3.4

3.4 GRAPHING $f(x)=a(x-h)^2+k$

Objective Today we will identify EVEN & ODD Functions and we will graph quadratics of the form $f(x)=a(x-h)^2+k$.

Warm-up

Tell whether the function $f(x) = -6x^2 + 24x - 8$ has a minimum value or a Maximum value. Then find the value.

Notes

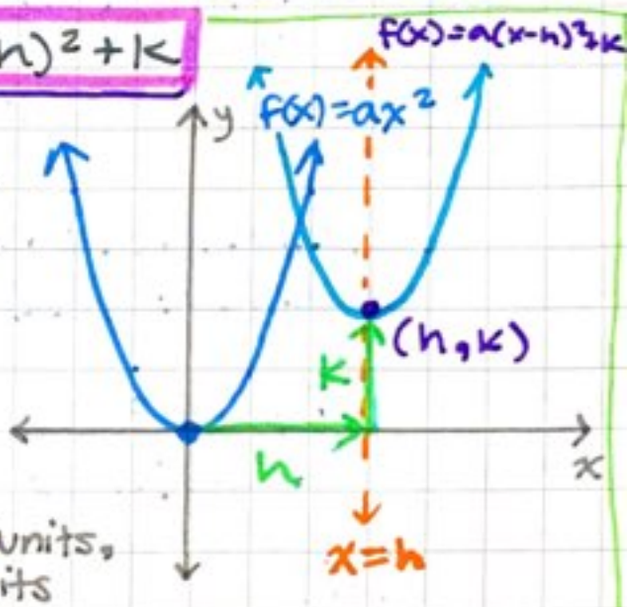
EVEN/ODD Functions

- **EVEN**: a function is **EVEN** when $f(-x) = f(x)$, (it is symmetric with respect to the y-axis).
- **ODD**: a function is **ODD** when $f(-x) = -f(x)$, (it has a Rotational Symmetry of 180° about the origin.)

GRAPHING $f(x) = a(x-h)^2 + k$

- The **VERTEX FORM** of a quadratic function is $f(x) = a(x-h)^2 + k$, where $a \neq 0$.
  - VERTEX: (h, k)
  - Axis of Symm: $x = h$

* HORIZontal translation h units, VERTical translation of k units from $f(x) = ax^2$. *



Practice Problems

Determine whether the function is even, odd, or neither.

⑤ $f(x) = 4x + 3$

EVEN IF $f(-x) = f(x)$

$f(-x) = 4(-x) + 3 = -4x + 3$

$f(x) \neq f(-x)$

ODD IF $f(-x) = -f(x)$

$-f(x) = -[4x + 3] = -4x - 3$

$f(-x) \neq -f(x)$

NEITHER

⑨ $p(x) = -x^2 + 8$

EVEN IF $p(-x) = p(x)$

$p(-x) = -(-x)^2 + 8$

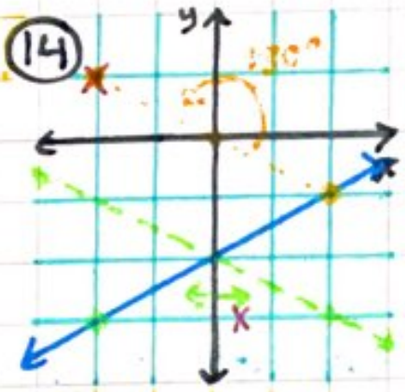
$= -x^2 + 8$

$p(-x) = p(x)$ ✓

$\Rightarrow$ EVEN

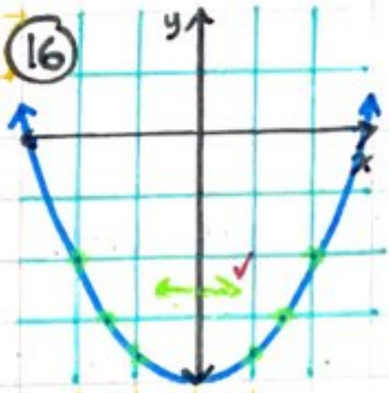
Determine whether the function represented by the graph is even, odd, or neither.

(14)



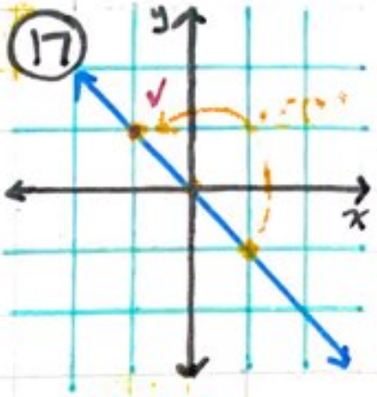
NEITHER

(16)



EVEN
(symm. about y-axis)

(17)



ODD
(Rot. Symm. of 180° about origin)

Find the VERTEX and the Axis of Symmetry of the graph of the function.

(20) $f(x) = \frac{1}{4}(x-6)^2$

V: (6, 0)

Axis of Symm: $x = 6$

(21) $y = -\frac{1}{8}(x-4)^2$

V: (4, 0)

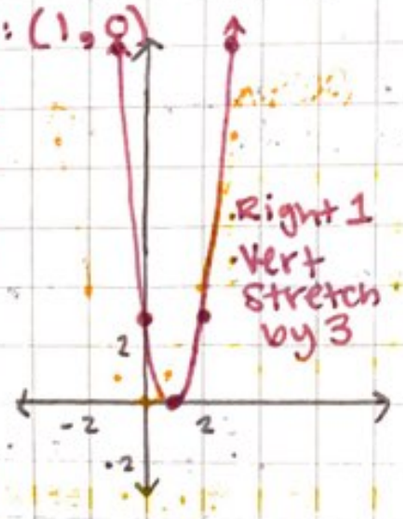
A. of Symm: $x = 4$

Graph the function. Compare the graph to the graph of $f(x) = x^2$.

(24) $p(x) = 3(x-1)^2$

V: (1, 0)

x	p
-1	12
0	3
1	0
2	3
3	12

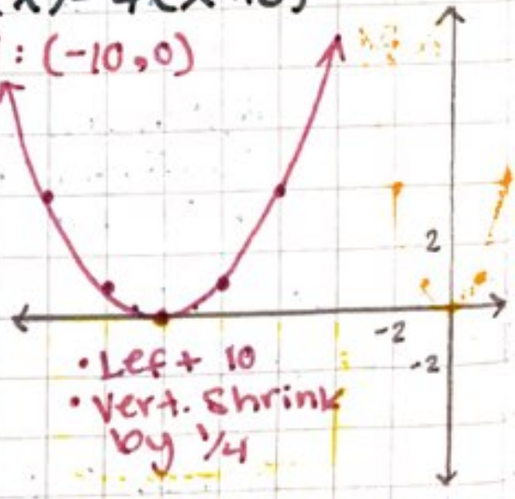


• Right 1
• Vert stretch by 3

(25) $r(x) = \frac{1}{4}(x+10)^2$

V: (-10, 0)

x	r
-12	1
-11	1/4
-10	0
-9	1/4
-8	1
-6	4



• Left 10
• Vert. Shrink by 1/4

Find the VERTEX and Axis of Symmetry of the graph of the function.

(33) $f(x) = -4(x+3)^2 + 1$

V: (-3, 1)

A.o.S: $x = -3$

(34) $y = -(x-6)^2 - 5$

V: (6, -5)

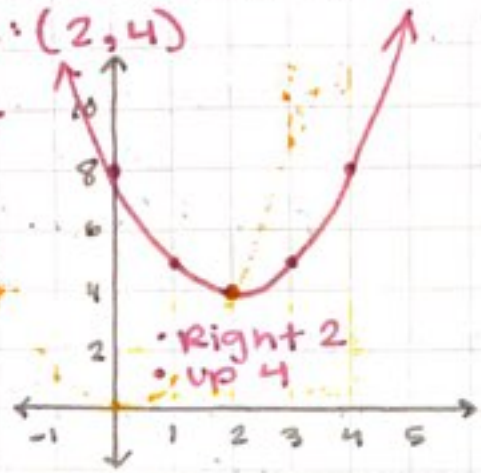
A.o.S: $x = 6$

Graph the function. Compare the graph to the graph of $f(x)=x^2$.

(39) $h(x)=(x-2)^2+4$

V: (2, 4)

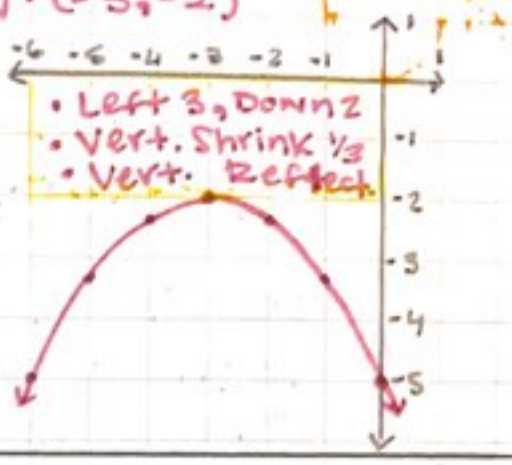
x	h
0	8
1	5
2	4
3	5
4	8



(43) $g(x)=-\frac{1}{3}(x+3)^2-2$

V: (-3, -2)

x	g
-5	$-1\frac{1}{3}$
-4	$-\frac{1}{3}$
-3	-2
-2	$-\frac{1}{3}$
-1	$-1\frac{1}{3}$
0	-5



HW 3.4a (Pg. 150) # 6, 8, 10, 13, 15, 18, 19, 22, 23, 26, 31, 32, 40, 41

3.4 Day 2

Warm-up

Graph $g(x)=-(x+3)^2-1$. Compare the graph to the graph of $f(x)=x^2$.

Notes/ Practice Problems

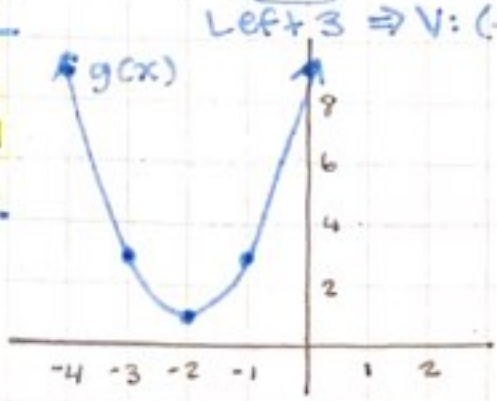
Graph g.

(49) $f(x)=2(x-1)^2+1$ V: (1, 1)

$g(x)=f(x+3)$

x	f	g
-4		9
-3		3
-2		1
-1	9	3
0	3	9
1	1	
2	3	
3	9	

Left 3 ⇒ V: (-2, 1)

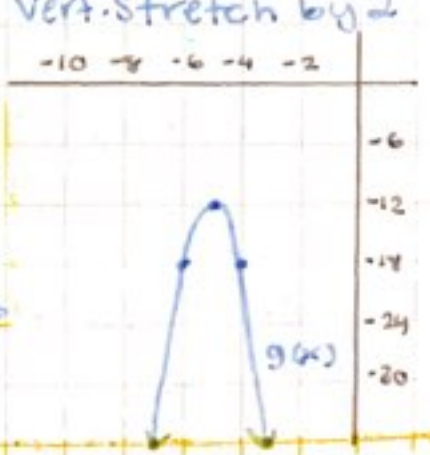


(51) $f(x)=-3(x+5)^2-6$ V: (-5, -6)

$g(x)=2f(x)$

x	f	g
-7	-18	-36
-6	-9	-18
-5	-6	-12
-4	-9	-18
-3	-18	-36

Vert. Stretch by 2



Write a quadratic function in Vertex Form whose graph has the given Vertex & passes through the point:

(57) V: (h, k) = (1, 2) Point: (x, y) = (3, 10) $f(x)=a(x-h)^2+k$

$10=a(3-1)^2+2$

$10=4a+2$

$8=4a$

$2=a$

$f(x)=2(x-1)^2+2$

Rewrite the quadratic in vertex form.

$f(x) = a(x-h)^2 + k \rightarrow$

(66) $y = 3x^2 + 6x - 1$

$a = 3$

$h = \frac{-b}{2a} = \frac{-6}{2(3)} = -1 = h$

$k = 3(-1)^2 + 6(-1) - 1$

$= 3 - 6 - 1 = -4 = k$

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

(67) $f(x) = -5x^2 + 10x + 3$

$a = -5$

$h = \frac{-10}{2(-5)} = 1 = h$

$k = f(1) = -5(1)^2 + 10(1) + 3$

$= -5 + 10 + 3 = 8 = k$

$f(x) = -5(x-1)^2 + 8$

Describe the transformation from the graph of f to the graph of h. Write an equation that represents h in terms of x.

(71) $f(x) = -(x+1)^2 - 2$

$h(x) = f(x) + 4$

Translated up 4

$h(x) = [-(x+1)^2 - 2] + 4$

$h(x) = -(x+1)^2 + 2$

(74) $f(x) = -(x+5)^2 - 6$

$h(x) = \frac{1}{3} f(x)$

Vert. shrink by 1/3

$h(x) = \frac{1}{3}[-(x+5)^2 - 6]$

$h(x) = -\frac{1}{3}(x+5)^2 - 2$

HW 3.4b (Pg. 150) #50, 53, 55, 58-60, 63, 65, 68, 72

3.5 Vocab.

3.5

3.5 GRAPHING $f(x) = a(x-p)(x-q)$

Objective: Today we will graph quadratic functions of the form $f(x) = a(x-p)(x-q)$ & use intercept form to find zeros.

Warm-up

Solve the equations.

(1) $x(x-1) = 0$

(3) $(3x-9)(4x+12) = 0$

(2) $(x+3)(x-8) = 0$

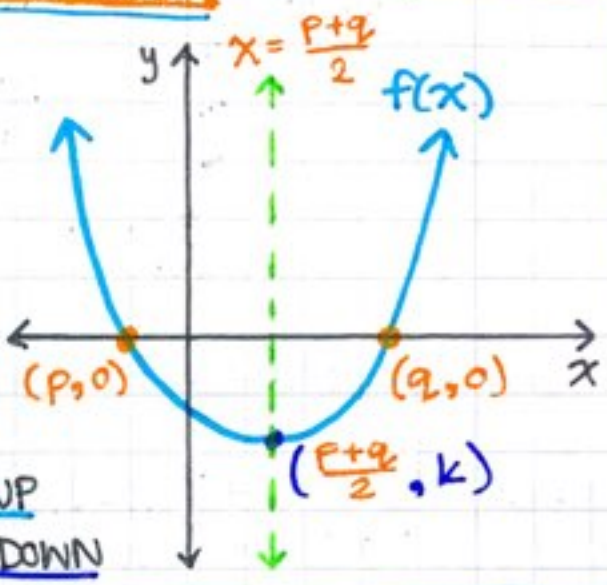
Notes

The **INTERCEPT FORM** of a quadratic function is $f(x) = a(x-p)(x-q)$

where $a \neq 0$ and the x-intercepts are at $(p,0)$ and $(q,0)$. (The ZEROS are $x=p$ & $x=q$)

GRAPHING $f(x) = a(x-p)(x-q)$

1. x-intercepts: $(p,0)$ & $(q,0)$
2. Axis of Symmetry: (HALFWAY between x-ints) $x = \frac{p+q}{2} = h$
3. IF $a>0$, Then OPENS UP
   IF $a<0$, Then OPENS DOWN



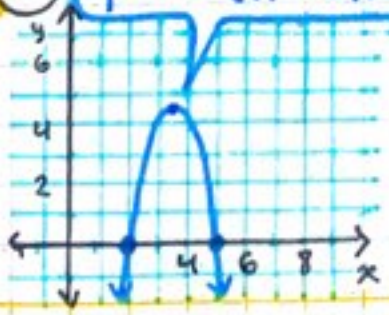
FACTORS and ZEROS

For ANY FACTOR $(x-n)$ of a polynomial, n is a ZERO of the function defined by the polynomial.

Practice Problems

Find the x-intercepts and axis of symmetry of the graph of the function.

(4) $y = -2(x-2)(x-5)$



$(2,0)$
$(5,0)$
$x = \frac{7}{2}$

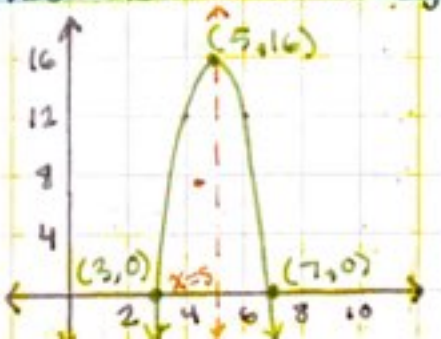
(5) $f(x) = -5(x+7)(x-5)$

$x+7=0 \quad x-5=0$
$x=-7 \quad x=5$
$(-7,0)$ & $(5,0)$
$x = \frac{-7+5}{2} \Rightarrow x=-1$

Graph the quadratic function. Label the vertex, x-intercepts, and axis of symmetry. Describe the Domain & Range.

(10) $h(x) = -4(x-7)(x-3)$

$(7,0)$ & $(3,0)$
$x=5 = h \quad k = h(5) = 16$
$V: (5,16)$
$D: \mathbb{R} \quad R: y \leq 16$



(16) $y = 3x^2 - 48$

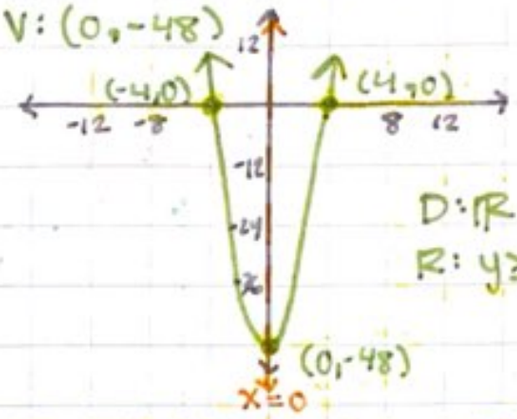
$0 = 3x^2 - 48$

$0 = 3(x^2 - 16)$

$0 = 3(x+4)(x-4)$

x-int: $(-4,0)$ & $(4,0)$ A.o.S: $x=0$

V: $(0,-48)$



(17) $g(x) = x^2 + 9x + 14$

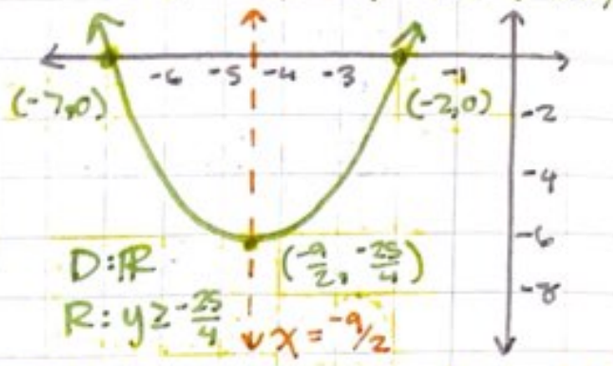
$0 = x^2 + 9x + 14$

$0 = (x+7)(x+2)$

x-int: $(-7,0)$ & $(-2,0)$

A.o.S: $x = -9/2$

V: $(-9/2, -25/4) = (-4.5, -6.25)$



Find the zero(s) of the function.

HW 3.5a (Pg. 198) #3, 6, 8, 11, 13, 18, 19, 21, 24, 27

(22) $f(x) = \frac{1}{3}(x+5)(x-1)$

$0 = \frac{1}{3}(x+5)(x-1)$

$x = -5$ $x = 1$

(28) $g(x) = -4x^2 - 8x - 4$

$0 = -4(x^2 + 2x + 1)$

$0 = -4(x+1)^2 \Rightarrow x = -1$

3.5 Day 2

Warm-up

Graph $f(x) = (x-2)(x+4)$. Describe the domain & range.

Notes/ Practice Problems

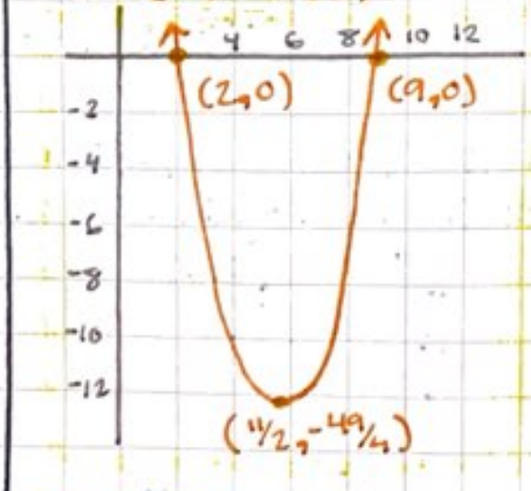
Use the zeros to graph the function.

(37) $y = x^2 - 11x + 18$

$0 = (x-2)(x-9)$

$x = 2$ $x = 9$ $h = \frac{2+9}{2} = \frac{11}{2}$

$k = (\frac{11}{2})^2 - 11(\frac{11}{2}) + 18 = -\frac{49}{4}$

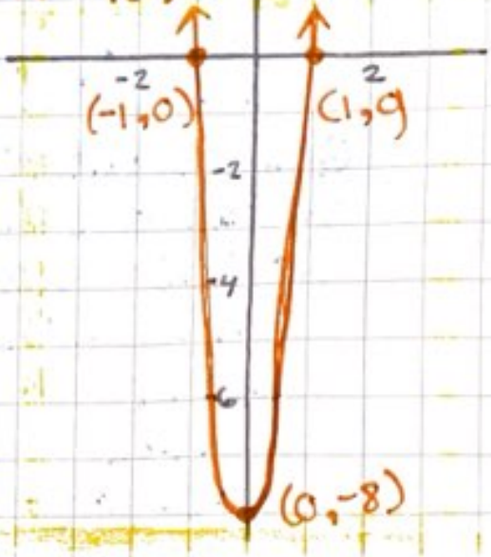


(40) $h(x) = 8x^2 - 8$

$0 = 8(x^2 - 1) = 8(x+1)(x-1)$

$x = -1$ $x = 1$ $h = 0$

$k = h(0) = -8$



Write a quadratic function in standard form whose graph satisfies the given condition(s). ↑ $f(x)=ax^2+bx+c$

44 Vertex: $(\overset{h}{4},\overset{k}{8})$ $a=1$

$f(x)=a(x-h)^2+k$

$=1(x-4)^2+8$

$=x^2-8x+16+8$

$f(x)=x^2-8x+24$

45 x-intercepts: $\overset{p}{1}$ and $\overset{q}{9}$ $a=1$

$f(x)=a(x-p)(x-q)$

$=1(x-1)(x-9)$

$=x^2-9x-x+9$

$f(x)=x^2-10x+9$

47 Passes through $(-4,0)$, $(3,0)$, and $(2,-18)$ (x, y)

$f(x)=a(x-p)(x-q)$ x-int: $p=-4$ $q=3$

$-18=a(2+4)(2-3) \Rightarrow -18=-6a \Rightarrow a=3$

$f(x)=3(x+4)(x-3)=3(x^2+x-12) \Rightarrow f(x)=3x^2+3x-36$

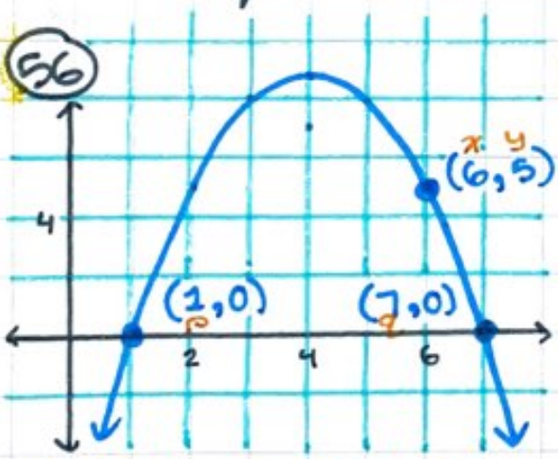
52 y INCREASES as x increases when $x<4$; y DECREASES as x increases when $x>4$. $h=4$ Let $k=0$ $a=(-1)$

$f(x)=a(x-h)^2+k$

$f(x)=-(x-4)^2 \Rightarrow f(x)=-x^2+8x-16$ ($x=4$) ← opens DOWN

Write the quadratic function represented by the graph.

56



$f(x)=a(x-p)(x-q)$

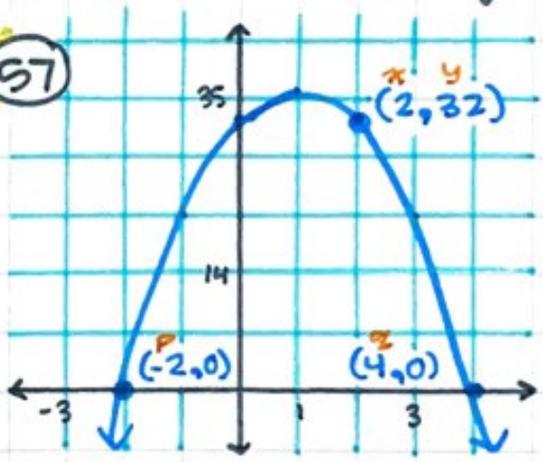
$5=a(6-1)(6-7)$

$5=-5a \Rightarrow a=-1$

$f(x)=-(x-1)(x-7)$

$f(x)=-x^2+8x-7$

57



$f(x)=a(x+2)(x-4)$

$32=a(2+2)(2-4)$

$32=-8a \Rightarrow a=-4$

$f(x)=-4(x+2)(x-4)$

$f(x)=-4x^2+8x+32$

HW 3.5b (Pg. 158) #34, 38, 39, 41, 43, 46, 48, 51, 55, 58, 61, 66-70

Stoplight Reflection

Review your Classwork, NOTES, & HW. Then Answer:

- What do I NEED to RELEARN/STUDY FIRST?
- What do I THINK I KNOW?
- What do I KNOW ... with confidence?