Grade 7

CONTENT BOOKLETS: TARGETED SUPPORT

Term 1

A MESSAGE FROM THE NECT

NATIONAL EDUCATION COLLABORATION TRUST (NECT)

Dear Teachers

This learning programme and training is provided by the National Education Collaboration Trust

(NECT) on behalf of the Department of Basic Education (DBE)! We hope that this programme provides you with additional skills, methodologies and content knowledge that you can use to teach your learners more effectively.

What is NECT?

In 2012 our government launched the National Development Plan (NDP) as a way to eliminate poverty and reduce inequality by the year 2030. Improving education is an important goal in the NDP which states that 90% of learners will pass Maths, Science and languages with at least 50% by 2030. This is a very ambitious goal for the DBE to achieve on its own, so the NECT was established in 2015 to assist in improving education.

The NECT has successfully brought together groups of people interested in education so that we can work collaboratively to improve education. These groups include the teacher unions, businesses, religious groups, trusts, foundations and NGOs.

What are the Learning programmes?

One of the programmes that the NECT implements on behalf of the DBE is the 'District

Development Programme'. This programme works directly with district officials, principals, teachers, parents and learners; you are all part of this programme!

The programme began in 2015 with a small group of schools called the Fresh Start Schools (FSS). The FSS helped the DBE trial the NECT Maths, Science and language learning programmes so that they could be improved and used by many more teachers. NECT has already begun this scale-up process in its Provincialisation Programme. The FSS teachers remain part of the programme, and we encourage them to mentor and share their experience with other teachers.

Teachers with more experience using the learning programmes will deepen their knowledge and understanding, while some teachers will be experiencing the learning programmes for the first time.

Let's work together constructively in the spirit of collaboration so that we can help South Africa eliminate poverty and improve education!

www.nect.org.za

Contents

TOPIC 1: WHOLE NUMBERS

INTRODUCTION

- This unit runs for 9 hours.
- It falls under the outcome, Numbers, Operations and Relationships and this outcome counts for 30% of the final exam.
- This unit covers concepts and skills for Whole Numbers and is the basis for high school mathematics. The complexity of concepts increases and teachers must make sure that rules and the groundwork is clearly understood.
- It is important for the learners to be able to understand and apply the concepts dealt with in this unit. A number of concepts are applied, such as, prime factors, LCM and HCF.
- Learners are introduced to new concepts such as profit, loss and discount, budgeting, interest and loans.

SEQUENTIAL TEACHING TABLE

INTERMEDIATE PHASE / GRADE 6	GRADE 7	GRADE 8 SENIOR PHASE/ FET PHASE
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Order, compare and represent numbers to at least 9-digit numbers • Represent prime numbers to at least 100 • Recognizing the place value of digits in whole • numbers to at least 9-digit numbers • Round off to the nearest 5, 10, 100, 1 000, 100 000, and 1 000 000 • Using a range of techniques to perform and check written and mental calculations of whole numbers including: estimation building up and breaking down numbers rounding off and compensating using addition and subtraction as inverse operations adding, subtracting in columns	• Revise the following done in Grade 6: order, compare and represent numbers to at least 9-digit numbers recognize and represent prime numbers to at least 100 round off numbers to the nearest 5, 10, 100 or 1 000 • Revise the following done in Grade 6: recognize and represent prime numbers to at least 100 order, compare and represent numbers to at least 9-digit numbers • Using a range of techniques to perform and check written and mental calculations of whole numbers including: -- estimation building up and breaking down numbers rounding off and compensating using addition and subtraction as inverse operations long division using a calculator • Solve problems that involve grouping and equal sharing with remainders	• Revise prime numbers to at least 100 • Calculation techniques • Use a range of strategies to perform and check written and mental calculations of whole numbers including: estimation rounding off and compensating adding, subtracting and multiplying in columns long division using a calculator • Solve problems that involve sharing in a given ratio where the whole is given • Solve problems involving whole numbers, including comparing two or more quantities of the same kind (ratio) comparing two quantities of different kinds (rate) • Solve problems that involve whole numbers, percentages and decimal fractions in financial contexts such as: profit, loss and discount budgets accounts loans simple interest • In the FET Phase: At this stage learners are applyong their knowledge on

• Order, compare and represent numbers to at least 9-digit numbers • Represent prime numbers to at least 100 • Recognizing the place value of digits in whole • numbers to at least 9-digit numbers • Round off to the nearest 5, 10, 100, 1 000, 100 000, and 1 000 000 • Using a range of techniques to perform and check written and mental calculations of whole numbers including: estimation building up and breaking down numbers rounding off and compensating using addition and subtraction as inverse operations • adding, subtracting in columns	• Solve problems involving whole numbers and decimal fractions, including -- financial contexts -- measurement contexts	the numbers and operations across all contexts and this is no longer and individuals section of mathematical knowledge. The FET phase requires an increasing depth of the knowledge gained in all the previous phases so that application of knowledge can be used to solve problems in a large variety of contexts. • This also is extended into the algebraic concepts covered during the remainder of the senior phase and the FET phase. • Number sense is the key to Mathematical Literacy in learners.

GLOSSARY OF TERMS

Term	Explanation / Diagram
Place Value	The position of a number shows its value. Numbers up to a hundred million HM | TM | M | HTh | TTh | Th | H | T | U
Odd and Even	Odd numbers begin at one and if you skip count from there you will land on the next odd number. Odd numbers cannot be divided by multiples of 2. Even numbers are multiples of 2 and if you skip count from 2 on, you will land on the next even number.
Ordering Numbers	This means to put them in order either ascending or descending.
Comparing Number	Look at the numbers from left to right and see which number is bigger
Commutative Property	This is changing the order of numbers in addition and multiplication, but this law does not work for subtraction or division.
Associative Property	This is grouping numbers in addition and in multiplication, but this law does not work for subtraction and division.
Distributive property of multiplication over addition and subtraction	3[4 + 5] = 3 x 4 + 3 x 5
0 – Additive Property	Adding a zero leaves a number the same.
1 – Multiplicative Property	Multiplying by one leaves a number unchanged.
Inverse **+ and –** **x and ÷**	Addition can be checked by subtraction. 25 + 67 = 92 and 92 -25 = 67 Multiplication can be checked by division 8 x 9 = 72 and 72 ÷ 8 = 9
Multiples	Multiples are numbers that can be divided by another number without a remainder. Multiples of 7: [7, 14, 21, 28, 35, 42, 49 ...]
Prime Numbers	This is a number that can be divided evenly only by 1 and itself. It is also a whole number greater than 1 Prime numbers: [2, 3, 5, 7, 11, 13, 17, 19, 23, 37 ... 93 ...]

Term	Explanation / Diagram
Factors	Factors are the numbers you multiply together to get another number. 6 x 5 = 30, so 6 and 5 are factors of 30
LCM	Lowest Common Multiple This is the smallest whole number that is shared between more than one list of multiples
HCF	The Highest Common Factor (H.C.F) of two (or more) numbers is the largest number that divides evenly into both numbers. In other words the H.C.F is the largest of all the common factors.
Rounding off	Rounding off means making a number simpler but keeping its value close to what it was. The result is less accurate, but easier to use.
Smaller than	A number that is smaller than another. <
Greater than	A number that is more than another. >
Problem solving	A problem presented in words which require mathematical skills in order to find a solution.
Budget	This is an estimate of income and expenditure for a particular time.
Interest	This is the amount charged on an amount of money loaned or the amount made by saving or investing money in a bank.
Profit	A financial gain... so you make money on the cost price of an item.
Loss	Money lost when expenditure exceeds income. (You spent more than you made).
Discount	A deduction from the regular price of an item
Ratio	This is a way of comparing two or more quantities.

SUMMARY OF KEY CONCEPTS

Properties of number

1. Commutative Property
   The order of numbers in addition or multiplication can change and still give the same result.

   4 + 2 = 6 and 2 + 4 = 6

   a + b = b + a

   4 × 5 = 20 and 5 × 4 = 20

   $a \times b = b \times a$

   The above law does not work for subtraction or division

2. Associative Property
   This works for addition and multiplication.

   It means that if you are adding or multiplying more than two numbers, it doesn't matter where you start or which numbers you pair up and do first.

   (7 + 3) + 5 = 15 or 7 + (3 + 5) = 15

   $(a + b) + c = a + (b + a)$

   (2 × 3) × 4 = 24 or 2 × (3 × 4) = 24

   $(a \times b) \times c = a \times (b \times c)$

   The above law does not work for subtraction or division.

3. Distributive Property

   $a(b + c) = (a \times b) + (a \times c)$

   $a(b - c) = (a \times b) - (a \times c)$

4. 0 - Additive Property
   Adding a zero leaves a number the same

   8+ 0 = 8 and 27 + 0 = 27

   $t + 0 = t$

5. 1 - Multiplicative Property
   Multiplying by one leaves a number unchanged.

   8 x 1 = 8 and 27 x 1 = 27

   t x 1 = t

Inverse Operations

1. Addition can be checked by subtraction.

   25 + 67 = 92 and 92 -25 = 67

2. Multiplication can be checked by division

   8 x 9 = 72 and 72 ÷ 8 = 9

Addition and Subtraction: up to 6 digits

1. Addition
   - By this stage learners have worked with addition and subtraction in columns, but will need to be reminded to set their work out methodically and neatly so as not to mix up the place value of their digits.
   - Also remind them to add what they carry over.
   - It may be useful to use different colours, if possible to show what is being carried.

   A question like this is what is expected at Grade 7 level.

   $$\begin{array}{rr} & 125638 \\ & 297857 \\ & 59321 \\ + & 40978 \\ \hline \end{array}$$

2. Subtraction
   - Learners have also worked with this concept for some time.
   - It is necessary to remind learners that at times they may need to 'borrow' from the digit to the left.
   - Remind them to make the digit they borrow from one less and to add to the digit that needs extra.
   - Also go over subtraction with zeros.

   A question like this is what is expected at Grade 7 level.

   $$\begin{array}{rr} & 900000 \\ - & 68495 \\ \hline \end{array} \qquad \begin{array}{rr} & 289063 \\ - & 196879 \\ \hline \end{array}$$

Multiplication and Division

1. Learners need to be reminded to multiply carefully and to set their work out methodically in order to avoid errors!

```
   5 869
 x    87
  41083
 469520
 510603
```

2. Remember the rules for long division: 1044 ÷ 29
   - Divide
   - Multiply
   - Bring down
   - Subtract

```
     36
29 ⟌1044
  - 87
    174
   -174
      0
```

Multiples

- Multiples are numbers that can be divided by another number without a remainder.
- Multiples are the answers to the times-tables.

1. To find the multiples of a given number:

   Find the multiples of 3.

   $3 \times 1 = 3$ $3 \times 2 = 6$ $3 \times 3 = 9$ $3 \times 4 = 12$

   [3; 6; 9; 12…] this list goes on indefinitely

2. If you are asked to find the first 5 multiples of a number it means count on five times

   For example: Find the first 5 multiples of 2

   $2 \times 1 = 2$ $2 \times 2 = 4$ $2 \times 3 = 6$ $2 \times 4 = 8$ $2 \times 5 = 10$

   [2, 4, 6, 8, 10] this list has 5 multiples and is closed as you were asked for the first 5 multiples of 2.

Factors

To find the factors of a given number:

e.g. Find the factors of 20

Think: which numbers can be multiplied together to make 20:

$1 \times 20 = 20$ $2 \times 10 = 20$ $4 \times 5 = 20$

So: the factors of 20 are: [1, 2, 4, 5, 10, 20]

Lowest Common Multiple or LCM

This is the smallest whole number that is shared between more than one list of multiples.

Multiples of 7: [1, 7, 14, 21, 28, 35, 42…]

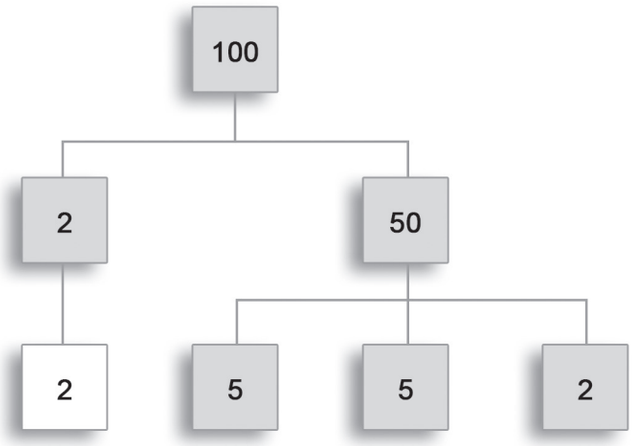
Multiples of 5: [1, 5, 10, 15, 20, 25, 30, 35, 40, 45…]

LCM for 5 and 7 = 35

Highest Common Factor or HCF

1. Factors of 24: [1,2,3,4,6,8,12,24]
2. Prime factorisation is finding which prime numbers multiply together to make the original number:
   12= 2 x 2 x3 … every factor is a prime number.
3. Factor trees or the ladder method are used to write larger composite number as a product of their prime factors. Learners should know their first few prime numbers VERY well, so that they don't accidentally use non-prime numbers while dividing.
   First five prime numbers
   2 ; 3 ; 5 ; 7 ; 11

For example: Write 100 as a product of its prime factors:
Here a factor tree is used.



therefore 100 = 2 x 2 x 5 x 5

Example: Write 200 as a product of its prime factors. (Here the ladder method is used)

2	200
2	100
2	50
5	25
5	5
	1

$\therefore$ 200 = 2 × 2 × 2 ×5 × 5 = $2^3 \times 5^2$

If larger numbers are used to find the highest common factor and lowest common multiple, then factorising the numbers (writing them as a product of their prime factors) is used.

For the sake of the example that follows, smaller numbers were used to demonstrate:

Example: Find the HCF and LCM of 8 and 12

First write each number as a product of its prime factors, using the ladder method or factor tree method (as shown above) where necessary.

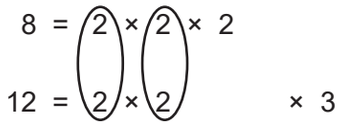
8 = 2 × 2 × 2

12 = 2 × 2 × 3

(Note how this has been written – make sure you have the same numbers underneath each other. This will help when you must circle the common factors)

HCF:

Circle all the factors that each number has in common (in this case, 2 x 2)



Write these down and calculate the answer

HCF: 2 × 2 = 4

(4 is the highest number that can go into 8 AND 12)

LCM

Write one of the numbers' product of prime factors down (choose any one)

2 × 2 × 2

Now look at the other number's prime factors and include any factors not already listed

2 × 2 × 2 × 3 (we already had 2 × 2 so need to include the × 3 to ensure we have all the prime factors of 12 listed)

Calculate the answer

LCM: 2 × 2 ×2 × 3 = 24

(24 is the lowest number that 8 AND 12 can both go into)

Ratio

A ratio is used to compare a share or size of two or more quantities.

It is represented as a:b

A colon is used to separate the items 2:3

This means that there are two of one measure and three of the one being compared.

Therefore, we can say that there are 2 aloes for every 3 roses

(There could be 6 aloes and 9 roses which is 6:9 but can be simplified to 2:3)

Rate

Rate is a comparison of two different measurements to result in a single comparison. km/h would be a comparison between the km travelled in a single measure of time (hour)

we use '/' which is read as 'per' and means to divide.

e.g. If 2kg of apples cost R25 we would compare the price at 1kg.
So 1kg would cost R12, 50
R12, 50 / kg (read as R12,50 per kilogram)

Finance

Ensure learners have a clear understanding of the following terms. If possible, bring manipulatives in while teaching finance or ask learners to bring in a cell phone account for example. Get learners to draw up a budget if they get pocket money. Ask learners to look for advertisements where discounts are offered. Have discussions about how a small business would be run and what would need to be done to make a profit rather than a loss. Working with percentages is essential to this topic. Ensure learners understand and can work with percentages before starting the finance section.

1. Budgets
   A budget is a plan of how money will be managed and spent. A budget is important – if a good budget is made and followed then a person is not likely to go into debt.

   “A budget is telling your money where to go instead of wondering where it went” (Dave Ramsey)

   For example: Jabu gets R70,00 pocket money every week. His weekly expenses are:

Transport	R12,50
Food	R20,00
Entertainment	R25,00
	R57,50

   Calculate how much he saves each week. (R12,50)
   What could he save in 5 weeks? (R62,50)

2. Accounts
   Some basic services like electricity, water and telephone are paid for in arrears (after the service has been used) and an account is sent to the customer, so he/she knows what to pay. Other services (like rent) are paid in advance (before the service has been used).

   It is also possible to have an account with a shop which allows a person to buy on credit and pay later. In this case interest (extra money) is charged. In other words, the item bought will cost more than it would have if cash had been paid.

3. Profit and Loss
   If a business makes more money than has been spent – there will be a profit
   If a business makes less money than has been spent – there will be a loss

4. VAT (Value added tax)
   This is a tax paid on almost every item you buy. The price tag always includes the tax, so you may not realise you are paying it. VAT in south Africa is 15%.

5. Loans
   When a person does not have the full amount to buy an item, it is possible to take a loan for the money needed. The loan would then be paid back (usually on a monthly basis) and interest would be added. All banks and some shops and private companies all offer loans.

6. Discount
   An amount (usually a percentage) offered off an original price.

Example: In a sale, all items in a shop are being sold with a discount of 15%. If an item was marked as costing R200, what price will you pay with the discount?

Step 1: Calculate the discount
15% of R200
= 15/100 ×200
= 30

Step 2: Subtract this from the original price
R200 – R30 = R170

7. Simple interest
   All loans always have interest added on. This is basically the fee paid for borrowing the money. It is usually a percentage and is mostly calculated on a yearly basis (in this case, it is simple interest). The good news is – when you save money you can earn interest.

   Simple interest works as follows: If you are borrowing money, a percentage of the amount borrowed is added to that amount annually. The same amount is added every year – even if a few years have passed and most of the loan may already have been paid back.

For example, if you borrow R 1000 and the interest charged is 12% p.a. (per annum or every year), how much would you pay back if:

a. you took 1 year to pay it back?

b. you took 5 years to pay it back?

Solution:

a. Interest: 12% of R1000=12/100×1000=120
   Total amount to pay back: R1000+R120=R1120
   Note that only 1×120 was added because the loan is only for 1 year.

b. Interest: 12% of R1000=12/100×1000=120
   Total amount to pay back: R1000+(R120×5)=R1000+R600=R1600

Note that this person will pay R600 interest as the R120 calculated is what will be charged per year.

TOPIC 2: EXPONENTS

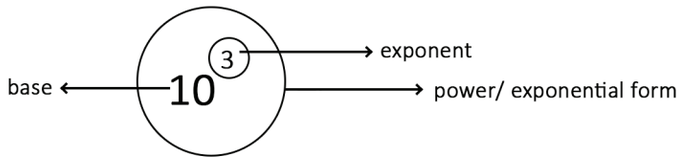
INTRODUCTION

- This unit runs for about 9 hours.
- It falls under the outcome, Patterns, Function and Algebra and this outcome counts for 30% of the final exam.
- This unit covers concepts and skills for algebra. The concepts increase in complexity and learners need to learn rules in order to apply them to solve equations. They need to be able to expand and simplify algebraic expressions
- It is important for the learners to understand how to apply the rules in order in order to simplify expressions involving exponents.

SEQUENTIAL TEACHING TABLE

INTERMEDIATE PHASE / GRADE 6	GRADE 7	GRADE 8 SENIOR PHASE/ FET PHASE
LOOKING BACK	CURRENT	LOOKING FORWARD
• Introduced to exponents • Calculations with whole numbers • Order, compare and represent numbers to at least 9-digit numbers • Represent prime numbers to at least 100 • Recognizing the place value of digits in whole numbers to at least 9-digit numbers • Round off to the nearest 5, 10, 100, 1 000, 100 000, and 1 000 000 • Using a range of techniques to perform and check written and mental calculations of whole numbers including: estimation building up and breaking down numbers rounding off and compensating using addition and subtraction as inverse operations • Adding, subtracting in columns	• Determine squares to at least 12 squared and their square roots • Determine cubes to at least 6 cubed and their cube roots • Compare and represent whole numbers in exponential form • Recognize and use the appropriate laws of operations using numbers involving exponents and square and cube roots • Perform calculations involving all four operations • Using numbers in exponential form, limited to exponents up to 5, and square and cube roots • Solve problems in contexts involving numbers in exponential form	• Compare and represent integers in exponential form • Compare and represent numbers in scientific notation • Extend scientific notation to include negative exponents • Calculations using numbers in exponential form • Revise the general laws of exponents • Extend the general laws of exponents to include: • integer exponents • Perform calculations involving all four operations with numbers in exponential form

GLOSSARY OF TERMS

Term	Explanation / Diagram
Square Number	Any number that is multiplied by itself makes a square number. $5 \times 5 = 25$
Cubed Number	A number multiplied by itself and multiplied by itself again gives you a cubed number $3^3 = 3 \times 3 \times 3 = 27$
Power of 10	10^2... this is read as ten to the power of two a^3 ... means... $a \times a \times a$ e.g. 50^3 means $50 \times 50 \times 50 = 2500 \times 50 = 125\,000$ A little trick is to look at the power and that will give you the amount of 0s behind the multiple of 10, 100 or 1 000.
Powers and Exponents	
Exponential Form	Exponential form is a way of expressing a standard number using a base and a smaller raised number called an exponent.

SUMMARY OF KEY CONCEPTS

Squares and Square roots to 12

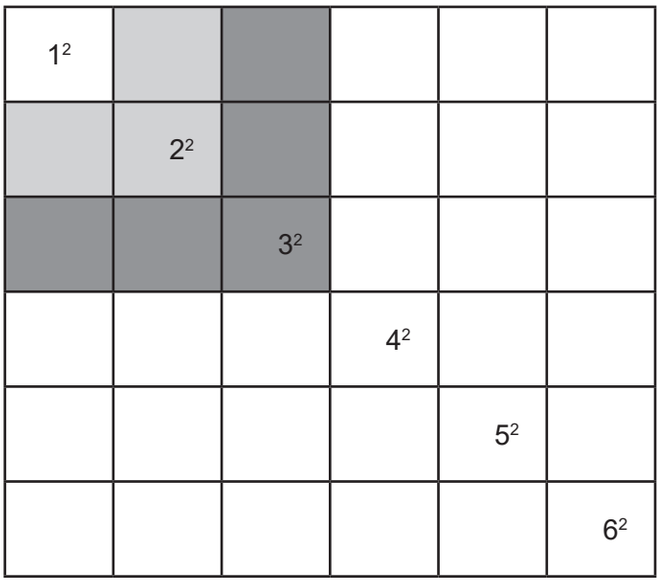
- Ensure learners understand the concept of squaring.
- Spend time using actual squares as shown on the following pages.
- Remind learners regularly that the exponent tells us how many times to use a factor in a multiplication calculation.

Learners should practice writing powers in their expanded form to ensure the conceptual understanding.

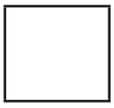
For example:

Practice expanding and simplifying using exponents by completing the following table:

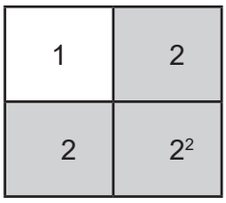
Power (exponential form)	Expanded notation
10^4	
	$3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$
	$8 \times 8 \times 8 \times 8$
5^6	
x^7	
	$a \times a \times a \times a \times a$



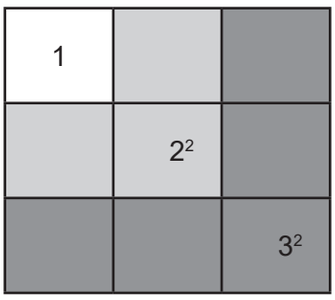
The white block represents 1^2 which is 1.



The light grey blocks and the white block make 4 blocks or 2 × 2 which is 2^2 or 4… there are 4 blocks



Repeat for 32 and you will see that if you multiply the length of blocks by the breadth you will find that there are 9 blocks and it is 3 × 3.



Finding the square root of a number is the inverse operation of squaring. To find the square root of 16, we need to find what number will be multiplied by itself to equal 16.

1. The square root of of each perfect square up to the 12th is written as follows:

$\sqrt{1} = 1$

$\sqrt{4} = 2$

$\sqrt{9} = 3$

$\sqrt{16} = 4$

$\sqrt{25} = 5$

$\sqrt{36} = 6$

$\sqrt{49} = 7$

$\sqrt{64} = 8$

$\sqrt{81} = 9$

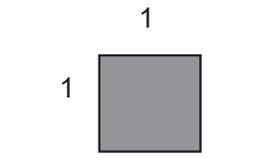
$\sqrt{100} = 10$

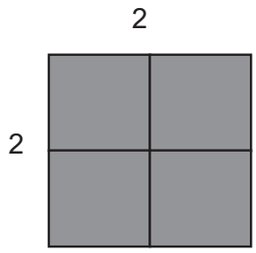
$\sqrt{121} = 11$

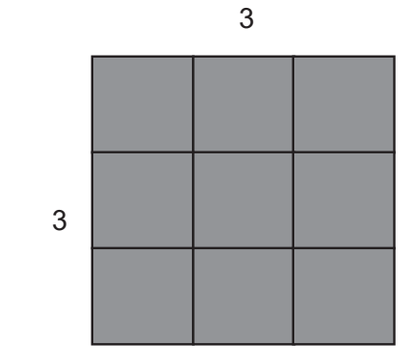
$\sqrt{144} = 12$

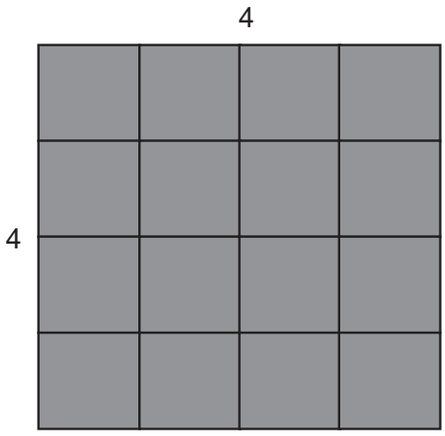
   - Ask learners to read these aloud to you to ensure they understand how to read the mathematical language correctly. For example, 'The square root of 81 is 9'.
   - Ask them to to explain why this is true.
   - **For example**, 'The square root of 81 is 9 because 9 x 9 is equal to 81'.

2. Learners could also draw the 1 x1 square on its own and the 2 x 2 square on its own and so on instead of using the large square which requires them to focus on only one part. Learners may struggle with the larger square.









Cubes and cube roots

To cube a number means multiplying a number by the square of the number (the number will be used 3 times).

1. a^3 … means… $a \times a \times a$
   e.g. 50^3 means $50 \times 50 \times 50 = 2500 \times 50 = 125\,000$

2. $1 \times 1 \times 1 = 1^3 = 1$

   $2 \times 2 \times 2 = 2^3 = 8$

   $3 \times 3 \times 3 = 3^3 = 27$

   $4 \times 4 \times 4 = 4^3 = 64$

   $5 \times 5 \times 5 = 5^3 = 125$

   $6 \times 6 \times 6 = 6^3 = 216$

3. $\sqrt[3]{1} = 1$

   $\sqrt[3]{8} = 2$

   $\sqrt[3]{27} = 3$

   $\sqrt[3]{64} = 4$

   $\sqrt[3]{125} = 5$

   $\sqrt[3]{216} = 6$

   Ask learners to read these aloud to you to ensure they understand how to read the mathematical language correctly. For example, 'The cube root of 8 is 2'.

   Ask them to to explain why this is true.

   For example, 'The cube root of 8 is 2 because 2 x 2 x 2 is equal to 8'.

Powers of 10

1. a^3 … means… $a \times a \times a$
   e.g. 50^3 means $50 \times 50 \times 50 = 25$

2. 10^1 means $10 \times 1 = 10$

   10^2 means $10 \times 10 = 100$

   10^3 means $10 \times 10 \times 10 = 1\,000$

   10^4 means $10 \times 10 \times 10 \times 10 = 10\,000$

   10^5 means $10 \times 10 \times 10 \times 10 \times 10 = 100\,000$

Exponents

Rules for writing in exponential form:

An exponent is used to tell how many times a number (or variable), which is called the base, is used as a factor: Multiply the base number times the base number as many times as the value of the exponent

Example: $5^6 = 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 15625$

5^6 is in exponential form

$5 \times 5 \times 5 \times 5 \times 5 \times 5$ … is in expanded form

15625 is in standard form

When the exponent is squared, we say we are squaring the base number

Example: 4^2 = four squared = 16

When the exponent is cubed, we say we are cubing the base number

Example: 4^3 = four cubed = 64

Some statements you may come across:

1. Write numbers in different forms

   $8^2 = 64$
   $2^2 = \sqrt{16}$

2. Write a list of numbers in ascending or descending order:

   4^2, $\sqrt[3]{8}$, 6, 7^2, $\sqrt{25}$

   In descending order:

   $4^2 = 16$, $\sqrt[3]{8} = 2$, 6, $7^2 = 49$, $\sqrt{25} = 5$
   descending: 49, 16, 6, 5, 2
   In original form: 7^2, 4^2, 6, $\sqrt{25}$, $\sqrt[3]{8}$

   In ascending order:

   $4^2 = 16$, $\sqrt[3]{8} = 2$, 6, $7^2 = 49$, $\sqrt{25} = 5$
   ascending: 2, 5, 6, 16, 49
   In original form: $\sqrt[3]{8}$, $\sqrt{25}$, 6, 4^2, 7^2

3. Examples of the types of questions that could be expected of learners:

   3.1 $\sqrt{6^2} + 8^2$
   $= \sqrt{36} + 64$
   $= 100$

   3.2 $\sqrt[3]{8} + \sqrt[3]{27}$
   $= 2 + 3$
   $= 5$

   3.3 $\sqrt[3]{1000} + 10$
   $= 10 + 10$
   $= 20$

   3.4. $4^3 + 2^3 - 6^2$
   $= 64 + 8 - 36$
   $= 36$

TOPIC 3: CONSTRUCTION OF GEOMETRIC FIGURES

INTRODUCTION

- This unit runs for 10 hours.
- It falls under the outcome, Shape and Space and this outcome counts for 30% of the final exam.
- This unit covers concepts and skills for geometry. Learners investigate new properties of shapes and formalize the naming of definitions.
- It is important for the learners to be able to use deduction of rules and apply them to constructions of shapes. They will also need to calculate unknown angles.
- Learners must have a geometry set.

SEQUENTIAL TEACHING TABLE

INTERMEDIATE PHASE / GRADE 6	GRADE 7	GRADE 8 SENIOR PHASE/ FET PHASE
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Basic measurement skills such as correct ruler use, reading various scales correctly and use of other geometric tools: protractors and such are required when this section is introduced in the later phases. • These skills are taught at various stages during the foundation and intermediate phase across Grades.	• Measuring angles • Accurately use a protractor to measure and classify angles: -- < 90o (acute angles) -- Right-angles -- > 90o (obtuse angles) -- Straight angles -- > 180o (reflex angles) • Accurately construct geometric figures appropriately using a compass, ruler and protractor, including: -- angles, to one degree of accuracy -- circles -- parallel lines -- perpendicular lines	• Accurately construct geometric figures appropriately using a compass, ruler and protractor, including bisecting angles of a triangle • Construct angles of 30°, 45°, 60° and their multiples without using a protractor • Investigating properties of geometric figures • By construction, investigate the angles in a triangle, focusing on the relationship between the exterior angle of a triangle and its interior angles • By construction, investigate sides, angles and diagonals in quadrilaterals, focusing on: -- the diagonals of rectangles, squares, parallelograms, rhombi and kites -- exploring the sum of the interior angles of polygons • By construction, explore the minimum conditions for two triangles to be congruent

GLOSSARY OF TERMS

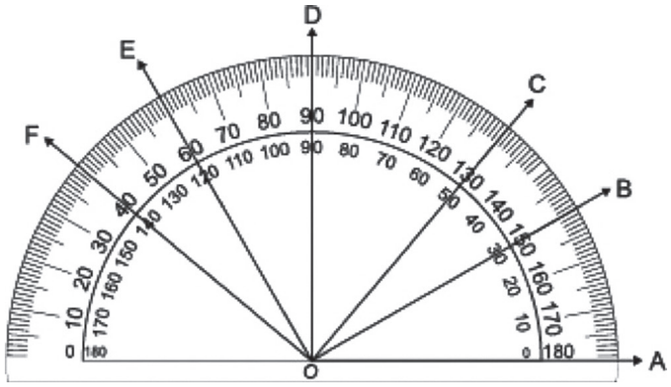
Term	Explanation / Diagram
Protractor	An instrument that measures angles, and helps to draw angles.
Classify	To arrange in classes or categories according to shared qualities or characteristics.
Angles	An angle is the amount of turning from a fixed point. In this example the hinge of the door is the fixed point. An angle is formed by two rays these are called the arms of the angle. These rays share a common endpoint, called the vertex of the angle.
Acute	An angle less than 90°
Right Angle/Perpendicular	An angle which is 90° a right angle is also forms a perpendicular
Obtuse	An angle bigger than 90° but less than 180°
Reflex	An angle bigger than 180° but less than 360°
Degree	A unit of angle measure
Accuracy to one degree	Make sure that when measuring angles that the angle is not more than 1° smaller or bigger than the given degree.
Parallel Lines	Lines that move in the same direction and never meet
Perpendicular	Perpendicular lines are lines which meet at 90°
Circle	A is a type of line that is bent around until its ends join.
Fixed Point	A point that is in a given position and not movable
Radius	The distance from the center of the circle to any point on the circumference
Arc	Part of the circumference
Circumference	The circumference of a circle is the distance around the circle. It is the circle's perimeter.

SUMMARY OF KEY CONCEPTS

Measuring Angles with a Protractor

1. Place the center point of the protractor on the vertex of the angle.

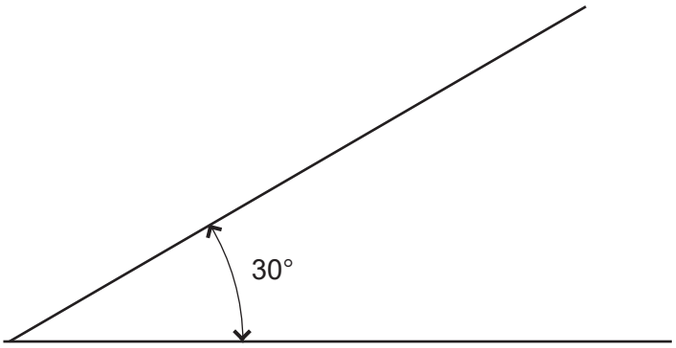
2. Always check to measure from 0°. It is best to get learners used to measuring angles in an anti-clockwise direction. This will assist them in Trigonometry in the FET phase.



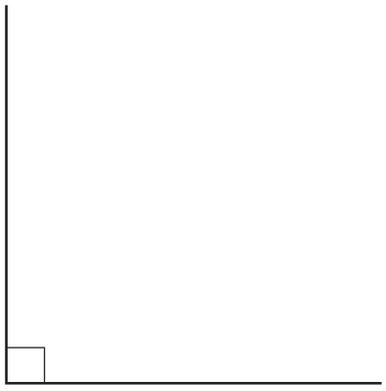
- Note that A (0°) is the starting point and all angles are measured in an anti-clockwise direction.
- From A to B, the angle measures 30°
- From A to C, the angle measures 50°
- From A to D, the angle measures 90°
- From A to E, the angle measures 120°
- From A to F, the angle measures 140°

3. Make sure that the line running through 0° and 180° is straight on one of the sides of the angle that is being measured.
4. Remember to show learners to count from 0°.
5. This is a skill which learners find difficult to do so it is a good idea to give them a lot of practice measuring angles.
6. If you do not have a board protractor, make one from cardboard so learners can be shown how to measure angles.

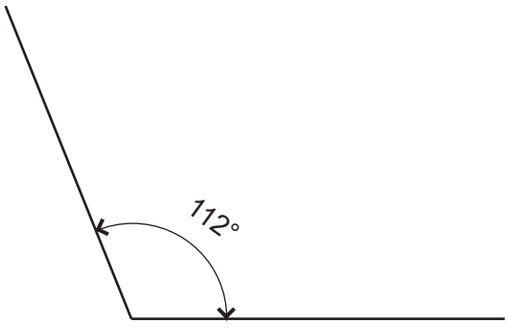
Classify Angles



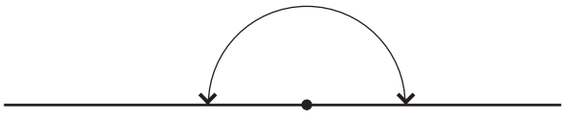
Acute angle: less than 90°



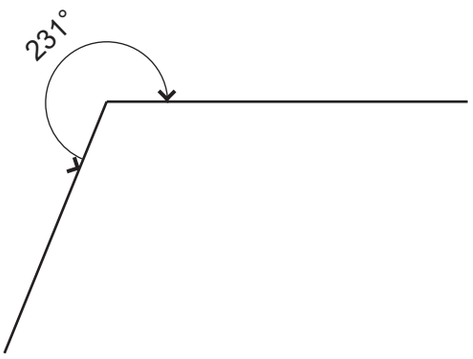
Right angle: 90°



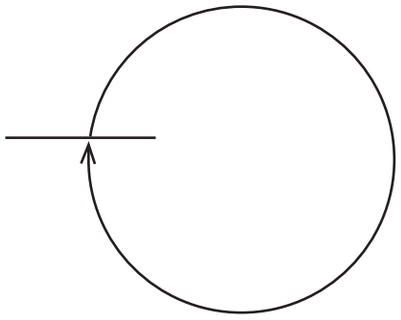
Obtuse angle: more than 90° but less than 180°



Straight angle/line: 180°

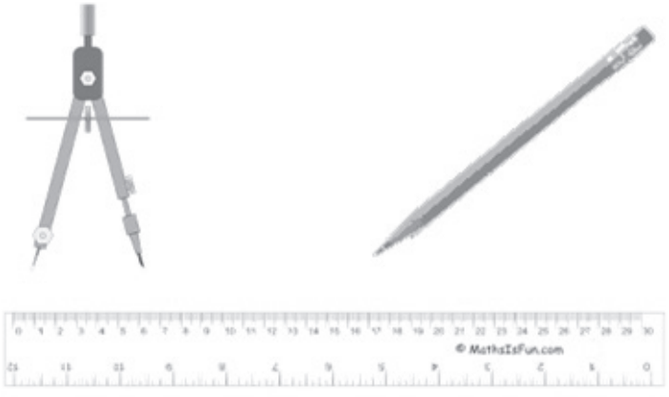


Reflex angle: more than 180° but less than 360°



360°: known as a revolution or circle

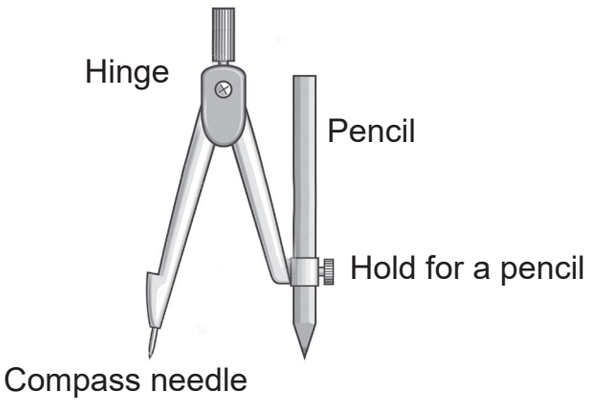
How to Construct a Circle



Construction means to draw shapes, angles or lines accurately.

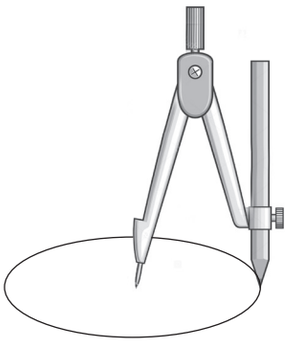
To construct the following are needed: a pair of compasses, a ruler and a sharp pencil.

1. A compass, or also known as a pair of compasses, is an instrument used to draw circles.
2. It consists of two movable arms hinged together where one arm has a pointed end and the other arm holds a pencil.



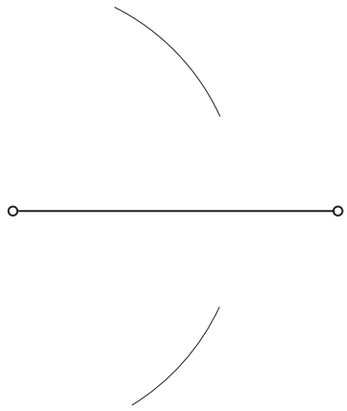
To construct a circle with a compass:

1. Make sure that the hinge, at the top of the compass, is tightened so that it does not slip.
2. Tighten the hold for the pencil so it also does not slip.
3. Align the pencil lead with the compass's needle.
4. Press down the needle and turn the knob at the top of the compass to draw a circle.

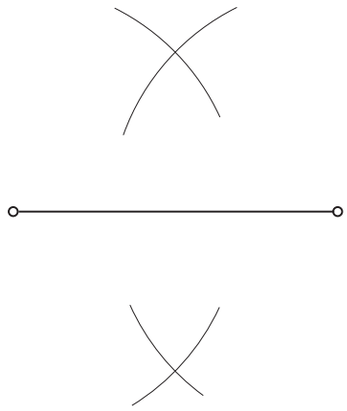


How to Construct a Perpendicular

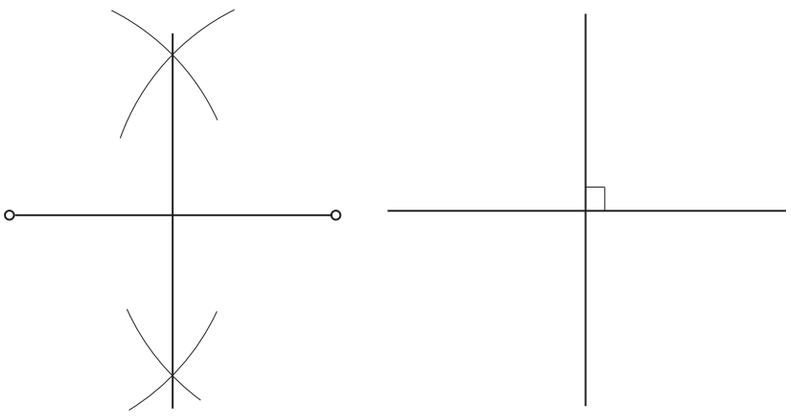
1. Draw a line of 8cm in length.
2. Put the compass at one end of your line segment (a line with a beginning and an end).
3. Adjust the compass to slightly longer than half the line segment length.
4. Use the compass to draw arcs above and below the line



5. Keeping the same compass width, draw arcs from other end of line.

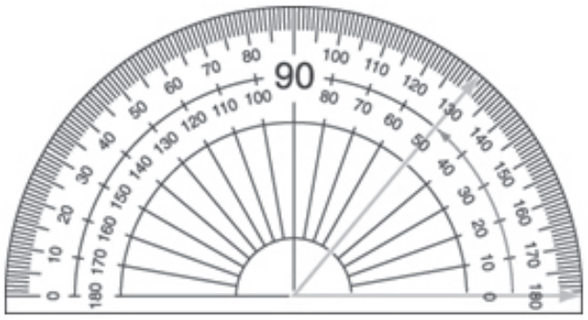


6. Place the ruler where the arcs cross, and draw the line segment.



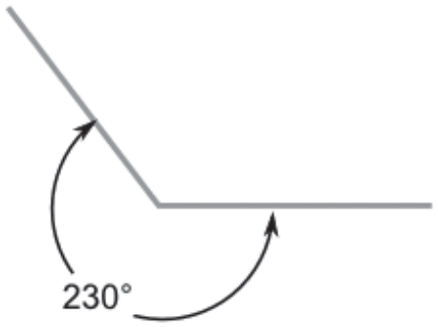
How to Construct an angle using a protractor

1. Draw a horizontal line segment of about 8 cm in length.
2. Use a ruler on this new line segment and make a mark where zero is and then another at about 6 cm.
3. Place the middle of the protractor on the zero points.
4. Count from 0° to 50° on the protractor.
5. Make a mark with your pencil where this is on your paper.
6. Now use your ruler to join through the 0° point and the mark which shows 50°.



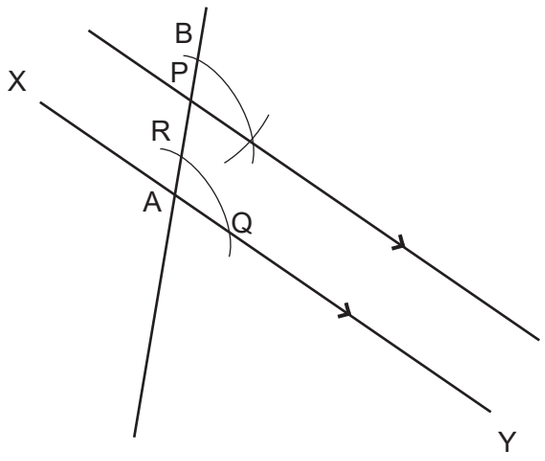
This can be done to measure any acute, right or obtuse angle. To construct a reflex angle, subtract the reflex from 360°. This will give you the internal angle which you can construct as it will be less than 180°. Once this angle has been constructed, remember to show that the reflex angle is the one that has been constructed as demonstrated below:

For example:
To construct a reflex angle of 230°, subtract this from 360°. 360° - 230° = 130°. Once the angle of 230° has been constructed, show that it is the reflex angle that was required by labelling it as follows



How to construct parallel lines using a compass.

1. Draw a line with a ruler.
2. Make a point above the line and name it P.
3. Join the point to the original line XY.
4. Place the point of the compass on A
5. Draw an arc from A.
6. Move the compass to point P make the same arc.
7. With the compass measure the distance RQ.
8. Move the compass to point B and make an arc to intersect the big arc.
9. Now draw a line, with a ruler, through P and the intersection point.



TOPIC 4: GEOMETRY OF 2D SHAPES

INTRODUCTION

- This unit runs for 10 hours.
- It falls under the outcome, Shape and Space and this outcome counts for 30% of the final exam.
- This unit covers concepts that form the basis for high school geometry.
- It is important for the learners to be accurate and to learn the rules that they will need to apply.

SEQUENTIAL TEACHING TABLE

INTERMEDIATE PHASE / GRADE 6	GRADE 7	GRADE 8 SENIOR PHASE/ FET PHASE
LOOKING BACK	CURRENT	LOOKING FORWARD
• Recognize, visualize and name 2-D shapes in the environment and geometric settings, focusing on - regular and irregular polygons - triangles, squares, rectangles, parallelograms, other quadrilaterals, pentagons, hexagons, heptagons, octagons, circles, similarities and differences between rectangles and parallelograms • Characteristics of shapes • Describe, sort and compare 2-D shapes in terms of -- number of sides -- lengths of sides -- sizes of angles -- acute -- right -- obtuse -- straight -- reflex -- revolution • Draw 2-D shapes on grid paper • Draw circles, patterns in circles and patterns with circles using a pair of pair of compasses • Recognize and name the following angles in 2-D shapes: -- acute -- right -- obtuse -- straight -- reflex -- revolution	• Classifying 2D shapes • Describe, sort, name and compare, triangles according to their sides and angles, focusing on: equilateral triangles isosceles triangles right-angled triangles • Describe, sort, name and compare quadrilaterals in terms of: -- length of sides -- parallel and perpendicular sides -- size of angles [right-angles or not] • Describe and name parts of a circle • Recognize and describe similar and congruent figures by comparing: -- shape -- size • Solve simple geometric problems involving unknown sides and angles in triangles and quadrilaterals, using known properties.	• Classifying 2D shapes • Revise properties and definitions of triangles in terms of their sides and angles, distinguishing between: -- equilateral triangles -- isosceles triangles -- right-angled triangles • Revise and write clear definitions of quadrilaterals in terms of their sides, angles and diagonals, distinguishing between: -- parallelogram -- rectangle -- square -- rhombus -- trapezium -- kite • Through investigation, establish the minimum conditions for congruent triangles • Through investigation, establish the minimum conditions for similar triangles • The entire FET Geometry curriculum is built on the foundational knowledge learners must acquire during this phase.

GLOSSARY OF TERMS

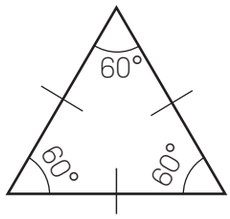
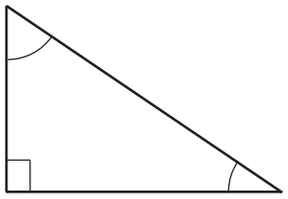
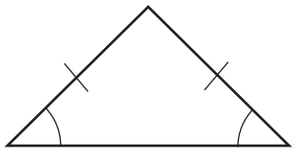
Term	Explanation / Diagram
Triangles	Triangles are three sided figures. The angles of all triangles add up to 180°.
Equilateral Triangle	This type of triangle has sides of equal length and the interior angles are 60° each.
Isosceles Triangle	This type of triangle has two sides of equal length and the angles opposite the equal sides are equal in size.
Right Angled Triangle	This type of triangle has an angle of 90°.
Circle	A is a type of line that is bent around until its ends join
Radius	This is a line from the centre of the circle to the circumference or perimeter of the circle is the radius. Plural: radii
Circumference	The circumference is the perimeter of the circle.
Diameter	The diameter is a chord that passes through the fixed point at the centre of a circle.
Chord	A chord is a line that joins two points on the circumference of a circle.
Segments	A segment is part of a circle that is between a chord and the circumference.
Sectors	A sector is part of the circle between two radii.
Congruency	2-D shapes which are identical because the corresponding sides are equal, but not in proportion, and the corresponding angles are the same size.

SUMMARY OF KEY CONCEPTS

Triangles

1. Describe, sort, name and compare to sides and angles

   Triangles are 3-sided figures. All triangles have interior angles that add up to 180°.

Equilateral Triangle	Right Angled Triangle	Isosceles Triangle
		
Sides are all of equal length. [the marking of a single dash on each of the three sides is showing that they are all equal in length].	If it is an isosceles triangle two sides will be of equal length and the angles opposite the 90° will be 45° each. But right-angled triangles are not necessarily isosceles.	The two sides opposite the angles, which are equal are the same length.
All three angles are 60° [an arc shows angles of equal size]	One angle is 90° [a block shows a 90° angle]	Two angles are the same size

Quadrilaterals: describe, sort, name and compare to sides and angles

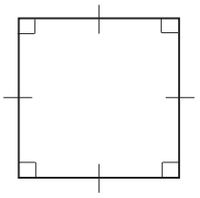
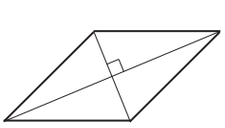
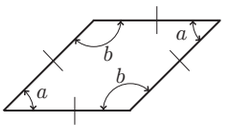
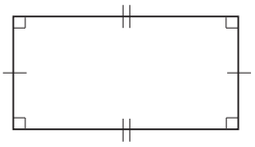
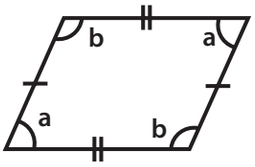
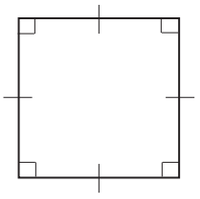
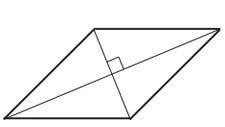
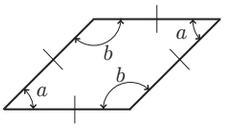
Learners need to describe, sort, name and compare quadrilaterals.

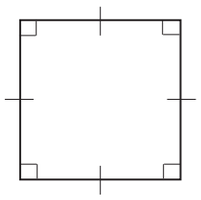
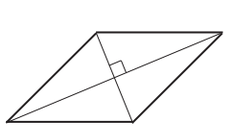
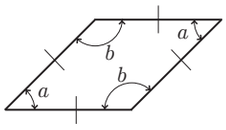
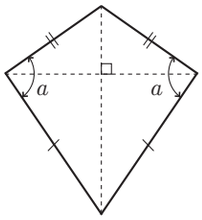
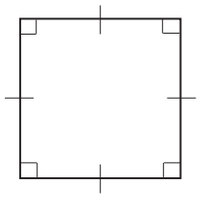
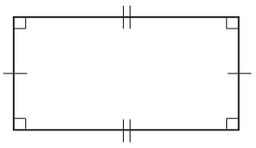
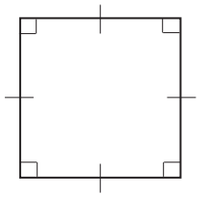
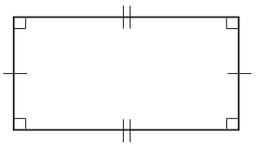
To assist learners in developing a conceptual understanding, time should be spent on drawing and measuring their own quadrilaterals.

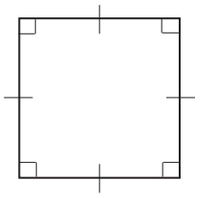
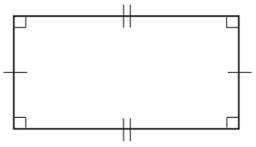
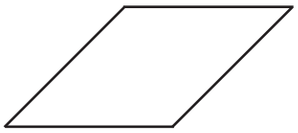
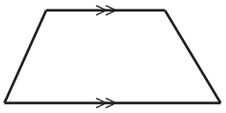
Quadrilaterals are 4-sided figures with straight lines.

The characteristics of quadrilaterals:

- 4 sides
- 4 corners
- the interior angles add up to 360°

Classify quadrilaterals	
All sides equal in length	 square   rhombus
Opposite sides equal	 rectangle  parallelogram  square   rhombus

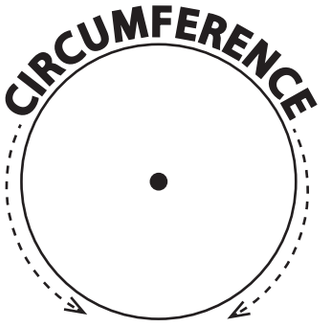
Classify quadrilaterals	
At least one pair of adjacent sides equal	 square   rhombus  kite
All four angles are right angles	 square  rectangle
Perpendicular sides Perpendiculars are right angles	 square  rectangle

Classify quadrilaterals	
Two pairs of opposite sides are parallel	 square  rectangle  parallelogram
One pair of opposite sides parallel	 trapezium

Parts of a circle

Learners need to be able to describe and name the parts of a circle.

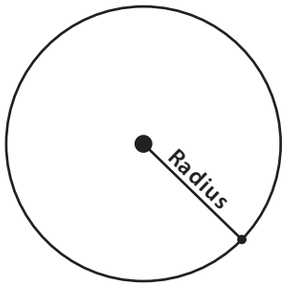
1. Circumference



A circle is a set of points on a plane that are the same distance from a fixed point (the centre of the circle) The circumference is the entire distance around the circle.

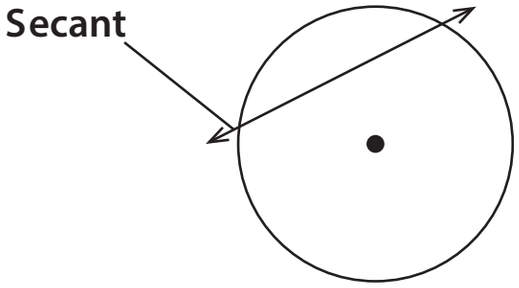
2. Radius

   The radius is the distance from the centre of a circle to any point.



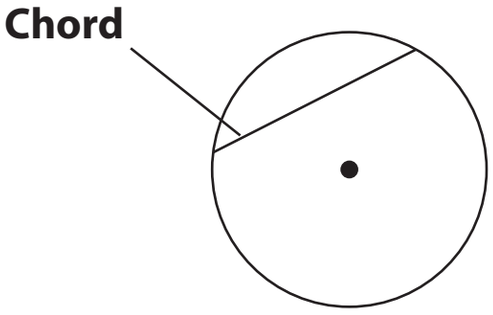
   The name of a line in a circle depends on its position in the circle

3. Secant



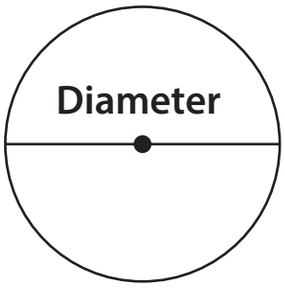
   A secant is a line that passes through any two points on a circle.

4. Chord



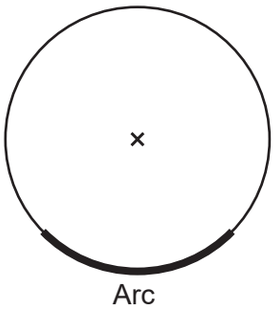
   A chord is a line that joins two points on the circumference of a circle.

5. Diameter



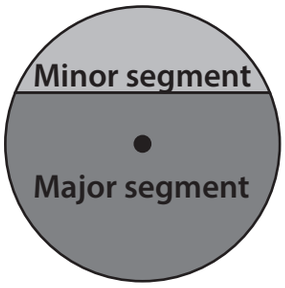
The diameter is a chord that passes through the centre of a circle.

6. Arc



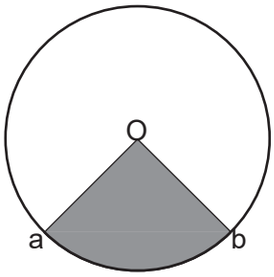
An arc is part of the circumference.

7. Sector



A sector is part of the circle between two radii.

8. Segment



A segment is part of a circle that is between a chord and the circumference.

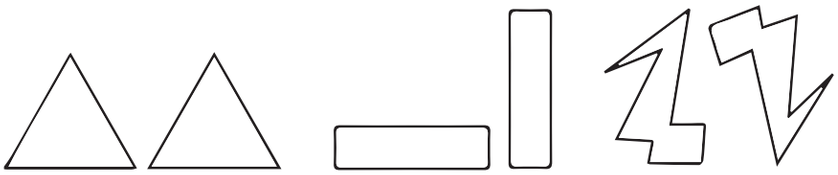
Congruent Shapes

The concepts Congruency and Similarity are important in geometry for future grades. At this level it is just important to ensure learners are familiar with the words and their meanings rather than any formal work regarding triangles.

Congruent:
In order for two shapes to be congruent, they need to be EXACTLY the same size.

(The word congruent comes from the Latin word 'congruere' which means 'to agree', so it is a way of saying that the shapes 'agree')

Examples of congruent shapes:
In each of these pairs, every side is equal in length and every angle is equal in size. The pairs of shapes are therefore congruent to each other.



Similarity:
Similar figures have the same shape but not the same size.

For two shapes to be similar, their angles must be equal but their sides only need to be in proportion. If two shapes are similar, the smaller one will fit perfectly inside the larger one.

Examples of Similar shapes:

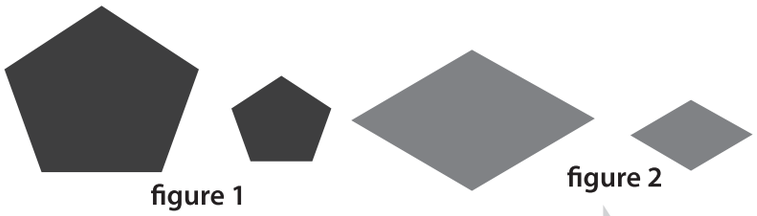
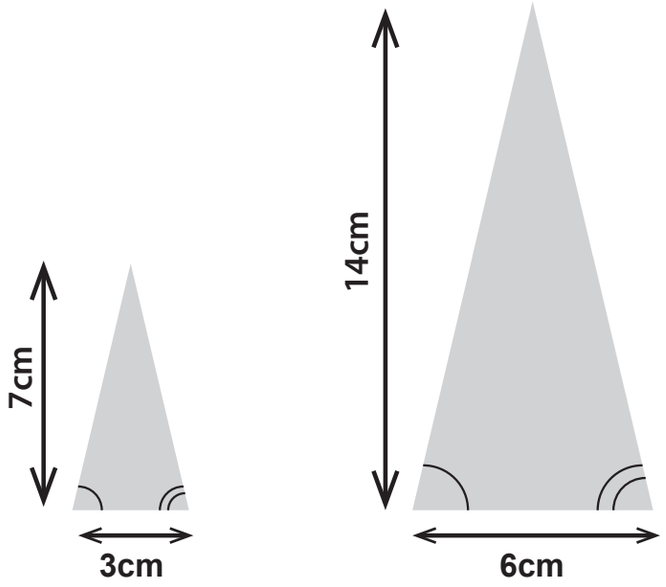


figure 1

figure 2


figure 3

figure 4



TOPIC 5: GEOMETRY OF STRAIGHT LINES

INTRODUCTION

- This unit runs for 2 hours.
- It falls under the outcome, Shape and Space and this outcome counts for 30% of the final exam.
- This unit covers concepts and skills for lines.
- It is important for the learners to know the terms and be able to apply them to geometry.

SEQUENTIAL TEACHING TABLE

INTERMEDIATE PHASE / GRADE 6	GRADE 7	GRADE 8 SENIOR PHASE/ FET PHASE
LOOKING BACK	**CURRENT**	**LOOKING FORWARD**
• Use of rulers and other measuring instruments as taught throughout the intermediate phase.	• Geometry of straight lines Define: • Line segment • Ray • Straight line • Parallel lines • Perpendicular lines	• Revise and write clear descriptions of the relationship between angles formed by: -- perpendicular lines -- intersecting lines -- parallel lines cut by a transversal

GLOSSARY OF TERMS

Term	Explanation / Diagram
Point	A point has no dimensions, only position.
Line segment	A line segment is part of a line that joins two points. It has an end points and a starting point.  Adding the word segment is important, because a line normally extends in both ways without end.
Ray	 This is a part of a line that starts at a point and goes off in a particular direction to infinity.
Perpendicular lines	Two lines that meet at a right angle or 90°. A line is said to be perpendicular to another line if the two lines cross at a right angle.
Parallel lines	Parallel lines are lines in a plane that do not meet; that is, two lines in a plane that do not intersect or touch each other at any point are said to be parallel.
Straight line	This is a line which is formed by 180°.

SUMMARY OF KEY CONCEPTS

Lines

In geometry a line:

- is straight (no curves),
- has no thickness,
- extends in both directions without end (infinitely).

Line segment

A line segment has a definite starting point and a definite ending point.

Ray

A line with a start point but no end point because it goes to infinity.

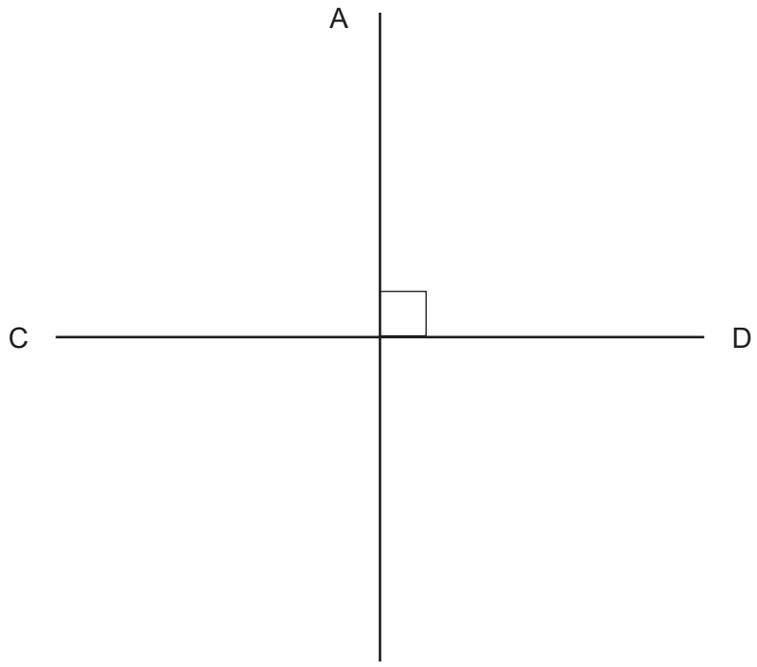
Straight line

A straight line is a line that is 180°. It is drawn with a ruler. It has no starting point and no end point. It is usually drawn with arrows on both sides to show it continues indefinitely in both directions.

Perpendicular lines

Perpendicular lines are lines that meet at right angles or 90°.

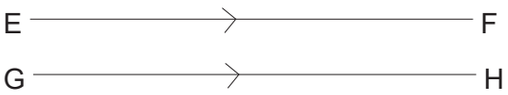
This is written as AB ⊥ CD



Parallel

Parallel lines are lines in a plane that do not meet; that is, two lines in a plane that do not intersect or touch each other at any point are said to be parallel.

To show that lines are parallel



This is written as EF || GH

Notes

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