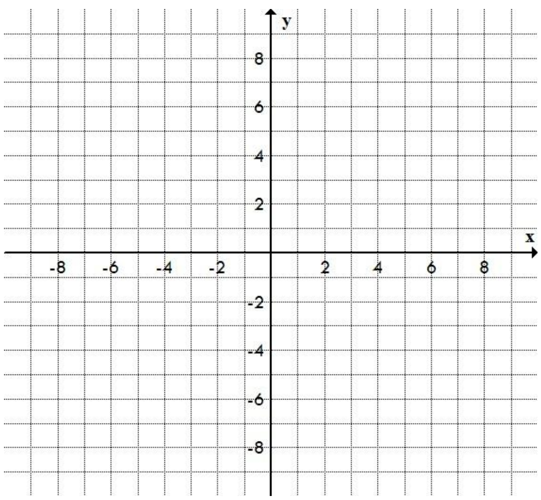
Modelling Quadratic Relations

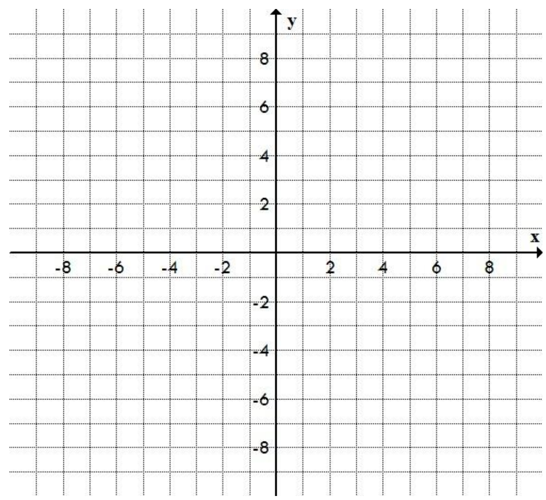
ACTIVITY

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

x	y
4	-3
5	0
6	3
7	6
8	9

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





LINEAR VS QUADRATIC

The graph of a Linear Equation ______________ is a ____________________________

The graph of a Quadratic Equation ______________ is a __________________________

1st & 2nd DIFFERENCES

1st differences: for evenly spaced _____ values, find the <u>difference</u> between consecutive _____ values

2nd differences: determine the <u>difference</u> between consecutive ________________________________

x	y	1st Differences
-3	7	
-1	4	
1	1	
3	-2	
5	-5	
7	-8	

x	y	1st Differences	2nd Differences
-3	0		
-2	-1		
-1	0		
0	3		
1	8		
2	15		

DEFINITIONS

Parabola: ____

Vertex: ____

Minimum: ____

Maximum: ____

LINEAR OR QUADRATIC? HOW TO TELL

If the graph is a parabola → ______________________________

If 1st differences are constant → ______________________________

If 2nd differences are constant→ ______________________________

If the degree of the polynomial is 1 (has x term only) → ______________________________

If the degree of the polynomial is 2 (has x^2 term) → ______________________________

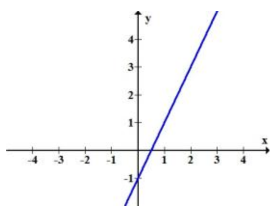
ACTIVITY

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

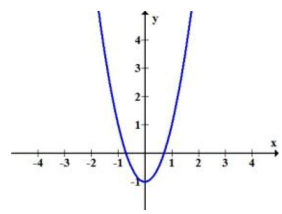
a) $y = -3(x + 1)^2 + 1$

b) $2x - y + 7 = 0$

c)



d)

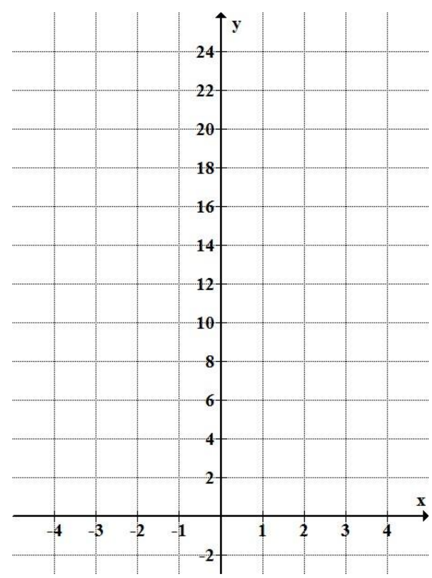


APPLICATION PROBLEM

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	
2	
3	
4	
5	



b) Use your graph to estimate how long the ball was in the air.

c) Use your graph to estimate the coordinates of the vertex of the relation. Explain the meaning of the coordinates of the vertex in this context.

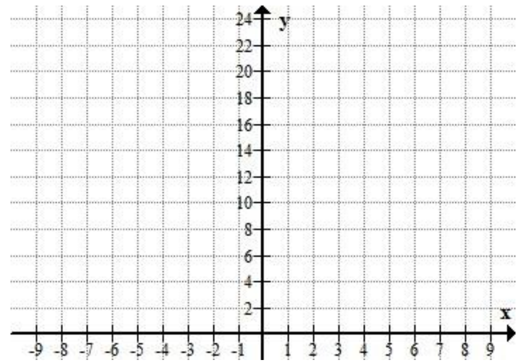
d) Explain the meaning of the data in the first row of the table.

Modelling Quadratic Relations Practice

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

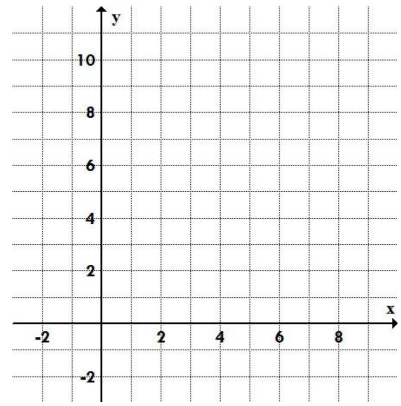
a)

x	*y*	1st Differences	2nd Differences
–5	25		
–3	9		
–1	1		
1	1		
3	9		
5	25		
7	49		



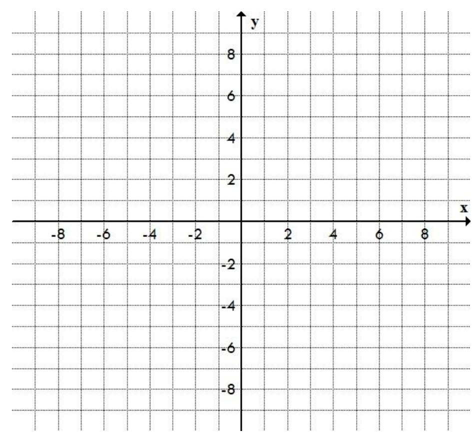
b)

x	*y*	1st Differences	2nd Differences
3	5		
4	6		
5	7		
6	8		
7	9		
8	10		
9	11		



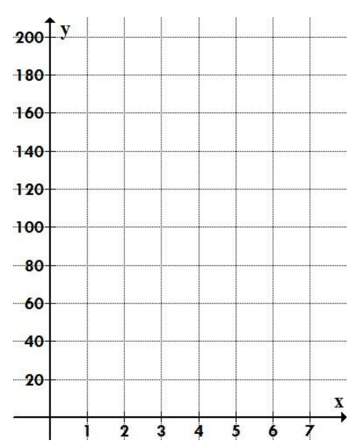
c)

x	*y*	1st Differences	2nd Differences
–3	–7		
–2	–2		
–1	1		
0	2		
1	1		
2	–2		
3	–7		



d)

x	*y*	1st Differences	2nd Differences
0	1		
1	2		
2	9		
3	28		
4	65		
5	126		
6	217		



2. 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?

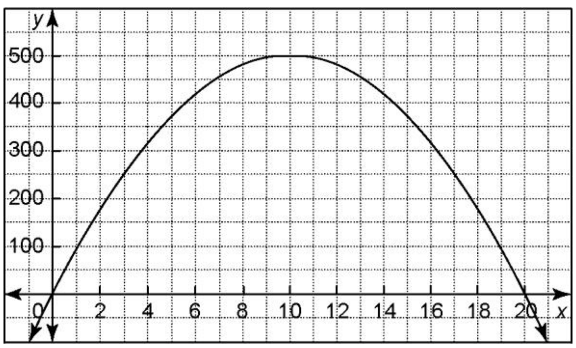
a) $y = x^3 + 4$ b) $y = 2x^2 + 5x - 6$

c) $y = 3x + 1$ d) $y = 6 + x^2$

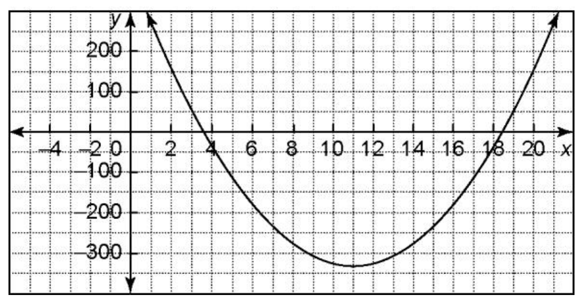
e) $y = x + 7$ f) $y = -4x^2 + 4$

4. Estimate the vertex value for each relation, and state if it is a maximum or a minimum.

a)



b)

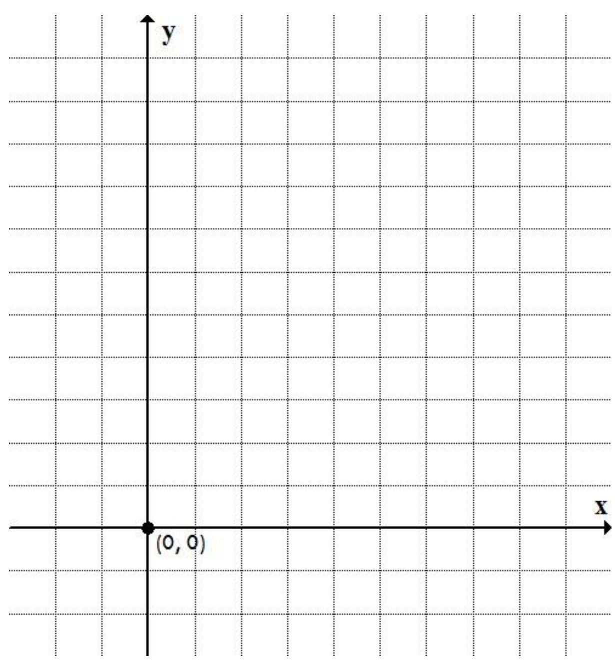


5. A box of food supplies is parachuted from a cargo plane over a remote village in Africa. The height, h, of the box, in metres, t seconds after being dropped from the plane is given by the relation:

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

a) Complete the table of values.

Time (s)	Height (m)
0	
10	
20	
30	
40	



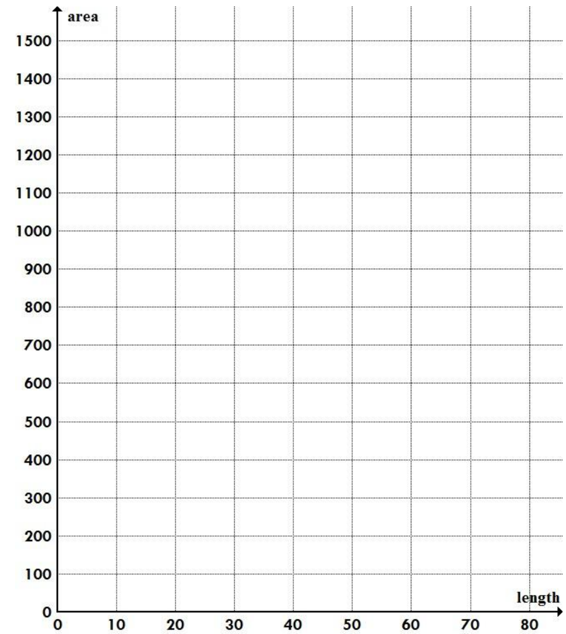
b) Graph the relation.

c) Is the relation quadratic? Explain.

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) Complete the table of values.

Length (m)	Width (m)	Perimeter (m)	Area (m^2)
70	10	160	
	20		
	30		
	40		
	50		
	60		
	70		



b) In the fourth column of the table, calculate the area for each pair of dimensions.

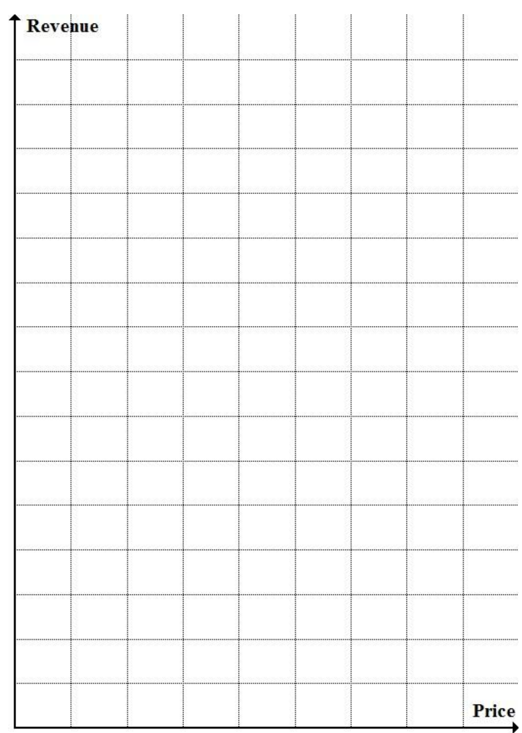
c) Draw a graph to compare the length and the area.

d) Use the graph to determine the dimensions of the playground with the greatest possible area.

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		
5		
6		
7		



b) Draw a graph to compare price and revenue.

c) Which price will result in a maximum revenue?

d) What is the maximum revenue?