Year 9 Extension Mathematics
Linear and Non-Linear graphs
Skills and Application Task

Your task: To investigate the graphical representations of Linear and Non-linear formula by creating a teaching resource within Virtual Reality (VR)

Using the VRTY platform, you will demonstrate your knowledge of Linear and Non-linear graphs using 360° imagery taken from around Trinity College North.

VRTY Link: https://vrty.io/

Notes:

- All parts of the SAT must be included within your VR world
- Care must be taken when taking 360° imagery around the College to protect the privacy of all students
- You will be assessed on the creativity of the VR world created in addition to the Mathematical concepts
- Show full working out and reasoning for all sections.
- Weighting for this SAT is 25% of the semester total of 100%.

Task A: 360° imagery

To create your virtual worlds, your group must capture some 360° imagery from around the College. Using these images, you will investigate and demonstrate the applications of graphs in the real world.

By using a planning template from VRTY you should map out your ideas and portals during this phase.

Project design considerations:

Tour typology	What type of tour will you produce?
Audience	Who is the intended audience for your tour?
Data information	What information and content will be included • Linear graphs • Quadratics • Exponentials • Circles
Content creation	What types of content will you include, how will you create these? (e.g. software, graphics, animations)

Viewer experience	What are you intending the viewer to experience? what do you need to include for our tour to be successful in its aim?

Some image ideas:

- Linear graphs: ramps and gradient (are the ones at the school consistent?), midpoint and distance of places in the school. Horizontal and vertical lines in the school (bridge over creek?)
- Circles: basketball/ netball rings, hoola hoops
- Parabola: throwing a ball, flight path
- Any other creative ideas?

Task B: Linear equations

Introduction

A linear function is in the form $y = mx + c$ with m being the gradient and c the y intercept.

Using the imagery taken, demonstrate the following:

1. The formula $y = mx + c$ and how the graph will look. Consider examples of positive and negative graphs
2. The effect of the value of m on the graph, including horizonal and vertical graphs
3. Calculating midpoint and distance using formula

Using Geogebra or Desmos, to graph the above functions and use in VRTY

Task C: Circles

Using Geogebra or Desmos, to graph the above functions and use in VRTY to create a VR world to investigate the following:

PART 1: The effect of $\boldsymbol{a}$

- Consider the circle equation; $x^2 + y^2 = a$
- Choose two $\boldsymbol{a}$ values ($a > 0$) and graph the equations for each on the same Cartesian plane using graphing software.

PART 2: The effect of $\boldsymbol{h}$

- Consider the circle equation; $(x - h)^2 + y^2 = 25$
- Choose two $\boldsymbol{h}$ values and graph the equations for each on the same Cartesian plane using graphing software.

PART 3: The effect of $\boldsymbol{k}$

- Consider the circle equation; $x^2 + (y - k)^2 = 25$
- Choose two $\boldsymbol{k}$ values and graph the equations for each on the same Cartesian plane using graphing software.

Task D: Quadratic Functions

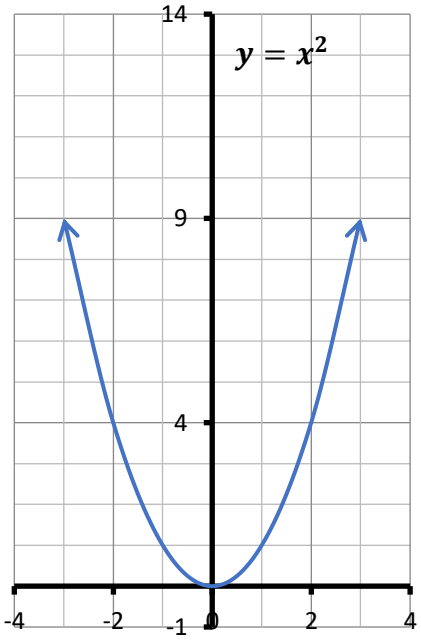
Introduction

The simplest Quadratic function is $y = x^2$ and its graph can be drawn from a table of values.

X	-3	-2	-1	0	1	2	3
Y	9	4	1	0	1	4	9

Observations:

- The curve is a **parabola** and it opens upwards.
- There are no negative y values, i.e., the curve does not go below the x-axis.
- The curve is **symmetrical** about the y-axis because, for example, when $x = -3$, $y = (-3)^2$ and when $x = 3$, $y = 3^2$ have the same value.
- The curve has a **turning point** or **vertex** at (0, 0).



Part 1

Using Geogebra or Desmos, to graph the above functions and use in VRTY to create a VR world to investigate the following:

1. What effect does the value **a** in $y = ax^2$ have on
   i. the position of the graph
   ii. the shape of the graph

Part 2

1. What effect does the value **b** in $y = x^2 + b$ have on
   i. the position of the graph
   ii. the shape of the graph

Part 3

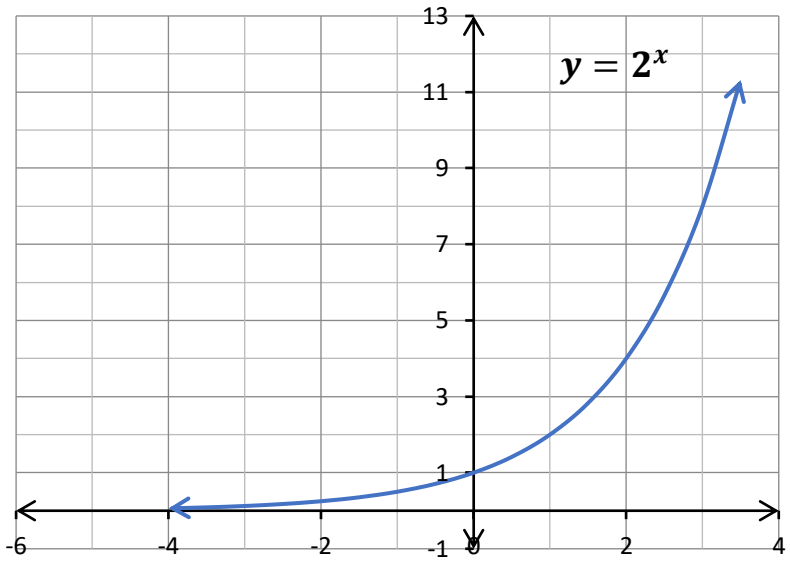
1. What effect does the value **c** in $y = (x - c)^2$have on
   i. the position of the graph
   ii. the shape of the graph

Task E: Exponential Functions

Introduction

The simplest exponential function is $y = 2^x$.

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	8



Part 1

Using Geogebra or Desmos, to graph the above functions and use in VRTY to create a VR world to investigate the following:

Consider the exponential functions $y = 3^x$

What effect does the value **a** in $y = a^x$ have on

i. the shape of the graph
ii. the y-intercept

Part 2

Consider the exponential functions $y = 2^x + 1$ and $y = 2^x - 3$

Compare these graphs to that of $y = 2^x$
What effect does the value **b** in $y = 2^x + b$ have on

i. the shape of the graph
ii. position of the graph
iii. the y-intercept

Middle School Mathematics Investigation Rubric

	Understanding	Fluency	Problem Solving and Reasoning
A (5)	Comprehensive knowledge and understanding of concepts and relationships. Proficient and accurate use of appropriate mathematical notation, representations, and terminology.	Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts. Successful development and application of mathematical models to find concise and accurate solutions. Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems.	Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments. Comprehensive interpretation of mathematical results in the context of the problem. Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations.
B (4)	Some depth of knowledge and understanding of concepts and relationships. Mostly accurate use of appropriate mathematical notation, representations, and terminology.	Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts. Some development and successful application of mathematical models to find mostly accurate solutions. Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems.	Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments. Mostly appropriate interpretation of mathematical results in the context of the problem. Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations.
C (3)	Generally competent knowledge and understanding of concepts and relationships. Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy.	Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in a variety of contexts. Successful application of mathematical models to find generally accurate solutions. Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems.	Generally effective communication of mathematical ideas and reasoning to develop some logical arguments. Generally appropriate interpretation of mathematical results in the context of the problem. Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations.
D (2)	Basic knowledge and some understanding of concepts and relationships. Some appropriate use of mathematical notation, representations, and terminology, with some accuracy.	Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in some contexts. Some application of mathematical models to find some accurate or partially accurate solutions. Some appropriate use of electronic technology to find some accurate solutions to routine problems.	Some communication of mathematical ideas, with attempted reasoning and/or arguments. Some interpretation of mathematical results. Drawing some conclusions from mathematical results, with some awareness of their reasonableness or limitations.
E (1)	Limited knowledge or understanding of concepts and relationships. Limited use of appropriate mathematical notation, representations, or terminology, with limited accuracy.	Attempted selection and limited application of mathematical techniques or algorithms, with limited accuracy in solving routine problems. Attempted application of mathematical models, with limited accuracy. Attempted use of electronic technology, with limited accuracy in solving routine problems.	Attempted communication of mathematical ideas, with limited reasoning. Limited interpretation of mathematical results. Limited understanding of the meaning of mathematical results, and their reasonableness or limitations.
N (0)	No knowledge or understanding of concepts and relationships. No use of appropriate mathematical notation, representations, or terminology.	No attempt at selection and no application of mathematical techniques or algorithms. No attempt at application of mathematical models. No use of electronic technology to find solutions.	No attempt at communication of mathematical ideas. No interpretation of mathematical results. No understanding of the meaning of mathematical results, and their reasonableness or limitations.

Result _____/40 Grade: _____