## ACTIVITY

# Modelling Quadratic Relations

Plot the points and draw the graph for each of the relations below.



#### LINEAR VS QUADRATIC

The graph of a Linear Equation	A=wx+P	is a 6traight line
The graph of a Quadratic Equat	ion $y = Ax^2 + Bx + C$	is a parabolic curve

### 1<sup>st</sup> & 2<sup>nd</sup> DIFFERENCES

1<sup>st</sup> differences: for evenly spaced  $\underline{\times}$  values, find the <u>difference</u> between consecutive  $\underline{\underline{\neg}}$  values 2<sup>nd</sup> differences: determine the <u>difference</u> between consecutive  $\underline{\underline{\neg}}$  <u>d</u>; <u>fference</u>

Х	У	1st Differences
-3	75	1-7
-1	4	4-1-2
	<u> </u>	1-4=-3
1	1	-0 13
ſ	-2/	-X-1= 2
0		-5 - (-1)3
5	-5 /	1 (1)- 2
		-8-(-5)=-3
7	-8	0 ( 1/2 )

All 1st diff. are the some; therefore, it's lineor

x	у	1 st Differences	
-3	0	-1-01-	2nd Differences
-2	-1/	$\frac{1}{2}$	1-(1)=2
- 1	0	(-(-1)) = +	3-(1)=2
0	3	$\frac{\partial}{\partial y} = \frac{\partial}{\partial y}$	5-(3)=2
1	8	8-(5)=7	7-15)=2
2	15	15-(8)=1	
411 it's	2nd d quad	liff are the bratic	same; therefore,

#### **DEFINITIONS**

Parabola:	symmet	rical "	J" sha	ped cuive t	hat ope	nsup/down;	
Vertex: 🧕	,owest or	<u>heigh</u>	est po	int on q	parabo	lq	<u> </u>
Minimum:	lowest .	point	onia	para bola	thot	opens up	$\underline{\mathbf{v}}$
Maximum:	highest	point	on a	parabola	that	opens down	

LINEAR OR QUADRATIC? HOW TO TELL	1.00	
If the graph is a parabola →Quadratic	-0-	
If 1 <sup>st</sup> differences are constant → <u>linear</u>		
If 2 <sup>nd</sup> differences are constant→ <u>quadratic</u>		
If the degree of the polynomial is 1 (has x term only) $ ightarrow$ _	lineor	y=2x+1
If the degree of the polynomial is 2 (has x <sup>2</sup> term) $ ightarrow$	quedratic	$y = \lambda x^{2} + 1$

#### ACTIVITY

For each example, evaluate or estimate for x = 2 and identify whether it is linear or quadratic.



#### **APPLICATION PROBLEM**

A football was thrown in the air. Its path can be modelled by the relation  $h = -5t^2 + 20t + 1.5$  where h is the height of the football in metres and t is the time in seconds.

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

t	h	
0	1.5	= -5(0) <sup>2</sup> +20(0)+1,5 =1,5
1	16.5	=-5(1)2+20(1)+1.5=-5+20+1.5
2	21,5	=-5(2)2+20(2)+1.5=-20+40+1.5
3	16.5	
4	1.5	= -5(4)2+20(4) +1.5= -80+80+1.5
5		=-5(5)2+20(5)+1.5=725+100+1.5
		-6.5



- b) Use your graph to estimate how long the ball was in the air. about 4.1 sec.
- c) Use your graph to estimate the coordinates of the vertex of the relation. Explain the meaning of c) Use your graph to estimate the coordinates of the vertex of the relation. Explain the gir for 2 sec, it is the coordinates of the vertex in this context. V(2,21,5) when the ball is in the gir for 2 sec, it is
   d) Explain the meaning of the data in the first row of the table. may height is 21.5m
   It's time spent for the duration of the ball trovelled in the pir. Page 2 of 5

# Modelling Quadratic Relations Practice

1. Graph each relation. Use the graph to determine if the relation is linear, quadratic, or neither.



- In question 1, complete the first and second differences to check if your diagram is correct. Are these expressions linear or non-linear.
- 3. Which of these relations are quadratic? How do you know?
  - a)  $y = \sqrt{3} + 4$  cubic b)  $y = 2\sqrt{2} + 5x - 6$  Q c) y = 3x + 1 C b)  $y = 6 + \sqrt{2}$  Q c)  $y = \sqrt{2} + 7$  C f)  $y = -4\sqrt{2} + 4$  Q
- 4. Estimate the vertex value for each relation, and state if it is a maximum or a minimum.



5. A box of food supplies is parachuted from a cargo plane over a remote village in Africa. The height, h, of the box, in metres, t seconds after being dropped from the plane is given by the relation:

$$h = -0.5t^2 + 1000$$

a) Complete the table of values.

Time (s)	Height (m)
0	-0.5(0)²+(005 = 1000m
10	=-0.7(10)²+1000 = 950
20	- 800
30	= 0.7 (30) <sup>2</sup> + 1000 = 550
40	= -0,5(40) <sup>2</sup> +1000 = 200

- b) Graph the relation.
- c) Is the relation quadratic? Explain.

Quadratic b/c the shope is a curve.



6. A daycare owner wants to use 160 m of fencing to build a small rectangular playground. She wants the playground to have the greatest possible area.

a) Coi	mplete th	e table of v	alues.	1500	area					<b>_</b>			
Length (m)	Width (m)	Perimeter (m)	Area (m²)	1400 1300			1						
70	10	160	700	1200			/						
B	20	160	200	1000		1							
50	30	160	1500	800		/					_		
40	40	160	1600	600	V	ļ							
30	50	160	1500	500 400								4	
20	60	160	1200	300 200									
3	70	160	705	100									length
				-	0	0	20 3	30 4	10 5	00	60	70	80

- b) In the fourth column of the table, calculate the area for each pair of dimensions.
- c) Draw a graph to compare the length and the area.
  - d) Use the graph to determine the dimensions of the playground with the greatest possible area.

It'd be a square with the dimensions L: 40 and w: 40

7. A golf warehouse sold 200 sleeves of golf balls for \$3 each. A survey suggests that for every \$1 increase in price, sales will drop by 40 sleeves.

a) Complete the table of values.

Price (\$)	Number Sold	Revenue (\$)
3	200	600
4	160	640
5	120	600
6	80	480
7	40	280

- b) Draw a graph to compare price and revenue.
- c) Which price will result in a maximum revenue?
- d) What is the maximum revenue?

max rev is \$640

