3.2 Quadratic Relations

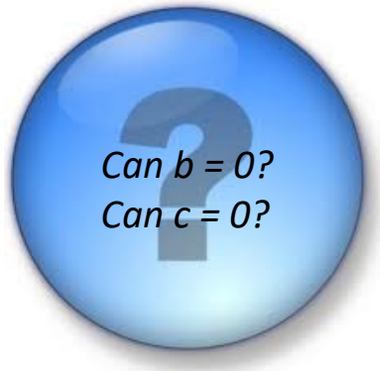
"Standard Form"

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

ex: $y = 2x^2 - 3x + 4$ OR $y = x^2 - 2$

Why can't $a = 0$?

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



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

$y = 2x^2 + 3x + 1$

$a = 2$
$b = 3$
$c = 1$

$y = 5x^2 - 4$

$a = 5$
$b = 0$
$c = -4$

$y = x^2$

$a = 1$
$b = 0$
$c = 0$

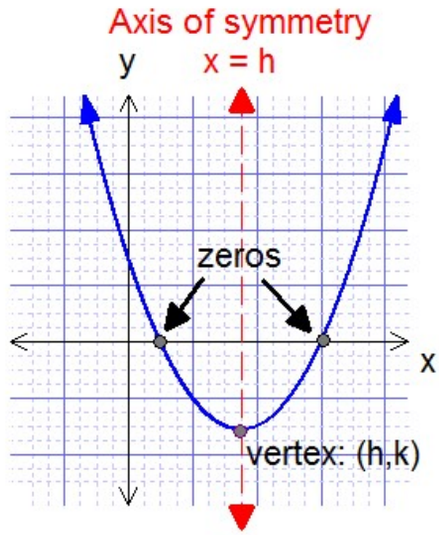
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Features of Quadratics

- 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?

the first differences are constant

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

x	y
-3	23
-2	10
-1	1
0	-4
1	-5
2	-2
3	5

First Differences

$10-23=-13$

$1-10=-9$

$-4-1=-5$

$-5-(-4)=-1$

$-2-(-5)=3$

$5-(-2)=7$

Second Differences

$-9-(-13)=4$

$-5-(-9)=4$

$-1-(-5)=4$

$3-(-1)=4$

$7-3=4$

2nd Diff. are constant!

∴ Quadratic

Mar 16-1:58 PM

- 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
-1	5
0	7
1	9
2	11
3	13

7 - 5 = 2
9 - 7 = 2
11 - 9 = 2
13 - 11 = 2

∴ Linear
1ST Diff constant

x	y
-2	3
-1	-3
0	-5
1	-3
2	3

-6 > 4
-2
2 > 4
6 > 4

∴ Quadratic!
2ND Diff constant

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

-3
-3
-3
-3

∴ Linear!

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

2 > 4
6 > 0
6 > 4
10

∴ Neither!

Mar 16-1:57 PM

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.

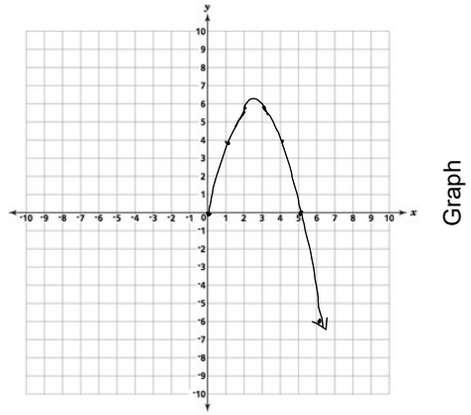
$y = -x^2 + 5x$

$x = 0$: $y = -(0)^2 + 5(0) = 0$

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

$x = 2$: $y = -(2)^2 + 5(2) = -4 + 10 = 6$

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



Graph

b) Determine the coordinates of the vertex.

Any two symmetrical points
Like zeroes!
$x = 0$ & $x = 5$

Add them up divide by 2

$x = \frac{0+5}{2}$

$= 2.5$

c) What was the maximum height of the ball?

"What is the y, when $x = 2.5$?"

$x = 2.5$

$y = -(2.5)^2 + 5(2.5)$

$= 6.25$

d) How far away does the ball land?

"Lands" at 5m

→ Zero at $x = 5$

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

"What is the y, when $x = 4$"

∴ The ball was 4m high.

Homework

SET 1: P. 172 #1 (GRAPH BY HAND)
#2, 6, 9 (WITH DESMOS)

SET 1: P. 172 #1 (GRAPH BY HAND)
#2, 5, 6, 9 (WITH TECHNOLOGY)

Mar 16-1:59 PM