Work with a range of patterns and functions and solve problems

Learner Guide
Primary Agriculture

NQF Level: 2            US No: 9007

My name: ..............................

Company: ..............................

Commodity: ...................... Date: ..............

The availability of this product is due to the financial support of the National Department of Agriculture and the AgriSETA. Terms and conditions apply.
Before we start...

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standard:

| Title: Work with a range of patterns and functions and solve problems |
| US No: 9007 | NQF Level: 2 | Credits: 3 |

The full unit standard will be handed to you by your facilitator. Please read the unit standard at your own time. Whilst reading the unit standard, make a note of your questions and aspects that you do not understand, and discuss it with your facilitator.

This unit standard is one of the building blocks in the qualifications listed below. Please mark the qualification you are currently doing:

<table>
<thead>
<tr>
<th>Title</th>
<th>ID Number</th>
<th>NQF Level</th>
<th>Credits</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Certificate in Animal Production</td>
<td>48976</td>
<td>2</td>
<td>120</td>
<td>☐</td>
</tr>
<tr>
<td>National Certificate in Mixed Farming Systems</td>
<td>48977</td>
<td>2</td>
<td>120</td>
<td>☐</td>
</tr>
<tr>
<td>National Certificate in Plant Production</td>
<td>48975</td>
<td>2</td>
<td>120</td>
<td>☐</td>
</tr>
</tbody>
</table>

Please mark the learning program you are enrolled in:

Your facilitator should explain the above concepts to you.

This Learner Guide contains all the information, and more, as well as the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed and include it in your Portfolio of Evidence. Your PoE will be required during your final assessment.

What is assessment all about?

You will be assessed during the course of your study. This is called formative assessment. You will also be assessed on completion of this unit standard. This is called summative assessment. Before your assessment, your assessor will discuss the unit standard with you.
Assessment takes place at different intervals of the learning process and includes various activities. Some activities will be done before the commencement of the program whilst others will be done during programme delivery and other after completion of the program.

The assessment experience should be user friendly, transparent and fair. Should you feel that you have been treated unfairly, you have the right to appeal. Please ask your facilitator about the appeals process and make your own notes.

How to use the activity sheets...

Your activities must be handed in from time to time on request of the facilitator for the following purposes:

♦ The activities that follow are designed to help you gain the skills, knowledge and attitudes that you need in order to become competent in this learning module.

♦ It is important that you complete all the activities and worksheets, as directed in the learner guide and at the time indicated by the facilitator.

♦ It is important that you ask questions and participate as much as possible in order to play an active role in reaching competence.

♦ When you have completed all the activities and worksheets, hand this workbook in to the assessor who will mark it and guide you in areas where additional learning might be required.

♦ You should not move on to the next step in the assessment process until this step is completed, marked and you have received feedback from the assessor.

♦ Sources of information to complete these activities should be identified by your facilitator.

♦ Please note that all completed activities, tasks and other items on which you were assessed must be kept in good order as it becomes part of your Portfolio of Evidence for final assessment.

Enjoy this learning experience!
How to use this guide ...

Throughout this guide, you will come across certain re-occurring “boxes”. These boxes each represent a certain aspect of the learning process, containing information, which would help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:

**What does it mean?** Each learning field is characterized by unique terms and definitions – it is important to know and use these terms and definitions correctly. These terms and definitions are highlighted throughout the guide in this manner.

You will be requested to complete activities, which could be group activities, or individual activities. Please remember to complete the activities, as the facilitator will assess it and these will become part of your portfolio of evidence. Activities, whether group or individual activities, will be described in this box.

**Examples** of certain concepts or principles to help you contextualise them easier, will be shown in this box.

**How am I doing?** The following box indicates a summary of concepts that we have covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of the concepts listed.

**My Notes ...**
You can use this box to jot down questions you might have, words that you do not understand, instructions given by the facilitator or explanations given by the facilitator or any other remarks that will help you to understand the work better.
What are we going to learn?

What will I be able to do? ................................................................. 6
Learning outcomes ........................................................................... 6
What do I need to know? ................................................................. 6
Session 1 Patterns ........................................................................... 7
Session 2 Functions ......................................................................... 18
Session 3 Functions and their graphs ............................................. 30
Am I ready for my test? ................................................................. 52
Checklist for Practical assessment ................................................. 54
Paperwork to be done ................................................................. 55
Bibliography .................................................................................. 56
Terms & Conditions ...................................................................... 56
Acknowledgements ...................................................................... 57
SAQA Unit Standard
Work with a range of patterns and functions and solve problems

Primary Agriculture NQF Level 2 Unit Standard No: 9007

What will I be able to do?

When you have achieved this unit standard, you will be able to:

♦ Convert flexibly between and within various representations of functions.
♦ Compare, analyse and describe the behaviour of patterns and functions.
♦ Represent situations mathematically in order to interpret and solve problems.

Learning Outcomes

At the end of this learning module, you must be able to demonstrate a basic knowledge and understanding of:

♦ Relationships between variables
♦ Mathematical functions
♦ Representations of functions and relations.

What do I need to know?

It is expected of the learner attempting this unit standard to demonstrate competence against the unit standard:

♦ Mathematics and Communications at NQF level 1

My Notes ...
Session 1

Patterns

After completing this session, you should be able to:
SO 1: Convert flexibly between and within various representations of functions.

In this session we explore the following concepts:
♦ understand how geometric patterns evolve;
♦ understand how number patterns evolve.

1.1 Geometric patterns

Number patterns are more easily understood once you grasp the basics of geometrical patterns.

Example

Ben is a store man and has to ensure that the stores are well organised. One of the main concerns in his job is to safely stack crates on top of each other. All of the crates he receives are 1m x 1m x 1m. Ben has worked out a pattern that ensures that the crates are stacked firmly, because they are as wide as they are long and as high as they are wide.
The table below shows the pattern:

<table>
<thead>
<tr>
<th>Dimension of Crate</th>
<th>1^3</th>
<th>2^3</th>
<th>3^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Crates used</td>
<td>1</td>
<td>8</td>
<td>27</td>
</tr>
</tbody>
</table>

What if he had to continue stacking crates in this pattern? He sees that:

<table>
<thead>
<tr>
<th>Dimension of Crate</th>
<th>1^3</th>
<th>2^3</th>
<th>3^3</th>
<th>4^3</th>
<th>5^3</th>
<th>6^3</th>
<th>7^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Crates used</td>
<td>1</td>
<td>8</td>
<td>27</td>
<td>64</td>
<td>125</td>
<td>216</td>
<td>343</td>
</tr>
</tbody>
</table>

He realises that he will need a lot of space to stack more than 3 crates by 3 crates by 3 crates. It will be impossible to continue with this pattern in his store.

For a pattern to emerge, we need to know at least 3 of the numbers or items in the sequence of patterns so that we can predict the next.

**Pattern 1:**

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</table>

In this sequence, we can predict that the next two objects will be:

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</table>

The pattern will end up as follows:

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**Pattern 2:**

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</tbody>
</table>

In this sequence, we can predict that the next two objects will be:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The pattern will end up as follows:

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pattern 3:**
In this sequence, we can predict that the next two objects will be:

\[
\begin{array}{cccc}
\heartsuit & \heartsuit & \heartsuit & \heartsuit \\
1 & 1+1 & 2+1 & \\
\end{array}
\]

The pattern will end up as follows:

\[
\begin{array}{cccc}
\heartsuit & \heartsuit & \heartsuit & \heartsuit \\
\heartsuit & \heartsuit & \heartsuit & \heartsuit \\
1 & 1+1 & 2+1 & 3+1 & 4+1 \\
\end{array}
\]

### 1.2 Number patterns

Number patterns can be very powerful and for one man named Sessa, it became his road to riches.

When the King of Persia learned to play chess, he enjoyed it so much that he wanted to reward the inventor of the game. The king called Sessa to the palace and told Sessa that he (the king) would grant any wish that Sessa may have to reward him for this fine game.

In those days, rice was the most valuable commodity. The more rice you owned, the richer you were.

Sessa told the king what his wish was. He wanted:

- one grain of rice for the first square on the chessboard
- two grains of rice for the second square
- four grains of rice for the third square
- and for each square that followed, the number of grains of rice should be doubled

The King, clearly not a number pattern expert, agreed to this wish. He called upon one of his servants to bring a bag of rice. The servant started counting and soon the king realised that he does not have enough grain in his country to fulfil Sessa’s wish. In fact, the total rice production in the world today, cannot fulfil Sessa’s wish.

Let’s look at a chessboard to understand the king’s dilemma. We start at the top left hand corner. The --- lines show the first 4 squares. You may continue to draw the squares, but a number pattern can solve our mystery much faster.
To work out how this pattern develops, we simplify the table. In this case, we use exponents \((to\ the\ power\ of)\) to do this (i.e. \(2^5 = 2 \times 2 \times 2 \times 2 \times 2\)): 

<table>
<thead>
<tr>
<th>Square Number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Grains</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>64</td>
<td>128</td>
<td>256</td>
</tr>
</tbody>
</table>

Do you see the pattern that is emerging? In every subsequent term, the exponent increases by \(^1\). If we were to extend this table to the 50\(^{th}\) square, the number of grains of rice would be \(2^{49}\).

We now represent this pattern in mathematical terms:

Let \(n\) be the number of grains. In Sessa’s pattern \(n = 2\).

The first term in Sessa’s pattern \(= 1 = 2^0\)

The second term in Sessa’s pattern \(= 2 = 2^1\)

The third term in Sessa’s pattern \(= 4 = 2^2\)

The fourth term in Sessa’s pattern \(= 8 = 2^3\)

The fifth term in Sessa’s pattern \(= 16 = 2^4\)

When we write this pattern in mathematical language, it will be:

\[ n = 2^{n-1} \]
Work with a range of patterns and functions and solve problems

Primary Agriculture  NQF Level 2  Unit Standard No: 9007

<table>
<thead>
<tr>
<th>Square number (n)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Grains ((2^{n-1}))</td>
<td>(2^{1-1})</td>
<td>(2^{2-1})</td>
<td>(2^{3-1})</td>
<td>(2^{4-1})</td>
<td>(2^{5-1})</td>
<td>(2^{6-1})</td>
<td>(2^{7-1})</td>
<td>(2^{8-1})</td>
<td>(2^{9-1})</td>
</tr>
<tr>
<td>=</td>
<td>(2^0)</td>
<td>(2^1)</td>
<td>(2^2)</td>
<td>(2^3)</td>
<td>(2^4)</td>
<td>(2^5)</td>
<td>(2^6)</td>
<td>(2^7)</td>
<td>(2^8)</td>
</tr>
<tr>
<td>=</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>64</td>
<td>128</td>
<td>256</td>
</tr>
</tbody>
</table>

It is also now much simpler to calculate any term that is required i.e.

Calculate the 41\text{st} term: \(41 = 2^{41-1} = 2^{40}\)

Once we have a table with two terms, we can draw a graph.

<table>
<thead>
<tr>
<th>Square Number (n)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Grains ((2^{n-1}))</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<td>=</td>
<td>1</td>
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<td>4</td>
<td>8</td>
<td>16</td>
<td>32</td>
<td>64</td>
<td>128</td>
<td>256</td>
</tr>
</tbody>
</table>

![Graph showing the number of grains for square numbers (1 to 9)]
In the early seventeenth century, a French mathematician, Blaise Pascal, developed a triangle that is known today as \textbf{Pascal’s triangle}. This is his triangle:

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
row 1 & & & & & & 1 \\
\hline
row 2 & & & & 1 & 1 & \\
\hline
row 3 & & 1 & 2 & 1 & & \\
\hline
row 4 & 1 & 3 & 3 & 1 & & \\
\hline
row 5 & 1 & 4 & 6 & 4 & 1 & \\
\hline
row 6 & 1 & 5 & 10 & 10 & 5 & 1 \\
\hline
row 7 & 1 & 6 & 15 & 20 & 15 & 6 & 1 \\
\hline
\end{tabular}
\end{center}

Pascal’s triangle works like this:

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
row 1 & & & & & & 1 \\
\hline
row 2 & & & & 1 & 1 & 1+0 1+0 \\
\hline
row 3 & & 1 & 2 & 1 & & 1+0 1+1 1+0 \\
\hline
row 4 & 1 & 3 & 3 & 1 & & 1+0 1+3 3+3 3+1 1+0 \\
\hline
row 5 & 1 & 4 & 6 & 4 & 1 & 1+0 1+4 4+6 6+4 4+1 1+0 \\
\hline
row 6 & 1 & 5 & 10 & 10 & 5 & 1 1+0 1+5 5+10 0+10 10+5 5+1 1+0 \\
\hline
row 7 & 1 & 6 & 15 & 20 & 15 & 6 & 1 \\
\hline
\end{tabular}
\end{center}
Multilevel marketing works in a similar way. If you are part of a multi-level marketing organisation, you might use this as part of your marketing strategy to recruit new salespeople.

You start as the main salesperson and you recruit two of your friends to act as agents for you. You then encourage your two agents to each appoint two new agents. Your first two agents now have to encourage their two new agents to each recruit two new agents and so it goes on.

If you are earning 1% commission on each person in such a downline, then it pays you to have more agents and to ensure that your agents recruit more agents, because you are increasing your commission without doing any work.

Each agent sells about R100's products a month. You earn 1% commission on each agent's sales:

![Diagram showing multilevel downline]

You earn R30 without selling anything!

Please complete Activity 1 at the end of this session.

My Notes ...

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........................................................................................................
1. Work out the next 5 terms in the number sequences below and explain your calculation using ‘n’ as your first term:
   
   a. 297; 290; 276; 255; ...
   b. 1; 10; 100; ...
   c. 3; 9; 81; ...
   d. 1; 4; 9; 16; ...
   e. 25; 26; 28; 31; ...

   My Name: ........................................
   My Workplace: ...................................
   My ID Number: ..................................
2. Write down the sequence of the numbers of dots. Work out the next three terms and explain in words how you got the answer.

3. If a cow produces its first she-calf at age two years and after that produces another single she-calf every year, how many she-calves are there after 12 years, assuming none die?

This is not as simple as it looks. To solve this problem you need to draw up a diagram:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number of female cows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
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<td>4</td>
<td>3</td>
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<td>5</td>
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<tr>
<td>6</td>
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<td>7</td>
<td></td>
</tr>
</tbody>
</table>
In year one the cow A has no offspring. In year two the cow has no offspring. In year three the cow has a calf B. In year 4 the cow has another calf C. In year 5 the cow has another calf D, but the first calf B also has her own calf E. And so on.

a. How many cows will there be in years 6 and 7?

b. Write the total number of cows as a sequence.

c. Determine the number pattern. Hint: It is called the Fibonacci Series.

d. Copy and complete the table below

<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of cows</td>
<td></td>
<td></td>
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<td></td>
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</table>

e. Do some research to find two other examples in nature where the Fibonacci series occurs.
Work with a range of patterns and functions and solve problems

Primary Agriculture  NQF Level 2  Unit Standard No: 9007

<table>
<thead>
<tr>
<th>Concept (SO 1)</th>
<th>I understand this concept</th>
<th>Questions that I still would like to ask</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appropriate information is selected to convert flexibly between and within various representations of functions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate representations are selected for specific applications.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversions represent the functions accurately and appropriately</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

My Notes ...

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Session 2: Functions

After completing this session, you should be able to:
SO 2: Compare, analyse and describe the behaviour of patterns and functions.

In this session we explore the following concepts:

♦ record data
♦ understand and apply the function of a straight line
♦ use the Cartesian plane

In this session, we develop an understanding of how to work out a straight-line graph and look at examples of where it can be applied.

2.1 Recording data

In the previous session, we were collecting and organising data by drawing up tables and sequencing the data from smallest to largest. Any data that is recorded and that stand in relation to each other, will enable you to draw a graph. (Sessa’s rice grains resulted in a curved line graph.)

When you record data, always remember to:

♦ check the formula or function that you have used creates a logical sequence in the data table
♦ check the answers for accuracy
♦ organise the data from smallest to largest
2.2 Functions of the Straight line Graph

A straight-line graph is a graph that represents data that increases proportionally in a linear manner and there is always an \( x \) and a \( y \) involved.

The function that is always used to indicate a straight line graph is:

\[
y = mx + c
\]

Richard weighs the crates that have to be loaded on a truck and his job is to ensure that the trucks aren’t overloaded. He still uses a spring loaded scale to weight the crates. Each crate weighs 10kg. Richard notices that when he weighs one crate the spring stretches to 2 metres. If he weighs three crates at once, the spring stretches to 6 metres. He sees a direct relationship between the weight of the crate and the stretch of the spring.

He records this on a table:

<table>
<thead>
<tr>
<th>Length of Spring</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of Crates</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

He draws this out on a graph:

- **Length of the spring**
  - If there is no weight on the spring, the spring does not stretch. Therefore nil weight is nil stretch on the spring. It cuts the \( y \)-axis at the zero point on this graph.
  - The length of the spring varies according to the weight of the crate. Both are variables (they change).
  - **Length of the Spring** is dependent on the **Weight of the Crate**.
  - The line steadily slopes upward. For every 10kg weight added, the spring stretches 2 metres. **DO YOU SEE A PATTERN?**
  - The Length of the Spring is the: dependent variable
  - Therefore, we use the symbol: \( y \)
• The Weight of the Crate is the: independent variable
  Therefore, we use the symbol: x

• The slope of the line is the: gradient
  And is represented by the symbol: m

• Let’s apply this to the function: y = mx + c
  2y = 10x + c

• In the function, c shows where the line goes through the y-axis. In this case it is at zero. So c is zero: 2y = 10x + 0
  2y = 10x

• But we have learnt to simplify everything in mathematics and we need to simplify this function so that we only have y not 2y.

• We apply the first rule in calculations:
  What we do to the left of the equal sign we must do to the right of the equal sign!

• \(2y = 10x\)
  \(\frac{2}{2}y = \frac{10}{2}x\) \quad Divide both sides by 2
  \(y = 5x\)

Let’s redraw this on a new graph, using \(x\) and \(y\), instead of weight and length:

<table>
<thead>
<tr>
<th>(x)</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y)</td>
<td>10</td>
<td>20</td>
<td>30</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

He draws this out on a graph:

Before we learn more about functions, let’s look at the plotting area of the graph.

### 2.3 The Cartesian Plane
Work with a range of patterns and functions and solve problems

Primary Agriculture NQF Level 2 Unit Standard No: 9007

The area on which we plot a graph is called the Cartesian Plane. It is a plane (or area) where:

- two axis’s, namely the x-axis (horizontal) and the y-axis (vertical),
- cut through each other at a 90° angle
- at the zero point of each axis
- all intervals to the right of the zero point on the x-axis are positive digits and all intervals to the left of the zero point are negative digits and this is named the x’ (x-complement) side of the x-axis
- all intervals north of the zero point on the y-axis are positive digits and all the points to the south of the zero point on the y-axis are negative digits and are plotted on the y’ complement (y-complement) side of the y-axis

The Cartesian Plane:

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>+4</td>
</tr>
<tr>
<td>-3</td>
<td>+3</td>
</tr>
<tr>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>-1</td>
<td>+1</td>
</tr>
<tr>
<td>-1</td>
<td>0</td>
</tr>
<tr>
<td>+1</td>
<td>-1</td>
</tr>
<tr>
<td>+2</td>
<td>-2</td>
</tr>
<tr>
<td>+3</td>
<td>-3</td>
</tr>
<tr>
<td>+4</td>
<td>-4</td>
</tr>
</tbody>
</table>

We have plotted all our graphs on a similar plane up to now, but we have not used the negative axis’s of the Cartesian plane. We will learn how this works in the examples that follow.

2.4 Working with \( y = mx + c \)

When given a straight line graph function for which you must plot a straight line graph on a Cartesian plane, you need to:

- simplify the function so that you have \( y \) standing alone on the left side of the function
- work out what the \( x \) and \( y \) values in the equation are, before proceeding with any further operations.

Solve the function: \( 2y = 4x + 8 \)
Simplify:
\[
\frac{2}{4}y = \frac{1}{2}x + \frac{8}{2}
\]
\[
y = 2x + 4
\]

Then draw up a table:

<table>
<thead>
<tr>
<th>x</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td></td>
</tr>
</tbody>
</table>

Version: 01 Version Date: July 2006
And assume that \( x \) is equal to 1. Replace \( x \) with 1 in the function and calculate what \( y \) will be in the function \( y = 2x + 4 \):
\[
\begin{align*}
  y &= 2 \cdot 1 + 4 \\
  &= 6 
\end{align*}
\]
Which means that if \( x = 1 \) then \( y = 6 \). Complete your table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
</tr>
</tbody>
</table>

Now assume that \( x \) is equal to 2. Replace \( x \) with 2 in the function and calculate what \( y \) will be in the function \( y = 2x + 4 \):
\[
\begin{align*}
  y &= 2 \cdot 2 + 4 \\
  &= 4 + 4 \\
  &= 8 
\end{align*}
\]
What means that if \( x = 2 \) then \( y = 8 \). Complete your table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Then assume that \( x \) is equal to 3. Replace \( x \) with 3 in the function and calculate what \( y \) will be in the function \( y = 2x + 4 \):
\[
\begin{align*}
  y &= 2 \cdot 3 + 4 \\
  &= 6 + 4 \\
  &= 10 
\end{align*}
\]
Which means that if \( x = 3 \) then \( y = 10 \). Complete your table.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Continue until you feel you have enough data to draw a graph. You should end up with a table such as:

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
</tr>
</tbody>
</table>

Now draw a Cartesian plane to plot out your graph.

- Find the point where \( x = 1 \). Draw a pencil line up to the point where \( y = 6 \). This is written as co-ordinates in the following format: \( \{1:6\} \). Always write the \( x \)-value first and the \( y \)-value last.
- Draw in the lines where \( x = 2 \) and \( y = 8 \). Coordinate pair = \( \{2:8\} \).
- Continue until you have drawn in all the lines. (All co-ordinate pairs i.e. \( \{3:10\} \) and \( \{4:12\} \) and \( \{5:14\} \),
- Finally join the points where the two lines meet with a straight line and check that the straight line cuts through 4 on the \( y \)-axis.
You can verify whether your graph is correct by taking a new ‘reading’ from the x-axis and substituting the x-value in the function.

Where \( x = -2 \):

\[
\begin{align*}
y &= 2x + 4 \\
&= 2 \cdot -2 + 4 \\
&= -4 + 4 \\
&= 0
\end{align*}
\]

\( \{x:y\}=\{-2:0\} \)

Where \( x = -3 \):

\[
\begin{align*}
y &= 2x + 4 \\
&= 2 \cdot -3 + 4 \\
&= -6 + 4 \\
&= -2
\end{align*}
\]

\( \{x:y\}=\{-3:-2\} \)
Work with a range of patterns and functions and solve problems

Primary Agriculture
NQF Level 2
Unit Standard No: 9007

Solve the function $2y = 4x - 2$

Simplify: $2y = 4x - 2$

$\frac{2}{2} y = \frac{4}{2} x - \frac{2}{2}$

$y = 2x - 1$

Then draw up a table:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$-2$</th>
<th>$-1$</th>
<th>$0$</th>
<th>$1$</th>
<th>$2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>$-5$</td>
<td>$-3$</td>
<td>$-1$</td>
<td>$1$</td>
<td>$3$</td>
</tr>
</tbody>
</table>

You can verify whether your graph is correct by taking a new 'reading' from the x-axis and substituting the x-value in the function.

Where $x = 3$: $y = 2x - 1$

$= 2.3 - 1$

$= 1.3$

$\{x:y\} = \{3:5\}$

Where $x = 7$: $y = 2x - 1$

$= 2.7 - 1$

$= 1.7$

$\{x:y\} = \{7:13\}$

Check whether your graph is consistent with these co-ordinates.

If you have to determine the function from a graph, then follow the following example:
The following graph is given and you have to determine the straight line function $y = mx + c$. Collect all the information possible from the graph:

- In the function $y = mx + c$, the $c$ is where $x = 0$. We read from the graph where the straight line intersects with the y-axis i.e. $(0:-4)$. This is called the Y-intercept. Replace the value in the equation: $y = mx - 4$
- $m$ represents the gradient (or the slope) of the straight line. Read the gradient from the graph. For every 2 intervals that $x$ increases, $y$ increases by 4. Therefore, our gradient is $4:2$ or simplified $2:1$. Our $m$ value is $2/1 = 2$.

Check whether this applies to this graph by substituting the values in the function:

$y = mx + c$
$= 2x - 4$

Where $x = 2$: $y = 2x - 4$
$= 2.2 - 4$
$= 4 - 4$
$= 0$

$\therefore \{x:y\} = \{2:0\}$

Where $x = 9$

$y = 2x - 4$
$= 2.9 - 4$
$= 18 - 4$
$= 14$

$\therefore \{x:y\} = \{9:14\}$
Concept (SO 2) | I understand this concept | Questions that I still would like to ask
--- | --- | ---
Patterns and functions are compared in terms of:
  i. Shape and symmetry,
  ii. Finding function values,
  iii. Finding input values,
  iv. The average rate of change of function values.
The key features of the graphs of functions are described and interpreted correctly.
The behaviour of functions is described as being increasing or decreasing or constant as determined visually from graphical representations.

My Notes …

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1. Draw the following straight line graphs on a Cartesian Plane.

   a  \( y = 3x - 2 \)

   b  \( 4y = 2x + 4 \)

   c  \( 2x + 2y = 4 \)
d \quad y = 3x

e \quad 2y = 8x - 6
2. Determine the equations of the following straight line graphs.

a) ________________

b) ________________

c) ________________

d) ________________

Facilitator comments:

Assessment:
Session 3

Functions and their Graphs

After completing this session, you should be able to:
SO 3: Represent situations mathematically in order to interpret and solve problems.

In this session we explore the following concepts:

- identify and work out the function of a hyperbola
- draw a hyperbola on the Cartesian plane
- identify and work out the function of a parabola
- draw a parabola on the Cartesian plane.

We will look at the hyperbola and the parabola, which are different to the straight line graph. The purpose of this session is to introduce you to these graphs and their application. This will be extended in subsequent NQF levels.

3.1 The hyperbola

Function of the hyperbola

The function of the hyperbola is \( y = \frac{k}{x} \). Once again we have two variables, \( x \) and \( y \), but a constant term (\( k \)) has to be considered. You can see from the function, \( y = \frac{k}{x} \), that we will be dealing with irrational numbers or fractions.

Terms in the Function of the Hyperbola

In the function: \( y = \frac{k}{x} \)

the \( y \) is once again the: \textit{dependent variable}
the \( x \) is again the: \textit{independent variable}
and the \( k \) is the: \textit{constant term}
The constant term does not change, it stays constant. (It remains the same throughout any calculations in the equation.)

We could also write this function as: \( xy = k \)

But we need to have \( y \) to the left of the equation to work out the graph. Therefore, the equation is simplified to eliminate \( x \) on the left-hand side i.e.

\[
\begin{align*}
xy &= k \\
\frac{xy}{x} &= \frac{k}{x} \\
y &= \frac{k}{x}
\end{align*}
\]

### Drawing the hyperbola graph

The procedure for drawing the hyperbola, stays the same as with the straight line graph. We assume a value for \( x \) and calculate \( y \).

#### Example

Solve the function: \( xy = 10 \)

Simplify the function:

\[
\begin{align*}
xy &= 10 \\
\frac{xy}{x} &= \frac{10}{x} \\
y &= \frac{10}{x}
\end{align*}
\]

Draw your table. Calculate by replacing the \( x \)-value and working out the \( y \)-value:

\[
\begin{array}{c|c|c|c|c}
\text{Where } x & 1 & 2 & 3 & 4 \\
\hline
y & \frac{10}{x} & \frac{10}{x} & \frac{10}{x} & \frac{10}{4} \\
\hline
& 10/1 & 10/2 & 10/3 & 2.5 \\
\end{array}
\]

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>NA</td>
<td>10</td>
<td>5</td>
<td>3.333</td>
<td>2.5</td>
<td>2</td>
</tr>
</tbody>
</table>

- Now draw a Cartesian plane to plot out your graph.
- Find the point where \( x = 2 \). Mark the point where \( y = 10 \) with a dot.
  - This is written as co-ordinates in the following format: \( \{2;10\} \).
  - Always write the \( x \)-value first and the \( y \)-value last.
- Mark the co-ordinates where \( x = 1 \) and \( y = 10 \). Coordinate pair: \( \{1;10\} \)
- Continue until you have plotted all the points. (All co-ordinate pairs i.e. \( \{1;10\} \) and \( \{2;10\} \)...)
Finally join the points.

But we have not finished. The value of x can also be negative. Therefore, we have to calculate the negative value of the hyperbola \( y = \frac{10}{x} \).

Draw your table. Calculate by replacing the x-value and working out the y-value:

\[
\begin{align*}
\text{Where } x &= -1 & \text{Where } x &= -2 & \text{Where } x &= -3 \\
y &= \frac{10}{x} & y &= \frac{10}{x} & y &= \frac{10}{x} \\
&= \frac{10}{-1} & \frac{10}{-2} & \frac{10}{-3} \\
&= -10 & -5 & -3.3333 \\
\text{Where } x &= -4 & \text{Where } x &= -5 \\
y &= \frac{10}{x} & y &= \frac{10}{x} \\
&= \frac{10}{-4} & \frac{10}{-5} \\
&= -2.5 & -2 \\
\end{align*}
\]

Plot your graph on the same Cartesian plane.

Find the point where \( x = -1 \). Mark the point where \( y = -10 \) with a dot. This is written as co-ordinates in the following format: \(-1:-10\). Always write the x-value first and the y-value last.

Mark the co-ordinates where \( x = -2 \) and \( y = -5 \). Coordinate pair: \(-2:-5\)

Continue until you have plotted all the points. (All co-ordinate pairs i.e. \(-3:-3.3\) and \(-5:-2\))

Finally join the points.

The hyperbola is never one single curved graph, it has a counterpart that looks like a mirror image of the first one. The complementary hyperbola, is calculated with the negative value of x.

When you work with the hyperbola, remember the following characteristics:

- the graph consists of two parts
- the graph has 2 lines of symmetry where \( y = x \) and \( y = -x \)
- because we cannot divide by 0, the y-value will never intersect with the x-axis. The hyperbola may get very close to the x-axis, but will never meet it.

My Notes ...

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Work with a range of patterns and functions and solve problems

Primary Agriculture

NQF Level 2

Unit Standard No: 9007

Graph of the hyperbola

The broken lines show the lines of symmetry that exist in the hyperbola.

You can verify whether your graph is correct by taking a new ‘reading’ from the x-axis and substituting the x-value in the function.

Where x = 7:

\[
\begin{align*}
y &= \frac{10}{x} \\
&= \frac{10}{7} \\
&= 1.42857 \\
&\approx 1.4
\end{align*}
\]

\(\{x:y\} = \{7:1.4\}\)

Where x = 10:

\[
\begin{align*}
y &= \frac{10}{x} \\
&= \frac{10}{10} \\
&= 1
\end{align*}
\]

\(\{x:y\} = \{10:1\}\)

Check whether your graph is consistent with these co-ordinates.
3.2 The parabola

The parabola can be defined with the following functions:

<table>
<thead>
<tr>
<th>Parabola</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = ax^2$</td>
<td></td>
</tr>
<tr>
<td>$y = ax^2 + c$</td>
<td></td>
</tr>
<tr>
<td>$y = ax^2 + bx$</td>
<td></td>
</tr>
<tr>
<td>$y = ax^2 + bx + c$</td>
<td></td>
</tr>
</tbody>
</table>

We will look at each parabola individually to support your understanding of the parabola.

**The function $y = ax^2$**

When you see the function $y = ax^2$, immediately draw up your table and substitute $x$ with a value. We will draw the graph for $y = 2x^2$.

Calculate and complete your table:

<table>
<thead>
<tr>
<th>Where $x = -3$</th>
<th>Where $x = -2$</th>
<th>Where $x = -1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 2x^2$</td>
<td>$y = 2x^2$</td>
<td>$y = 2x^2$</td>
</tr>
<tr>
<td>$= 2.(-3)^2$</td>
<td>$= 2.(-2)^2$</td>
<td>$= 2.(-1)^2$</td>
</tr>
<tr>
<td>$= 2(-3)(-3)$</td>
<td>$= 2(-2)(-2)$</td>
<td>$= 2(-1)(-1)$</td>
</tr>
<tr>
<td>$= 2.9$</td>
<td>$= 2.4$</td>
<td>$= 2.1$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Where $x = -0$</th>
<th>Where $x = 1$</th>
<th>Where $x = 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y = 2x^2$</td>
<td>$y = 2x^2$</td>
<td>$y = 2x^2$</td>
</tr>
<tr>
<td>$= 2.0^2$</td>
<td>$= 2.1^2$</td>
<td>$= 2.2^2$</td>
</tr>
<tr>
<td>$= 2.0$</td>
<td>$= 2.1.1$</td>
<td>$= 2.2$</td>
</tr>
<tr>
<td>$= 0$</td>
<td>$= 2.1$</td>
<td>$= 8$</td>
</tr>
</tbody>
</table>

Where $x = 3$

<table>
<thead>
<tr>
<th>$y = 2x^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$= 2.3^2$</td>
</tr>
<tr>
<td>$= 2.3.3$</td>
</tr>
<tr>
<td>$= 2.9$</td>
</tr>
<tr>
<td>$= 18$</td>
</tr>
</tbody>
</table>
The parabola has a complementary graph which is represented in this case by the function: \( y = -2x^2 \)

Calculate and complete your table:

<table>
<thead>
<tr>
<th>Where ( x = -3 )</th>
<th>Where ( x = -2 )</th>
<th>Where ( x = -1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = -2x^2 )</td>
<td>( y = -2x^2 )</td>
<td>( y = -2x^2 )</td>
</tr>
<tr>
<td>( = -2(-3)^2 )</td>
<td>( = -2(-2)^2 )</td>
<td>( = -2(-1)^2 )</td>
</tr>
<tr>
<td>( = -2(-3)(-3) )</td>
<td>( = -2(-2)(-2) )</td>
<td>( = -2(-1)(-1) )</td>
</tr>
<tr>
<td>( = -2.9 )</td>
<td>( = -2.4 )</td>
<td>( = -2.1 )</td>
</tr>
<tr>
<td>( = -18 )</td>
<td>( = -8 )</td>
<td>( = -2 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Where ( x = 0 )</th>
<th>Where ( x = 1 )</th>
<th>Where ( x = 2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = -2x^2 )</td>
<td>( y = -2x^2 )</td>
<td>( y = -2x^2 )</td>
</tr>
<tr>
<td>( = -2.0^2 )</td>
<td>( = -2.1^2 )</td>
<td>( = -2.2^2 )</td>
</tr>
<tr>
<td>( = -2.0 )</td>
<td>( = -2.1.1 )</td>
<td>( = -2.2.2 )</td>
</tr>
<tr>
<td>( = 0 )</td>
<td>( = -2.1 )</td>
<td>( = -2.4 )</td>
</tr>
<tr>
<td>( = -2 )</td>
<td>( = -2 )</td>
<td>( = -8 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Where ( x = 3 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = -2x^2 )</td>
</tr>
<tr>
<td>( = -2.3^2 )</td>
</tr>
<tr>
<td>( = -2.3.3 )</td>
</tr>
<tr>
<td>( = -2.9 )</td>
</tr>
<tr>
<td>( = -18 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>( x )</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>-18</td>
<td>-8</td>
<td>-2</td>
<td>0</td>
<td>-2</td>
<td>-8</td>
<td>-18</td>
</tr>
</tbody>
</table>

Features of the parabola \( y = ax^2 \) in general form:

- the \( y \)-axis is the line of symmetry
- the turning point is where \( x = 0 \) and \( y = 0 \), which is where the \( x \)-axis and
- \( y \)-axis meet on the Cartesian plane.
The function $y = ax^2 + c$

In the function $y=ax^2 + c$, we have a $y$-intercept, which is $c$. The rest of the parabola remains the same. In our calculations, we need to make room for the $+c$ that has been added.

Solve and draw the parabola: $y=3x^2 + 2$

Calculate and complete your table:

<table>
<thead>
<tr>
<th>$x$</th>
<th>$y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>29</td>
</tr>
<tr>
<td>-2</td>
<td>14</td>
</tr>
<tr>
<td>-1</td>
<td>5</td>
</tr>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>29</td>
</tr>
</tbody>
</table>

The parabola has a complementary graph which is represented in this
Work with a range of patterns and functions and solve problems
Primary Agriculture NQF Level 2 Unit Standard No: 9007

case by the function:
\[ y = -3x^2 + 2 \]

(Remember that it is the value of \( a \) that creates the complement.)

Calculate and complete your table:

<table>
<thead>
<tr>
<th>( x )</th>
<th>(-3)</th>
<th>(-2)</th>
<th>(-1)</th>
<th>(0)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>(-25)</td>
<td>(-10)</td>
<td>(-1)</td>
<td>(2)</td>
<td>(-1)</td>
<td>(-10)</td>
<td>(-25)</td>
</tr>
</tbody>
</table>

Features of the parabola \( y = ax^2 + c \)

- the \( y \)-axis is the line of symmetry
- the turning point is where \( x = 0 \) and \( y = c \)
- the value of \( a \) indicates the possibility of where the graph intersects the \( x \)-axis
The parabola for the equation $y = 3x^2 + 2$ and $y = -3x^2 + 2$. 
The function \( y = ax^2 + bx \)

In this function, the value of \( c = 0 \). Therefore it has been omitted from the equation.

Solve and draw the parabola: \( y = 3x^2 + 2x \)

Calculate and complete your table:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
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<td>-2</td>
<td>8</td>
<td>-1</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
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<tr>
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<td>5</td>
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<td>16</td>
<td>2</td>
<td>16</td>
<td>3</td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

The parabola has a complementary graph which is represented in this case by the function:

\( y = -3x^2 + 2x \)
Where $x = -3$

\[ y = -3x^2 + 2x \]
\[ = -3(-3)^2 + 2(-3) \]
\[ = -3(-3)(-3) + 2(-3) \]
\[ = -27 - 6 \]
\[ = -33 \]

Where $x = -2$

\[ y = -3x^2 + 2x \]
\[ = -3(-2)^2 + 2(-2) \]
\[ = -3(-2)(-2) + 2(-2) \]
\[ = -12 - 4 \]
\[ = -16 \]

Where $x = -1$

\[ y = -3x^2 + 2x \]
\[ = -3(-1)^2 + 2(-1) \]
\[ = -3(-1)(-1) + 2(-1) \]
\[ = -3 - 2 \]
\[ = -5 \]

Where $x = 0$

\[ y = -3x^2 + 2x \]
\[ = -3.0^2 + 2.0 \]
\[ = 0 \]

Where $x = 1$

\[ y = -3x^2 + 2x \]
\[ = -3.1^2 + 2.1 \]
\[ = -3.1.1 + 2.1 \]
\[ = -3 + 2 \]
\[ = -1 \]

Where $x = 2$

\[ y = -3x^2 + 2x \]
\[ = -3.2^2 + 2.2 \]
\[ = -3.2.2 + 2.2 \]
\[ = -12 + 4 \]
\[ = -8 \]

Where $x = 3$

\[ y = -3x^2 + 2x \]
\[ = -3.3^2 + 2.3 \]
\[ = -3.3.3 + 2.3 \]
\[ = -27 + 6 \]
\[ = -21 \]

<table>
<thead>
<tr>
<th>$x$</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>-33</td>
<td>-16</td>
<td>-5</td>
<td>0</td>
<td>-1</td>
<td>-8</td>
<td>-21</td>
</tr>
</tbody>
</table>

Features of the parabola $y = ax^2 + bx$

- The graph touches the $y$-axis at $y=0$ which is the value of $c$.
- Two $x$-intercepts are expected in this graph and we determine this by calculating $ax^2 + bx = 0$.
- The turning point is determined by $x = -\frac{b}{2a}$ and the $y$-value calculated by the substitution onto the original equation.
- The axis of symmetry will be where $x = -\frac{b}{2a}$. 
The parabola \( y = 3x^2 + 2x \) and \( y = -3x^2 + 2x \).
The function $y = ax^2 + bx + c$

The final parabola function is a combination of all the previous parabola functions we worked with.

Solve and draw the parabola: $y = 2x^2 + 2x + 1$

Calculate and complete your table:

<table>
<thead>
<tr>
<th>$x$</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>13</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>13</td>
<td>24</td>
</tr>
</tbody>
</table>

The parabola has a complementary graph which is represented in this case by the function:

$y = -2x^2 + 2x + 1$

Calculate and complete your table:

<table>
<thead>
<tr>
<th>$x$</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>22</td>
<td>11</td>
<td>-3</td>
<td>-2</td>
<td>2 + 2 + 1</td>
<td>8 + 4 + 1</td>
<td>24</td>
</tr>
</tbody>
</table>
Where \( x = -0 \)

\[
\begin{align*}
y &= -2x^2 + 2x + 1 \\
&= -2 \cdot (-0)^2 + 2 \cdot (-0) + 1 \\
&= 1
\end{align*}
\]

Where \( x = 1 \)

\[
\begin{align*}
y &= -2x^2 + 2x + 1 \\
&= -2 \cdot 1^2 + 2 \cdot 1 + 1 \\
&= -2 + 2 + 1 \\
&= 1
\end{align*}
\]

Where \( x = 2 \)

\[
\begin{align*}
y &= -2x^2 + 2x + 1 \\
&= -2 \cdot 2^2 + 2 \cdot 2 + 1 \\
&= -8 + 4 + 1 \\
&= -3
\end{align*}
\]

Where \( x = 3 \)

\[
\begin{align*}
y &= -2x^2 + 2x + 1 \\
&= -2 \cdot 3^2 + 2 \cdot 3 + 1 \\
&= -18 + 6 + 1 \\
&= -12
\end{align*}
\]

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>22</td>
</tr>
<tr>
<td>-2</td>
<td>11</td>
</tr>
<tr>
<td>-1</td>
<td>-3</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>-3</td>
</tr>
<tr>
<td>3</td>
<td>-12</td>
</tr>
</tbody>
</table>

Features of the parabola \( y = ax^2 + bx + c \)

- The \( y \)-intercept is at \( x = 0 \) i.e. the value of \( c \)
- \( x \)-intercepts always occur when \( y = 0 \) i.e. when solving \( ax^2 + bx + c = 0 \)
- (always expecting 2 solutions)
  - The turning point is at the point \( \left( -\frac{b}{2a}, -\frac{4ac - b}{4a} \right) \)
  - The axis of symmetry is the line \( x = -\frac{b}{2a} \)
The parabola $y=2x^2 + 2x + 1$ and $y=-2x^2 + 2x + 1$ are as follows:
Please complete Activity 4 & 5 at the end of this session.

My Notes ...

<table>
<thead>
<tr>
<th>Concept (SO 2)</th>
<th>I understand this concept</th>
<th>Questions that I still would like to ask</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accurate point-by-point plotting is used to model contextual problems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate symbolic representations are used to model contextual problems.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representations are analysed and manipulated efficiently in arriving at results.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representations are verified in terms of available data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Results are interpreted correctly in terms of the situation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpretations and predictions are based on the properties of the mathematical model.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

My Notes ...

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............................................................................................................................................................
1. Draw the graphs representing the functions of the hyperbola on a Cartesian plane
   a. $8xy = 4$
   b. $y = \frac{3}{x}$
   c. $3xy = 12$
   d. $y = \frac{4}{2x}$
   e. $xy = 5$
1. Draw the parabola for the following graphs on a Cartesian plane:

   a. \( x^2 + x + 4 \)
   b. \( x^2/2 + x - 2 \)
   c. \( 3y = 21x^2 + 9x + 6 \)
   d. \( y = 4x^2 - 2x \)
   e. \( y = 6x^2 \)
Work with a range of patterns and functions and solve problems

Primary Agriculture  NQF Level 2  Unit Standard No: 9007

Facilitator comments:

Assessment:
1. Draw the following graphs on the same Cartesian plane provided on the next page.
   a. \( y = 2x + 4 \)
   b. \( 3x + y = 9 \)
   c. \( y = 4x^2 + 3 \)
   d. \( 2x^2 - 3x - 3 = y \)

2. Complete the following three number patterns by writing the next three terms, and then write the sequence as an “n” value of the first term.
   a. 56; 112; 168; ...
   b. 1 594 323; 531 441; 177 147; ....
   c. 1; 8; 27; 64; ...
Work with a range of patterns and functions and solve problems

Primary Agriculture

NQF Level 2

Unit Standard No: 9007

Facilitator comments:

Assessment:

Version: 01

Version Date: July 2006
Am I ready for my test?

- Check your plan carefully to make sure that you prepare in good time.
- You have to be found competent by a qualified assessor to be declared competent.
- Inform the assessor if you have any special needs or requirements before the agreed date for the test to be completed. You might, for example, require an interpreter to translate the questions to your mother tongue, or you might need to take this test orally.
- Use this worksheet to help you prepare for the test. These are examples of possible questions that might appear in the test. All the information you need was taught in the classroom and can be found in the learner guide that you received.

1. I am sure of this and understand it well
2. I am unsure of this and need to ask the Facilitator or Assessor to explain what it means

<table>
<thead>
<tr>
<th>Questions</th>
<th>1. I am sure</th>
<th>2. I am unsure</th>
</tr>
</thead>
</table>
| 1. Complete the following number series by writing the next three numbers  
  a 2; -4; 8; -16 ...  
  b 1; 6; 11; ......  
  c 1; 2; 4; 8; ......  
  d 144; 121; 100; 81; ......  
  e 1; 1; 2; 3; 5; ......  | | |
| 2. a Draw the graph of y = 4x-2  
  b Find the equation of the graph below | | |

![Graph](image)
3. Draw the equations of the following two graphs on the same set of axes:
   i) \( xy = 8 \)  
   ii) \( y = x^2 - x - 6 \)

4. A farmer monitors the growth of a particular calf by recording its mass over time. He finds the following results: At one month the calf had a mass of 25 kg. A month later the calf weighed 50 kg. By month three the calf had gained 25 kg compared to month two. By month four the calf weighed 100 kg.
   a) record the farmers results in a suitable table.
   b) draw a graph to show the results
Use the **checklist** below to help you prepare for the part of the practical assessment when you are observed on the **attitudes** and **attributes** that you need to have to be found competent for this learning module.

<table>
<thead>
<tr>
<th>Observations</th>
<th>Answer Yes or No</th>
<th>Motivate your Answer (Give examples, reasons, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can you identify problems and deficiencies correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you able to work well in a team?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do you work in an organised and systematic way while performing all tasks and tests?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you able to collect the correct and appropriate information and / or samples as per the instructions and procedures that you were taught?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you able to communicate your knowledge orally and in writing, in such a way that you show what knowledge you have gained?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can you base your tasks and answers on scientific knowledge that you have learnt?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you able to show and perform the tasks required correctly?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are you able to link the knowledge, skills and attitudes that you have learnt in this module of learning to specific duties in your job or in the community where you live?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- The assessor will complete a checklist that gives details of the points that are checked and assessed by the assessor.
- The assessor will write commentary and feedback on that checklist. They will discuss all commentary and feedback with you.
- You will be asked to give your own feedback and to sign this document.
- **It will be placed together with this completed guide in a file as part of you portfolio of evidence.**
- The assessor will give you feedback on the test and guide you if there are areas in which you still need further development.
## Learner Information Form

<table>
<thead>
<tr>
<th><strong>Unit Standard</strong></th>
<th>9007</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Date(s)</strong></td>
<td></td>
</tr>
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<td><strong>Assessment Date(s)</strong></td>
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</tr>
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<td><strong>Surname</strong></td>
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<tr>
<td><strong>First Name</strong></td>
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<td><strong>Learner ID / SETA Registration Number</strong></td>
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<tr>
<td><strong>Job / Role Title</strong></td>
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</table>

Please assist the assessor by filling in this form and then sign as instructed.
Bibliography

Books:


‘Life skills’ by Edna Rooth

Terms & Conditions

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**Users are free to produce and adapt this material to the maximum benefit of the learner.**

**No user is allowed to sell this material whatsoever.**
Acknowledgements

- **Project Management:**
  - M H Chalken Consulting
  - IMPETUS Consulting and Skills Development

- **Donors:**
  - Citrus Academy
  - Boland College
  - Weskus College

- **Developer:**
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  - Cabeton Consulting

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- **Technical Editing:**
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- **OBE Formatting:**
  - Ms P Prinsloo
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■ **Design:**
  ♦ Didacsa Design SA (Pty) Ltd

■ **Layout:**
  ♦ Ms A du Plessis
  ♦ Ms N Matloa
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REGISTERED UNIT STANDARD:

Work with a range of patterns and functions and solve problems

<table>
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<tr>
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<td>Work with a range of patterns and functions and solve problems</td>
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<th>NSB</th>
<th>PROVIDER NAME</th>
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<td>NSB 10-Physical, Mathematical, Computer and Life Sciences</td>
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<td>Mathematical Sciences</td>
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<th>REGISTRATION END DATE</th>
<th>SAQA DECISION NUMBER</th>
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<td>2007-12-02</td>
<td>SAQA 1657/04</td>
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</table>

PURPOSE OF THE UNIT STANDARD

This unit standard is designed to provide credits towards the mathematical literacy requirements of the NQF at level 2. The essential purposes of the mathematical literacy requirements are that, as the learner progresses with confidence through the levels, the learner will grow in:

An insightful use of mathematics in the management of the needs of everyday living to become a self-managing person

An understanding of mathematical applications that provides insight into the learner’s present and future occupational experiences and so develop into a contributing worker

The ability to voice a critical sensitivity to the role of mathematics in a democratic society and so become a participating citizen.

People credited with this unit standard are able to:

Convert flexibly between and within various representations of functions.

Compare, analyse and describe the behaviour of patterns and functions.

Represent situations mathematically in order to interpret and solve problems.
LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING

The credit value is based on the assumption that people starting to learn towards this unit standard are competent in Mathematics and Communications at NQF level 1.

UNIT STANDARD RANGE

This unit standard includes the requirement to:

Use algebraic notation to express generality.

Make conjectures, demonstrate and explain their validity.

Recognise equivalence among expressions and situations resulting from manipulation and rearrangement to forms appropriate for solving problems.

Work with:
- Functions for which there are rules and for which there are no rules;
- Functions that are discrete (rules and no rules);
- Functions that are continuous (rules and no rules).

Investigate, and interpret graphs of situations with regard to the following:
- Increasing/decreasing,
- Maximal/minimal,
- Continuous I discrete,
- Rate of change,
- Intercepts,
- Interpolation/extrapolation.

*(The above must be done in relation to the contexts in which the functions are acting as models.)*

Work with the following basic functions: \( y = ax + b; y = LIX^a + b; y = ax; xy = k, \)

In terms of their:
- Shape and symmetry,
- Finding function values,
- Finding input values,
- Analysing the behaviour of function values (the rate of change).

Represent, interpret and solve problems that relate to these functions by using point-by-point plotting and numerical analysis.

Convert flexibly among various representations of the above functions (i.e. words, tables, formulae, graphs).

Learners are not expected to master each concept and procedure when they first encounter it, but rather to continually develop their mathematical understandings through encounters with mathematical models of realistic situations.

The contexts and situations should be used to develop a critical awareness of human rights, social, economic, political, cultural and environmental issues. Examples of the power of modelling as a descriptive tool to describe situations between two variables and as an analytic tool to gain additional information about the situation must be developed.

Specific Outcomes and Assessment Criteria:

**SPECIFIC OUTCOME 1**

Convert flexibly between and within various representations of functions.

**OUTCOME RANGE**

This outcome includes the requirement to:
Translate from one representation to another (i.e. verbal, tables, formulae, graphs).

Deal with situations involving the range of functions specified in the main range statement as well as functions for which there is no rule.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**
1. Appropriate information is selected to convert flexibly between and within various representations of functions.

**ASSESSMENT CRITERION 2**
2. Appropriate representations are selected for specific applications.

**ASSESSMENT CRITERION 3**
3. Conversions represent the functions accurately and appropriately.

**SPECIFIC OUTCOME 2**
Compare, analyse and describe the behaviour of patterns and functions.

**OUTCOME RANGE**
This outcome includes the requirement to work with functions.

Identify, contrast and compare the features of the functions listed in the main range statement as well as functions for which there are no rules.

Recognise equivalent forms of an expression, equation or function.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**
1. Patterns and functions are compared in terms of:
   i. Shape and symmetry,
   ii. Finding function values,
   iii. Finding input values,
   iv. The average rate of change of function values.

**ASSESSMENT CRITERION 2**
2. The key features of the graphs of functions are described and interpreted correctly.

**ASSESSMENT CRITERION 3**
3. The behaviour of functions is described as being increasing or decreasing or constant as determined visually from graphical representations.

**SPECIFIC OUTCOME 3**
Represent situations mathematically in order to interpret and solve problems.

**OUTCOME RANGE**
This outcome includes the requirement to:
Use expressions, functions and equations to represent situations.

Develop strategies for deciding whether symbolic, representations are reasonable and interpret such results.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**
1. Accurate point-by-point plotting is used to model contextual problems.

**ASSESSMENT CRITERION 2**
2. Appropriate symbolic representations are used to model contextual problems.

**ASSESSMENT CRITERION 3**
3. Representations are analysed and manipulated efficiently in arriving at results.

**ASSESSMENT CRITERION 4**
4. Representations are verified in terms of available data.

**ASSESSMENT CRITERION 5**
5. Results are interpreted correctly in terms of the situation.

**ASSESSMENT CRITERION 6**
6. Interpretations and predictions are based on the properties of the mathematical model.

**UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS**

Providers of learning towards this unit standard will need to meet the accreditation requirements of the GENFETQA.

Moderation Option: The moderation requirements of the GENFETQA must be met in order to award credit to learners for this unit standard.

**UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE**

The following essential embedded knowledge will be assessed through assessment of the specific outcomes in terms of the stipulated assessment criteria. Candidates are unlikely to achieve all the specific outcomes, to the standards described in the assessment criteria, without knowledge of the listed embedded knowledge. This means that the possession or lack of the knowledge can be inferred directly from the quality of the candidate's performance against the standards.

- Relationships between variables
- Mathematical functions
- Representations of functions and relations.

**Critical Cross-field Outcomes (CCFO):**
Identify and solve problems using critical and creative thinking:
Solve a variety of problems based on patterns and functions.

UNIT STANDARD CCFO COLLECTING
Collect, analyse, organise and critically evaluate information:
Gather, organise, evaluate and interpret information to compare and represent relationships
and functions.

UNIT STANDARD CCFO COMMUNICATING
Communicate effectively:
Use everyday language and mathematical language to describe relationships, processes and
problem solving methods.

UNIT STANDARD CCFO CONTRIBUTING
Use mathematics:
Use mathematics to, describe and represent realistic and abstract situations and to solve
problems.

UNIT STANDARD ASSESSOR CRITERIA
Assessors should keep the following general principles in mind when designing and
conducting assessments against this unit standard:

Focus the assessment activities on gathering evidence in terms of the main outcome
expressed in the title to ensure assessment is integrated rather than fragmented. Remember
we want to declare the person competent in terms of the title. Where assessment at title
level is unmanageable, then focus assessment around each specific outcome, or groups of
specific outcomes.

Make sure evidence is gathered across the entire range, wherever it applies. Assessment
activities should be as close to the real performance as possible, and where simulations or
role-plays are used, there should be supporting evidence to show the candidate is able to
perform in the real situation.

Do not focus the assessment activities on each assessment criterion. Rather make sure the
assessment activities focus on outcomes and are sufficient to enable evidence to be gathered
around all the assessment criteria.

The assessment criteria provide the specifications against which assessment
judgements should be made. In most cases, knowledge can be inferred from the quality of
the performances, but in other cases, knowledge and understanding will have to be tested
through questioning techniques. Where this is required, there will be assessment criteria to
specify the standard required.

The task of the assessor is to gather sufficient evidence, of the prescribed type and quality,
as specified in this unit standard, that the candidate can achieve the outcomes again and
again and again. This means assessors will have to judge how many repeat performances are
required before they believe the performance is reproducible.

All assessments should be conducted in line with the following well documented principles of
assessment: appropriateness, fairness, manageability, integration into work or learning,
validity, direct, authentic, sufficient, systematic, open and consistent.

UNIT STANDARD NOTES
N/A
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