I. GRAPHING FORM FOR PARABOLAS

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

A. • WHEN "a" IS POSITIVE THE PARABOLA WILL OPEN UPWARD

• WHEN "a" IS NEGATIVE THE PARABOLA WILL OPEN DOWNWARD

B. IF $|a|$ IS A PROPER FRACTION, THE PARABOLA WILL BE OBTUSE.

IF $|a|$ IS EQUAL TO 1, THE PARABOLA WILL BE STANDARD.

IF $|a|$ IS GREATER THAN 1, THE PARABOLA WILL BE ACUTE.

C. VERTEX (h, k)

↳ k: TAKE THE VALUE PROVIDED IN THE EQUATION.

↳ h: TAKE THE OPPOSITE VALUE IN THE PARENTHESES.

• WHEN THE PARABOLA OPENS UPWARD THE VERTEX WILL CONTAIN THE MINIMUM y-VALUE FOR THE PARABOLA.

• WHEN THE PARABOLA OPENS DOWNWARD THE VERTEX WILL CONTAIN THE MAXIMUM y-VALUE FOR THE PARABOLA.

D. Δx – USING THE VERTEX AS THE CENTER POINT IN A t-CHART USE THE Δx VALUE TO COUNT IN THE x COLUMN OF THE t-CHART.

• Δx WILL BE THE DENOMINATOR OF THE "a" COEFFICIENT.

II PREDICTING PARABOLIC BEHAVIOR

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

- OPENS DOWNWARD
- OBTUSE OPENING
- VERTEX $(2,5)$ MAX
- $\Delta x = 3$

x	y	
-4	-7	$= -\frac{1}{3}(-4-2)^2+5$
-1	2	$= -\frac{1}{3}(-1-2)^2+5$
2	5	
5	2	
8	-7	

* y-VALUES ARE SYMMETRIC ABOUT THE VERTEX.

Ex 2 $y = \frac{1}{4}(x+3)^2 - 1$

- OPENS UPWARD
- OBTUSE OPENING
- VERTEX $(-3,-1)$ MIN
- $\Delta x = 4$

x	y	
-11	15	$\frac{1}{4}(-11+3)^2-1$
-7	3	$\frac{1}{4}(-7+3)^2-1$
-3	-1	
1	3	
5	15	

Ex 3 $y = -7(x+1)^2 - 3$

- OPENS DOWNWARD
- ACUTE OPENING
- VERTEX $(-1,-3)$ MAX
- $\Delta x = 1$

x	y	
-3	-31	$-7(-3+1)^2-3$
-2	-10	$-7(-2+1)^2-3$
-1	-3	
0	-10	
1	-31	

Ex 4 $y = 2(x-5)^2 + 3$

- OPENS UPWARD
- ACUTE OPENING
- VERTEX (5, 3) MIN
- $\Delta x = 1$

x	y	
3	11	$2(3-5)^2+3$
4	5	$2(4-5)^2+3$
5	3	
6	5	
7	11	

Ex 5 $y = -(x-3)^2 + 1$

- OPENS DOWNWARD
- STANDARD OPENING
- VERTEX (3, 1) MAX
- $\Delta x = 1$

x	y	
1	-3	$-(1-3)^2+1$
2	0	$-(2-3)^2+1$
3	1	
4	0	
5	-3	

Ex 6 $y = (x+7)^2 - 2$

- OPENS UPWARD
- STANDARD OPENING
- VERTEX (-7, -2)
- $\Delta x = 1$

x	y	
-9	2	$(-9+7)^2-2$
-8	-1	$(-8+7)^2-2$
-7	-2	
-6	-1	
-5	2	

III COMPLETING THE SQUARE

CONVERTING STANDARD FORM EQUATIONS INTO GRAPHING FORM.
(THIS IS MOST COMMONLY CALLED THE H, K FORM)

Ex 1 $y = \underline{3x^2 - 12x} + 3$: FOCUS ON THE FIRST TWO TERMS (THE GOAL IS TO GET x^2 BY ITSELF.)

$y = 3[x^2 - 4x \quad] + 3$: COMPLETE THE SQUARE BY TAKING HALF THE MIDDLE TERM (-4) AND SQUARING IT.

$y = 3[x^2 - 4x \underline{+4}] + 3 \underline{-12}$: IN THIS PROBLEM ADDING FOUR INSIDE THE BRACKETS WAS LIKE ADDING 12 SO BALANCE BY SUBTRACTING 12.

$y = 3(x-2)^2 - 9$: FACTOR & RESULT IS THE GRAPHING FORM.

Ex 2 $y = \underline{-2x^2 - 12x} + 5$

$y = -2[x^2 + 6x \quad] + 5$: HALF MIDDLE TERM & SQUARE TO COMPLETE BRACKETS

$y = -2[x^2 + 6x \underline{+9}] + 5 \underline{+18}$: $-2(9) = -18$ SO BALANCE BY ADDING 18

$y = -2(x+3)^2 + 23$: FACTOR AND THE RESULT IS THE GRAPHING FORM.

Ex 3 $y = \underline{x^2 - 12x} + 2$: FOCUS ON FIRST TWO TERMS

$y = 1\left[x^2 - 12x + \underline{36}\right] + 2 \underline{-36}$: COMPLETE SQUARE AND BALANCE BY SUBTRACTING 36.

$y = 1(x-6)^2 - 34$: FACTOR

Ex 4 $y = \underline{-x^2 - 8x} - 7$: PULL NEGATIVE FROM FIRST TWO TERMS.

$y = -1\left[x^2 + 8x + \underline{16}\right] - 7 + 16$: SINCE $-1(16) = -16$ BALANCE WITH $+16$ ON END.

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

Ex 5 $y = \underline{-\tfrac{1}{3}x^2 - 4x} - 11$

$y = -\tfrac{1}{3}\left[x^2 + 12x \quad\right] - 11$: NOTICE THAT WHEN A FRACTION IS FACTORED OUT THE RESULTING NUMBERS GET <u>LARGER</u>

$y = -\tfrac{1}{3}\left[x^2 + 12x + \underline{36}\right] - 11 \underline{+12}$: $-\tfrac{1}{3}(36) = -12$ SO BALANCE WITH $+12$.

$y = -\tfrac{1}{3}(x+6)^2 + 1$: FACTOR

Ex 6 $y = \underline{\tfrac{1}{5}x^2 - 2x} + 7$: FACTOR OUT $\tfrac{1}{5}$

$y = \tfrac{1}{5}\left[x^2 - 10x \underline{+25}\right] + 7 \underline{-5}$: BALANCE $\tfrac{1}{5}(25) = 5$ WITH -5

$y = \tfrac{1}{5}(x-5)^2 + 2$: FACTOR

Ex 7 $y = \underline{\tfrac{1}{2}x^2 - 3x} + 7$: FACTOR OUT $\tfrac{1}{2}$

$y = \tfrac{1}{2}\left[x^2 - 6x \underline{+9}\right] + 7 \underline{-4\tfrac{1}{2}}$: BALANCE $\tfrac{1}{2}(9) = 4\tfrac{1}{2}$ WITH $-4\tfrac{1}{2}$

$y = \tfrac{1}{2}(x-3)^2 + 2\tfrac{1}{2}$: SOMETIMES FRACTIONS MUST BE DEALT WITH!

Ex 8 $y = \underline{-3x^2 - 12x}$: FACTOR OUT -3

$y = -3\left[x^2 + 4x + 2\right] + 6$: BALANCE $-3(2) = -6$ WITH $+6$, NOTICE THERE WAS NO CONSTANT ORIGINALLY WRITTEN IN THE PROBLEM.

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