Quadratic Relations Motivation | MFM2P

The school store decides to start selling cupcakes. Being in charge, you aren't sure exactly what to charge per cupcake, but you do know that you want to maximize the money you make.

Your teacher gave you this bit of market research:

"If you charge $2.00 per cupcake, you normally sell 10 every hour. Every time you lower the price by $0.10, you sell one more cupcake per hour. Every time you increase the price by $0.10, you sell one less cupcake per hour."

The question you need to ask is "What price should you charge per cupcake in order to make the most money possible?

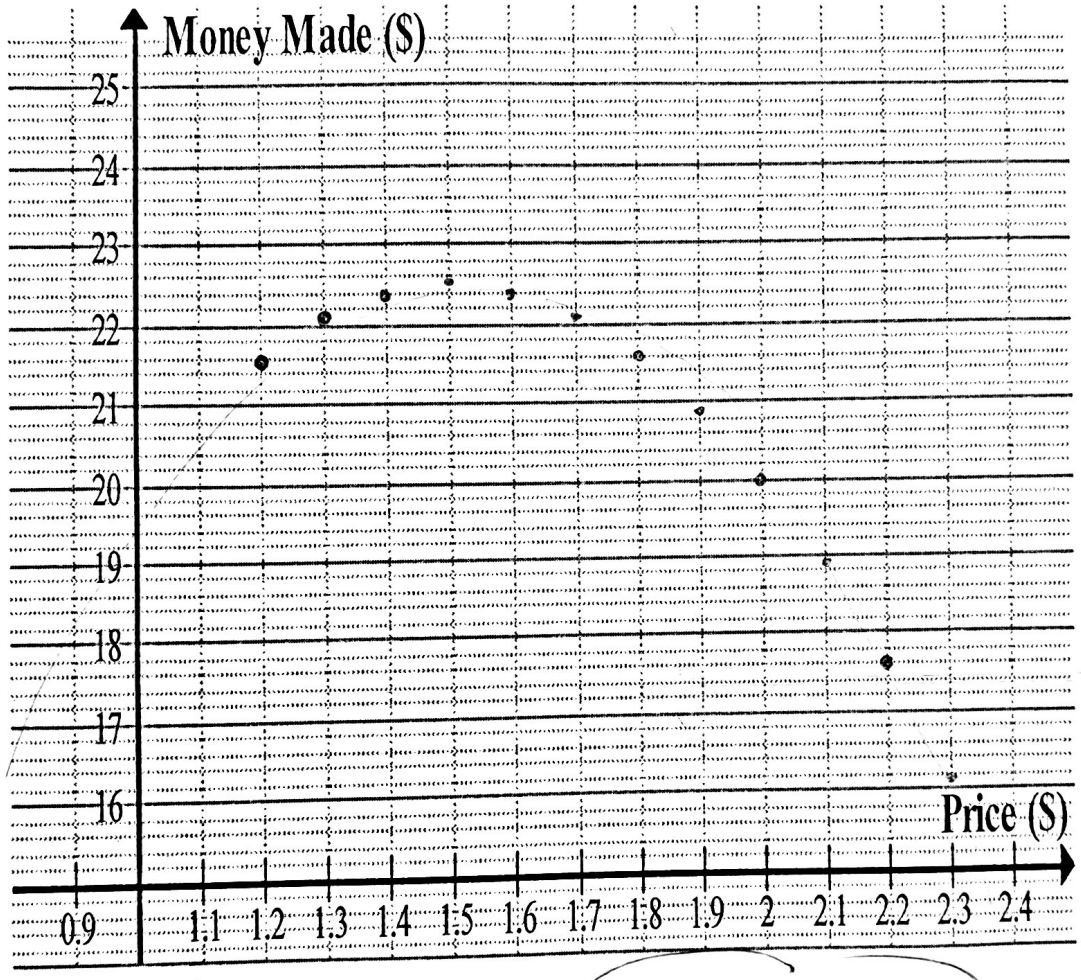
a) Fill in the table below to find out (start at 10 shirts and work up and down)

Price per Cupcake	Number of Cupcakes sold per hour	Total money made per hour (1^{st} × 2^{nd} columns)
$2.30	7	$16.10
$2.20	8	$17.60
$2.10	9	$18.90
$2.00	10	10 × $2.00 = $20.00
$1.90	11	$20.90
$1.80	12	$21.60
$1.70	13	$22.10
$1.60	14	$22.40
$1.50	15	$22.50
$1.40	16	$22.40
$1.30	17	$22.10
$1.20	18	$21.60

Conclusion: The maximum money of $22.50 is made per hour when you charge $1.50 per cupcake.

b) Plot the data from the other side on the grid below:

Cupcake Price vs. Money Made



c) Is this relationship a linear relationship or a non-linear relationship?

Investigation: Quadratic Relations | MFM2P

For the following 4 relations, describe the written rule, generate points using your table of values, and draw each graph.

Relation #1

y-values are...

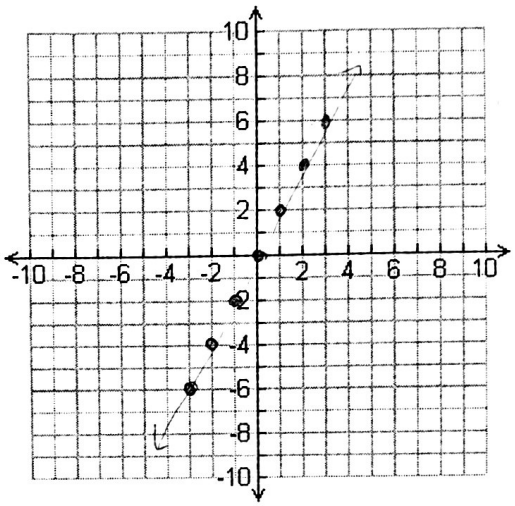
Equation: $y = 2x$

Written Rule:

double the x-values

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

Graph:



Relation #2

y-values are...

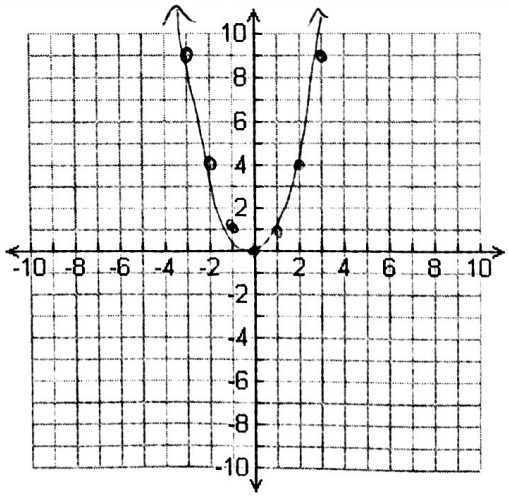
Equation: $y = x^2$

Written Rule:

the square of the x-values

x	y
-3	$(-3)^2 = 9$
-2	$(-2)^2 = 4$
-1	1
0	0
1	1
2	4
3	9

Graph:



Relation #3

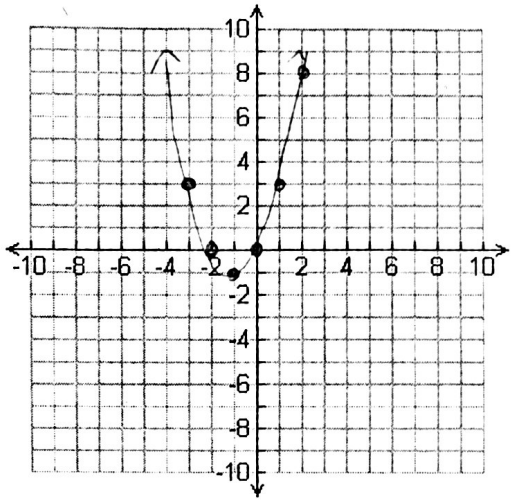
Equation: $y = x^2 + 2x$

y-values are...

Written Rule:
the squares of the x's plus double the x's

x	y
-3	9 - 6 = 3
-2	4 - 4 = 0
-1	1 - 2 = -1
0	0 + 0 = 0
1	1 + 2 = 3
2	4 + 4 = 8
3	9 + 6 = 15

Graph:



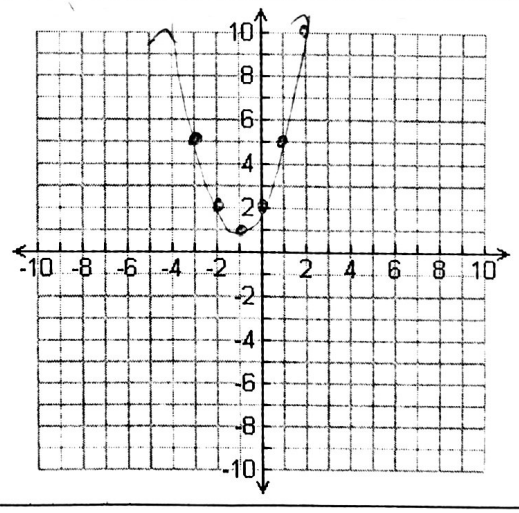
Relation #4

Equation: $y = x^2 + 2x + 2$

Written Rule:

x	y
-3	5
-2	2
-1	1
0	2
1	5
2	10
3	17

Graph:



The last 3 of these graphs represents a **quadratic relation.** Over the next few days we will be exploring:

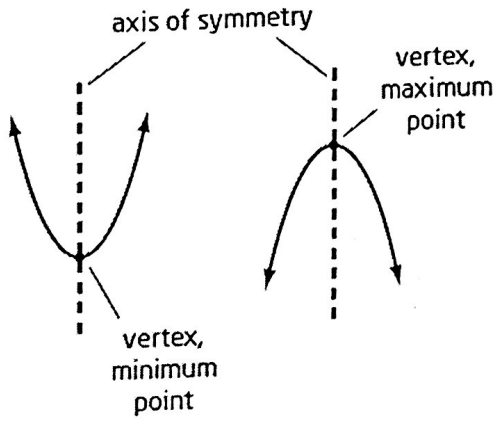
- Properties of Quadratic Relations
- Different Forms of Quadratic Relations
- How to Graph Quadratic Relations

Properties of Quadratic Relations | MFM2P

Summary:

1) Equations with "x^2" are quadratic relations

2) The graph of a quadratic relation is a parabola.



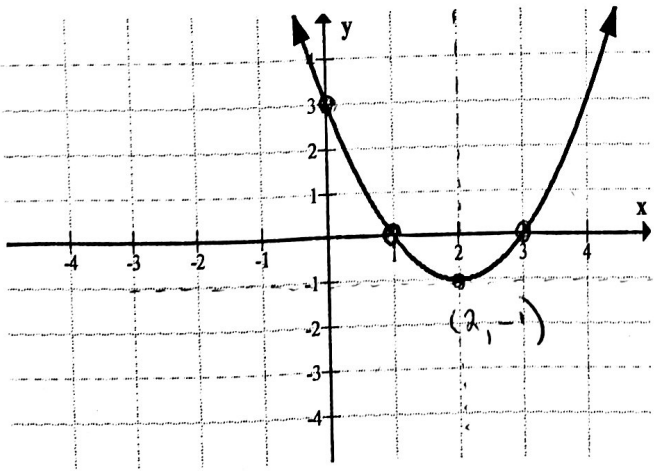
3) The vertex of a parabola is the highest or lowest point

4) Parabolas are symmetric. The axis of symmetry divides the parabola in half through the vertex.

Just like lines, parabolas can have x-intercepts (zeros) and a y-intercept. The highest or lowest y-value is called the optimum value.

Example: State the properties of the following quadratic relations?

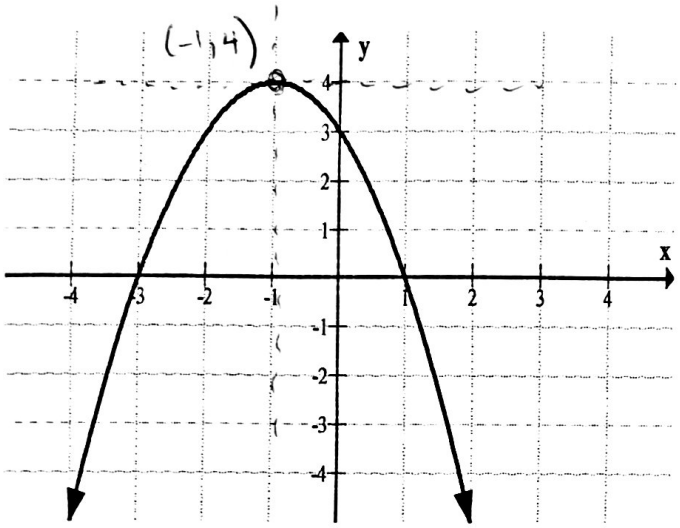
a)



Vertex	(2, -1)
x-intercepts	(1, 0) & (3, 0)
y-intercept	(0, 3)
Axis of Symmetry	x = 2
Optimal Value	y = -1

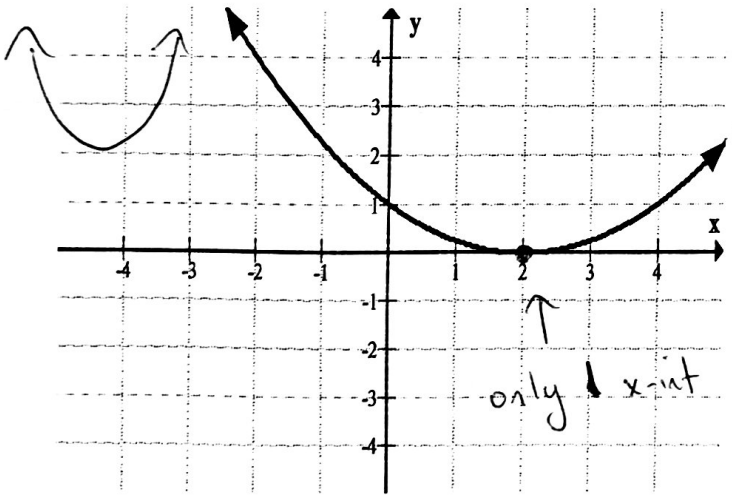
} vertex

b)



Vertex	$(-1, 4)$
x-intercepts	-3 & 1
y-intercept	3
Axis of Symmetry	$x = -1$
Optimal Value	$y = 4$

c)



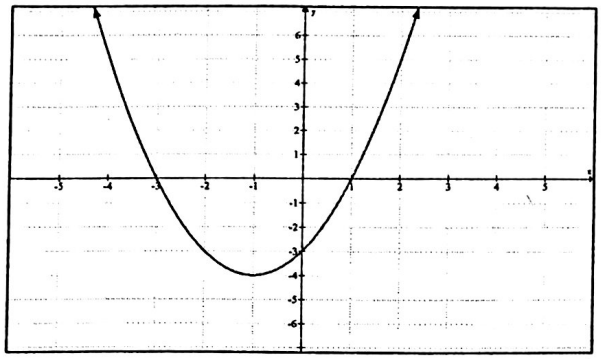
← point

Vertex	$(2, 0)$
x-intercepts	$(2, 0)$ only one
y-intercept	$(0, 1)$
Axis of Symmetry	$x = 2$ } VERTEX
Optimal Value	$y = 0$ } VERTEX

Practice: Key Features of a Parabola | MFM2P

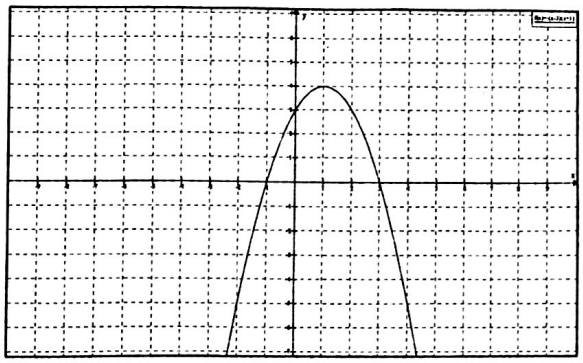
Identify all the key parts of the following parabolas. There may be some surprises!!!

a)



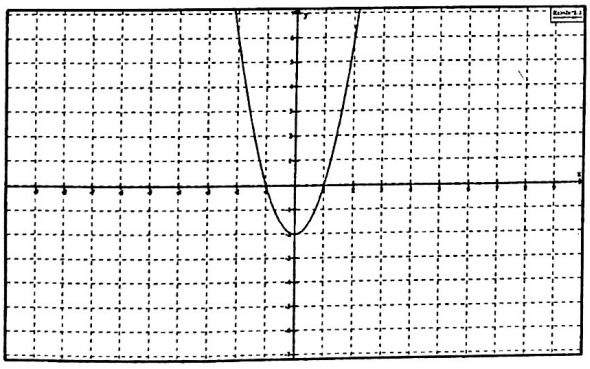
Vertex	$(-1, -4)$
x-intercepts/zeros	-3 & 1
y-intercept	$(0, -3)$
Axis of Symmetry	$x = -1$
Direction of Opening	↑
Optimal Value	$y = -4$

b)



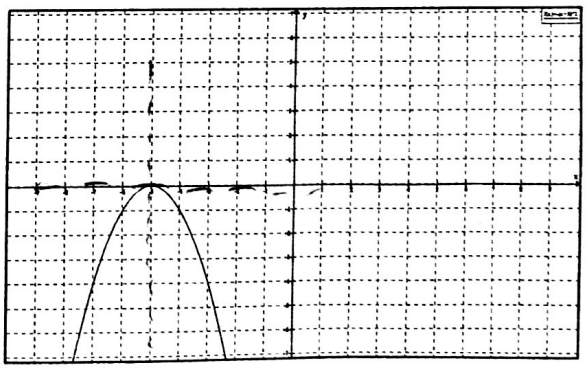
Vertex	$(1, 4)$
x-intercepts/zeros	-1 & 3
y-intercept	$(0, 3)$
Axis of Symmetry	$x = 1$
Direction of Opening	↓
Optimal Value	$y = 4$

c)



Vertex	$(0, -2)$
x-intercepts/zeros	-1 & 1
y-intercept	$(0, 2)$
Axis of Symmetry	$x = 0$
Direction of Opening	↑
Optimal Value	$y = -2$

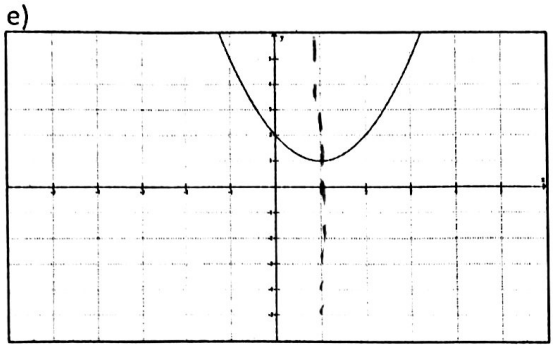
d)



Vertex	$(-5, 0)$
x-intercepts/zeros	$(-5, 0)$
y-intercept	N/A (too low)
Axis of Symmetry	$x = -5$
Direction of Opening	↓
Optimal Value	$y = 0$

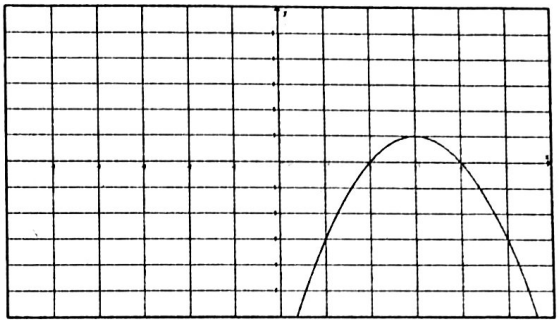
Practice: Key Features of a Parabola | MFM2P

e)



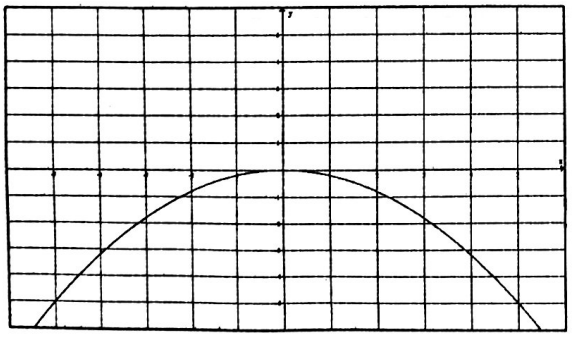
Vertex	(1, 1)
x-intercepts/zeros	None
y-intercept	(0, 2)
Axis of Symmetry	$x = 1$
Direction of Opening	↑
Optimal Value	$y = 1$

f)



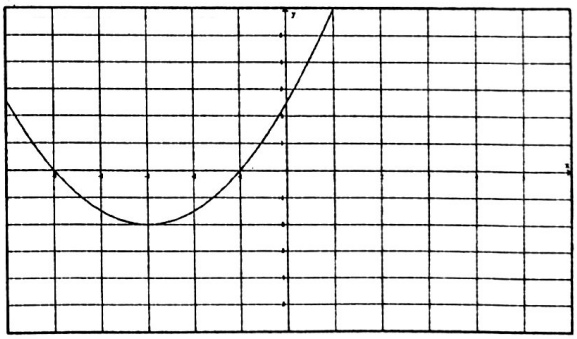
Vertex	(3, 1)
x-intercepts/zeros	2 & 4
y-intercept	N/A (too low)
Axis of Symmetry	$x = 3$
Direction of Opening	↓
Optimal Value	$y = 1$

g)



Vertex	(0, 0)
x-intercepts/zeros	(0, 0) ONLY ONE
y-intercept	(0, 0)
Axis of Symmetry	$x = 0$
Direction of Opening	↓
Optimal Value	$y = 0$

h)



Vertex	(−3, −2)
x-intercepts/zeros	−5 and −1
y-intercept	(0, 2.5)
Axis of Symmetry	$x = -3$
Direction of Opening	↑
Optimal Value	$y = -2$