

PICTON HIGH SCHOOL

Creating Opportunities Achieving Success



Year 11 Mathematics Advanced 2024 - Assessment 2

Due Date: Friday 5 th July Term 2 Week 10	Assessment Name: Investigative Assessment
Mark: /181 (chnaged to a mark out of 30)	Weighting: 30%

TASK DESCRIPTION:

You are to use your knowledge and understanding of the skills covered in the Year 11 Mathematics Advanced class to answer a series of questions within the topic of Functions.

Your submission must include the use of graphing technology such as Desmos or Geogebra to investigate different functions and their translations and dilations. You will also investigate how these variations will impact on the domain and range of the functions.

You will be given 7 different parts. Parts A to F will require you to answer questions and the use of graphing technology. Part G will require you to create a mathematical artwork using graphing technology. Each part needs to be individually saved as a word document and emailed to bret.metcalfe@det.nsw.edu.au

All parts will be due on the same day, but submission for each individual part can be made prior to the due date.

NOTE: You will be allocated one lesson to work on this assessment task.

DIRECTIVES TO BE ASSESSED:

Interpret	To draw meaning from a mathematical situation.
Model	To give a representation of mathematical problem obtained.
Analyse	To identify causes, key factors, relationships and possible results.
Reason	To use logical thinking to make sense of a situation or idea.
Solves	To manipulate something for a particular purpose to find the answer for mathematical problems.
Uses	To manipulate something for a particular purpose to solve mathematical problems.
Organise	To arrange data or values in order, tables and/or graphs.

SYLLABUS OUTCOMES TO BE ASSESSED:

MA11-2	uses the concepts of functions and relations to model , analyse and solve practical problems
MA11-8	uses appropriate technology to investigate, organise , model and interpret
MA11-9	provides reasoning to support conclusions which are appropriate to the context

ASSESSMENT CRITERIA – STUDENT CHECKLIST:

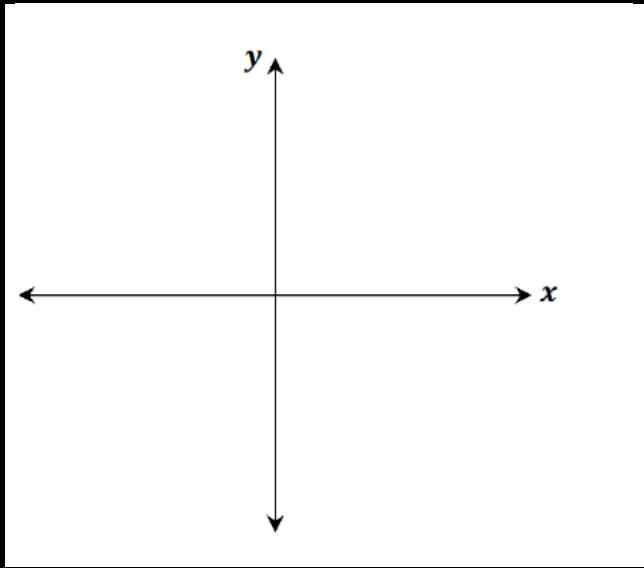
- Have you completed the questions in the relevant chapters to ensure you are aware of the functions and their graphs studied in this unit of work?
- Have you completed your set of questions and the sketches required saving each part in a word document?
- Have you uploaded your files to CANVAS?

Part A Linear Functions

26 marks

$$y = mx + c$$

1. Using graphing technology, sketch the graph of $y = x$ and fill-in the required details below, showing all working.

	Equation: $y = x$
	Domain:
	Range:
	x – intercept:
	y – intercept:
Odd/Even/Neither:	

Marking criteria	6 marks in total	/6
Sketch of the linear function $y = x$	1 mark	
1 mark for each correct answer:		
• domain	1 mark	
• range	1 mark	
• x-intercept	1 mark	
• y-intercept	1 mark	
• odd/even/neither	1 mark	

2. Using graphing technology sketch multiple graphs in the form $y = mx$. Be sure to substitute positive and negative whole number values for 'm', as well as fractional and decimal values of 'm' for your investigation.

Submit at least 4 different sketches stating the equations you have used for each different value of 'm' you have chosen.

Marking criteria	4 marks in total	/4
1 mark for each correct graph where 'm' is		
• positive	1 mark	
• negative	1 mark	
• a fraction and	1 mark	
• a decimal	1 mark	

3. Summarise how the value of 'm' effects the

- shape
- gradient
- domain and
- range of the graphs you have submitted.

Marking criteria	4 marks in total	/4
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1 mark for correctly summarising how the value of 'm' effects the:	
<ul style="list-style-type: none"> • shape • gradient • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark

4. Sketch multiple graphs in the form of $y = x + c$. Again, make sure you substitute positive and negative whole number values for 'c'. Submit at least 2 graphical examples for each value of 'c' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each correct graph where 'c' is		
<ul style="list-style-type: none"> • positive • negative 	1 mark 1 mark	

5. Summarise how the value of 'c' effects the

- shape
- gradient
- domain and
- range of the graphs.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'c' effects the:		
<ul style="list-style-type: none"> • shape • gradient • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark	

6. Sketch multiple graphs of the form $y = c$ and $x = c$. Be sure to use both positive and negative values for 'c'. Submit at least 2 examples of each graph with a minimum of 4 graphs in total.

Marking criteria	4 marks in total	/4
2 marks for correctly sketching $y = c$	2 marks	
2 marks for correctly sketching $x = c$	2 marks	

7. How do the graphs you have submitted in question 6 above, differ from the original graph of $y = x$. What effect does the value of 'c' have in these cases?

Marking criteria	2 marks in total	/2
Correct answer to both the two questions	2 marks	

Part B Quadratic Functions

29 marks

$$y = a(x - h)^2 + k$$

$$y = ax^2 + bx + c$$

1. Sketch the graph of $y = x^2$ below and fill-in the required details showing all working.

	Equation: $y = x^2$
	Domain:
	Range:
	x – intercept:
	y – intercept:
	Odd/Even/Neither:

Marking criteria	6 marks in total	/6
Sketch of the quadratic function of $y = x^2$ 1 mark for each correct answer:	1 mark	
• domain	1 mark	
• range	1 mark	
• x-intercept	1 mark	
• y-intercept	1 mark	
• odd/even/neither	1 mark	

2. Using graphing technology sketch multiple graphs in the form $y = ax^2$. Be sure to substitute positive and negative whole number values for 'a', as well as fractional and decimal values of 'a' for your investigation. Submit at least 4 different sketches stating the equation you have used for each value of 'a' you have chosen, stating the equations you have used.

Marking criteria	4 marks in total	/4
1 mark for each graph where 'a' is		
• positive	1 mark	
• negative	1 mark	
• a fraction and	1 mark	
• a decimal	1 mark	

3. Summarise how the value of 'a' effects the

- shape
- dilation
- domain and
- range of the graphs you have submitted

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'a' effects the:		

<ul style="list-style-type: none"> • shape 	1 mark
<ul style="list-style-type: none"> • dilation 	1 mark
<ul style="list-style-type: none"> • domain and 	1 mark
<ul style="list-style-type: none"> • range of the graphs. 	1 mark

4. Sketch multiple graphs in the form of $y = x^2 + k$. Make sure you substitute positive and negative whole number values for 'k'. Submit at least 2 graphical examples for the values of 'k' you have used, stating the equation you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'k' is		
<ul style="list-style-type: none"> • positive 	1 mark	
<ul style="list-style-type: none"> • negative 	1 mark	

5. Summarise how the value of 'k' effects the

- shape
- position
- domain and
- range of the graphs.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'k' affects the:		
<ul style="list-style-type: none"> • shape 	1 mark	
<ul style="list-style-type: none"> • position 	1 mark	
<ul style="list-style-type: none"> • domain and 	1 mark	
<ul style="list-style-type: none"> • range of the graphs. 	1 mark	

6. Sketch multiple graphs in the form of $y = (x - h)^2$. Make sure you substitute positive and negative whole number values for 'h'. Submit at least 2 graphical examples for each value of 'h' you have used, stating the equation you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'h' is		
<ul style="list-style-type: none"> • positive 	1 mark	
<ul style="list-style-type: none"> • negative 	1 mark	

7. Summarise how the value of 'h' affects the shape, position, domain and range of the graph.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'h' effects the: <ul style="list-style-type: none">• shape• position• domain and• range of the graphs.	1 mark 1 mark 1 mark 1 mark	

8. Looking at the graphs you have submitted throughout Part B, how do they differ from your original graph of $y = x^2$ in relation to the graph $y = a(x - h)^2 + k$? Make reference to the affect of a , h and k

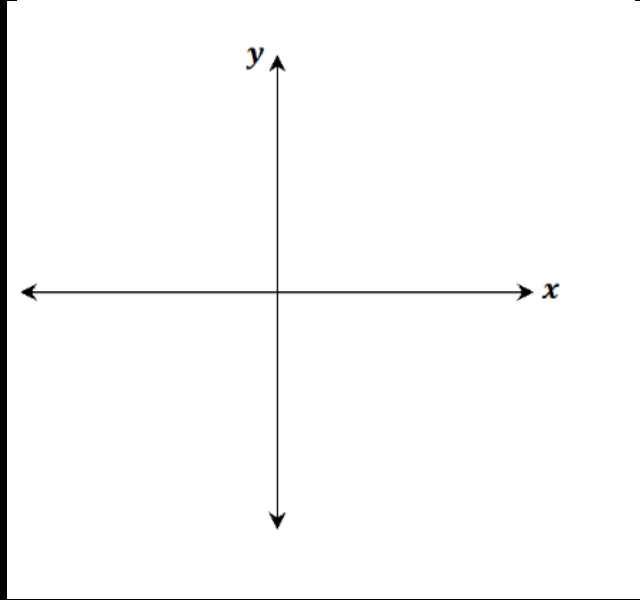
Marking criteria	3 marks in total	/3
1 mark for correctly summarising how the values of 'a', 'h' and 'k' effects the graph. Effect of 'a' Effect of 'h' Effect of 'k'	1 mark 1 mark 1 mark	

Part C Absolute Value Functions

29 marks

$$y = a|x - h| + k$$

1. Sketch the graph of $y = |x|$ below and fill-in the required details showing all working.

	Equation: $y = x $
	Domain:
	Range:
	x – intercept:
	y – intercept:
	Odd/Even/Neither:

Marking criteria	6 marks in total	/6
Sketch of the function of $y = x $	1 mark	
1 mark for each correct answer:		
• domain	1 mark	
• range	1 mark	
• x-intercept	1 mark	
• y-intercept	1 mark	
• odd/even/neither	1 mark	

2. Using graphing technology sketch multiple graphs in the form $y = a|x|$. Be sure to substitute positive and negative whole number values for 'a', as well as fractional and decimal values of 'a' for your investigation. Submit at least 4 different sketches stating the equation you have used for each value of 'a' you have chosen.

Marking criteria	4 marks in total	/4
1 mark for each correct graph where 'a' is		
• positive	1 mark	
• negative	1 mark	
• fraction and	1 mark	
• decimal	1 mark	

3. Summarise how the value of 'a' effects the

- shape
- position
- domain and
- range of the graphs you have submitted

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'a' effects the: <ul style="list-style-type: none"> • shape • position • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark	

4. Sketch multiple graphs in the form of $y = |x| + k$. Make sure you substitute positive and negative whole number values for 'k'. Submit at least 2 graphical examples for each value of 'k' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'k' is <ul style="list-style-type: none"> • positive • negative 	1 mark 1 mark	

5. Summarise how the value of 'k' effects the

- shape
- position
- domain and
- range of the graphs.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'k' affects the: <ul style="list-style-type: none"> • shape • position • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark	

6. Sketch two graphs in the form of $y = |x - h|$. Make sure you substitute positive and negative whole number values for 'h'. Submit at least 2 graphical examples for each value of 'h' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'h' is <ul style="list-style-type: none"> • positive • negative 	1 mark 1 mark	

7. Summarise how the value of 'h' affects the shape, position, domain and range of the graph.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'h' effects the: <ul style="list-style-type: none"> • shape • position • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark	

8. Looking at the graphs you have submitted throughout Part C, how do they differ from your original graph of $y = |x|$ in relation to the graph $y = a|x - h| + k$? Make reference to the effect of a , h and k

Marking criteria	3 marks in total	/3
1 mark for correctly summarising how the values of 'a', 'h' and 'k' effects the graph. Effect of 'a' Effect of 'h' Effect of 'k'	1 mark 1 mark 1 mark	

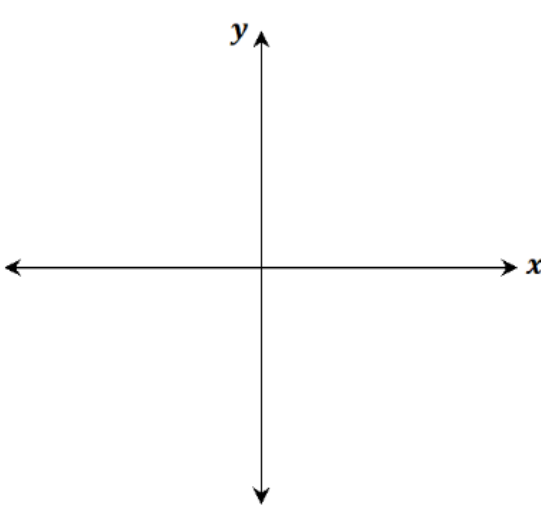
Part D Cubic Functions

29 marks

$$y = a(x - h)^3 + k$$

$$y = ax^3 + bx^2 + cx + d$$

2. Sketch the graph of $y = x^3$ below and fill-in the required details showing all working.

	Equation: $y = x^3$
	Domain:
	Range:
	x – intercept:
	y – intercept:
	Odd/Even/Neither:

Marking criteria	6 marks in total	/6
Sketch of the quadratic function $y=x^3$ 1 mark for each correct answer:	1 mark	
• domain	1 mark	
• range	1 mark	
• x-intercept	1 mark	
• y-intercept	1 mark	
• odd/even/neither	1 mark	

2. Using graphing technology sketch multiple graphs in the form $y = ax^3$. Be sure to substitute positive and negative whole number values for 'a', as well as fractional and decimal values of 'a' for your investigation. Submit at least 4 different sketches for each value of 'a' you have chosen, stating the equations you have used.

Marking criteria	4 marks in total	/4
1 mark for each correct graph where 'a' is		
• positive	1 mark	
• negative	1 mark	
• fraction and	1 mark	
• decimal	1 mark	

3. Summarise how the value of 'a' effects the

- shape
- dilation
- domain and
- range of the graphs you have submitted

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'a' effects the:		
• shape	1 mark	

<ul style="list-style-type: none"> dilation domain and range of the graphs. 	1 mark
	1 mark
	1 mark

4. Sketch multiple graphs in the form of $y = x^3 + k$. Make sure you substitute positive and negative whole number values for 'k'. Submit at least 2 graphical examples for each value of 'k' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each correct graph where 'k' is <ul style="list-style-type: none"> positive negative 	1 mark	1 mark

5. Summarise how the value of 'k' effects the

- shape
- position
- domain and
- range of the graphs.

Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'k' affects the: <ul style="list-style-type: none"> shape position domain and range of the graphs. 	1 mark	1 mark
	1 mark	1 mark
	1 mark	1 mark

6. Sketch two graphs in the form of $y = (x - h)^3$. Make sure you substitute positive and negative whole number values for 'h'. Submit at least 2 graphical examples for each value of 'h' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'h' is <ul style="list-style-type: none"> positive negative 	1 mark	1 mark

7. Summarise how the value of 'h' affects the shape position, domain and range of the graph.

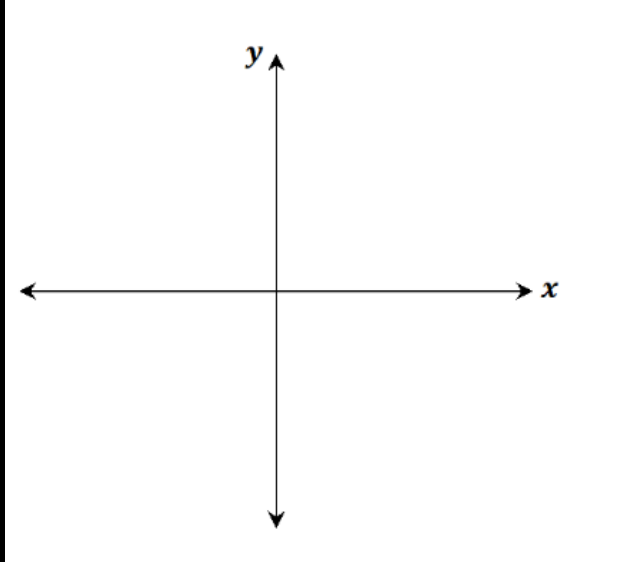
Marking criteria	4 marks in total	/4
1 mark for correctly summarising how the value of 'h' effects the: <ul style="list-style-type: none"> • shape • position • domain and • range of the graphs. 	1 mark 1 mark 1 mark 1 mark	

8. Looking at the graphs you have submitted throughout Part D, how do they differ from your original graph of $y = x^3$ in relation to the graph $y = a(x - h)^3 + k$? Make reference to the effect of a , h and k

Marking criteria	3 marks in total	/3
1 mark for correctly summarising how the values of 'a', 'h' and 'k' effects the graph. Effect of 'a' Effect of 'h' Effect of 'k'	1 mark 1 mark 1 mark	

$$(x - a)^2 + (y - b)^2 = r^2$$

3. Sketch the graph of $x^2 + y^2 = r^2$ below and fill-in the required details showing all working.

	Equation: $x^2 + y^2 = r^2$
	Domain:
	Range:
	x – intercept:
	y – intercept:

Marking criteria	5 marks in total	/5
Sketch of the quadratic function $y=x^2$ 1 mark for each correct answer:	1 mark	
<ul style="list-style-type: none"> • domain • range • x-intercept • y-intercept • 	1 mark	
	1 mark	
	1 mark	
	1 mark	

2. Using graphing technology sketch multiple graphs in the form $x^2 + y^2 = r^2$. Be sure to substitute positive and negative whole number values for both 'x' and 'y'.
Submit at least 4 different sketches for each value of 'x' and 'y' you have chosen, stating the equations you have used.

Marking criteria	4 marks in total	/4
1 mark for each graph:		
<ul style="list-style-type: none"> • where 'x' is positive and 'y' is positive • where 'x' is positive and 'y' is negative • where 'x' is negative and 'y' is positive • where 'x' is negative and 'y' is negative 	1 mark	
	1 mark	
	1 mark	
	1 mark	

3. Sketch multiple graphs in the form of $r^2 = (x - a)^2 + y^2$. Make sure you substitute positive and negative whole number values for 'a'. Submit at least 2 graphical examples for each value of 'a' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'a' is		

<ul style="list-style-type: none"> • positive • negative 	1 mark
	1 mark

4. Sketch multiple graphs in the form of $r^2 = x^2 + (y-b)^2$. Make sure you substitute positive and negative whole number values for 'b'. Submit at least 2 graphical examples for each value of 'b' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'b' is		
<ul style="list-style-type: none"> • positive • negative 	1 mark	
	1 mark	

5. Summarise how the value of 'a' and 'b' effects the

- position
- domain and
- range of the graphs.

Marking criteria	3 marks in total	/3
1 mark for correctly summarising how the values of 'a' and 'b' affects the:		
<ul style="list-style-type: none"> • position • domain and • range of the graphs. 	1 mark	
	1 mark	
	1 mark	

6. Sketch multiple graphs in the form of $r = \pm\sqrt{x^2 + y^2}$. Again, make sure you substitute positive and negative whole number values for x'and 'y'. Submit at least 2 graphical examples for $r = \sqrt{x^2 + y^2}$ and 2 examples for $r = -\sqrt{x^2 + y^2}$ you have used, stating the equations you have used.

Marking criteria	4 marks in total	/4
<ul style="list-style-type: none"> • 2 examples for $r = \sqrt{x^2 + y^2}$ • 2 examples for $r = -\sqrt{x^2 + y^2}$ 	2 marks	
	2 marks	

7. What function have you sketched in question 6 above and what is the domain and range of each of the graphs.

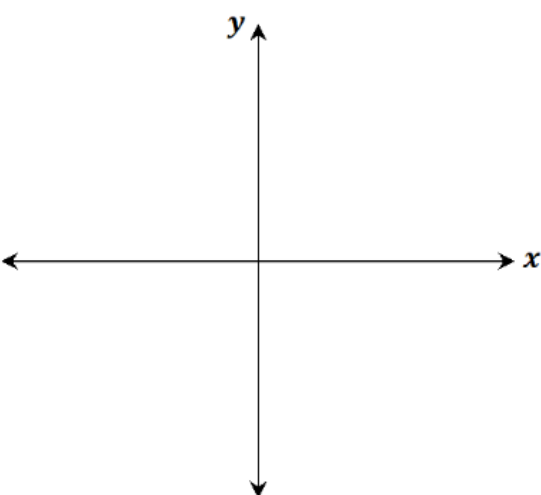
Marking criteria	9 marks in total	/9
<ul style="list-style-type: none"> • Name of the function • domain • range of the graphs. 	1 mark	
	4 marks	
	4 marks	

Part F The Hyperbola

24 marks

$$y = \frac{a}{bx + k}$$

4. Sketch the graph of $y = \frac{1}{x}$ below and fill-in the required details showing all working.

	Equation: $y = \frac{1}{x}$
	Domain:
	Range:
	Asymptotes:

Marking criteria	5 marks in total	/5
Sketch of the function $y = \frac{1}{x}$ 1 mark for each correct answer: <ul style="list-style-type: none"> • domain • range • asymptotes 	1 mark 1 mark 1 mark 2 marks	

2. Using graphing technology sketch multiple graphs in the form $y = \frac{a}{x}$. Be sure to substitute positive and negative whole number values for 'a', as well as fractional and decimal values of 'a' for your investigation. Submit at least 4 different sketches for each value of 'a' you have chosen, stating the equations you have used.

Marking criteria	4 marks in total	/4
1 mark for each graph where 'a' is <ul style="list-style-type: none"> • positive • negative • fraction and • decimal 	1 mark 1 mark 1 mark 1 mark	

3. Summarise how the value of 'a' effects the
- shape

- asymptotes
- domain and
- range of the graphs you have submitted

Marking criteria	5 marks in total	/5
1 mark for correctly summarising how the value of 'a' effects the: <ul style="list-style-type: none"> • shape • asymptotes • domain and • range of the graphs. 	1 mark 2 marks 1 mark 1 mark	

4. Sketch multiple graphs in the form $y = \frac{1}{x+k}$. Make sure you substitute positive and negative whole number values for 'k'. Submit at least 2 graphical examples for each value of 'k' you have used, stating the equations you have used.

Marking criteria	2 marks in total	/2
1 mark for each graph where 'k' is <ul style="list-style-type: none"> • positive • negative 	1 mark 1 mark	

5. Summarise how the value of 'k' effects the

- shape
- position
- asymptotes
- domain and
- range of the graphs.

Marking criteria	6 marks in total	/6
1 mark for correctly summarising how the value of 'k' affects the: <ul style="list-style-type: none"> • shape • position • asymptotes • domain and • range of the graphs. 	1 mark 1 mark 2 marks 1 mark 1 mark	

6. Looking at the graphs you have submitted throughout Part F, how do they differ from your original graph of $y = \frac{1}{x}$ in relation to the graph $y = \frac{a}{x+k}$? Make reference to the effect of a and k

Marking criteria	2 marks in total	/2
1 mark for correctly summarising how the values of 'a' and 'k' effects the graph. Effect of 'a' Effect of 'k'	1 mark 1 mark	

Part G Function Transformations

15 marks

In this part your task is to create a design composed of the functions and relations you have learn about.

1. Go to <https://www.desmos.com/calculator> and create a free account if you have not already done so. This allows you to save your work. Be sure you use a username and password that is school appropriate and that you can remember.

2. Use this link below if you have any questions about how to create a particular graph

https://s3.amazonaws.com/desmos/Desmos_Calculator_User_Guide.pdf

This link is also in your Canvas page.

Make sure you read about sliders, they will help and can be used with either variables in the function or in domain limits.

3. To limit a function:

Type the function in and then in curly brackets, type the limitation.

For example: If you want the quadratic to lie between -2 and 2, type: $y = x^2 \{-2 \leq x \leq 2\}$

4. To shade a graph, write a function as an inequality.

5. Refer to the previous parts of this assignment for examples of functions and relations which can be used.

A simple example of a design can be found at <https://desmos.com/calculator/6pwfivhdej>

Note the use of sliders and domain limits

Plan your design

Make sure you read the rubric so you understand the project requirements

- Your artwork should contain different functions/relations and their transformations
- You will need to record:
 - The equation of the function used
 - A description of the transformation
 - The equation of the transformation function
- Record the information in a table like the example below:

Original Function	Transformation description	Equation of the transformed function
$x^2 + y^2 = 25$	Origin is shifted right 2 units and up 1 unit	$(x - 2)^2 + (y - 1)^2 = 25$

You can create anything you like. Plan your design on a piece of paper. Your artwork **MUST** be original and not a copy of artworks online that have been drawn by Desmos or other students.

Note: You can change the colour of the lines you use by holding down the cursor on the colour button next to the equation and a menu of colours pops up. You can change your line from solid to dotted and change colour.

Marking Rubric 15 marks

Original Function	Uses at least 5 function/relation graphs	3 marks
	Uses at least 4 function/relation graphs	2 marks
	Uses at least 3 function/relation graphs	1 mark
	Uses less than 2 function/relation graphs	0 marks
Transformation Description	Provides correct descriptions for each of the transformed function/relations used	3 marks
	Provides equations with a single error	2 marks
	Provides equations with two errors	1 mark
	Makes multiple errors	0 marks
Equations of the transformed functions	Provides correct equations for each of the transformed functions	3 marks
	Provides equations with a single error	2 marks
	Provides equations with two error	1 mark
	Makes multiple errors	0 marks
Transformation types	Uses three transformations at least once	3 marks
	Uses only two transformations	2 marks
	Uses only one transformation	1 mark
	No transformations used	0 marks
Shading	Uses three or more inequalities to include shading	3 marks
	Uses two inequalities to include shading	2 marks
	Uses one inequality to include shading	1 mark
	No shading demonstrated	0 marks

