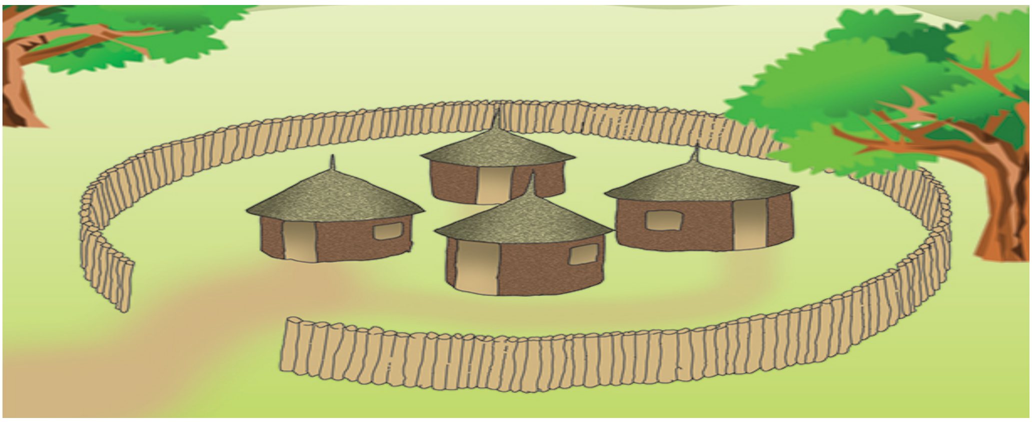
Metres are usually smaller than kilometres, they are used to represent a certain length which is normally shorter compared to kilometres.

An example can be the 1 metre chalk board ruler.

The chalk board ruler consists of 100cm

Thus 1 metre= 100 cm

1Km = 1000metres



The difference between the huts in this compound can be measured in metres.

A km is longer than a metre and is mostly used to represent the distance of a place. For example, the distance between two different towns is approximately 40KM.

Example 2.

The distance between two different towns is 750M.

Convert 750M to Km

1Km = 1000M

$? \quad = 750m$

$$1\times \frac{750}{1000} = 0.75$$

Answer= 0.75Km

1 millimetre [mm]	
1 centimetre [cm]	10 mm
1 metre [m]	100 cm
1 kilometre [km]	1000 m

The speed of a moving vehicle is also measured in terms of kilometres.

This school bus travels at a speed of 50KM per hour.
1 Kilometre = 1000M

Example 3.

Convert 7.5 Km into metres

1Km = 1000m

7.5km =?

7.5×1000=7 500

Answer = 7500metres.

Activity 4:

1. Approximately, what is the distance between your home and school in kilometres?
2. Convert the kilometres into metres.

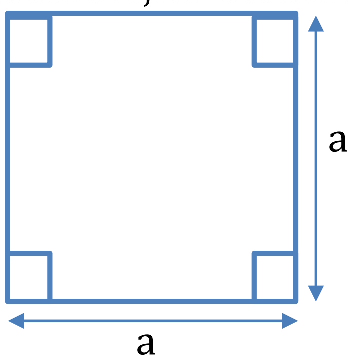
Exercise 3.

In groups, convert the following; Explain the method you used to work out.

1. Convert 6 Km to metres.
2. Convert 0.575Km to metres.
3. Convert 7.50Km to metres.

2.3 Calculating area of a rectangle and square

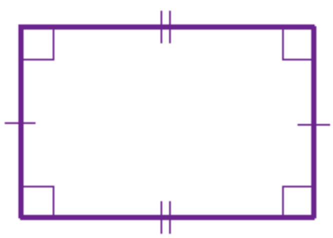
A square is a four equal sided object. Each internal angel is 90°.

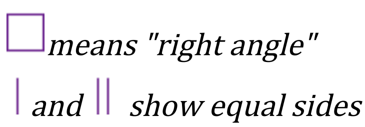


Area of a square = side length squared.

$$= \text{Area} = a^2 = a \times a$$

A rectangle has four sides but two pairs of equal sides unlike a square that has all sides equal.



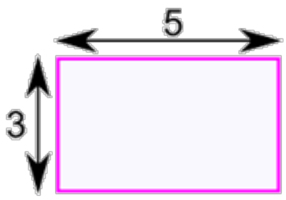


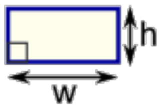
Each internal angle is 90°.

Opposite sides are parallel and equal in length.

Example 4.

What is the area of the rectangle?





Area = w × h
w = width
h = height

We know Area = width multiplied by height:

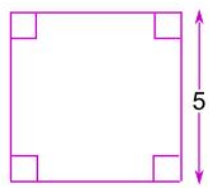
Area = w x h

The area is =<u>15 units square</u>

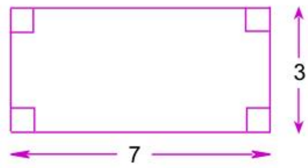
Activity 5:

In groups, calculate;

1. What is the area of the square?



2. Calculate the area of the rectangle below.



Exercise 4.

1. The area of a square is 16 cm^2. What is the length and width? Discuss your answer.
2. The area of a rectangle is 45 cm^2. If its length is 9 cm, then what is the width?
3. A rectangle with length 10m and width 4m are cut into squares. What is the maximum possible area of a square? Explain your answer?
4. The area of a square is 16 mm^2. What is the measurement of one side?
5. The length of a rectangle is 12 cm and its width is 5 cm smaller. The area of the rectangle is? Explain your answer.
6. How many squares with the side of 2 cm cover the surface of a rectangle with a length of 24 cm and a width of 8 cm?

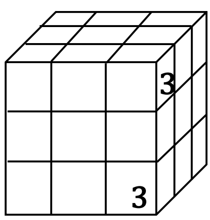
2.4 Calculate volume of a cube and cuboid

Facts about a cube

- It has 6 Faces
- Each face has 4 edges (and is a square)
- It has 12 Edges
- It has 8 Vertices (corner points) and at each vertex 3 edges meet

Finding the volume of cubes

Example 5.



Volume = base area x height

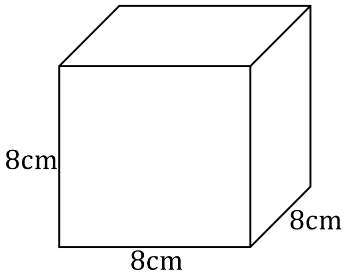
= (3 x 3) x 3

= <u>**27 cubic units**</u>

3

Volume= Length (L) ^{3}
If the length is 4 then then volume = $(4)^3$
This is also equivalent to 4×4×4=64

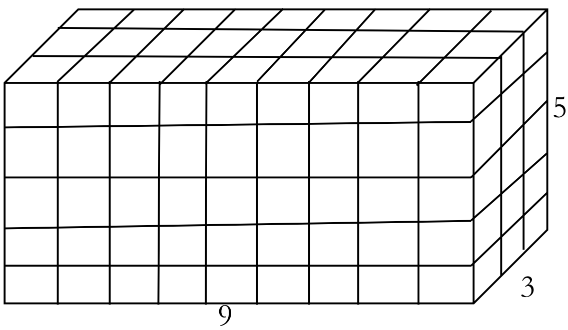
Example 6.



Volume = base area x height
= (8cm x 8cm) x 8cm **=** **<u>512cm³</u>**

Finding the volume of cuboids

Example 7.



Volume = base area ×height
= (9× 3) × 5
= 27× 5 = **135 cubic units**

A cuboid is a box shaped object.
It has six flat sides and all angles are right angled.
The volume of a cuboid is found using the formula:

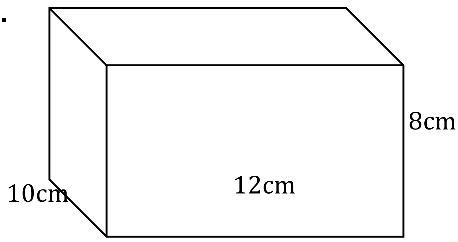
Volume = Length × Width × Height

This can also be represented as:

$$V = l \times w \times h \text{ or } V = lwh$$

Example 8.

1.



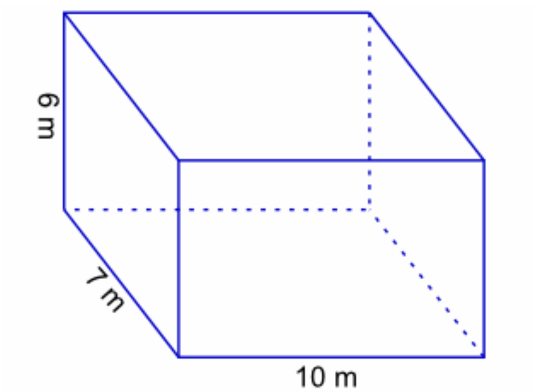
Volume = base area(L X W) × height

$V = (12cm \times 10cm) \times 8cm$

$V = 120cm^2 \times 8cm$

$V = 960cm^3$

2. What is the volume of the cuboid below?



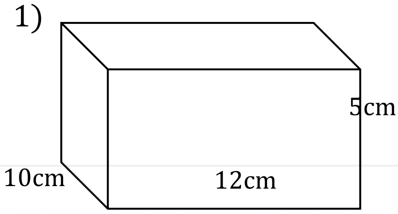
Formula = l × w × h

Thus in this case 10×7×6=420

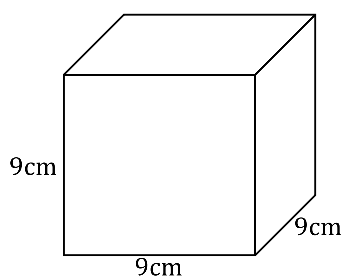
Exercise 5.

Find the volume of the following figures.

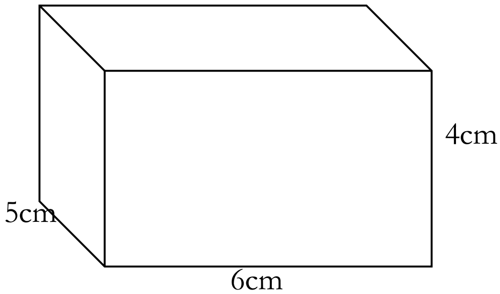
1)



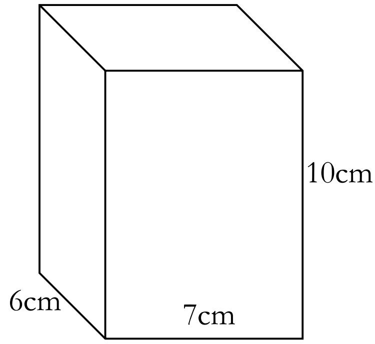
2)



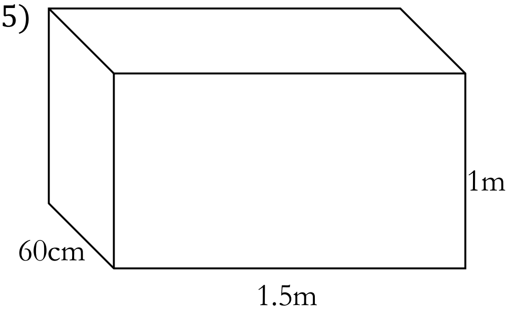
3)



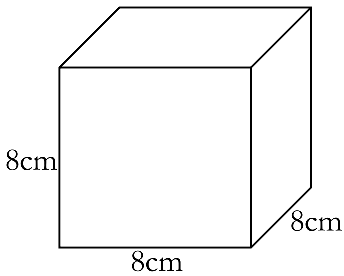
4)



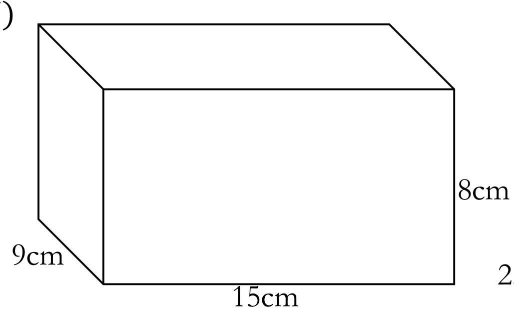
5)



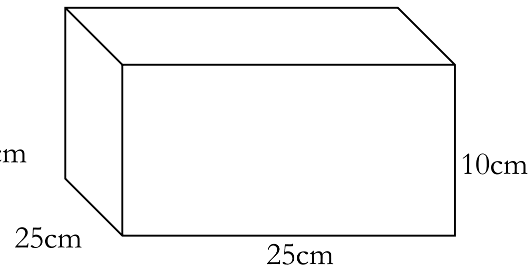
6)



7)



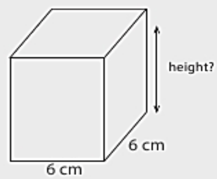
8)



9. A rectangular tank measures 1.2m by 0.8m by 0.5m. What is the volume in cm^3?
10. The base area of a rectangular tank is $15m^2$ and has a height of 1.5m. What is the volume of the tank in cubic metres?
11. One cube measures 8cm. Another cube measures 10cm. What is the sum in their volume in cubic centimetres?

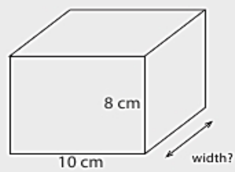
12. A rectangular container with a base area of 150m² and a height of 12m. What is its volume in cubic metres?
13. A tank is a cube in shape. The height of the tank is 8.1metres. What is its volume in cubic metres?
14. A rectangular container is 80cm long, 50cm wide and 40cm. What is the volume in cm³?
15. A cube shaped tank is 5.5m. What is its volume in cubic metres?

Calculate the length of the unknown edges.



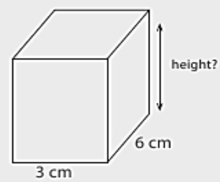
Volume: 288 cm^3

Height: _____ cm



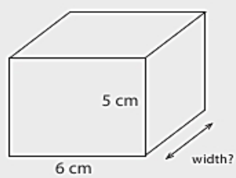
Volume: 720 cm^3

Width: _____ cm



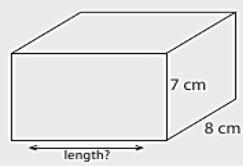
Volume: 180 cm^3

Height: _____ cm



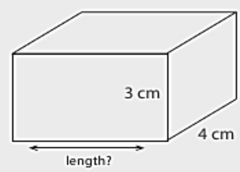
Volume: 210 cm^3

Width: _____ cm



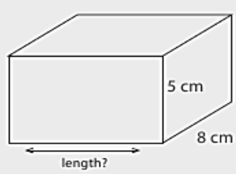
Volume: 560 cm^3

Length: _____ cm



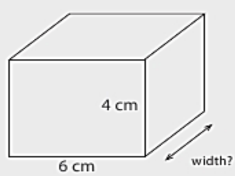
Volume: 72 cm^3

Length: _____ cm



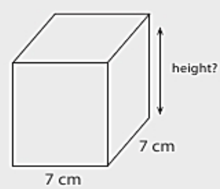
Volume: 360 cm^3

Length: _____ cm



Volume: 120 cm^3

Width: _____ cm



Volume: 343 cm^3

Height: _____ cm

2.5 Time

Time is the indefinite continued progress of existence and events.

Time can be expressed in hours, minutes or seconds.

A clock has three different hands, the hour hand, the minutes hand and the seconds' hand.

The hour hand indicates the number of hours; minute hand indicates the minutes and the second hand show the number of seconds.

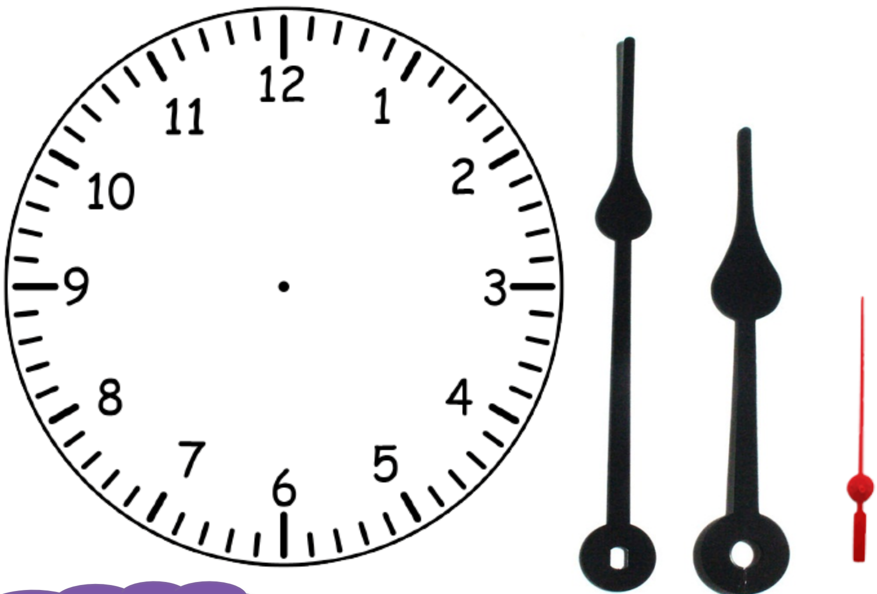
Example 9.

What is the time?

The Time on the clock is 10:10 AM/PM

The interval between a number and the other represent one hour but also represents five minutes and five seconds.
In the clock interface above the hour hand is at 10 which is also 10AM/PM.
The minute hand is at 2 which indicate its 10 minutes past 10.
The second hand is usually the thinnest and usually at the top of the other two, in this case it is at 7 which is 35 seconds.

The second hand rotates first, when it makes a full rotation (60 seconds) =1minute.
When the minute hand makes a full rotation (60 minutes) = 1 hour.
When the hour hand makes a full rotation (12 hours) = $\frac{1}{2}$ a day.
From the diagram below shows three different hands of a clock. The small Black Hand is the hour hand while the other black is the minute hand. The small hand in red is the second hand.



Activity 6:

In groups, your teacher will provide different phases from the manually operating clock and you are to identify the time and note the different time set.

Example 10.

Conversion of hours into minutes and second

1. Convert 2 hours into minutes

$1hour = 60minutes$ or 60 minutes $= 1hour$

1 minute $= 60$ seconds

1 hour $= 60 \times 60$ seconds $= 3600$ seconds.

So, 2 hours $= 2 \times 60$

$=$ **120 minutes**

2. Convert 2 hours to minutes and seconds.

2hours = ___ minutes= ____seconds

$= 2 \times 60minutes$

$= 120minutes$

$120minutes \times 60$ seconds

$=$ **7200 seconds**

3. Convert 360 minutes to hours

$60min = 1hr$

$$360min = \frac{\overset{6}{\cancel{360min}}}{\cancel{60min}} = 6hrs$$

In time we use Seconds (sec), Minutes (min) and Hours (hrs) as units of telling time.

Exercise 6.

i. Change the following hours to minutes.

1) 4hours 2) $2\frac{1}{2}$ hours 3) 5 hours

4) 10 hours 5) 7 hours 6) 12 hours

7) $5\frac{1}{4}$ hours 8) $3\frac{3}{4}$ hours 9) $4\frac{1}{4}$ hours

ii. Change the following minutes to hours.

1) 240 minutes 2) 180 minutes 3) 270minutes

4) 225 minutes 5) 45 minutes6) 15 minutes

iii. Change the following to seconds.

1) 60 minutes2) 2 hours 3) 6 minutes

4) 6 hours 5) 45 minutes6) 4 hours

iv. Change the following to minutes.

1) 180 Sec 2) 360 Sec 3) 240 Sec

4) 480 Sec 5) 720 Sec 6) 560 Sec

v. Change the following into minutes and seconds.

1) 90 Sec 2) 75 Sec 3) 300 Sec

4) 150 Sec 5) 435 Sec 6) 100 Sec

vi. Musa travelled from town A to town B. If he took $4\frac{3}{4}$ hours. How many minutes did he spend on his journey?

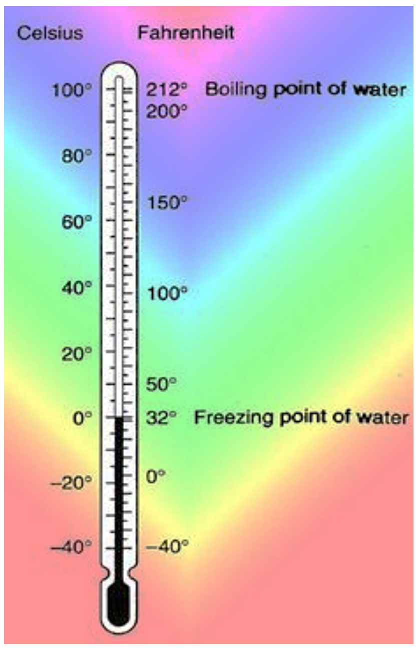
vii. A period in a class lasts 45mins. If there are 7 periods in a day, how many hours and minutes do pupils spend in the periods?

2.6 Measure temperature of objects in Celsius or Fahrenheit

Temperature is how hot or cold something is.

Temperature can be measured in Celsius or Fahrenheit.

They both describe temperature.



Thermometer

This block of ice would measure 0° Celsius, or 32° Fahrenheit. To convert Celsius into Fahrenheit or vice versa one can use either the interactive thermometer or the formula below:

°F to °C Subtract 32, then multiply by 5, then divide by 9.

$$°C = \frac{(°F - 32) \times 5}{9}$$

°C to °F Multiply by 9, then divide by 5, then add 32.

$$°F = \frac{°C \times 9}{5} + 32$$

Activity 7:

In groups of five use a thermometer to measure the temperatures water and record it in Celsius and Fahrenheit.
The temperature of a certain area was 12°c, 15°c, 17°c, 18°c, 20°c and 22°c to the left of zero. What was the total temperature in the 6 months?

Exercise 7.

1. Convert the following Celsius to Fahrenheit. What operations are you going to use?
   a. 24^0
   b. 19^0
   c. 46^0
   d. 37^0
2. Convert the following Fahrenheit to Celsius. What method will you use and why?
   a. 168^0
   b. 72^0
   c. 143^0
   d. 200^0

2.7 Money

Profit and loss in business.

In business people do make profits but also make losses at times.

Profit: is the extra money someone makes after deducting all the expenses.

Example 11.

A farmer harvested 80 suck of potatoes, each suck cost around SSP6000 from the cost of seeds and labor. If he sold each suck at SSP9500 he made a profit.

$80 \times 6000 = \text{SSP}480{,}000$

$80 \times 9500 = \text{SSP } 760{,}000$

Answer= 760,000 – 480,000=280,000

Loss: occurs when a product is sold less than the production cost.

Example 12.

From the example above, assume the farmer sold the sack of potatoes at SSP 5500 for each sack which cost SSP 6000.

$5500 \times 80 = 440{,}000$

$6000 \times 80 = 480{,}000$

Answer= 480,000 - 440,000 = SSP 4,000

Exercise 8.

1. A TV was bought for SSP 18,950 and old at a loss of SSP 4780. Find the selling price.
2. Mr. Smith buys pencils at SSP 450 per hundred and sells each at SSP 5. Find his loss or profit.
3. Davis bought a second hand cycle for SSP 500. He spent SSP 80 in repairs and SSP 175 in repainting. He then sold it to John for SSP 900. How much did he gain or lose?

4. A fruit vendor bought 600 apples for SSP 4800. He spent SSP 400 on transportation. How much should he sell each to get a profit of SSP 1000?
5. Tim bought a box of chocolates for SSP 650 and sold it to Tom at a profit of SSP 75. Find the selling price.

Currencies within particular regions

When traveling or moving around different regions it is advisable to change into the countries form of currencies.

Different countries use different types of currencies like Dollar, shilling and Pound. This makes it easier to buy goods and services in a country.

Activity 8:

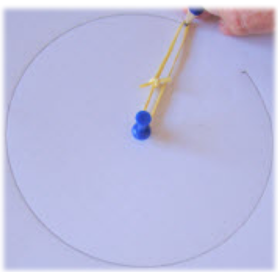
With the guidance of the teacher, visit any exchange bureau and ask how they exchange the currencies. Which currencies do they change? What is the exchange rate? Does the exchange rate change?

2.8 Parts of a circle

A circle is a 2-dimensional shape made by drawing a curve that is always the same distance from a center.

Activity 9.

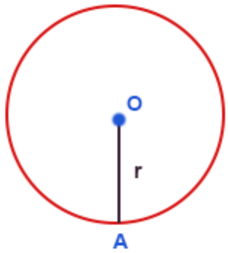
Put a pin in a board or a stick on the ground, put a loop of string or rope around it, and insert a pencil or another stick into the other loop. Keep the string stretched and draw the circle.



Try dragging the point to see how the radius and circumference differences.

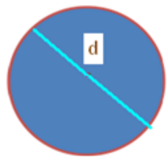
Radius, Diameter and Circumference

Radius: It is defined as the distance between the centre of the circle and a point on the circle.
It is represented as r. In the diagram below, OA is the radius of circle.



Diameter: Diameter is the distance between two points on the circle which passes through the center of the circle. It is represented by d.

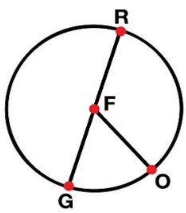
$$d = 2r \; or \; r = \frac{d}{2}$$



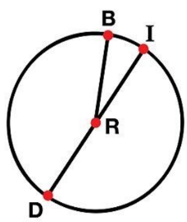
Exercise 9:

In groups, identify the radius and diameter of the circles below. How did you get your answer?

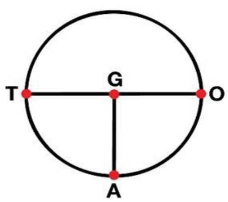
a.



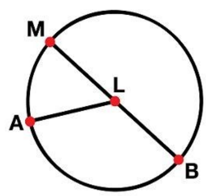
b.



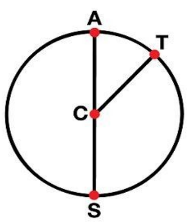
c.



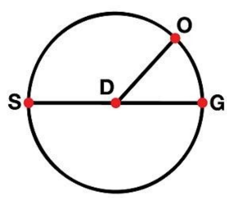
d.



e.



f.

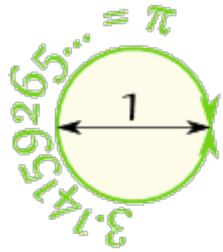


2.9 Calculate the value of π

The distance round a circle is the circumference.

In some ways Pi (π) is a really straightforward number – calculating Pi simply involves taking any circle and dividing its circumference by its diameter.

$$\pi = \frac{Circumference}{Diameter}$$

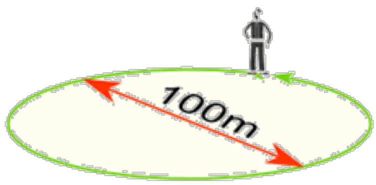


When we divide the circumference by the diameter, we get 3.141592654... Which is the number π (Pi)
Therefore, when the diameter is 1, the circumference is 3.141592654...

We can say: Circumference = **π** × Diameter

Activity 10.

Walk around a circle which has a diameter of 100m, how far have you walked?



Distance walked = Circumference = **π** × 100m

= **314m** (to the nearest m)

Now, substituting 14 in r in the formula for area of circle, πr^2,

The area will be $\left(\frac{22}{7}\right) \times 14^2 = \left(\frac{22}{7}\right) \times 14 \times 14 = 22 \times 28 = 616cm^2$

Activity 11.

Use a string or tape measure to measure circular objects like plates.

Measure around the edge (the **circumference**):

Measure across the circle (the **diameter**):

Divide:

$$\pi = \frac{Circumference}{Diameter}$$

That is how we find π of a circular object.
Try it again and measure more accurately.
Also, note that the Diameter is twice the Radius:

Diameter = 2 × Radius

Therefore, this is true:

Circumference = 2 × **π** × Radius

Area of a circle, technically, is π times the radius squared.

i.e. Area of a circle = $\pi \times r^2$.

Write either $\frac{22}{7}$ or approximately **3.14** for π

Let us solve a few questions on area of a circle, when different parameters are given

Example 13.

1. Find the area of a circle whose radius is 7cm.

   Answer:
   Substitute 7 in radius, r in the area of a circle, $\pi \times r^2$.
   So, area of circle is $\pi \times 7^2 = \left(\frac{22}{\cancel{7}}\right) \times \cancel{49}\ 7 = 22 \times 7 = 154$.
   Expressed along with units, the area of circle is 154 sq. cm.

2. Find the area of a circle whose circumference is 88cm.

   Answer:
   Using the formula for circumference of a circle $2\pi r$, let us find radius r:
   Since, $2\pi r = 88$, therefore, $2 \times \left(\frac{22}{7}\right) \times \mathrm{r} = 88$,
   Finally, $\mathrm{r} = (288 \times 7)/44 = 14$ cm.

2.10 Units of area in acres and hectares

Convert acres to hectares

You may be wondering **how many hectares there are in x acres.**
To convert from acres to hectares multiply your **x** figure by 0.405.

Example 14

Convert 20 acres to hectares.

Formula: $Acres \times 0.405 = Hectares$

Calculations: $20\ Acres \times 0.405 = 8.1\ hectares$

Result: 20 acres is equal to 8.1 hectares

Activity 12.

In pairs, convert the following acres to hectares. Show your working out
a. 164 acres b. 634 acres c. 46 acres

d. 363 acres	e. 349 acres	f. 67 acres
g. 797 acres	h. 946 acres	i. 82 acres

Convert hectares to acres

Alternatively, you may want to know **how many acres there are in x hectares.**

To convert from hectares to acres multiply your **x** figure by 2.471.

Example 15.

Convert 40 hectares to acres.

Formula: $hectares \times 2.471 = acres$

Calculations: $40\ hectares \times 2.471 = 98.84\ acres$

Result: 40 hectares is equal to 98.84 acres

Activity 13.

In pairs, convert the following hectares to acres. How do you work it out?

a. 164 hectares	b. 634 hectares	c. 46 hectares
d. 363 hectares	e. 349 hectares	f. 67 hectares
g. 797 hectares	h. 946 hectares	i. 82 hectares

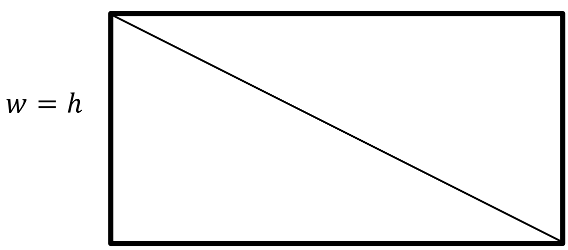
2.11 Find the area of triangles

We can calculate the area of a triangle when we know the Base and Height.

When we know the base and height it is easy.

It is simply **half of base times height**

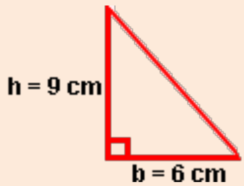
Area $= \frac{1}{2}$bh



$l = b$

Example 16.

Find the area of a right triangle with a base of 6 centimetres and a height of 9 centimetres.



Solution:

$A = \frac{1}{2} \cdot b \cdot h$

$A = \frac{1}{2} \times (6 \text{ cm}) \times (9 \text{ cm})$

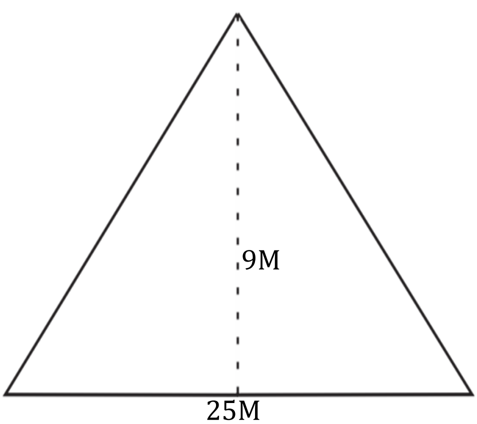
$A = \frac{1}{2} \times (54 \text{ cm}^2)$

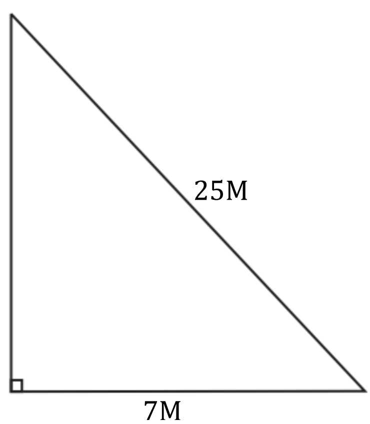
$A = 27 \text{ cm}^2$

Exercise 10:

1. Find the area of triangle drawn below. Write down how you worked it out.

a)





b)

2.12 Solve problems involving units of capacity

We use liter to represent as the standard unit.

$$1 \text{ millilitre} = 0.001 \text{ litre}$$

$$1 \text{ centiliter} = 0.01 \text{ litre}$$

$$1 \text{ decilitre} = 0.1 \text{ litre}$$

$$1 \text{ kilolitre} = 1000 \text{ litres}$$

Example 17.

A soda can holds 250 ml of liquid. If someone was to pour 20 soda cans of water into a bucket, how many liters of water are transferred to the bucket?

Solution:

First, find the total volume of the water.

$\text{Total volume in ml} = 20\ cans \times \frac{250\ ml}{cans}$

$\text{Total volume in ml} = 5000 \text{ ml}$

Second, convert ml to L

$1 \text{ L} = 1000 \text{ ml}$

Set up the conversion so the desired unit will be cancelled out.

In this case, we want L to be the remaining unit.

$\text{Volume in L} = (volume\ in\ ml) \times (1\ L/1000\ ml)$

$\text{volume in L} = \left(\frac{5000}{1000}\right) \text{L}$

$\text{volume in L} = 5 \text{ L}$

ANSWER:

5 liters of water was poured into the bucket.

Activity 14.

In groups;

Find a variety of containers. Fill them with water, without measuring the amount of water poured into each container.

Estimate the capacity of each container and record these values in the table.

Use measuring devices or container to measure the actual capacity of water in each container and record these values.

Exercise 11:

Work in pairs, tell your partner how you would work out the following.

1. How many ml does 10 L represent?
2. How many L does 4000 ml represent?
3. How many mL does 7.4 L represent?

2.13 Conversion of tonnes to kilograms and kilograms to grams

How to convert Tonnes to Kilograms

1 ton (t) is equal to 1000 kilograms (kg).
1 t = 1000 kg
The mass *m* in kilograms (kg) is equal to the mass m in ton (t) times 1000:
$m_{(kg)} = m_{(t)} \times 1000$

Example 18.

Convert 5t to kilograms:

$m_{(kg)} = 5t \times 1000 = 5000$ kg

How to convert Kilograms to Tonnes

1 gram (kg) is equal to 1000000 tons (t).

$$1\ kg\ =\ (\frac{1}{1000})\ t\ =\ 0.001\ t$$

The mass m in tons (t) is equal to the mass m in kilograms (kg) divided by 1000:

$m_{(t)} = m_{(kg)}$ / 1000

Example 19.

Convert 5 kg to tons:

$m_{(t)}$ = 5 kg / 1000 = 0.005 t

How to convert Grams to Kilograms

1 gram (g) is equal to 0.001 kilograms (kg).

1 g = (1/1000) kg = 0.001 kg

The mass m in kilograms (kg) is equal to the mass m in grams (g) divided by 1000:

$m_{(kg)} = m_{(g)}$ / 1000

Example 20.

Convert 5 g to kilograms:

$m_{(kg)}$ = 5 g / 1000 = 0.005 kg

How to convert Kilograms to Grams

1 kilogram (kg) is equal to 1000 grams (g).

1 kg = 1000 g

The mass m in grams (g) is equal to the mass m in kilograms (kg) times 1000:

$m_{(g)} = m_{(kg)} \times 1000$

Example 21.

Convert 5kg to grams:

$m_{(g)} = 5 \text{ kg} \times 1000 = 5000 \text{ g}$

Exercise 12:

Show your working out.

1. If one paperclip has the mass of 1 gram and 1 000 paperclips have a mass of 1 kilogram, how many kilograms are 8 000 paperclips?
2. If an object weighed 5 kilograms, how many grams would it weigh?
3. If an object weighed 9 000 grams, how many kilograms would it weigh?
4. Charlie's eraser has a mass of 20 grams. How many milligrams are in 20 grams?
5. Steven goes to the grocery store and is looking at a mango. It has a mass of 0.8 kilograms. How many grams is the mango?
6. A box contains 4 bags of sugar. The total mass of all 4 bags is 6 kg. What is the mass of each bag in grams?

2.14 Profit and loss

Formulas of profit and loss are given below.

When the Selling Price (SP) is greater than Cost Price (CP) the man makes a Profit or Gain.

Selling Price (SP) > Cost Price (CP) → Profit or Gain

Profit = Selling Price (SP) – Cost Price (CP)

When the Selling Price (SP) is less than Cost Price (CP) the man suffers a Loss.

Selling Price (SP) < Cost Price (CP) → Loss

Loss = Cost Price (CP) - Selling Price (SP)

Example 22.

John bought a bicycle for SSP 3 390 and sold to a buyer for SSP 3 820. Did he make profit or loss by selling the bicycle? .How much is the loss or profit?

Solution

As the selling price is more than the cost price, John has profit in selling the bicycle.

Profit = SP – CP

= SSP 3 820 – SSP 3 390 = SSP 430

Exercise 13:

Work in groups to write some word problems that:

1. The answer shows the profit.
2. The answer shows the loss.

Give your problem to another group to work it out.

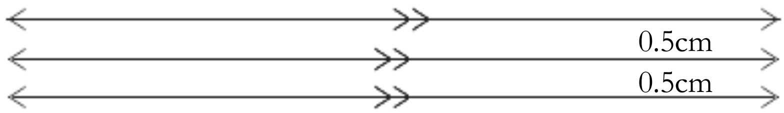
Check that they have solved the problem correctly.

UNIT 3: GEOMETRY

3.1 Angles properties of parallel and perpendicular lines

- Lines that divide items into equal parts are called **parallel lines**
- Parallel lines throughout their distance will keep the same distance.

Example:

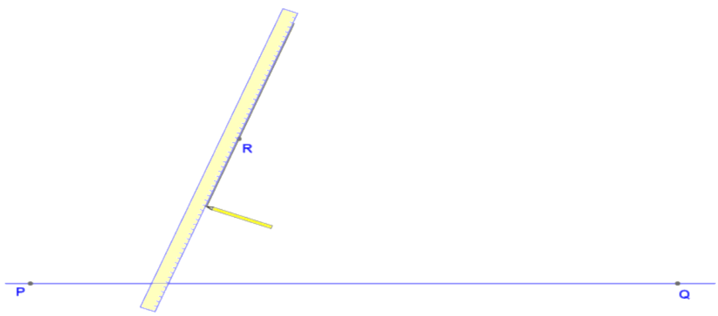


The distance or gaps between the lines will remain the same throughout.

3.2 Constructing parallel lines

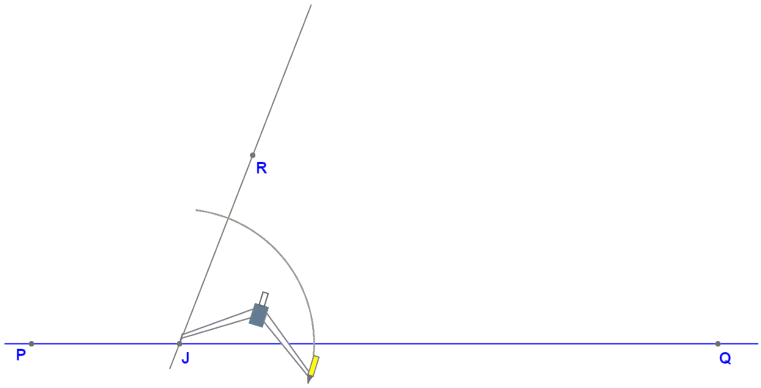
We need a ruler and pair of compass.

1. Using your ruler, draw a line through point R.

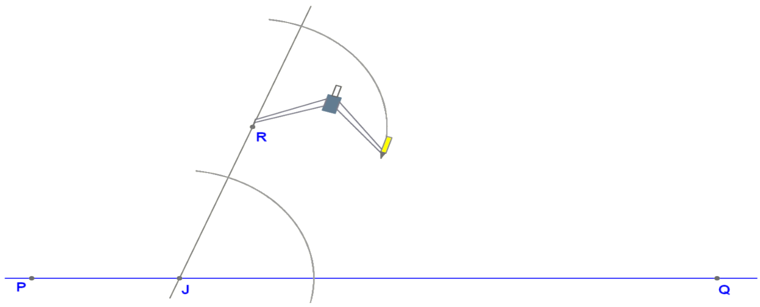


This is simply a straight line which passes through *R* and intersects with given line.

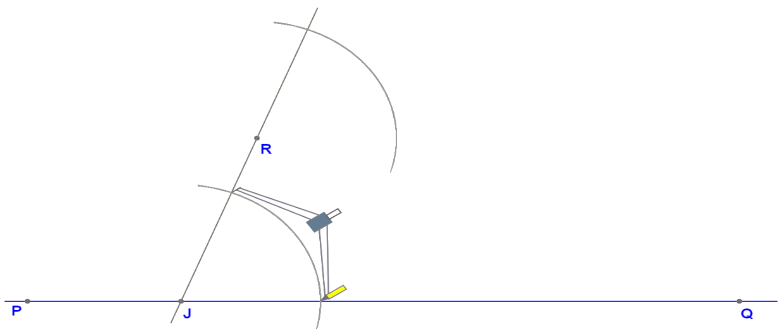
2. Using the compass, mark the angle formed by the transversal



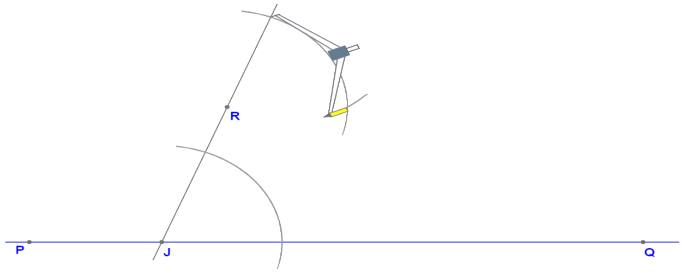
3. Using the same distance on the compass, construct a copy of the angle formed by the transversal at point R



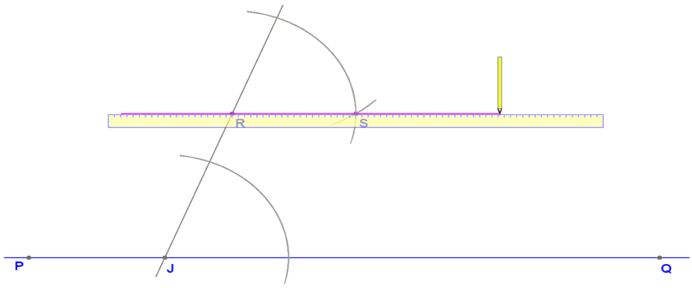
4. Measure the curve using a compass.



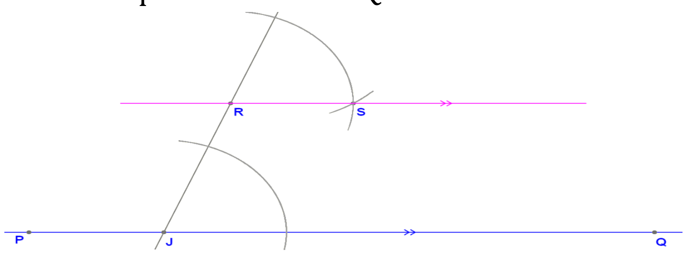
5. Using the same distance mark on the copied arc.



6. Join point R and S by drawing a line using a ruler.



7. Done. Line RS is parallel to line PQ



Activity 1:

In pairs, draw a straight line and follow the steps to construct a parallel line.

Uses of parallel lines

We use parallel lines in construction of houses, carpentry like making a chair, farming when planting seedlings etc.

3.3 Construct angles.

Constructing a 60º Angle

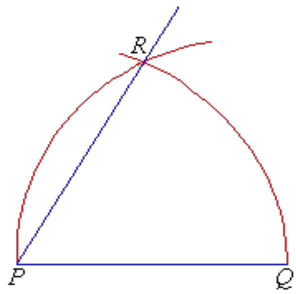
We know that the angles in an equilateral triangle are all 60º in size. This suggests that to construct a 60º angle we need to construct an equilateral triangle as described below.

Step 1: Draw the arm *PQ*.

Step 2: Place the point of the compass at *P* and draw an arc that passes through *Q*.

Step 3: Place the point of the compass at *Q* and draw an arc that passes through *P*. Let this arc cut the arc drawn in Step 2 at *R*.

Step 4: Join *P* to *R*. the angle *QPR* is 60^0



Activity 2:

In pairs, draw a 60^0 angle.

Constructing a 30º Angle

We know that:

$$\frac{1}{2} \text{ of } 60° = 30°$$

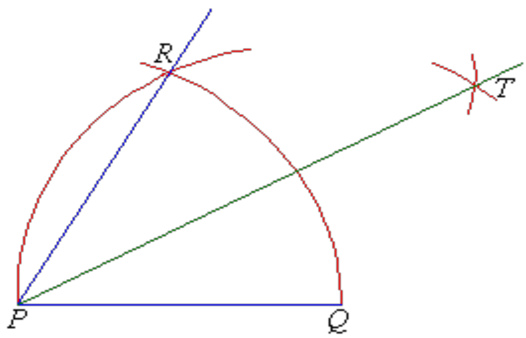
So, to construct an angle of 30º, first construct a 60º angle and then bisect it. Often, we apply the following steps.

Step 1: Draw the arm *PQ*.

Step 2: Place the point of the compass at *P* and draw an arc that passes through *Q*.

Step 3: Place the point of the compass at *Q* and draw an arc that cuts the arc drawn in Step 2 at *R*.

Step 4: With the point of the compass still at Q, draw an arc near T as shown.
Step 5: With the point of the compass at R, draw an arc to cut the arc drawn in Step 4 at T.
Step 6: Join T to P. The angle QPT is 30º.



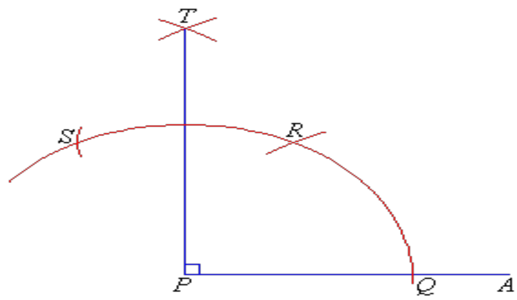
Activity 3:

In pairs, draw a 30^0 angle.

Constructing an angle of 90º.

We can construct a 90º angle either by bisecting a straight angle or using the following steps.

Step 1: Draw the arm PA.
Step 2: Place the point of the compass at P and draw an arc that cuts the arm at Q.
Step 3: Place the point of the compass at Q and draw an arc of radius PQ that cuts the arc drawn in Step 2 at R.
Step 4: With the point of the compass at R, draw an arc of radius PQ to cut the arc drawn in Step 2 at S.
Step 5: With the point of the compass still at R, draw another arc of radius PQ near T as shown.
Step 6: With the point of the compass at S, draw an arc of radius PQ to cut the arc drawn in step 5 at T.
Step 7: Join T to P. The angle APT is 90º.

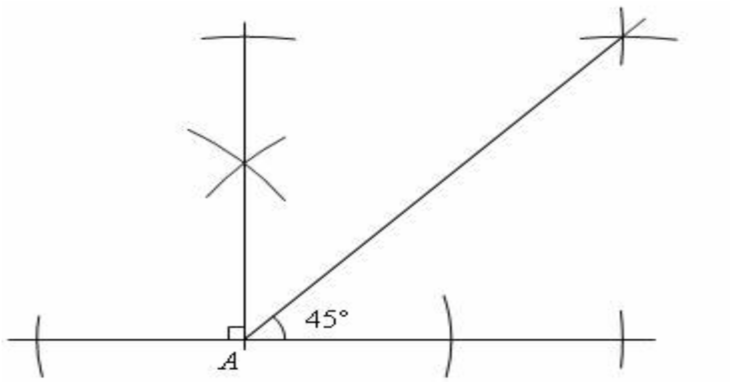


Activity 4:

In pairs, draw a 90^0 angle.

Constructing an angle of 45º

Bisect the angle of 90º



Measure angles

Activity 5:

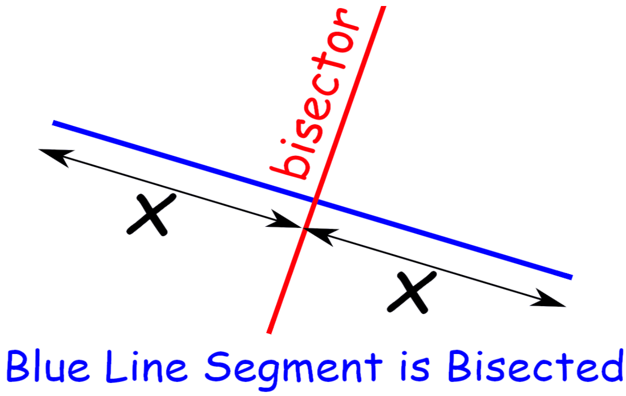
In pairs, bisect a 90^0 angle.

3.4 Constructing and bisecting lines

"Bisect" means to divide into two equal parts.
You can bisect lines, angles, and more.
The dividing line is called the "bisector"

Bisecting a Line

Here the blue line bisects the red line:

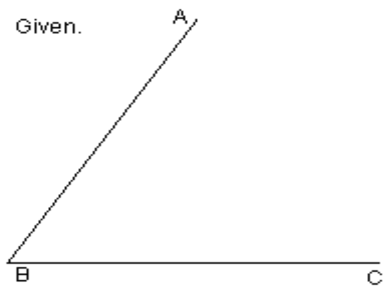


Activity 6.

In groups collect safe objects and bisect them.
For example, piece of paper and sticks.

Below are the steps used to construct bisecting lines

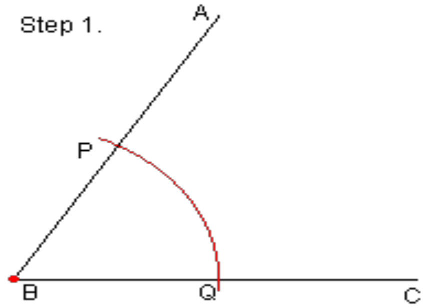
Given. An angle to bisect. For this example, angle ABC.



Step 1. Draw an arc that is centered at the vertex of the angle.

This arc can have a radius of any length. However, it must intersect both sides of the angle.

We will call these intersection points **P** and **Q.** This provides a point on each line that is an equal distance from the vertex of the angle.

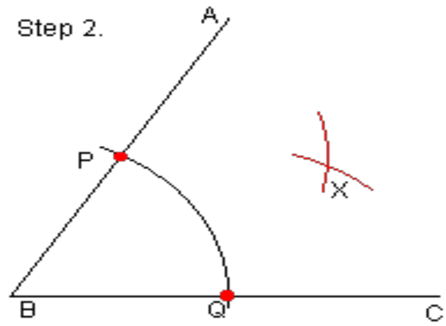


Step 2. Draw two more arcs. The first arc must be centered on one of the two points **P** or **Q.** It can have any length radius.

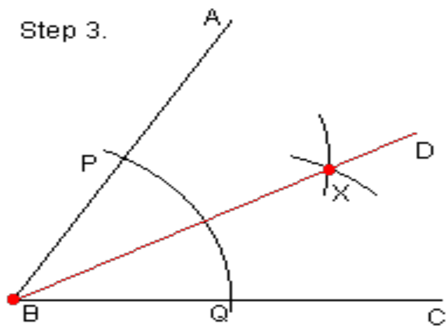
The second arc must be centered on whichever point (P or Q) you did NOT choose for the first arc.

The radius for the second arc MUST be the same as the first arc.

Make sure you make the arcs long enough so that these two arcs intersect in at least one point. We will call this intersection point **X.**



Step 3. Draw a line that contains both the vertex and **X.**



Line BD is the angle bisector

Activity 7.

Now, try to do this construction of 60^0 in pairs. Explain the steps to your partner.

Exercise 1:

Draw an angle of any size and bisect the angle.

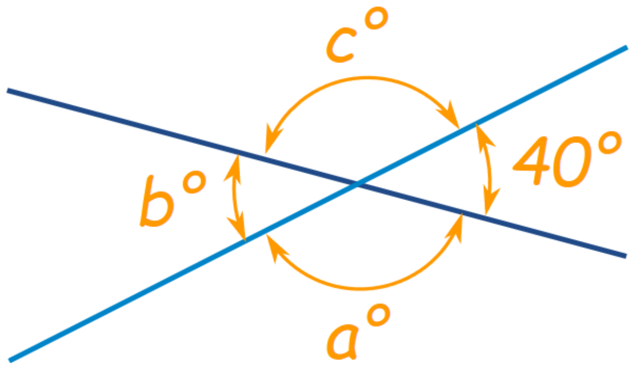
3.5 Identifying vertically opposite and supplementary angles

Vertically Opposite Angles

Vertically Opposite Angles are the angles opposite each other when two lines cross.

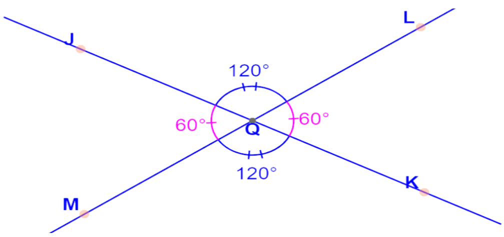
Example 1.

Find angles a°, b° and c° below:



Because b° is vertically opposite 40°, it must also be 40°
A full circle is 360°, so that leaves $360° - 2\times40° = 280°$
Angles a° and c° are also vertically opposite angles, so must be equal, which means they are 140° each.
Answer: **a = 140°, b = 40° and c = 140°.**

Observe the angles below.



Angle MQK is vertically opposite to angle JQL.

Angle MQJ is vertically opposite to angle KQL.

Activity 8.

In groups, collect the materials required to do the activity below and follow the steps.

Material required:

Paper, carbon paper, ruler, pencil, pair of scissors, glue.

Procedure:

Step1: On a sheet of paper draw two intersecting lines AB and CD. Let the two lines intersect at O.

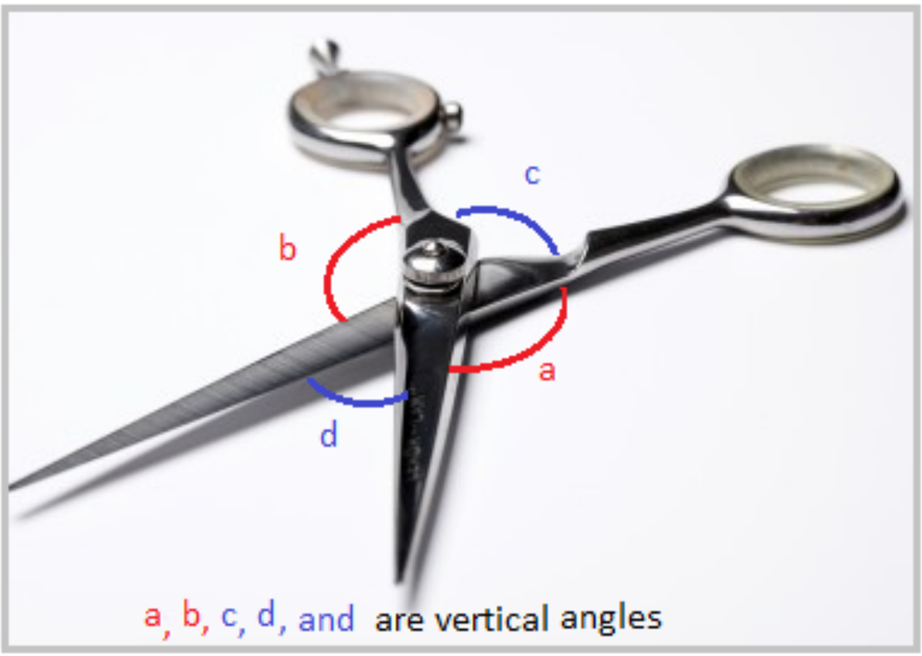
Step 2: Label the two pairs of vertically opposite angles as angle1 opposite to angle 2 and angle 3 opposite to angle 4.

Step 3: Make a duplicate of angle 2 and angle 3 and cut it.

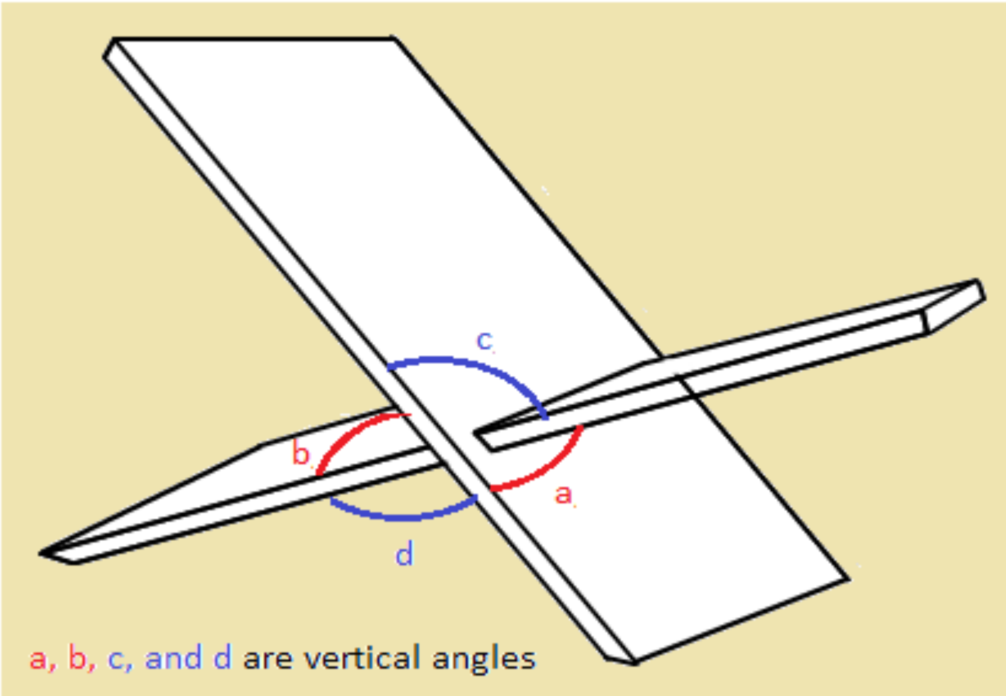
Step 4: Place the cut out of angle 2 on angle 1. Are they equal?

Step 5: Place the cut out of angle 3 on angle 4. Are they equal? Write your observations and result.

In real life, vertical angles are shown as follows:

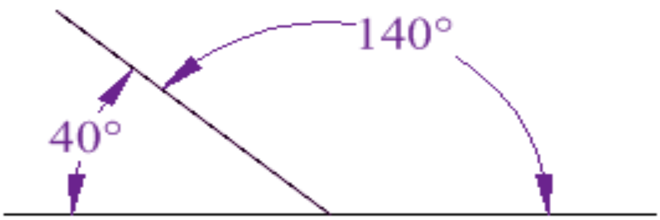


Supplementary Angles

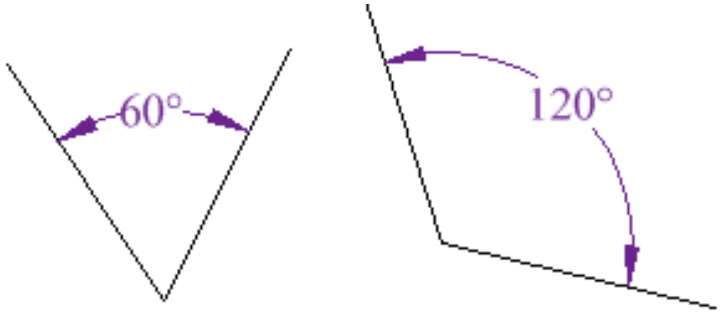


Two Angles are Supplementary when they **add up to 180 degrees.**

These two angles (140° and 40°) are Supplementary Angles, because they add up to 180°:



Notice that together they make a straight angle.

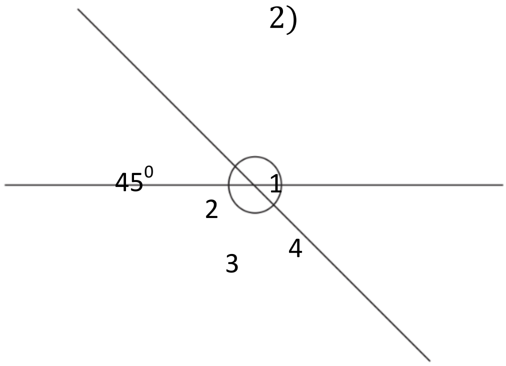


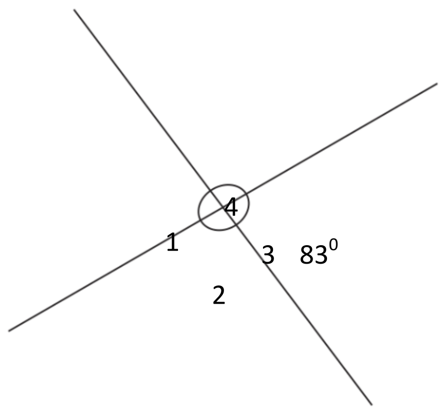
But the angles don't have to be together.

These two are supplementary because
60° + 120° = 180°

Exercise 2:

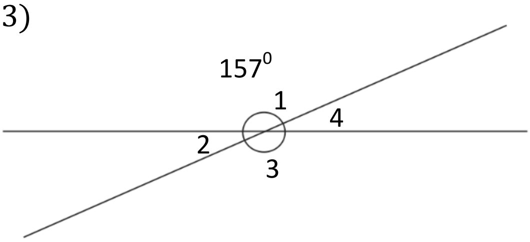
Find angles using the information given. 1)
2)





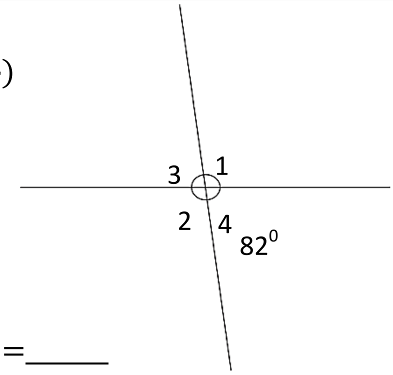
1=______	1=______
2=45^0	2=______
3=______	3=83^0
4=______	4=______

3)



$1 = 157^0$
2=______
3=______
4=______

4)



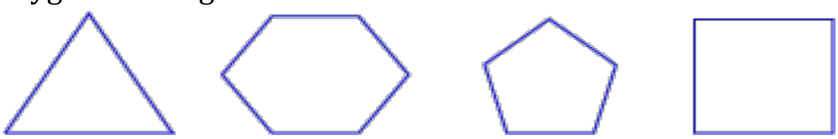
1=______
2=______
3=______
$4 = 82^0$

Explain how you can work this out.

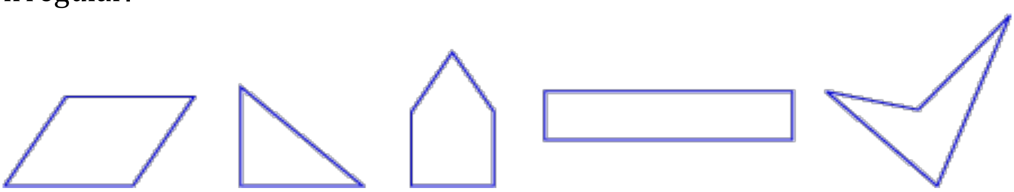
What did you do first? How can you check if your answers are correct?

3.6 Line of Symmetry

Reflection Symmetry (sometimes called *Line Symmetry* or *Mirror Symmetry*) is easy to see, because one half is the reflection of the other half. Regular polygons have sides that are all the same length and angles that are all the same size.
These polygons are regular:

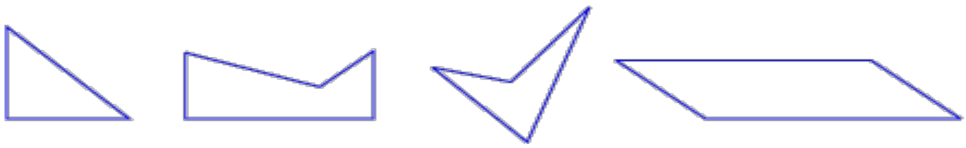


The polygons below are not regular. Such polygons are referred to as irregular.



A polygon has line symmetry, or reflection symmetry, if you can fold it in half along a line so the two halves match exactly. The "folding line" is called the line of symmetry.
These polygons have line symmetry. The lines of symmetry are shown as dashed lines. Notice that two of the polygons have more than one line of symmetry.

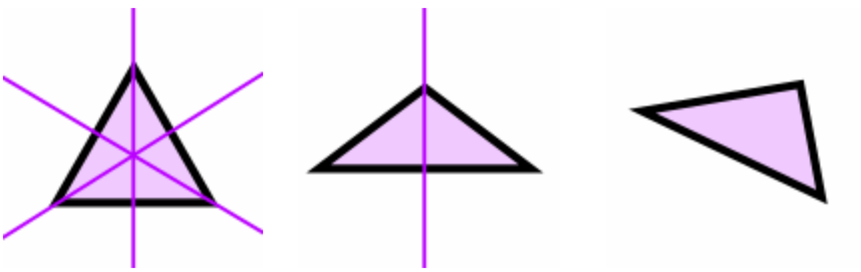
These polygons do not have line symmetry:



Not all shapes have lines of symmetry, or they may have several lines of symmetry.

Example 2.

A Triangle can have 3, or 1 or no lines of symmetry:



Equilateral Triangle	Isosceles Triangle	Scalene Triangle
(all sides equal, all angles equal)	(two sides equal, two angles equal)	(no sides equal, no angles equal)
3 Lines of Symmetry	**1** Line of Symmetry	**No** Lines of Symmetry

In this picture the dog has her face made perfectly symmetrical with a bit of photo magic.
The white line down the center is the **Line of Symmetry** (also called the "Mirror Line").

The Line of Symmetry (also called the **Mirror Line**) can be in **any direction.**

The reflection in this lake also has symmetry, but in this case:

- the **Line of Symmetry** runs left-to-right.
- It is not perfect symmetry, because the image is changed a little by the lake surface.

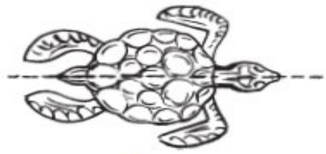
But there are four common directions, and they are named for the line they make on the standard XY graph.

Artists, professionals, designers of clothing or jewelry, car manufacturers, architects and many others make use of the idea of symmetry.

The beehives, the flowers, the tree-leaves, religious symbols, rugs, and handkerchiefs — everywhere you find symmetrical designs.

Architecture

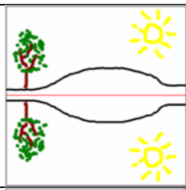
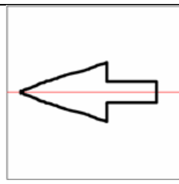
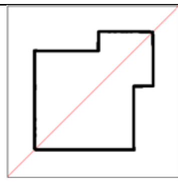
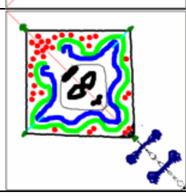
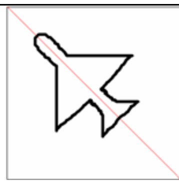
Engineering



Nature

Example 3.

See these examples (the artwork was made using Symmetry Artist):

Sample Artwork	Example Shape
	
	
	

Activity 9:

In groups, observe symmetry in the environment around you, especially animals, plants, leaves, flowers, crystals, etc.
Do you see any symmetrical observation? Share your thinking in class. Explain where and why there is symmetry.

Exercise 3.

1. Construct parallel lines of;

    a) 5cm   b) 7cm   c) 10cm   d) 3cm

    What method would you use and why?

2. Construct the following angles

    a) 60^0
    b) Bisect 60^0
    c) 90^0
    d) Bisect 90^0

    How are you going to tackle it? How did you check your answers?

3. How many lines of symmetry are there in the below letters shapes?

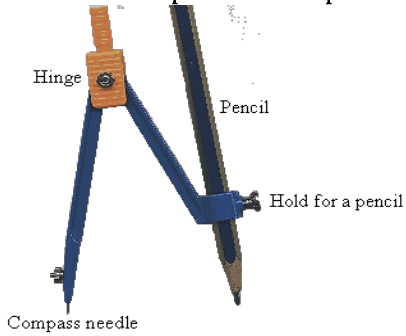
A   **H**

T   **X**

What did you notice when checking your answers?

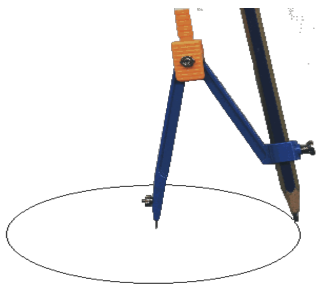
3.7 Constructing a circle of a given radius

A circle can be drawn on a paper by moving a pencil along the boundary of a bangle, or a coin etc., or by using a pair of compasses and pencil.
Note that a compass is also called a pair of compasses.



Steps to draw a circle with a pair of compasses:

- ✍ Make sure that the hinge at the top of a pair of compasses is tightened so that it does not slip.
- ✍ Tighten the hold for the pencil so it also does not slip.
- ✍ Align the pencil lead with the pair of compasses needle.
- ✍ Press down the needle and turn the knob at the top of the pair of compasses to draw a circle.



Example 4.

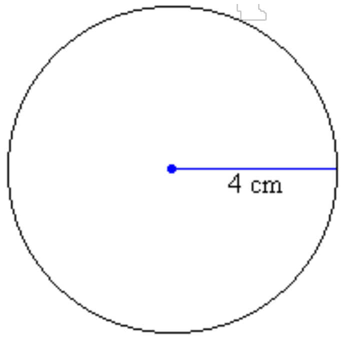
Use a pair of compasses to draw a circle of radius 4 cm.

Solution:

Step 1: Use a ruler to set the distance from the point of the pair of compasses to the pencil's lead at 4 cm.

Step 2: Place the point of the pair of compasses at the centre of the circle.

Step 3: Draw the circle by turning the pair of compasses through 360º.



Activity 10.

Work in pairs,

1. Use a pair of compasses to draw a circle of radius 5 cm.
2. Use a pair of compasses to draw a circle of diameter 12 cm.
3. Use a pair of compasses to draw a circle of radius 4.5 cm.
   a. Draw the diameter of the circle
   b. Use a ruler to measure the length of the diameter.

4. Construct circles of the following radius

   a. 2.3cm b. 6.0cm d. 5.4cm

4. Construct circles of the following diameters

   a. 10cm b. 13cm d. 19cm

Exercise 4:

In pairs, draw;

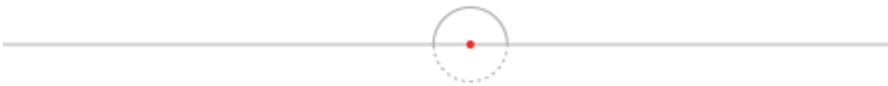
1. A circle with a diameter of 3 cm.
2. A circle with a diameter of 8 cm.
3. A circle with a radius of 5 cm.
4. A circle with a radius of 25 mm.

3.8 Making patterns with circles

We can make different patterns. Below are steps in making a spiral using two points.

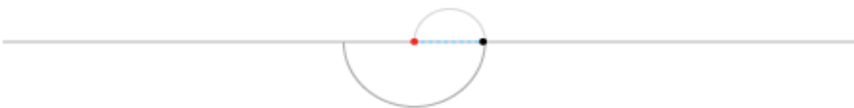
Step 1

On a horizontal line, draw a semicircle that is as small as possible. This is the first turning of the spiral, and the two points where it cuts the line are the construction points.



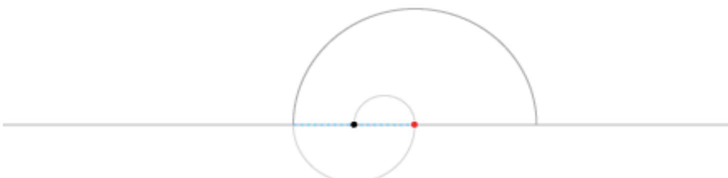
Step 2

Place the pair of compasses on one of the points, open it to meet the other, and draw a semicircle on the other side of the line. The two semicircles make a continuous curve.



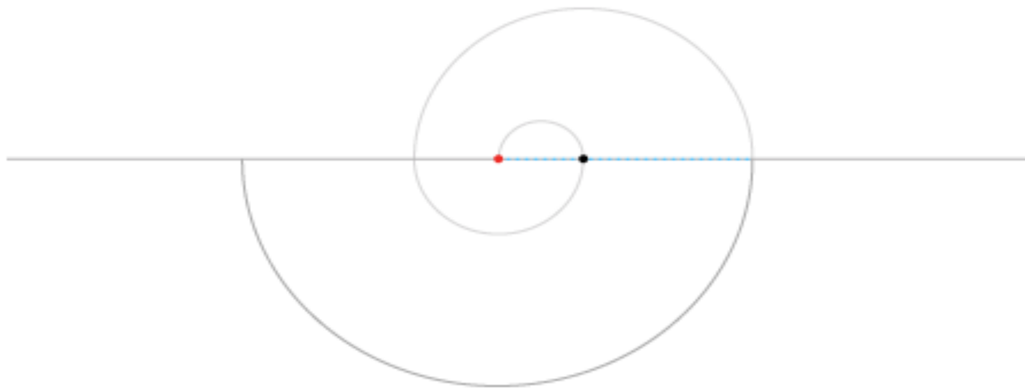
Step 3

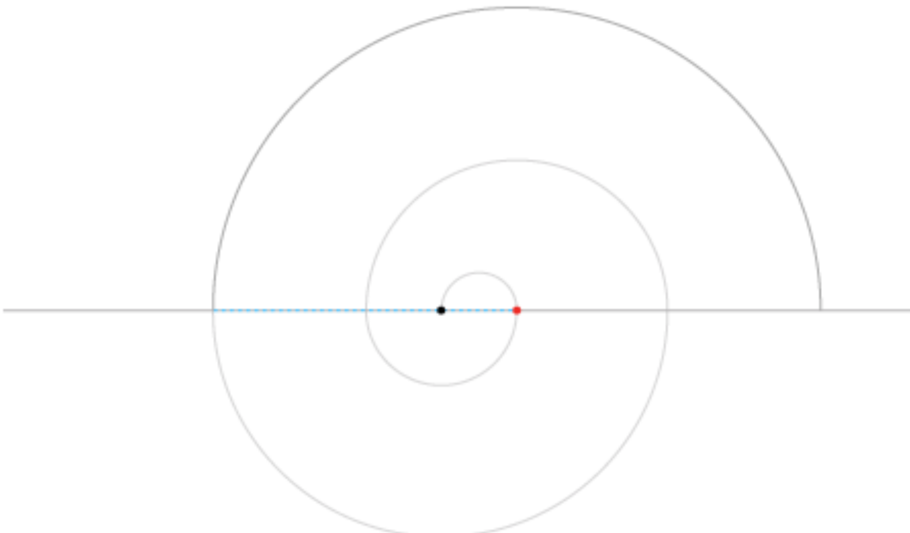
Move the pair of compasses back to the first point, open it to meet the end of the curve, and draw another semicircle.



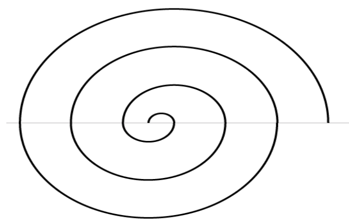
Step 4

Continue in this vein, moving the pair of compasses from one of the construction points to the other and adjusting the opening each time to take up the curves where you left off.





Carry on as much as desired. The spiral will look like this:



Activity 11.

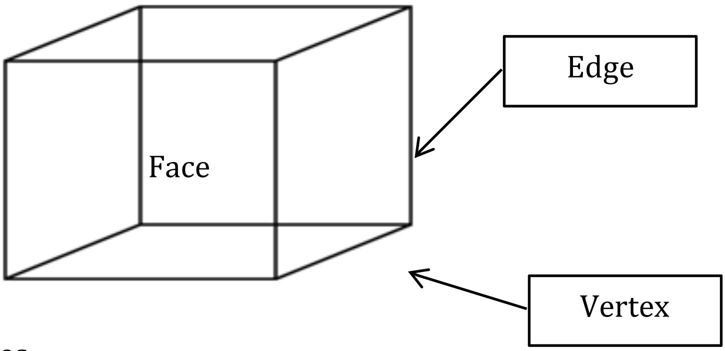
In groups, use a pair of pair of compasses to draw this spiral shape.
Present your final product to the class.

Exercise 5:

Work with your partner, draw a pattern of a circle using different radiuses.

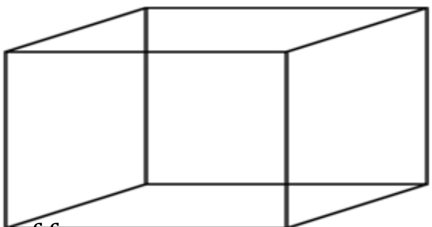
3.9 Properties of 3D shapes

Cube



Faces are flat shapes
Edges are lines where faces meet
Vertex is a point where edges meet (corner)
A cube has:

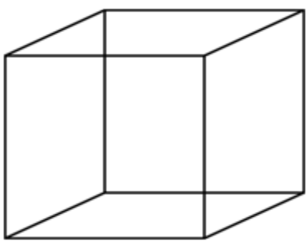
- 6 square faces
- 8 vertices
- 12 Edges



Look at the cuboid;
With your partner write the number of faces.

3.10 Making cubes and cuboids

Cube: is a box-shaped solid object that has six identical square faces.

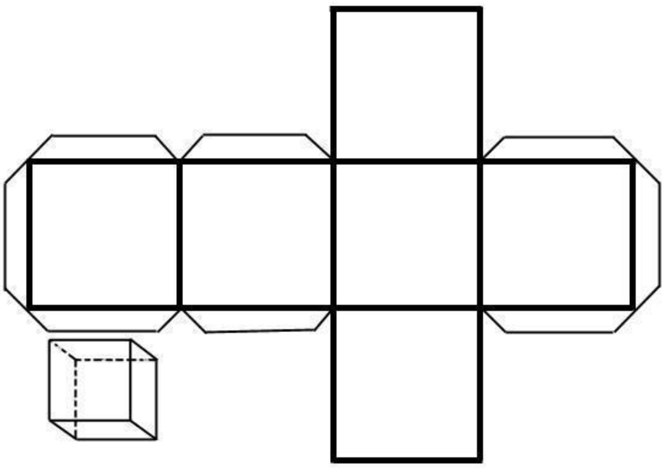


Steps to follow:

1. Draw the net below on your choice of material, whether it be paper, cardboard or paper-board.

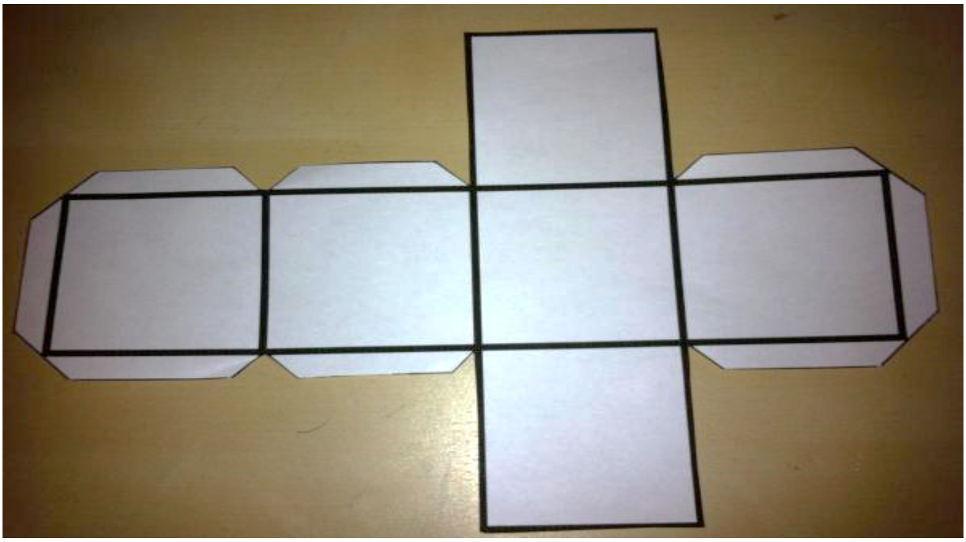
   Make sure all sides of each square are the same size, as well as making the flaps similar. Consistency and correct measurements are key here.

   We have used thick lines to easily show what to do as a guide.

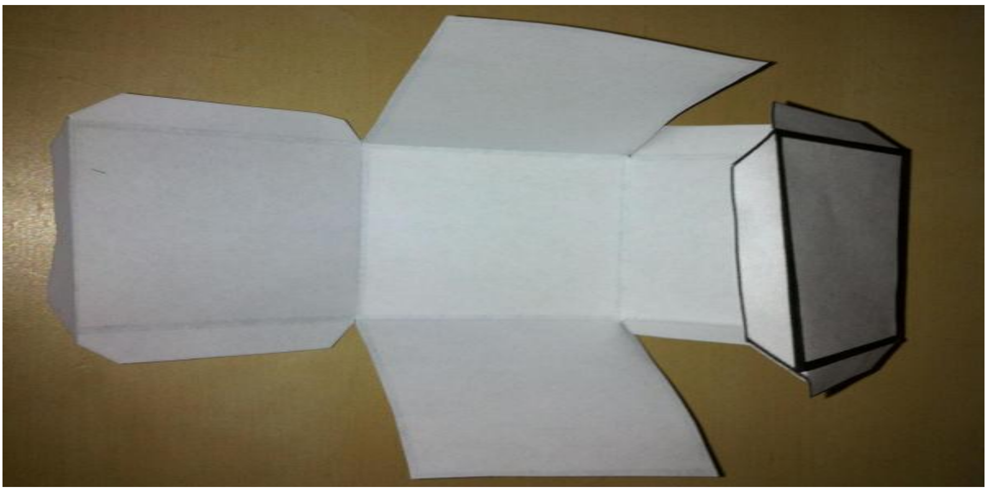


2. Cut out the cube net with scissors. This is the most convenient method.

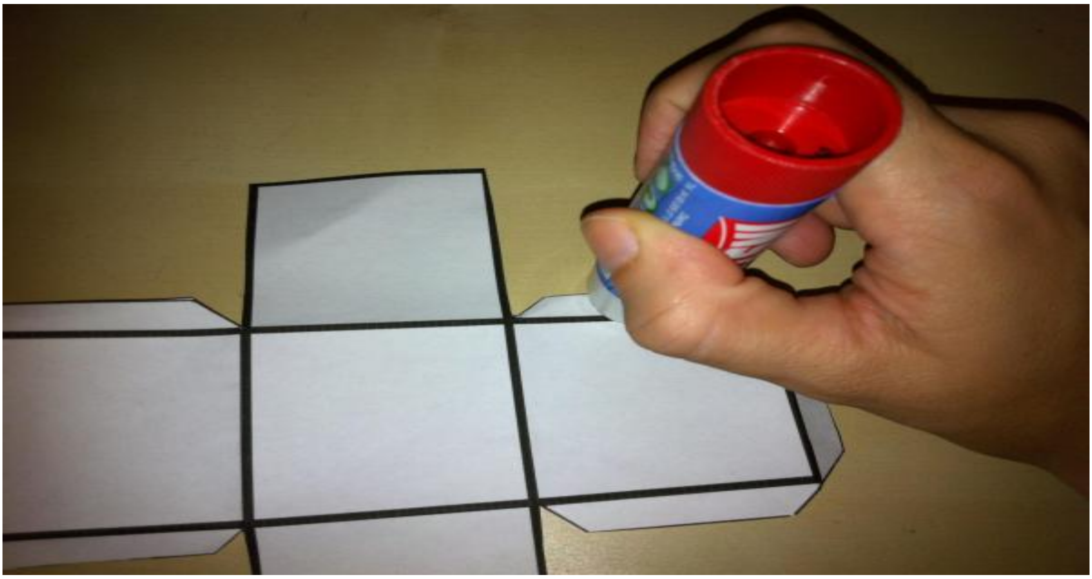
However, you could also use a razor and ensure your surface does not get damaged.
When working with blades of any kind you must ensure safety. Do not allow a child to use a blade.



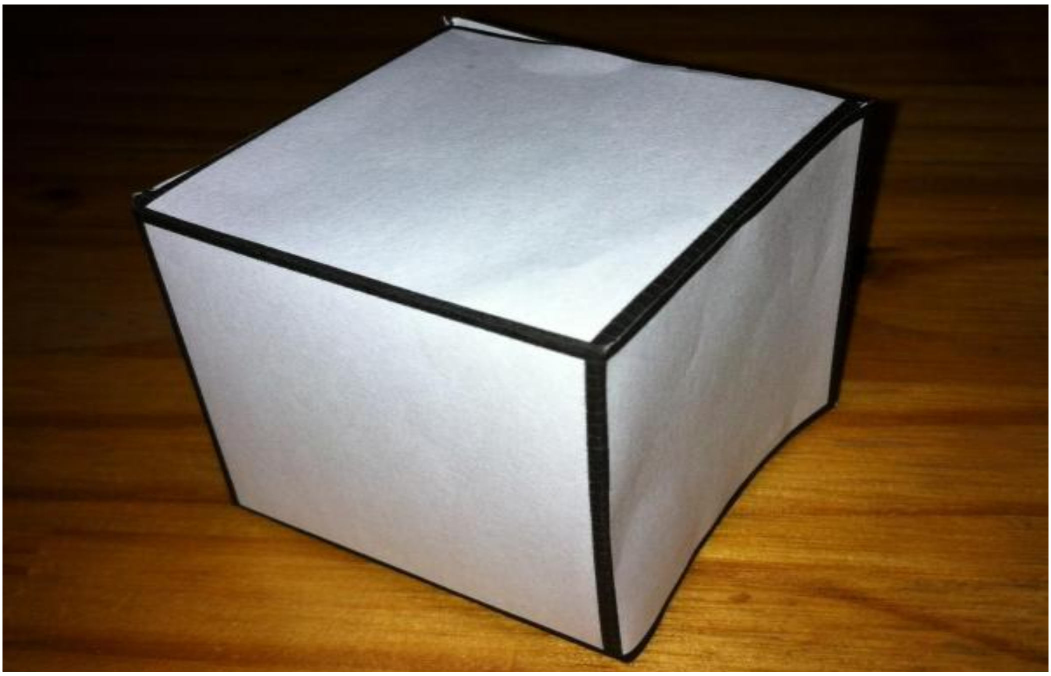
3. Fold along all lines of the net. Try mounting the cube before applying any glue to be sure that each tab fits in and the template has been measured and cut accurately.



4. Put glue on one of the tabs and paste it into place. Press it so that it is well attached. Do the same with the other sides.



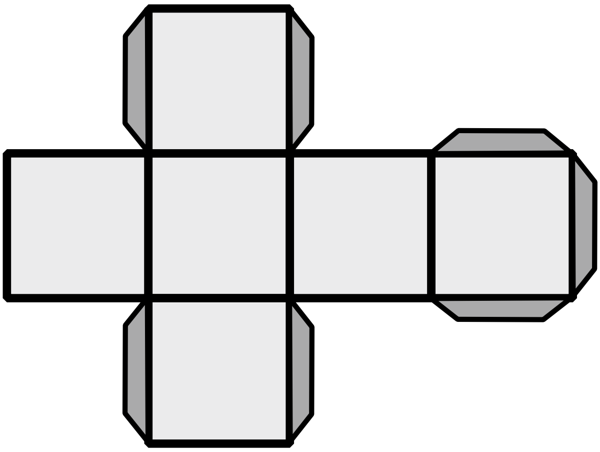
5. Then you have made your cube.



Activity 12.

Draw and cut out the net diagram below.

Apply glue to the dark parts and fold the edges.



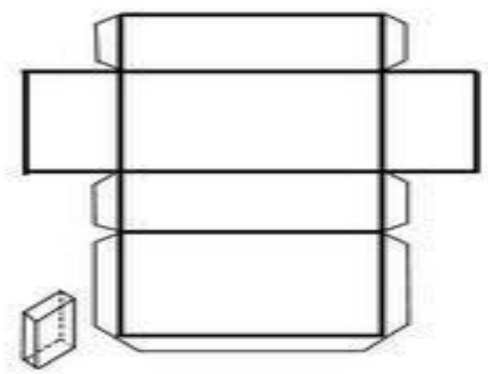
What object did you make?

How many sides does it have?

Cuboid

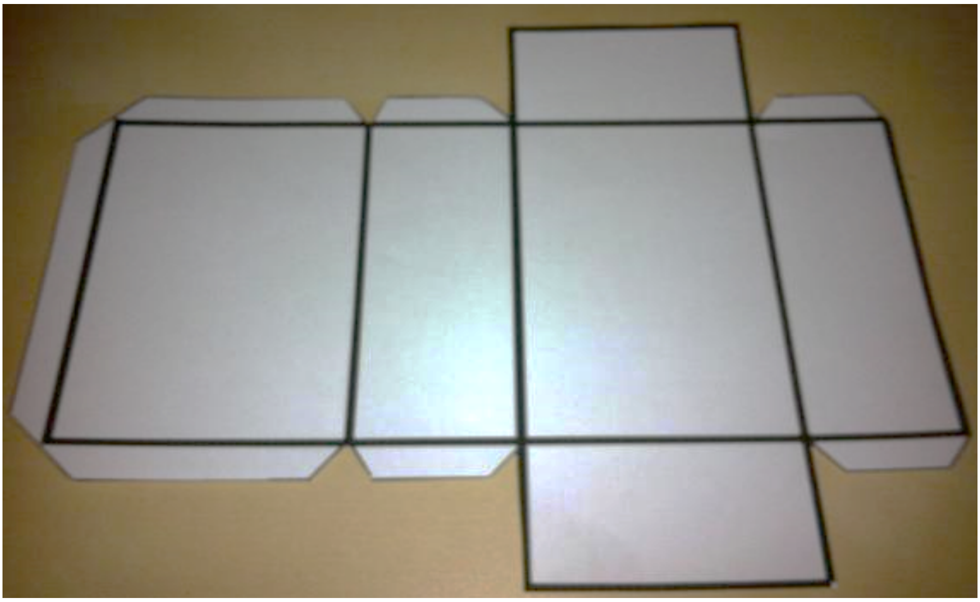
A cuboid is a box-shaped solid object. It has six flat sides and all angles are right angles.
All of its faces are rectangles.
Steps to follow:

1. Copy this cuboid net on paper or cardboard. We have used thick black lines so that we can easily identify where to fold.



2. Cut out the cuboid net with scissors. The tabs on the side of the cuboid net designed to seal the cuboid tight when you glue them.

They are cut at 45º angles so that they all fit snugly together.



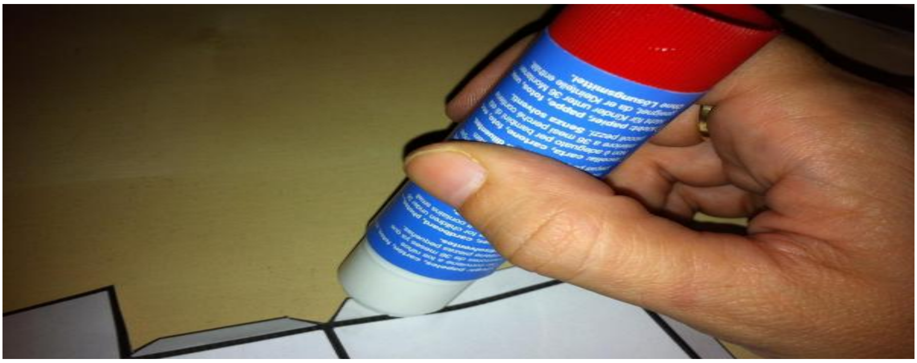
3. Fold along all the lines of the template. Try to put the rectangular prism together before adding glue to be sure where each tab will go.

We do this to make sure the cuboid net has been drawn and cut out correctly.

Depending on how we want to use our cuboid, we should consider which type of material we want to make it from.

4. Put glue on one of the tabs of the sides of the cuboid net and paste it into place.

Press it, so that it is well attached. Do the same with the other sides.

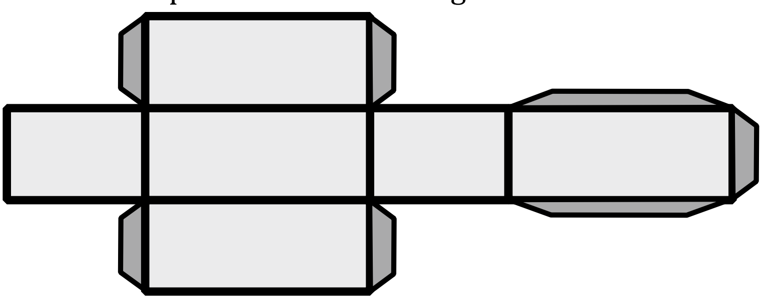


5. Once all the tabs have been glued into place, check that the shape is properly rectangular and there you have it, your cuboid from paper.

Activity 7.

Draw and cut out the net diagram below.

Apply glue to the dark parts and fold the edges.



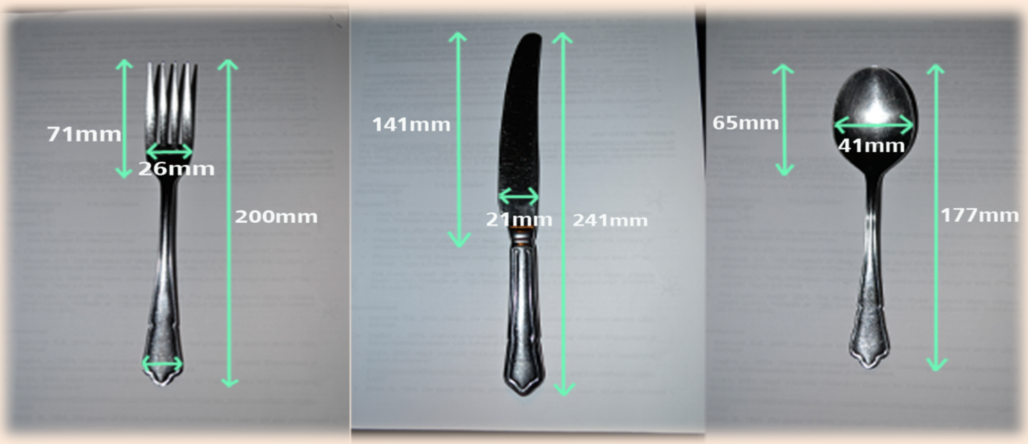
What object did you make?

How many sides does it have?

3.11 Conversion of length

We can measure how long things are, or how tall, or how far apart they are. Those are examples of length measurements.

Example 5.

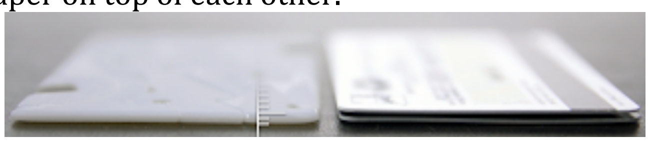


These are the measurements of a fork, knife and spoon that we use.

These common measurements that we use are:

- ☑ Millimetres
- ☑ Centimetres
- ☑ Metres
- ☑ Kilometres

Small units of length are called **millimetres.**
A millimetre is about the thickness of a credit card or about the thickness of 10 sheets of paper on top of each other.



When we have 10 millimetres, it can be called a **centimetre.**

1 centimetre = 10 millimetres

A fingernail is about **one centimetre wide**.

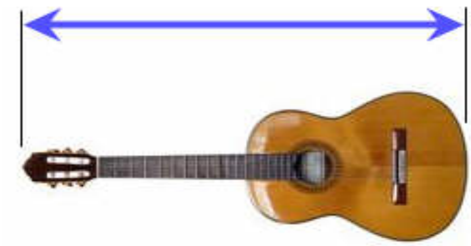
We have two tape measures, one in mm, the other in cm

We can use millimetres or centimetres to measure how tall we are, or how wide a table is, but to measure the length of football field it is better to use **metres**.

A **metre** is equal to 100 centimetres.

1 metre = 100 centimetres

The length of this guitar is about 1 metre



Metres can be used to measure the length of a house, or the size of a playground.

And because a centimetre is 10 millimetres:

1 metre = 1000 millimetres

A **kilometre** is equal to 1000 metres.

When we need to get from one place to another, we measure the distance using **kilometres**.

The distance from one city to another can be measured using kilometres.

Example 6.

Convert 298 cm to m

100 cm = 1 m

298 cm = 298

100

= 2.98 m

Convert 2.98 m = cm

1 m = 100 cm

2.98 m = 2.98 × 100

= 298 cm

Exercise 6:

In groups, convert the following.

1. Centimetres to metres

a. 9200 cm	4620 cm	6426 cm	2130 cm
7718 cm	976 cm	3580 cm	5800 cm
25.3 m			

2. Metres to Centimetres

83.6 m	17.45 m	79.21 m	28.64 m
87.9 m	3.49 m	3 m	

3.12 Writing scale in ratio form

A scale is simply a ratio, and therefore can be written in different ways. The most commonly used methods of writing a scale are: as a fraction.

Example 7.

A line on a drawing that is one centimetre long, but is represents a real measurement of 1 metre (which equals 100 centimetre) could be written as a fraction $\left(\frac{1}{100}\right)$.

It could have been written as a comparison ratio (1:100).

Architects often write the scale of a drawing when drawing plans

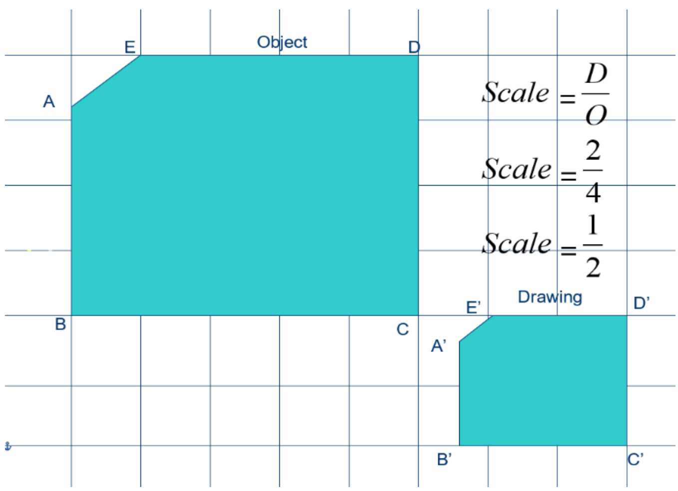
3.13 Making scale drawing.

Scale drawings can be used to rearrange furniture, find appropriate sizes for new items, and reconfigure room size and building size without having to refer back to the actual room or building being worked on.

$$\text{Scale} = \frac{\text{Length of a side of the drawing}}{\text{Length of corresponding side of the object}} = \frac{D}{O}$$

Example 8.

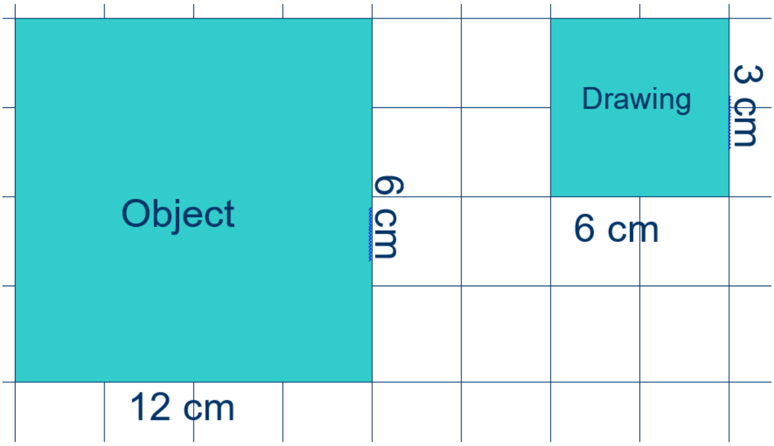
Find the scale of the drawing.



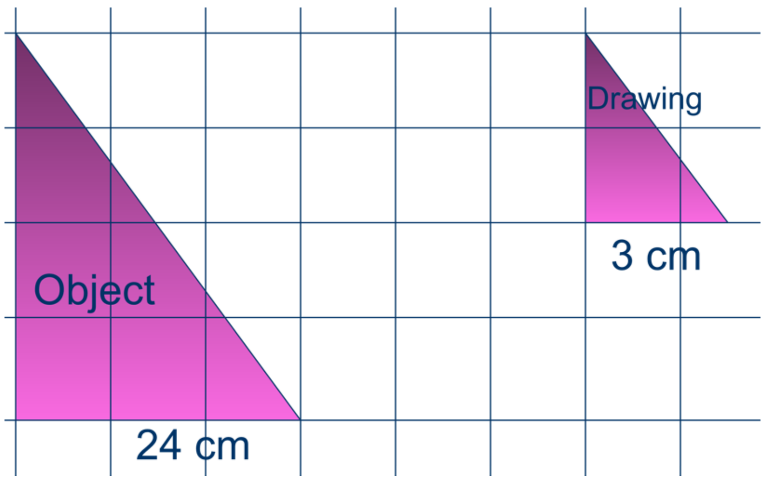
Exercise 7:

1. Find the scale of the following.

a.



b.



2. A man in a photograph is 2cm tall. His actual height is 1.8m. Write a scale statement and determine the scale.

UNIT 4: ALGEBRA

What do you remember in algebra that you learnt in Level 2?

In learner's **book 2**, we studied simple algebraic expressions. We looked at how **to collect** like terms together. i.e.

$$x + 2y + x + y - 2$$

Collecting the like terms together, we have

$$x + x + 2y + y - z$$
$$= 2x + 3y - z$$

4.1 Purpose of Algebraic equations

What do you think is the purpose of algebra?

The ***purpose of Algebra equation,*** is to make it easy to state a mathematical relationship and its equation by using letters of the alphabet or other symbols to represent entities as a form of shorthand.
Algebra allows you to substitute values in order to solve the equations for the unknown quantities.
There are numerous mathematical relationships that have been established in science, finance and other areas. Examples include the relationship between force and acceleration, conversion of centimetres to inches, and determining the payments on a loan with a given interest rate. These relationships are stated as *equation*s.
Algebra allows you to use letters of the alphabet or other symbols to represent objects and numbers. This makes it more convenient
You can state a physical equation by using letters to represent the elements of the equation. For example, force equals mass times acceleration.

Solving Algebraic equations

In this sub unit, we shall discuss how to solve the simple algebraic equations.

Example 1.

Solve the equation below.

$$x - 4 = 0$$

Solution

Here, we are required to determine the value of x(unknown term)

In this case, we must ensure that the unknown x is on one side of the equal sign while the digit or number on the opposite side of the equal side.

$$x - 4 + 4 = 0 + 4$$

$$x = 4.$$

Because the value x is on the same side as x and it is negative, we add on both sides an equal value so that on the side where we have x, the sum of the digits is zero. If it was a positive, we would subtract on both sides i.e.

$$x + 5 = 0$$

Solution

$$x + 5 - 5 = 0 - 5$$

$$x = -5$$

Addition Problems

To solve equations, the general rule is to do the opposite. For example, consider the following example.

Example 2.

Solve the equation below.

$$x + 7 = -5$$

Solution

$x + 7 = -5$	The 7 is added to the *x.*
$-7 \quad -7$	Subtract 7 from both sides to get rid of it.
$x = -12$	Our solution

Then we get our solution, $x = -12$.

The same process is used in each of the following examples.

$$\begin{array}{rcl} 4 + x &=& 8 \\ -4 & & -4 \\ \hline x &=& 4 \end{array} \qquad \begin{array}{rcl} 7 &=& x + 9 \\ -9 & & -9 \\ \hline -2 &=& x \end{array}$$

Activity 1:

Solve the following equation.

a) $14 = b + 3$ b) $-1 + k = 5$ c) $n + 8 = 10$

How are you going to solve this?

Subtraction Problems

In a subtraction problem, we get rid of negative numbers by adding them to both sides of the equation.

Example 3.

$x - 5 = 4$	The 5 is negative, or subtracted from x
$+5 \quad +5$	Add 5 to both sides
$x = 9$	Our Solution!

Then we get our solution x = 9.

The same process is used in each of the following examples. Notice that each time we are getting rid of a negative number by adding.

Example 4.

Solve the equations below.

$-6 + x = -2$ $-10 = x - 7$ $5 = -8 + x$

Solution

$$\begin{array}{rcl} -6 + x &=& -2 \\ +6 & & +6 \\ \hline x &=& 4 \end{array} \qquad \begin{array}{rcl} -10 &=& x - 7 \\ +7 & & +7 \\ \hline -3 &=& x \end{array} \qquad \begin{array}{rcl} 5 &=& -8 + x \\ +8 & & +8 \\ \hline 13 &=& x \end{array}$$

Activity 2:

Solve the following equation.

a) $m - 4 = -13$ b) $-14 = x - 18$ c) $-13 - p = -19$

What do you think the answer or result will be?

How will you check the answer?

Multiplication Problems

In multiplication problems, we get rid of the denominator by multiplying on both sides.

Example 5.

1. Solve $\frac{x}{5} = -3$

$5 \times \frac{x}{5} = -3 \times 5$ Multiply both sides by 5

$x = -15$ Our Solution

The same process is used in each of the following example.

Example 6.

1. Solve $\frac{x}{-7} = -2$

$-7 \times \frac{x}{-7} = -2 \times -7$ Multiply both sides by -7

$x = 14$

2. Solve $\frac{x}{8} = 5$

$8 \times \frac{x}{8} = 5 \times 8$ Multiply both sides by 8

$x = 40$

Activity 3:

Solve the following equation.

a) $\frac{5}{9} = \frac{b}{9}$ b) $\frac{1}{2} = \frac{a}{8}$ c) $\frac{k}{13} = -16$

What do you think the answer or result will be?
How will you check the answer?

Division Problems

With a division problem, we get rid of the number by dividing on both sides.

Example 7.

Solve $4x = 20$

$\frac{4x}{4} = \frac{20}{4}$ Divide both sides by 4

$x = 5$ Our solution

We get our solution $x = 5$

With multiplication problems it is very important that care is taken with signs. If x is multiplied by a negative then we will divide by a negative.

Example 8.

Solve $-5x = 30$

$\frac{-5x}{-5} = \frac{30}{-5}$ Divide both sides by -5

$x = -6$ Our Solution

The same process is used in each of the following examples. Notice how negative and positive numbers are handled as each problem is solved.

Activity 4:

Solve the following equation.

a) $3n = 24$ b) $v - 16 = -30$ c) $-8k = 120$

What do you think the answer or result will be?
How will you check the answer?

The process described above is fundamental to solving equations. This process should be mastered. These problems may seem different, but the process and patterns used will remain the same.

Activity 5:

In pairs, obtain the values of the unknown in each of the equations below.

i) $y + 3 = 4$
ii) $y - 4 = 0$
iii) $x + 2 = 2$
iv) $x - 2 = 3$
v) $x + 3 = 0$

Hint: ensure that the unknowns are on one side while numbers on the opposite side of the equal side.

Exercise 1.

Working in pairs, Solve three equation each.
Tell your partner how you worked it out using mathematical steps.
How can you check your answer?

1) $v + 9 = 16$
2) $x - 11 = -16$
3) $30 = a + 20$
4) $x - 7 = -26$
5) $13 = n - 5$
6) $340 = -17x$
7) $-9 = \frac{n}{12}$
8) $20v = -160$
9) $340 = 20n$
10) $16x = 320$
11) $-16 + n = -13$
12) $p - 8 = -21$

13) $180 = 12x$

14) $20b = -200$

15) $\frac{r}{14} = \frac{5}{14}$

16) $-7 = a + 4$

17) $10 = x - 4$

18) $13a = -143$

19) $\frac{p}{20} = -12$

20) $9 + m = -7$

4.2 Formation of algebraic equations and solving

The table below lists some key words and phrases that are used to describe common mathematical operations.

To write algebraic expressions and equations, assign a variable to represent the unknown number. In the table below, the letter "x" is used to represent the unknown.

In groups, Play the matching game.

OPERATION	KEY WORD	EXAMPLE	TRANSLATION
Addition (+)	plus	A number plus three	$x + 3$
	more than	Ten more than a number	$x + 10$
	the **sum** of	The sum of a number and five	$x + 5$
	the **total** of	The total of six and some number	$6 + x$
	increased by	A number increased by two	$x + 2$
	added to	Eleven added to a number	$x + 11$
Subtraction (−)	minus	A number minus seven	$x - 7$
	less than	Four less than a number	$x - 4$
	the difference of	The difference of a number and three	$x - 3$
	less	Nine less a number	$9 - x$
	decreased by	A number decreased by twelve	$x - 12$
	subtracted from	Six subtracted from a number	$x - 6$
Multiplication (×)	times	Eight times a number	$8x$

	the **product** of	The product of fourteen and a number	$14x$
	twice; double	Twice a number; double a number	$2x$
	multiplied by	A number multiplied by negative six	$-6x$
	of	Three fourths of a number	$\frac{3}{4}x$
Division (÷)	the **quotient** of	The quotient of a number and seven	$\frac{x}{7}$
	divided by	Ten divided by a number	$\frac{10}{x}$
	the ratio of	The ratio of a number to fifteen	$\frac{x}{15}$
Equals (=)	equals	Seven less than a number **equals** ten.	$x - 7 = 10$
	is	Three times a number **is** negative six.	$3x = -6$
	is the same as	Eight **is the same as** twice a number.	$8 = 2x$
	amounts to	Nine less a number **amounts to** twenty.	$9 - x = 20$

Example 9.

1. A farmer has 40 animals in his farm. The number of goats is thrice the number of cows. How may cows dose the farmer have?

Solution

Let the number of cows be x

Therefore, goats= $3x$

Total=40 animals

$$3x + x = 40$$

$$4x = 40$$

$$X = 10$$

Therefore he has 10 cows

2. The length of a rectangle is 3cm more that the width. Given that the perimetre of the rectangle is 50cm, what are the dimensions of the length and width?

Solution

Perimetre of a rectangle=2L+2W
=2(L+W)
Let the width be w
Therefore length is w+3
50=2(w+3+w)
50=2(2w+3)
50=4w+6
4w=50-6
4W=44
W=11
Therefore the length= $w + 3 = 11 + 3 = 14cm$
Width= $11cm$

Note; more means we add.
Less means we subtract.

3. Mary has SSP200 less than Tom. If they both have a total of SSP1000, how much does Tom have?

Solution

Tom has SSP x
Mary = $(x - 200\ )$
Total = SSP1000

$$x + x - 200 = 1000$$
$$2x - 200 = 1000$$
$$2x = 1200$$
$$x = \text{SSP}600$$

Therefore Tom has SSP600.

Activity 6:

In groups form and solve the algebraic expressions. What operations are you going to use?

1. The number of mathematics text books in a school is 4 times the number of science text books. If the total number of the books in the school are 200, how many English text books are in the school?
2. Deng has SSP150 more than Paul. Paul has twice the amount Jane has. If the total amount they have altogether is SSP1200, how much does Paul have?

Exercise 2.

1. The length of a classroom is 8 m more than the width. Give that the area of the classroom is 80m, what is the length of the classroom?
2. Peter is 3 years younger than his dad. If the sum of their ages is 40 years, what is the age of peter? How old was the father 3 years ago?
3. The number of chairs at home is four times the number of tables. If the sum of the chairs and table is 10, how many tables are there?
4. In a class, the number of boys is three times the number of girls. If the difference between the number of boys and girls is 20, how many girls are there? (hint: difference means subtract)
5. A gardener is wanting to plant some trees. She plants p mangoes. She plants 5 more oranges than she does mangoes.
    a. Find an expression for the number of oranges that the gardener had planted.
    b. The gardener had actually planted 56 oranges. Form an equation, using this information.
    c. Solve the equation that you found in part (b) to write down the number of tulips that were planted.
6. A large van can hold g parcels for delivery. Fast delivery Ltd. have 9 of these vans. How many parcels will they be able to deliver?
7. David hires a car. There is an initial standing charge of SSP 2500.00 and then the hire costs a further SSP700.00 per hour.

How much will it cost for 6 hour hire?

8. A rectangle with a perimetre 4a has width 20cm. Find:
   a. An expression for its length.
   b. An expression for its area.

Summary

The primary purpose of Algebra is to allow you to substitute letters for the names of items, thus creating an equation.
Then you can substitute in values to solve for an item.
You can manipulate the equation to put it in terms of one of the unknown.

4.3 Solving equations

We use this method to find the unknown.

Example 10.

Solve $4w + 2 = 18$

What do I add to 2 to get 18?

$4w = 16$

What do I multiply by 4 to get 16?

$W = 4$

Activity 7.

In pairs, solve the following equations.

a. $3z - 4 = 5$

b. $7p + 3 = 17$

c. $9y - 8 = 19$

d. $5y - 17 = 18$

e. $6e + 7 = 31$

f. $22f + 2 = 46$

Example 10.

Solve $\frac{4}{5}q - 2 = 6$

$(5\times\frac{4}{5}q) - (2\times5) = 6\times5$ First remove the fraction by multiplying. Everything with the common denominator.

$4q - 10 = 30$

$4q - 10 + 10 = 30 + 10$ Remove the -10 from 4q by adding 10 to both sides of equation.

$4q = 40$

$4q \div 4 = 40 \div 4$ Remove the 4 multiplied by the q by dividing both sides of the equation by 4.

$q = 10$ Therefore the answer is q is equal to 10.

NOTE: If any sign goes to the other side of the equal (=) sign, it becomes opposite.

That is, (+) becomes (-), (×) becomes (÷) and vice versa.

Activity 8.

In pairs, solve the following equations. Show your working out and explain how you got your answer

a) $\frac{5}{6}r - 2 = 3$

b) $\frac{2}{3}q + 1 = 11$

c) $\frac{4}{8}p + 2 = 9$

d) $\frac{4}{6}s - 2 = 4$

4.4 Simplify algebraic equations expressions.

Example 11.

1. Solve $5y + 2y + 14$

$(5y + 2y) + 14$ First combine the like terms.

$7y + 14$ Simplify.

2. Solve $3x(y + 1 + 2y)$

$(3x \times y) + (3x \times 1) + (3x \times 2y)$ First multiply everything by 3x to remove the bracket.

$3xy + 3x + 6xy$ Combine the like terms together.

$9xy + 3x$ Simplify.

Activity 9.

In groups, simplify the following equations expression.

a) $7y + 9y + 6$

b) $2x\ (2 + 7y + 2y)$

c) $3x + 6 = 2x$

Example 12.

Solve 4(y+4) +2(y-6)-4z

$(4\ x\ y) + (4\ x\ 4) + (2\ x\ y) - (2\ x\ 6) - 4z$ First you have to remove the brackets, by multiplying by the number outside each bracket.

$4y + 16 + 2 - 12 - 4z$

$4y + 2y + 16 - 12 - 4z$ Put like terms together.

$6y + 4 - 4z$ Answer

Activity 10.

In groups, simplify the following expression and show your work.

a) $8(2y + 3x) - 2(y + 6x)$

b) $y(5 + 2x) + 2(2 - y)$

c) $2(3x - 4) + x(2 + y)$

d) $3(4y - 6) + 2(4 - y)$

Exercise 3:

In pairs, simplify the following expression and find the value for the letters.

1. $2z + 4 = 10$
2. $6y - 2 = 16$
3. $7p - 3 = 39$
4. $12 + 2q = 8q$
5. $5z + 6 - 3z$
6. $10y - 4 + 5y$
7. $15z - 6 + 3z + 4$
8. $25q + 10p - 15q + 7p$
9. $19r + 14 - 12r$
10. $6p + 2 - 3p = 20$
11. $13q + 5 - 3q = 35$
12. $17p + 5 - 2p - 3 = 32$

Example 13.

Write each phrase as an algebraic expression.

Phrase	Expression
nine increased by a number x	9 + x
fourteen decreased by a number p	14 - p
seven less than a number t	t - 7
the product of 9 and a number n	9 × n or 9n

Activity 11.

Work in pairs, solve the following equations. Discuss how you arrived at your answers.

1) $5z + 4 = 19$
2) $10 = \frac{y}{3} + 6$
3) $7 - 3x = -26$
4) $7 = \frac{y-5}{2}$
5) $-21 = -3 + 9x$
6) $\frac{n}{7} - 5 = -2$
7) $3m - 5 = 19$
8) $45 = z + 23$ 14) $-7 + 4x = -43$
9) $17 = 11 - x$

Word problems

In life, many problems are disguised in the form of mathematical equations, and if we know the mathematics, it is simple to solve those problems.

Example 14.

Find three consecutive numbers whose sum is 216.

Solution:

1. Understand the problem

The task is to find three consecutive numbers whose total is 216.

2. Write the variable

Let "x" represent the first number

So, x = First number

$x + 1$ = Second number

$x + 2$ = Third number

3. Write the equation

When you add up all the numbers, you are supposed to get 216.

$x + (x + 1) + (x + 2) = 216$

$3x + 3 = 216$

4. Solve the equation

Subtract 3 from both sides

$3x + 3 - 3 = 216 - 3$

$3x = 213$

Divide each side by 3

$\frac{3x}{3} = 213 \div 3$

$x = 71$

5. Check your answer

First number + Second number + Third number = 216

$x + (x + 1) + (x + 2)$

$71 + (71 + 1) + (71 + 2)$

$71 + 72 + 73 = 216$

So the three numbers whose sum is 216 are 71, 72 and 73

Example 15.

The area of a rectangle is $72cm^2$, in which the width is twice its length. What is the dimension of the rectangle?

Solution:

1. Understand the problem

The area of a rectangle is 72 cm. The width is twice its length. What is the length and width of the rectangle?

2. Write the variable

Let "x" be the length and "$2x$" be the width

3. Write the equation

Length × Width = Area

$x \times (2x) = 2x^2 =$ Area

4. Solve the equation

$2x^2 =$ Area

$2x^2 = 72$

$x^2 = \frac{72}{2}$

$x2 = 36$

$x = 6$

x = Length

So, the length is 6 cm

The width is twice its length

$2x = 2 \, x \, 6 = 12$

So, the width is 12 cm

5. Check your answer

The length is 6 cm and width is 12 cm

The perimeter i.e. the distance around the edges is the sum of lengths and widths. Since rectangle has two lengths and two breadths, hence the equation is,

2 × (Length + Width)

$2 \times (6 + 12) = 2 \, x \, 18 = 36 \, cm$

Exercise 4:

Using the strategy shared, solve the equations below;

1) $4(3y - 5) - 7y = -60$ 2) $19 = 9 + 2(x - 7)$ 3) $10x - 7x = 12$

4) $9z + 11 - 5z = 27$ 5) $-7 + 6n - 9 = -4$ 6) $6(y + 7) = 66$

In pairs, write the equations for the problems below then solve them.

a) The product of negative 4 and y increased by 11 is equivalent to -5.

b) Eight more than five times a number is negative 62.

c) 8 less than twice a number is twelve.

d) The product of 5 and x decreased by 7 is as much as 42.

e) How old am I if 400 reduced by 2 times my age is 244?

f) For a field trip 4 learners rode in cars and the rest filled nine buses. How many learners were in each bus if 472 learners were on the trip?

g) You bought a magazine for SSP100 and four erasers. You spent a total of SSP 180. How much did each eraser cost?

UNIT 5: STATISTICS

Every day we come across different kinds of information in the form of numbers through newspapers and other media of communication.
This information may be about food production in our country, population of the world, import and export of different countries etc.
In all these kinds of information, we use numbers. These numbers are called **data**. The data help us in making decisions.
Statistics involves collecting, organizing and analyzing data.

Data is a plural of datum (Latin word) meaning facts or things which are known and from which conclusions can be made. Data can be numerical figures, ratings, description, quotations, notes etc.

Quantitative data uses display numerical data to explore traits and situations. It can be continuous or discrete data.

5.1 Why data is collected

Activity 1:

In groups, discuss why do you think data collection is important to our country. Present your answers to the rest of the class.

Which methods are used in collecting data in our country?

- Teachers can use data to assess the learner's ability.
- Data collected can be used to assess the general progress of the school.
- Data collected can be used to understand the areas that needs improvement.
- Data collected can be used to predict about the future of our nation.

Methods of collecting data

i) **Observation method**-collecting data by observing.

ii) **Interview method**-involves presentation of oral verbal stimuli and reply in terms of oral-verbal responses.
It can be structured or unstructured.
Structured involves use of pre-determined questions and of highly standard techniques of recording.
Unstructured do not follow a system of pre-determined questions and is characterized by flexibility of approach to questioning.

iii) **Questionnaire**
This is a set of specific questions which should be answered by a respondent or the person giving data.

iv) **Experimentation** - this is a way of collecting data through doing experiments.

Steps in collecting data

Step 1: Identify issues for collecting data.
Step 2: Select issues and set goals.
Step 3: Plan an approach and methods

- What will the data be collected about?
- What locations or geographical areas will the data be gathered from?
- How should data be collected?
- Qualitative Data
- Quantitative Data.

What sources of data should be used to collect information?

- Pre-existing or official data.
- Survey data.
- Interviews and focus groups.
- Observed data.**Step 4:** Collect data.

Step 5: Analyze and interpret data.
Step 6: Act on result.

Activity 2:

With the guide of the teacher, in pairs:

i. Prepare a structured and an unstructured interview that will be presented to class 6 pupils on why learners perform well in Mathematics and what they think should be done to improve the performance in the subject.

ii. Prepare a questionnaire that will help you answer the question on the negative impact of internet on learners.

Exercise 1.

Collect data in class about age of your classmates, brothers and sisters for every learner. Present the data collected to the class.

5.2 Representation of data

The main purpose of representation of statistical data is to make collected data more easily understood. Methods commonly used are;

i) Bar graphs
ii) Line graphs
iii) Pie charts

Bar graphs

A bar graph consists of a number of spaced rectangles which generally have major axes vertical. Bars are of uniform width. The axes must always be labeled and scales indicated.

Steps in construction of bar graphs/column graph:

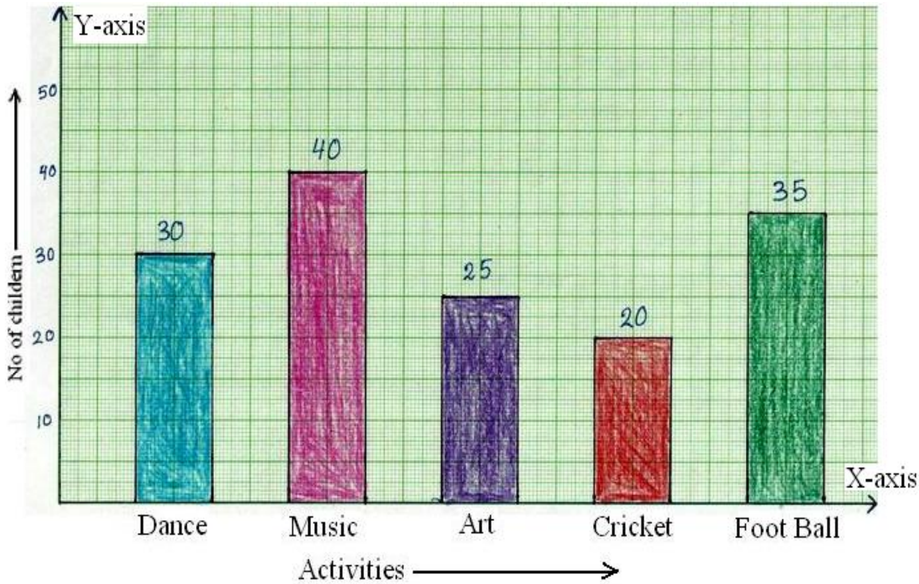
- ☑ On a graph book, draw two lines perpendicular to each other, intersecting at 0.
- ☑ The horizontal line is x-axis and vertical line is y-axis.

☑ Along the horizontal axis, choose the uniform width of bars and uniform gap between the bars and write the names of the data items whose values are to be marked.

☑ Along the vertical axis, choose a suitable scale in order to determine the heights of the bars for the given values. (Frequency is taken along y-axis).

☑ Calculate the heights of the bars according to the scale chosen and draw the bars.

☑ Bar graph gives the information of the number of children involved in different activities.

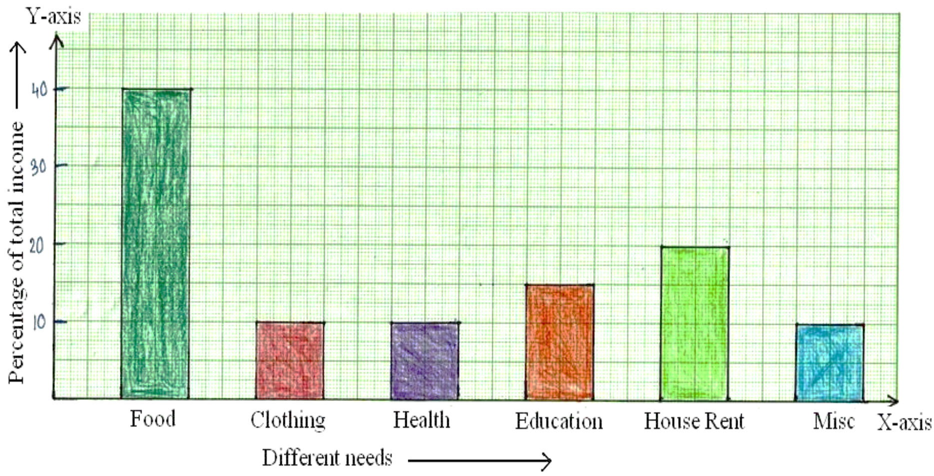


Example 1.

1. The percentage of total income spent under various heads by a family is given below.

Different Heads	Food	Clothing	Health	Education	House Rent	Miscellaneous
% Age of Total Number	40%	10%	10%	15%	20%	5%

Represent the above data in the form of bar graph.

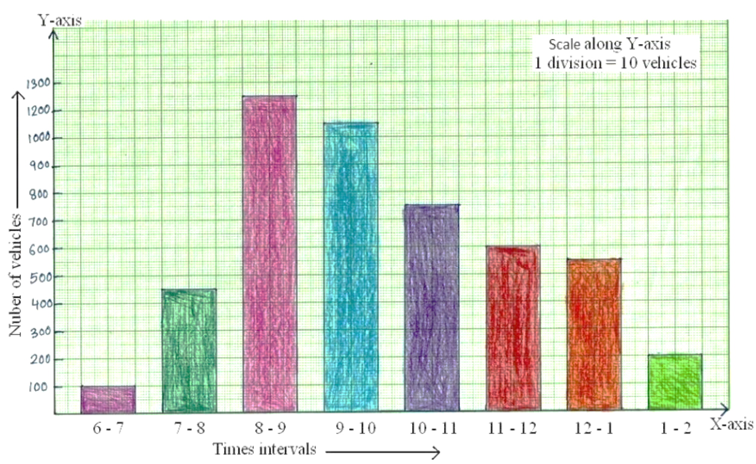


Solution

2. The vehicle traffic at a busy road crossing in a particular place was recorded on a particular day from 6am to 2 pm and the data was rounded off to the nearest tens.

Time in Hours	6 - 7	7 - 8	8 - 9	9 - 10	10 - 11	11 - 12	12 - 1	1 - 2
Number of Vehicles	100	450	1250	1050	750	600	550	200

Solution



This Bar graph gives the number of vehicles passing through the crossing during different intervals of time.

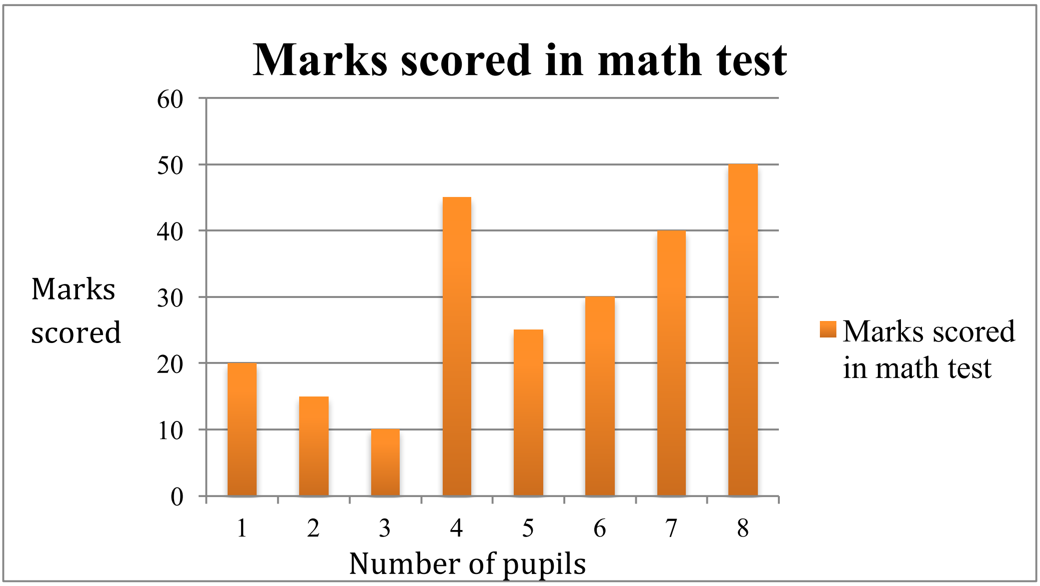
Exercise 2.

1. The data below shows the marks scored in a mathematics test done by primary 5 in a certain school. The test was marked out of 50. The data was: 30, 25, 50, 15, 25, 50, 25, 10, 50, 30, 15, 10, 25, 40, 35, 50, 45, 35, 30, 50, 40, 50, 45, 40, 45, 50, 30, 35, 50, 45, 40, 50, 40, 25, 40, 30, 50, 40, 10, 20, 35, and 30. The data was then recorded in a table as shown below.

Data recorded in a table

Mark scored	10	15	20	25	30	35	40	45	50
Number of pupils	3	2	1	5	6	9	7	4	8

Data represented in a bar graph.



From the graph:

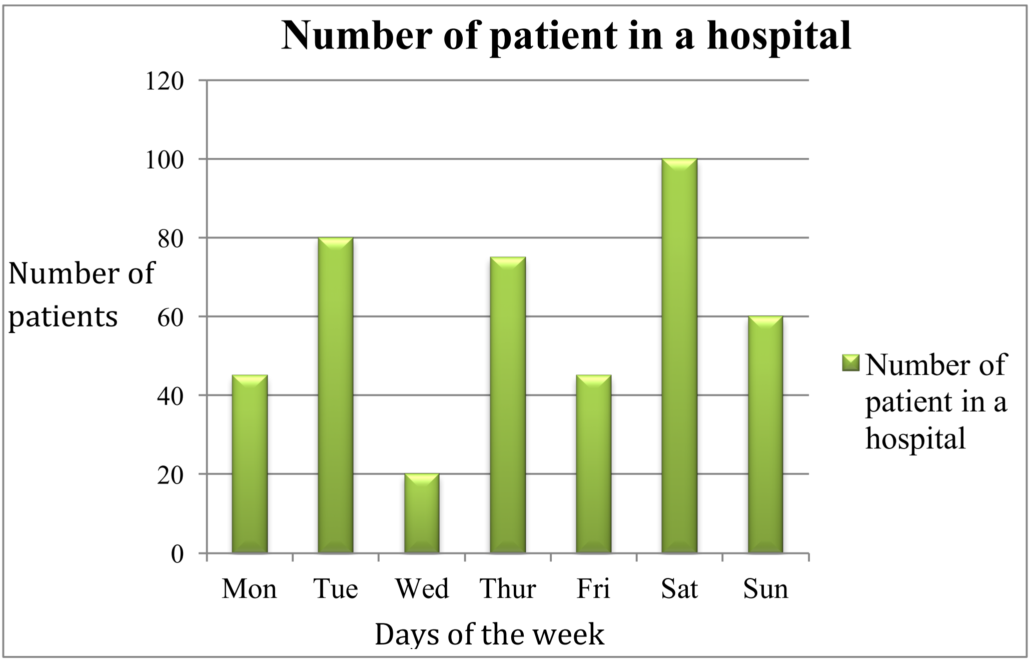
a. How many pupils scored 40marks?
b. How many more pupils scored 30 marks than 20 marks?
c. Which marks were scored by seven pupils?

d. What was the difference between the highest score and the lowest score?
e. How many pupils sat for the test altogether?

2. The following data was collected in a certain hospital to show the number of patients who visited the hospital in a week.
45, 80, 20, 75, 45, 100, 60

Data recorded in a table

Days of the week	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Number of patient	45	80	20	75	45	100	60



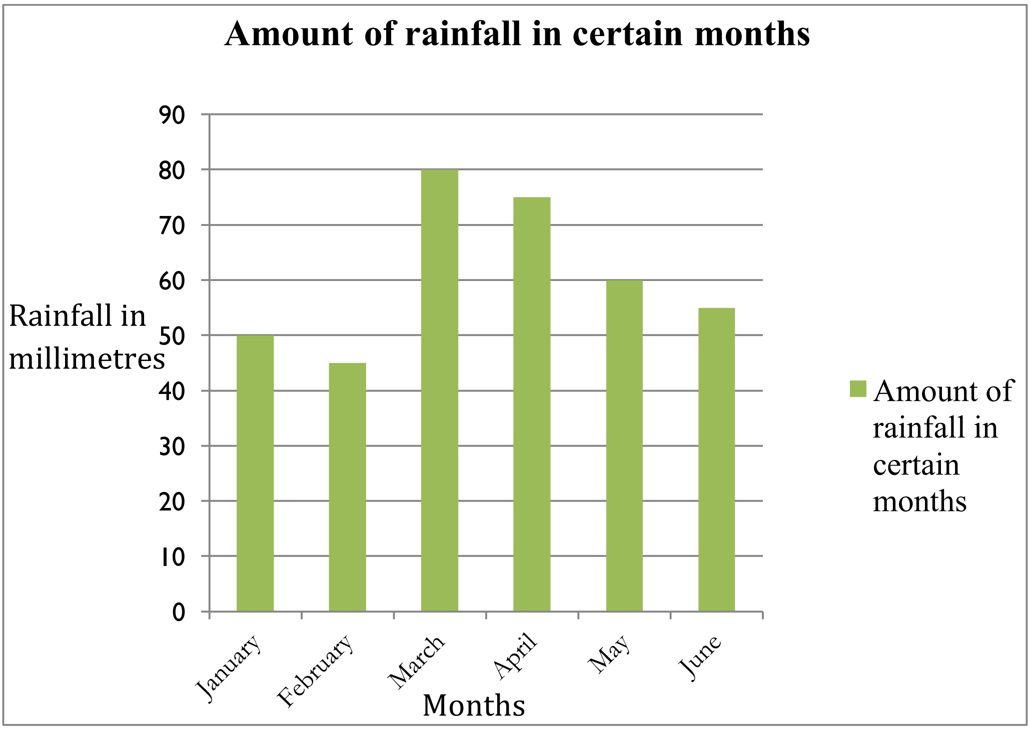
a. How many patients visited the hospital on Thursday?
b. How many less patients visited the hospital on Saturday than on Sunday?
c. On which two days did the same number of patients visit the hospital?
d. Which day did 60 patients visit the hospital?
e. How many patients visited the hospital in the last 3 days of the week?

f. On which day did the least number of patients visit the hospital?

3. The data below represents the amount of rainfall received in a certain district in the first 6months of the year:
Jan 50mm, Feb 45mm, March 80mm, April 75mm, May 60mm and June 55mm.

Data is recorded in a table as shown below.

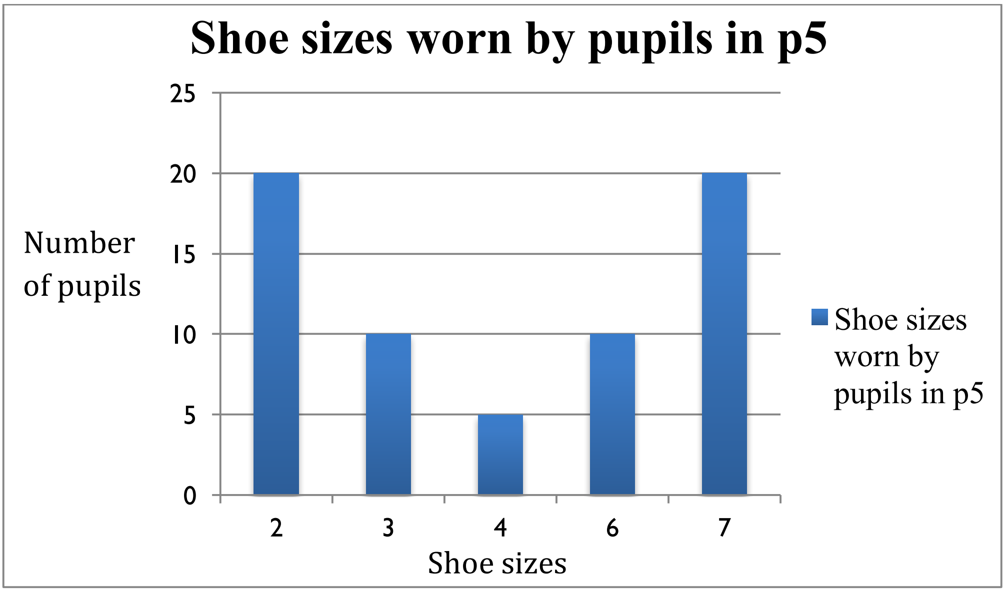
Months	Jan	Feb	Mar	Apr	May	June
Amount of rainfall in (mm)	50	45	80	75	60	55



a. Which month did the district receive 45mm of rainfall?
b. Which month had the most amount of rainfall received?
c. How much less in mm was the rainfall received in the month of June than the month of May?
d. How much rainfall in mm was received in the first ½ part of the year?

4. The data below shows shoe sizes worn by pupils in primary 5 in a certain school. 2, 3, 4, 6, 7
The data was recorded in a table as shown below.

Shoe sizes	2	3	4	6	7
Number of pupils	20	10	5	10	20



a. How many pupils chose shoe size 6?
b. What shoe size number was chosen by 20 pupils?
c. How many more pupils chose shoe size 6 than size 4?
d. What shoe size numbers were chosen by the same number of pupils?
e. Which is the least chosen shoe size?
f. How many pupils altogether chose the shoe sizes?
g. Collect data, record them in a table and represent them in a bar graph.

5.3 Reading and interpretation of data from tables

What is 'interpreting data?

Data means **information**. So interpreting data just means explaining what information it is telling you.

Information is sometimes shown in **tables, charts and graphs** to make the information easier to read. It is important to read all the different parts of the table, chart or graph.

Tables

A table is used to write down a number of pieces of data about different things.
This is used in preparing data for interpretation.

Example 2.

Table example

Name	Colour	Number of gears	Price
Ranger	Silver	5	£140
Outdoor	Blue	10	£195
Tourer	Red	15	£189
Starburst	Silver	15	£215
Mountain	White	5	£129

The **title** of the table tells us what the table is about.

The **headings** tell us what data is in each column.

To find out the colour of the tourer bike, you look across the Tourer row until it meets the colour column. So a Tourer bike is red.

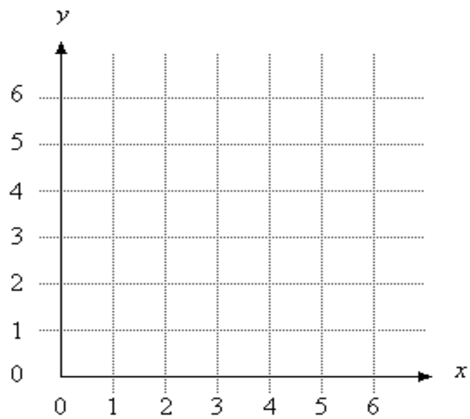
Tally marks and frequency tables

Tally marks are used for **counting** things. They are small vertical lines (like the number 1) each one representing one unit.
The 5th tally mark in a group is always drawn across the first four - as this makes it easier to count the total in groups of five.
In the second column of the table below, we have used tally marks to keep track of how many bikes we have sold.
This table is known as a **frequency table** and it shows the totals of the tally marks at the bottom.

Bike	Tally	Total
Ranger	III	3
Outdoor	卌	5
Tourer		0
Starburst	II	2
Mountain	卌 卌	10
Total bikes sold	卌 卌 卌 卌	20

5.4 *x* and *y* axes, scale and co-ordinates

x and y axes are two perpendicular lines, labeled like number lines.
The **horizontal axis** is called the ***x*-axis**. The **vertical axis** is called the ***y*-axis**.
The point where the *x*-axis and *y*-axis intersect is called the **origin**.



Scale

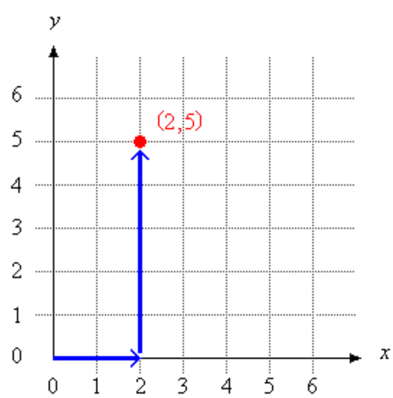
The scale is what you mark on the axes. It is the relation between the units you're using, and their representation on the graph i.e., the distance between marks.

In the above graph the scale is 1 square box represents 1 unit.

Co-ordinates

The numbers on a coordinate grid are used to locate points. **Ordered pair** of numbers is a number on the *x*-axis called an ***x*-coordinate**, and a number on the *y*-axis called a **y-coordinate.** Ordered pairs are written in parentheses (*x*-coordinate, *y*-coordinate). The origin is located at (0,0)..

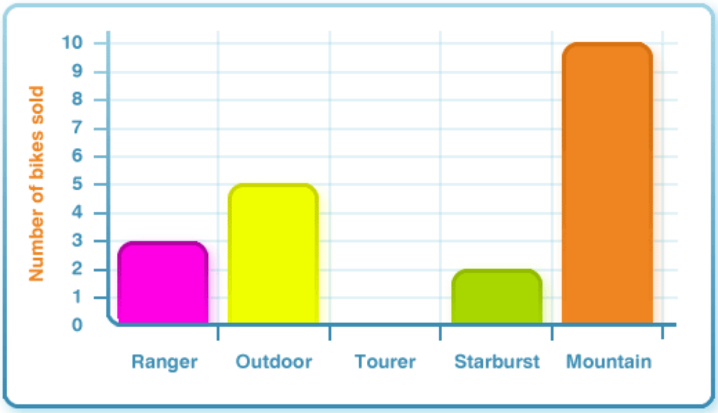
The location of (2,5) is shown on the coordinate grid below. The *x*-coordinate is 2. The *y*-coordinate is 5. To locate (2,5), move 2 units to the right on the *x*-axis and 5 units up on the *y*-axis.



Bar charts

Bar charts are one way of showing the information from a frequency table.

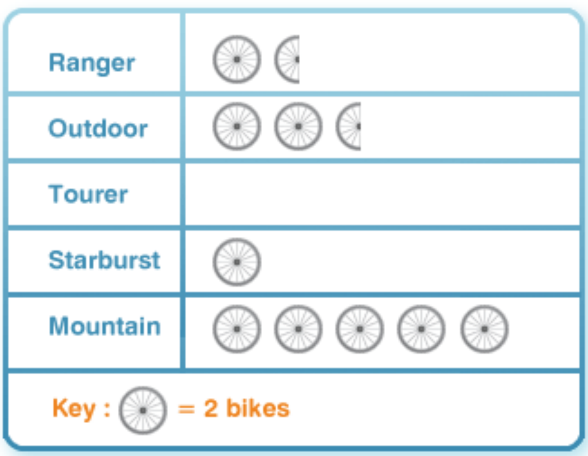
This bar chart represents the data from the table on the previous page:



The heights of the bars in this bar chart show **how many** of each bike were sold.

Pictograms

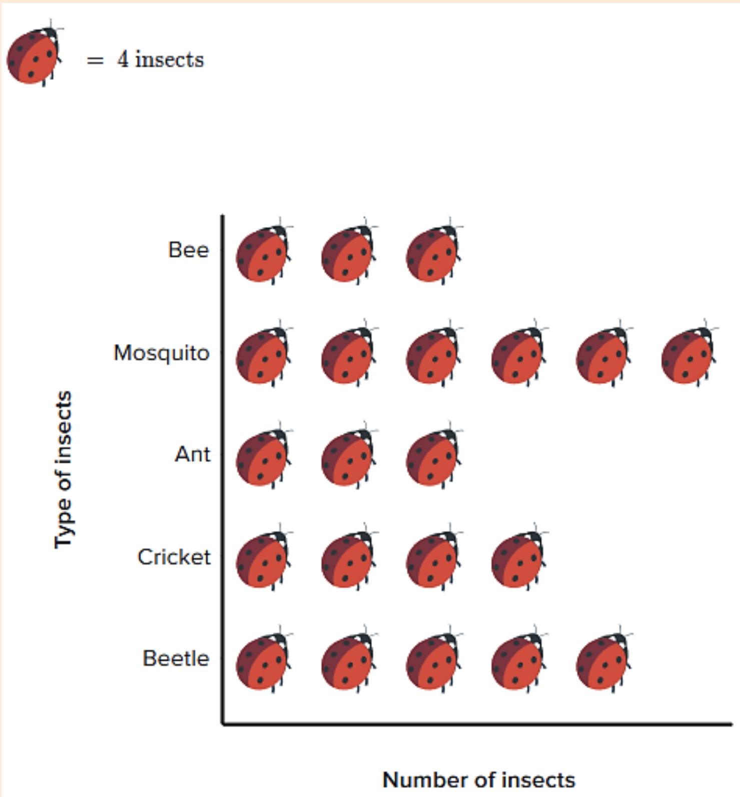
A picture graph is a type of graph that uses pictures and symbols to represent data.



The **key** shows that 2 bikes are represented by a picture of a wheel. So half a wheel must represent 1 bike.

Example 3.

Nyandeng counted insects in the yard for a science project. She made a picture graph of the number and type of insects she saw.



1. Which insect did Nyandeng count more often than crickets but less often than mosquitoes?

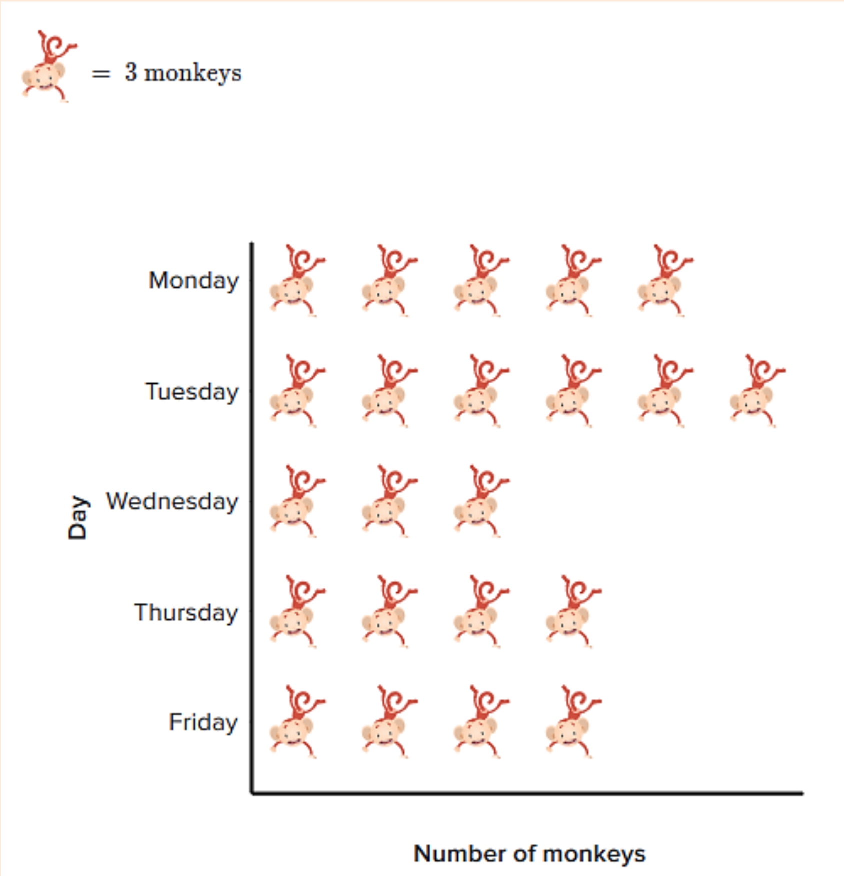
   Beetle

2. Nyandeng counted 4 more ants and added them to the picture graph. Which insect were equal to the ants?

   Cricket

Example 4.

Lopir loves animals. The picture graphs below show the number of monkeys and seals Lopir counted at the zoo last week.



On which day did Lopir count fewer monkeys?

Wednesday

On which day did Lopir count more monkeys?

Tuesday

On which days did Lopir count same number of monkeys?

Thursday and Friday

Pie charts

A circle graph is a visual way of displaying data that is written in percentages.

The circle represents 100%. The circle is divided into sections.
Each section shows what part of 100 that item represents.
The circle graph uses different colors for each category being described.
The colours are used to show different segments.

Example 5.

This circle graph describes a Nick's spending habits. Looking at it with your

partner discuss how Nick spends his money.

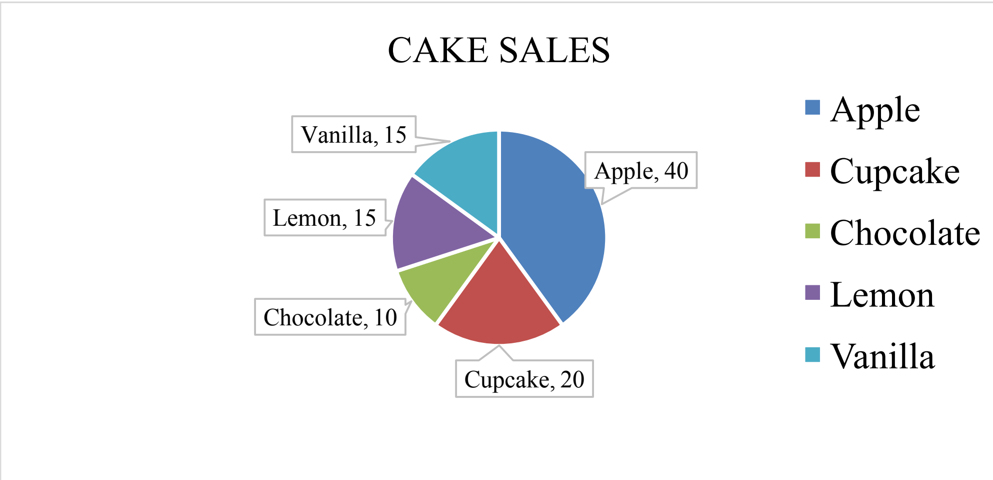
What percent is not spent on saving?

Solution:

Each color represents what money is spent on. Orange is savings, blue is cloth, and purple is food.
First, look at the wedge that represents savings.
The orange wedge represents the amount spent on savings.
Then, determine about how much of the total is spent on savings.
The orange wedge takes up about half or 50% of the circle.
This circle graph shows that half of the money is saved.

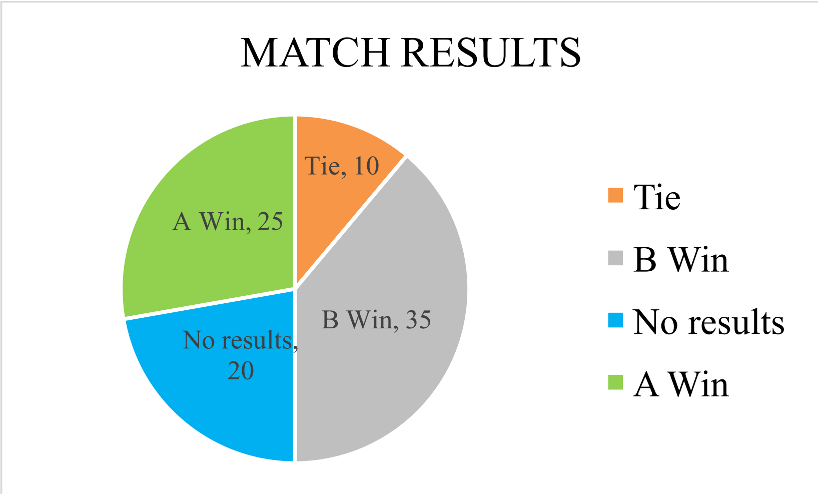
Exercise 3:

1. John has a cake shop. This month he sold the following number of cakes.



a) How many apple cakes were sold in a month?
b) Which two cakes were sold in the same volume?
c) Which cakes were sold more than lemon cakes?
d) Which cakes were most popular?
e) Which cakes were the least popular?

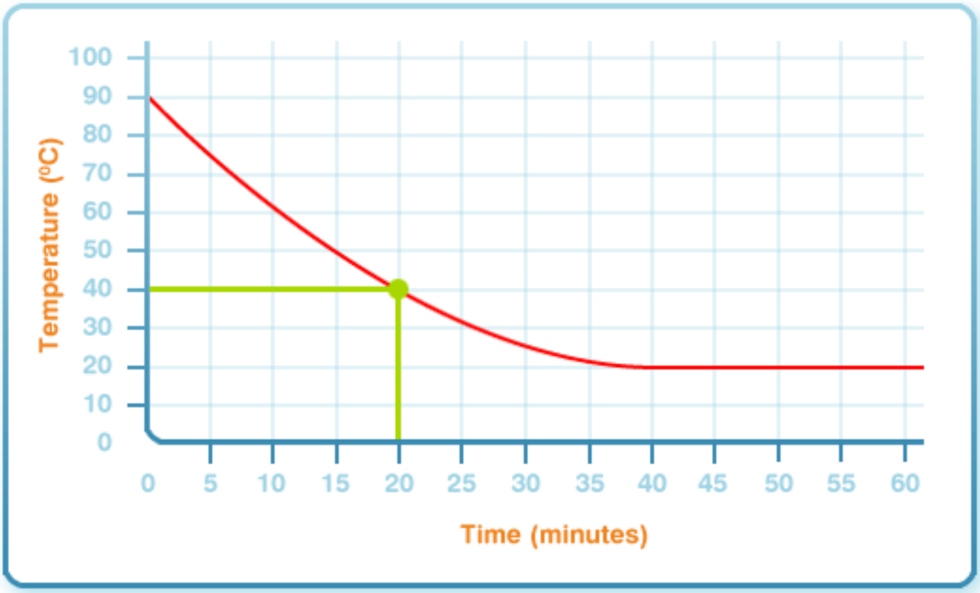
2. Two Teams A & B played some matches. Here are the results:



a) Which team won the most matches?
b) Which team loss the most matches?
c) How many more matches did one team get over the other?
d) What is the difference between ties and no result matches?
e) How many matches did the teams play?

Line graphs

A line graph is used to **plot** a set of data over an amount of time. This line graph plots the temperature of a hot drink over an hour. You can see how the drink temperature cools over time:



Always look carefully at the scale on each axis of the graph - each mark represents a different number.

To find the temperature of the drink after 20 minutes:

Find the 20 minutes mark along the bottom axis of the graph.

With a ruler or your finger, follow the line upwards until you reach the curved graph line.

Now follow the line to the left until you reach the vertical axis.

You can now read the temperature of the graph and find out that the drink was 40°C after 20 minutes.

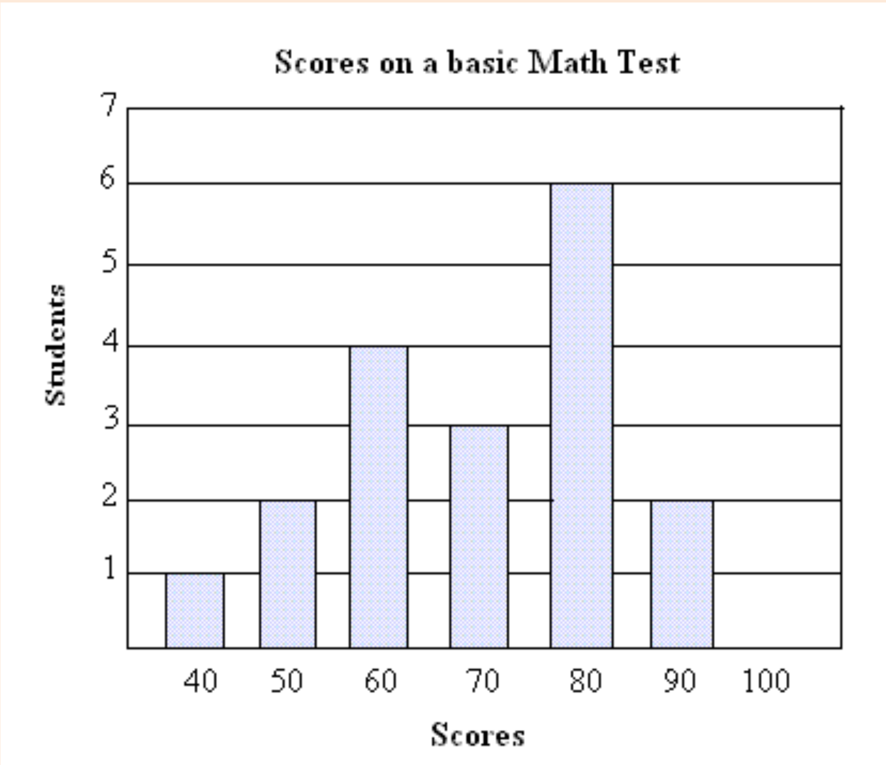
Activity 3.

Visit a nearby market and collect data about things sold there.

Present the data in picture graph, line graph, bar graph and pie chart.

Example 6.

Use the bar graphs below to answer the following questions:



What is the scale of the graph?

The scale is on the left of the graph and it is 1 unit.

What is the title of the graph?

The title is "score on a basic math test"

How many student scored 80?

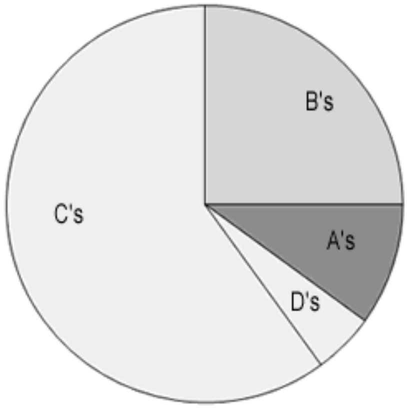
6 students score 80

How many students got 60 on the test?

4 students score 60

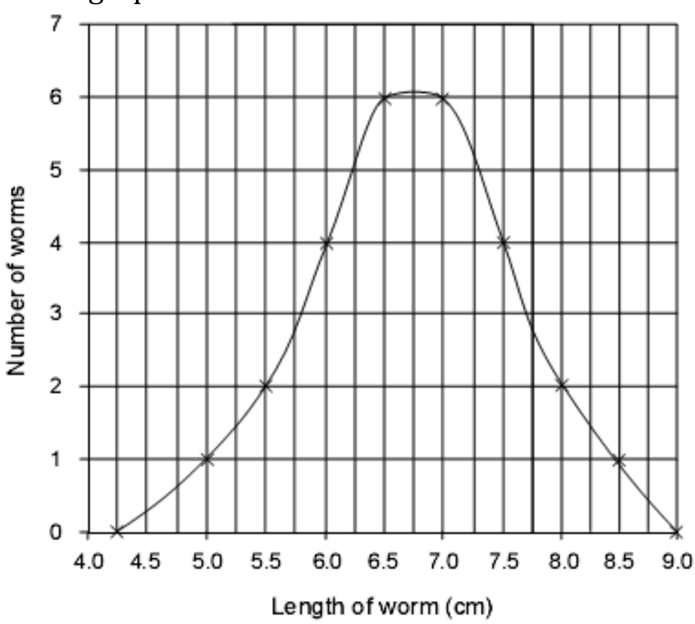
Exercise 4:

1. Mrs. Kiden's class grades were graphed as a pie graph. Based on this graph:



   a) Which grade did the largest percentage of learners receive?
   b) The smallest percentage of learners received what grade?
   c) Estimate what percentage of the class received a B.
   d) Based on the graph, do you think Mrs. Kiden's class is hard working? Why or why not?

2. The line graph shows the number of worms collected and their lengths.



With your partner discuss and answer the following questions.

a) What length of worm is most common?
b) What was the longest worm found?
c) How many worms were 6 cm long?
d) How many worms were 7.25 cm long?
e) The peak of the curve represents?

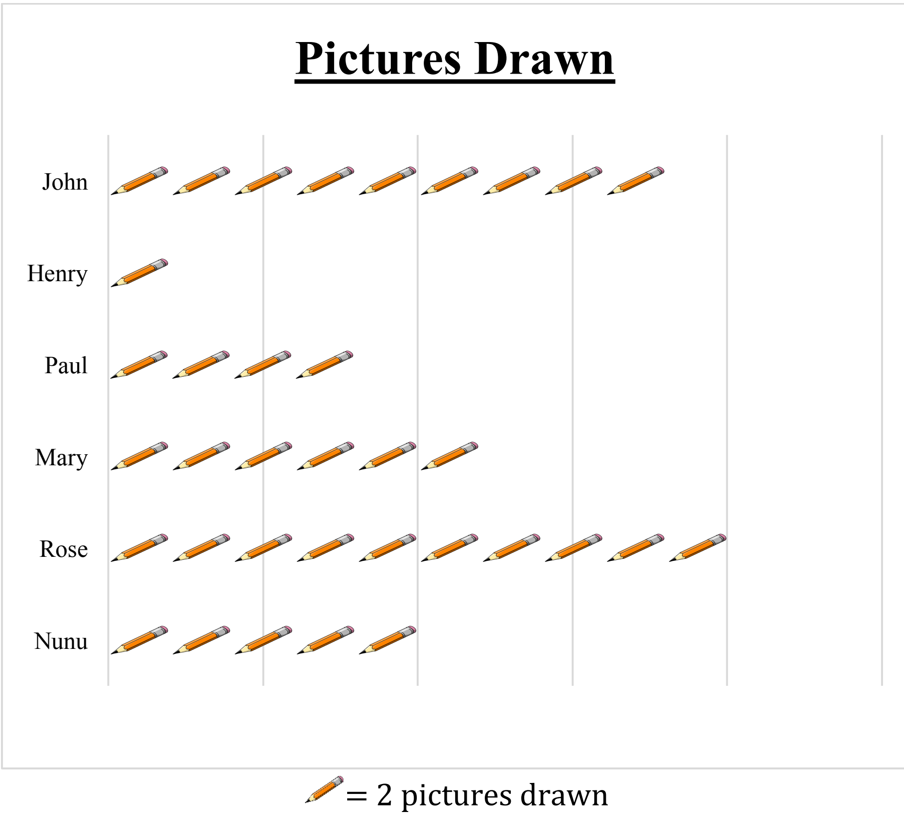
Activity 7.

Visit a nearby road and collect data about colours of cars.

Present the data in pictograms, line graph, bar graph and pie chart.

Exercise 5:

1. Several learners were helping to decorate the school halls by drawing pictures to hang up. The pictograph below shows the number of pictures each learner drew.



a) Who drew the most pictures?

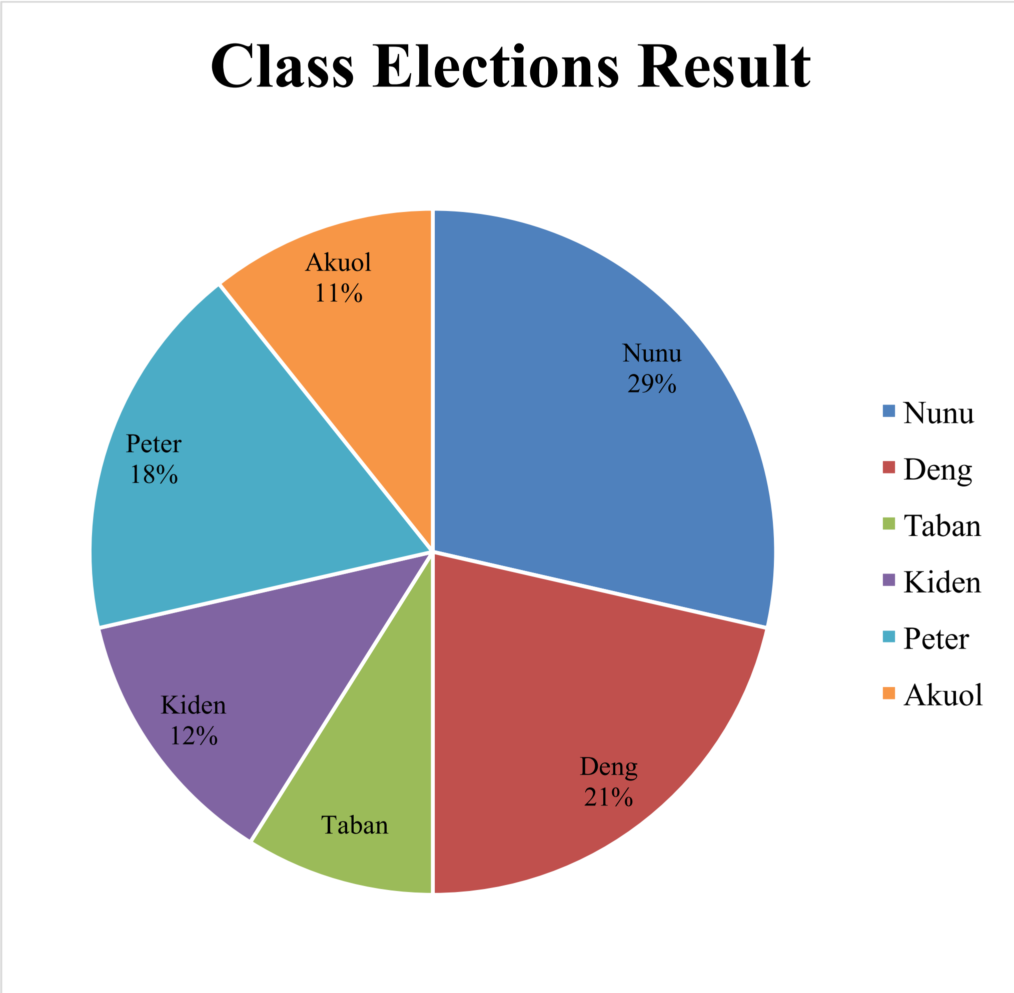
b) Who drew the fewest pictures?

c) Did Olivia or Vanessa draw more pictures?

d) How many pictures did Henry draw?

e) How many pictures did Paige draw?

2. Look at the pie graph below and use it to answer the questions that follow.



a) Who won the election?

b) Who got the least number of votes?

c) What percent of people voted for Kiden?

d) What percent of people voted for Peter and Kiden?

e) Which two candidates had about half the votes?