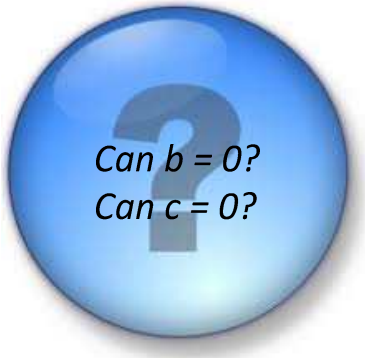
3.2 Quadratic Relations

A **quadratic function**'s equation that can be written in the form $y = ax^2 + bx + c$, where a, b and c are constants and $a \neq 0$.

Why can't $a = 0$?

$$y = ax^2 + bx + c$$
$$y = 0(x^2) + bx + c$$
$$y = bx + c$$

This is linear



Here are three examples of quadratic relations; state the values of a, b and c.

$y = 2x^2 + 3x + 1$ → a = 2, b = 3, c = 1

$y = 5x^2 - 4$ → a = 5, b = 0, c = -4

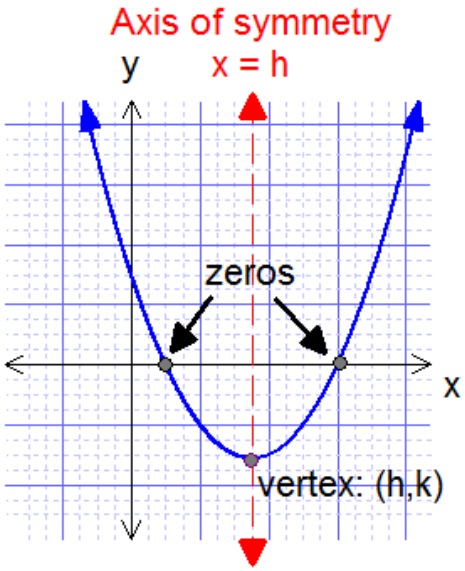
$y = x^2$ → a = 1, b = 0, c = 0

Features of Quadratics

- The ***vertex*** of a parabola is either the minimum point (opens up) or maximum point (opens down).

- A vertical line of symmetry which goes through the vertex is called the ***axis of symmetry***.

- The x-intercept(s) of a parabola are called its ***zeros*** or roots.



How can you tell if data is linear?

Check for constant first differences

Let's examine some data from the last lesson. What patterns do you notice?

Side Length	Total # of Toothpicks
0	0
1	3
2	9
3	18
4	30
5	45

1st Difference: 3, 6, 9, 12, 15

2nd Diff: 3, 3, 3, 3

Constant 2nd Diff!

∴ Quadratic

- Linear Relation: if a relation has constant first differences (ie. slope) the relation is linear.
- Quadratic Relation: if a relation has constant second differences the relation is quadratic.

both depend on a constant increment of the independent variable

Ex.3 Calculate the first and second differences to determine whether the relation is linear, quadratic, or neither.

x	y	1ST	
-1	5		
0	7	2	
1	9	2	
2	11	2	
3	13	2	

Linear

x	y	1ST	2ND
-2	3		
-1	-3	-6	
0	-5	-2	4
1	-3	2	4
2	3	6	4

QUADRATIC

x	y		
-3	7		
0	4	-3	
3	1	-3	
6	-2	-3	
9	-5	-3	

Linear

x	y		
1	4		
2	6	2	
3	12	6	4
4	18	6	0
5	28	10	4

NEITHER

Applications

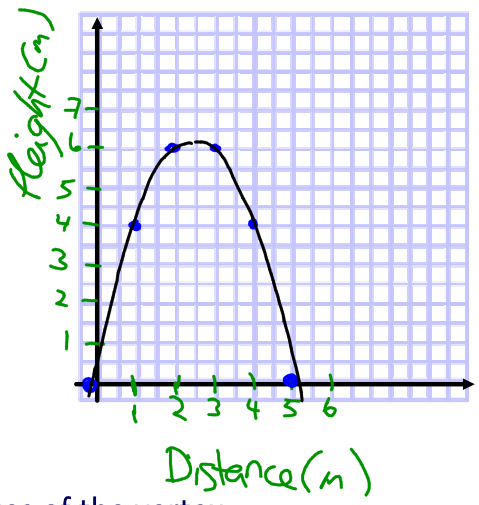
Ex. 4 The path of a golf ball is modelled by the equation $y = -x^2 + 5x$, where x represents the horizontal distance travelled by the ball in metres and y represents the height of the ball in metres.

a) Complete the table of values and graph the relation.

$y = -x^2 + 5x$

x	y
0	0
1	4
2	6
3	6
4	4
5	0

$y = -1^2 + 5(1)$
$= -1 + 5$
$= 4$



b) Determine the coordinates of the vertex.

$(2.5, \frac{25}{4})$

$y = -(\frac{5}{2})^2 + 5(\frac{5}{2})$

c) What was the maximum height of the ball?

$\frac{25}{4} = 6.25$ ∴ Max was 6.25 m

d) How far away does the ball land?

5m

e) What was the height of the ball 4 m away from the golfer?

Graphically

4m high

By Solving

$x = 4$

$y = -4^2 + 5(4)$
$= 4$

∴ height was 4m

FBUHL

Your Turn:

p. 172 #1,2,3
(By hand)

p. 172 #5,6
(w/ Technology)