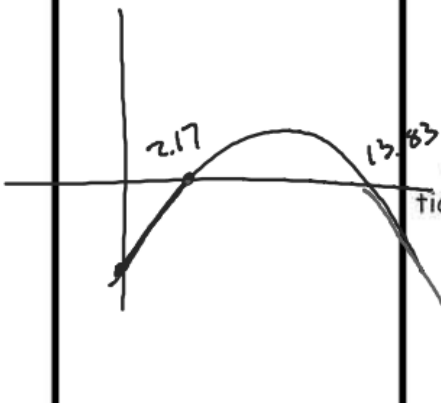
The **Break-even point** is the ticket price for which the event's income will equal expenses. Another way to think of the break-even point is the ticket price when profit is zero.

a. Write and solve an equation that can be used to find the break-even ticket price for this particular planned concert.

b. Write and solve an inequality that can be used to find ticket prices for which the planned concert will make a positive profit.

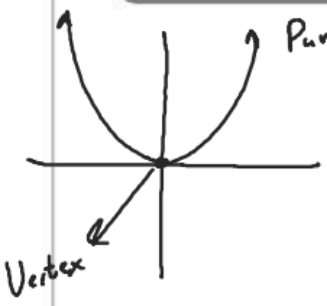
$2.17 < x < 13.83$



c. Write and solve an inequality that can be used to find ticket prices for which the planned concert will lose money.

$0 \leq x < 2.17$ or $x > 13.83$

What you will learn about:
How to predict the shape of and location of graphs of quadratic functions



1. Study the tables and graphs produced by such functions for several combinations of positive and negative numbers.

Set 1		Set 2	
Y_1	$y = x^2$ (parent function)	Y_4	$y = -x^2$
Y_2	$y = 4x^2$		$y = -\frac{1}{2}x^2$
Y_3	$y = \frac{1}{3}x^2$		$y = 3x^2$

a. Using Set 1 how is the graph of $y = ax^2$ compared to the graph of $y = x^2$.

$a > 1$ Graph gets skinnier
Vertical Stretch

$0 < a < 1$ Graph gets wider
Vertical Compression

b. Using Set 2 how is the graph of $y = ax^2$ compared to the graph of $y = x^2$.

$a > 0$ opens up (Vertex min)

$a < 0$ opens down → Reflection over x-axis
(Vertex max)

C. Explain the effects that the coefficient a has on the quadratic function $y = ax^2$.

$Y = X^2$

$Y = 4x^2$
Vertical Stretch by a factor of 4

$Y = \frac{1}{3}x^2$
Vertical Compression by factor of $\frac{1}{3}$

$Y = -\frac{1}{2}x^2$
- Reflection over x-axis
- Vertical Compression by factor of $\frac{1}{2}$

Adding a Constant

2. Study the tables and graphs produced by such functions for several combinations of positive and negative numbers

Set 1	**Set 2**	**Set 3**
$y = x^2$	$y = -x^2$	$y = 2x^2$
$y = x^2 + 3$	$y = -x^2 + 5$	$y = 2x^2 + 1$
$y = x^2 - 4$	$y = -x^2 - 1$	$y = 2x^2 - 3$

a. How is the graph of $y = ax^2 + c$ related to the graph of $y = ax^2$?

$c > 0$ Vertical shift up

$c < 0$ Vertical Shift Down

b. How is the relationship between $y = ax^2 + c$ and $y = ax^2$ shown in the tables (x, y) values for the functions?

$y = x^2$

x	y
-1	1
0	0
1	1
2	4
3	9

$y = x^2 + 3$

x	y
-1	4
0	3
1	4
2	7
3	12

Factored and Expanded Forms

When you studied problems about income from an amusement park bungee jump and promotion of a concert, you looked at functions relating income to ticket price. The resulting income rules has similar forms:

Bungee Jump: $I = p(50 - p)$

Concert Promotion: $I = x(4{,}000 - 250x)$

Just as you did in early courses you can apply properties of numbers and operations to rewrite these rules in equivalent expanded form.

Standard Form

ax^2+bx+c

$p(50-p)$

$p=0$ $\quad 50-p=0$

$+p \quad +p$

$50=p$

3. a. Using the distributive property rewrite the rule $I = p(50 - p)$ in expanded form. *Write your answer in standard form.*

$p(50-p)$

$50p-p^2 \Rightarrow -p^2+50p$ $\quad b=50$ $\quad a=-1$

b. Use similar ideas to rewrite ideas $x(4{,}000 - 250x)$ in an equivalent expanded form. *Write you answer in standard form.*

$x(4000-250x)$

$4000x-250x^2$

$-250x^2+4000x+0$

$x(4000-250x)$ $\quad \frac{-b}{2a}=\frac{-50}{2(-1)}$

$X=0$ $\quad 4000-250x=0$

$+250x \quad +250x$

$\frac{4000}{250}=\frac{250x}{250}$

$x=16$

c. Study the graphs of the two income functions: $I = p(50 - p)$and $I = x(4{,}000 - 250x)$. In each case, find the coordinates of:

i. the y-intercepts

Bungee: $(0,0)$ $\quad$ Concert: $(0,0)$

ii. the x-intercepts

Bungee: $(0,0)$ $(50,0)$ $\quad$ Concert: $(0,0)$ $(16,0)$

iii. the maximum point

Bungee: $(25,625)$ $\quad$ $(8,16{,}000)$

d. How could you find these special points in part b by analyzing the symbolic function rules in factored and/or expanded forms?

ax^2+bx+c

- Standard Form
  y-intercept "c" value
- x-value of vertex
  $x=-\frac{b}{2a}$
- x-intercepts
  Set equal to zero solve

Factored form

- x-intercepts
  set each factor equal to zero and solve.
- y-intercept Let variable equal zero.
- Vertex halfway between intercepts