Week 11/12
Term 2
2024

HAWKER COLLEGE
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Learning Brief
MM1

Goals

Quadratic Formula

when $ax^2 + bx + c = 0$

$$x = \frac{-b \pm \sqrt{(b)^2 - 4ac}}{2a}$$

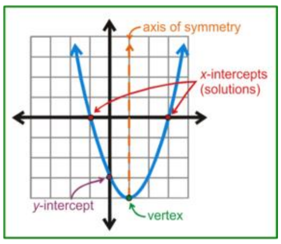
By the end of this fortnight, you will:
- Further develop mathematical models with quadratic functions
- Use algebraic methods and graphing software to identify the key features of linear and quadratic functions
- Develop quadratic skills (factorising, completing the square, solving quadratic equations)
- Graph quadratic functions
- Find turning points and zeros of quadratics and understand the role of the discriminant
- Recognise features of the graph of the general quadratic y=ax^2+bx+c and vertex form y=a(x-h)^2+k
- Use technology to graph quadratic functions and solve problems
- Solve simultaneous quadratic and linear equations

Theoretical Components

You will need to have a good working knowledge of domain and range, functions and relations for the assignment.

Quadratics:
You need to know about dilation, vertical translation, horizontal translation, vertex, axis of symmetry, reflection, roots, and intercepts
Forms: Base form $y = x^2$
General form $y = ax^2 + bx + c$
Vertex (h,k) form $y = a(x - h)^2 + k$
Fully factorised form $y = (ax - m)(fx - n)$

Online reading
Quadratics:
- https://www.mathsisfun.com/algebra/quadratic-equation.html
- https://www.mathsisfun.com/algebra/quadratic-equation-graphing.html
- https://www.mathsisfun.com/algebra/quadratic-equation-real-world.html



Practical Components

Resources:
Make notes on the following chapters and websites:
- 2F Solving quadratic equations - completing the square
- 2G The quadratic formula
- 2H The discriminant
- 2I Graphs of quadratic functions as power functions (turning point form)
- 2J Graphs of quadratic functions (intercepts method)
- 2L Simultaneous quadratic and linear equations

Do the following questions:
Organise your solutions neatly in your exercise book.
Chapter 2 of Maths Quest 11 Mathematical Methods (pdf – Google Classroom)
- 2F: 2
- 2G: 1a, 1h, 2, 8, 10, 13
- 2H: 5
- 2I: 6 (any 5), 7
- 2J: 3a, 4b, 5e, 5g, 9a, 9b
- 2L: 1j, 1l, 1n, 3, 7

Investigation

See next page

Other

Fun fact: The rational root theorem says that any rational root of a monic polynomial with integer coefficients must be an integer. A consequence of this is that the square root of any positive integer that is not a perfect square is irrational: any root of a quadratic $f(x) = x^2 - a$, if a is a positive integer, must be either an integer or irrational.

Week 11 and 12 Investigation

Part 1: Use DESMOS to **investigate the effect that the value of *k* has on the shape and position of the graph** $y = x^2$ in the following situations:

	$k < 0$ $Let\ k = -1$	$k > 0$ $Let\ k = 1$	$0 < k < 1$ $Let\ k = ½$	$k > 1$ $Let\ k = 2$
$y = kx^2$		--		
$y = x^2 + k$			--	--
$y = (x + k)^2$			--	--
$y = (kx)^2$		--		
$y = x^2 + kx$			--	--
Any other observations?				

Match the description by placing the relevant letter in the correct box. Then state the type of transformation - whether it is a translation, reflection, or dilation.

A – the parabola shifts downward

B – the parabola becomes wider

C – the parabola shifts left and down

D – the parabola becomes wider quickly

E – the parabola shifts upward

F – the parabola becomes narrower

G – the parabola is concave down

H – the parabola is the same

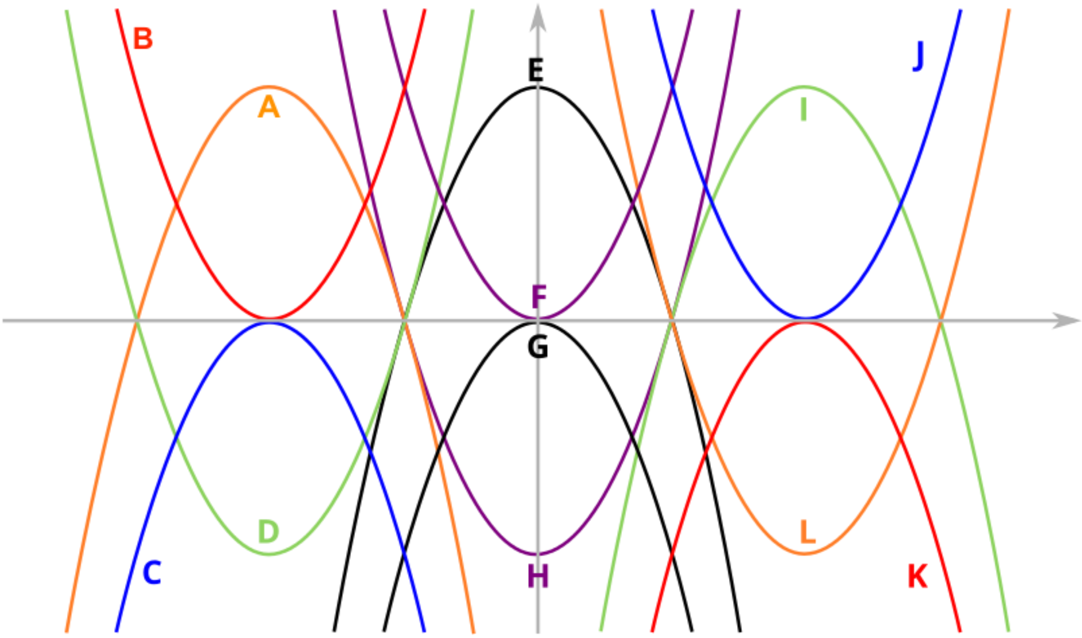
I – the parabola shifts right and down

J – the parabola becomes narrow quickly

K – the parabola shifts left

L – the parabola shifts right

Part 2:



Given that two of the parabolas have equations

$$y = x^2 - 12x + 27 \text{ and } y = -x^2 + 12x - 36$$

Find the equations of the other parabolas.

A		**G**	
B		**H**	
C		**I**	
D		**J**	
E		**K**	
F	$y = x^2$	**L**	

Part 3: We are investigating function families:

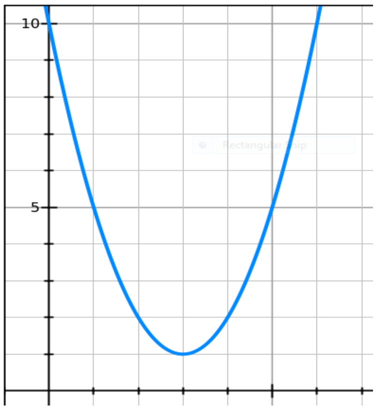
- Linear
- Quadratic
- Square Root
- Cubic
- Hyperbolas (reciprocal functions)
- Semi-Circles
- Absolute Value
- Exponential
- Logarithmic
- Hybrid / Piecewise

Your investigation is to sketch an example of EACH of the above functions and identify and describe what it is about these functions that make them identifiable as the function named.

- What are their main features?
- How are their equations recognisable algebraically?
- Give the equation of the example you have chosen?
- State the domain and range?

For example:
Linear function is so named because linear means 'line' and the linear functions are always straight lines.

Quadratic example: $y = (x - 3)^2 + 1$
Domain: x can be any real number
$(-\infty < x < \infty)$
Range: y can be any real number
$y \geq 1$



Consider working in pairs, sharing the functions, and then coming together in one of your lessons to swap notes, explain to each other and finish the investigation by the end of Week 12. This will hopefully achieve/encourage group collaboration and communications skills when sharing with your partner.

Sketching tools:
https://www.desmos.com/calculator
https://graphsketch.com/
https://www.intmath.com/functions-and-graphs/graphs-using-jsxgraph.php