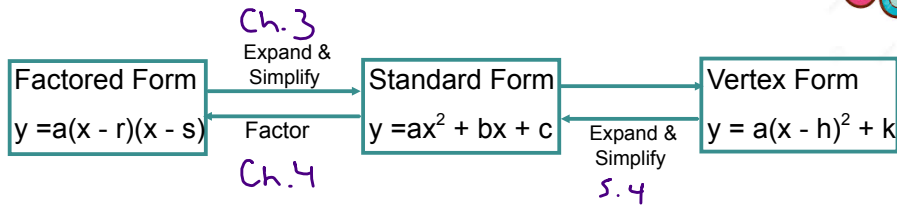


Date: \_\_\_\_\_

### 5.5 Solving Problems Using Quadratic Relations



- 1) How can we get from factored form to vertex form? *Find vertex, sub in for h & k (use a value)*
- 2) What about from standard form to vertex form? *Factor, then find the vertex + write in vertex form*
- 3) Can every expression in vertex form be written in factored form? *No - not every parabola has zeros (can't factor!) - not all zeros are nice numbers*

#### Finding Zeros Given an Equation in Vertex Form

Think about what we already know. If you have the relation  $y = -2(x - 3)^2 + 8$ , how can you find its zeros?

*x-intercepts: let y=0*

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

$$-2(x-3)^2 = -8$$

$$\frac{-2(x-3)^2}{-2} = \frac{-8}{-2}$$

$$(x-3)^2 = 4$$

*A twist to square roots →*

$$\sqrt{(x-3)^2} = \pm\sqrt{4}$$

$$x-3 = \pm 2$$

$$x-3 = 2 \rightarrow x = 5$$

$$x-3 = -2 \rightarrow x = 1$$

*(2)^2 = 4      (-2)^2 = 4*

Try to use the same process to find the zeros for  $y = 2(x - 3)^2 + 8$ . What happens?

*Let y=0: 2(x-3)^2 + 8 = 0*

$$2(x-3)^2 = -8$$

$$\frac{2(x-3)^2}{2} = \frac{-8}{2}$$

$$(x-3)^2 = -4$$

$$\sqrt{(x-3)^2} = \pm\sqrt{-4}$$

$$x-3 = \pm\sqrt{-4} \leftarrow \text{impossible!}$$

*∴ There are no zeros.*

How can you tell how many zeros a parabola has by looking at a relation in vertex form?

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

- When  $a + k$  have the same sign → no zeros
- When  $a + k$  " opposite signs → two zeros
- When  $k = 0$ , one zero



## More Practice

- 1) Determine the values of  $a$  and  $b$  in  $y = ax^2 + bx + 8$  if the vertex is located at  $(1, 7)$ .

$h, k$

$$y = a(x-h)^2 + k \quad \text{vertex } (h, k) \quad y = mt + b$$

$$8 = a(0-1)^2 + 7 \quad y = (x-1)^2 + 7$$

$$8 = (-1)^2 a + 7 \quad \text{C+S} \quad (0, 8) \quad a = 1$$

$$1 = 1a \quad y = (x-1)(x-1) + 7 \quad (x, y) \quad b = -2$$

$$a = 1 \quad = x^2 - x - x + 1 + 7$$

$$= x^2 - 2x + 8 \quad \leftarrow \text{Standard form}$$

- 2) A ticket to a school dance is usually \$6 and 250 students attend. The social committee knows that for every \$1 increase in the price of a ticket, 25 fewer students will attend the dance. Determine a quadratic relation to model the revenue, and then determine the price that maximizes revenue.

Let  $x$  be the # of \$1 price increases.

Price =  $6 + 1x$       Quantity =  $250 - 25x$       Price  $\times$  quantity

$R = (6+x)(250-25x)$  ( $\leftarrow$  factored form)

We need  $x$ -coord of vertex.  $x + 6 = 0$       A of S  
 $x = -6$        $x = \frac{-b \pm 10}{2}$

So find zeros, then a of S.  $25x + 250 = 0$   
 $(-6, 0), (10, 0)$        $-25x = -250$        $x = 2$   
 $x = 10$

$\therefore$  They need to increase the price twice and change \$8.

- 3) A quadratic relation  $y = -2(x-5)^2 + 2$  is reflected over the  $x$ -axis and translated 4 units left and 5 units down. Write the equation of the resulting relationship in vertex and standard form. How many zeros do you expect this parabola to have?

① Graph  $y = -2(x-5)^2 + 2$

② Apply transformation.

③ Equations

$y = 2(x-1)^2 - 7$  ( $\leftarrow$  vertex)

$y = 2(x-1)(x-1) - 7$

$= 2(x^2 - x - x + 1) - 7$

$= 2(x^2 - 2x + 1) - 7$

$= 2x^2 - 4x + 2 - 7$

$= 2x^2 - 4x - 5$  ( $\leftarrow$  standard)

