Warm Up

Given the sequence 0, 22, 70, 156, 292, 490, 762, ...

Determine the value of t_{75} without using a pencil and paper!

Δ_1: 22, 48, 86, 136

Δ_2: 26, 38, 50

Δ_3: 12, 12 cubic

X	Y1
75	849742

X=75

Pattern from Levels of Difference??

How can the first term in a sequence be determined using levels of difference?

Let's have a look at an example of each type of sequence:

X	Y_1
1	0
2	0
3	2
4	6
5	12
6	20
7	30

X=1

Plot1 Plot2 Plot3
$Y_1 = X^2 - 3X + 2$
$Y_2 =$
$Y_3 =$
$Y_4 =$
$Y_5 =$
$Y_6 =$
$Y_7 =$

D_1: 0, 2, 4, 6, 8

D_2: 2, 2, 2 . . .

$t_n = n^2 - 3n + 2$

D_1: 2

X	Y_1
1	6
2	25
3	56
4	99
5	154
6	221
7	300

X=1

Plot1 Plot2 Plot3
$Y_1 = 6X^2 + X - 1$
$Y_2 =$
$Y_3 =$
$Y_4 =$
$Y_5 =$
$Y_6 =$
$Y_7 =$

D_1: 19, 31, 43, 55, 67

D_2: 12, 12, 12 . . .

$t_n = 6n^2 + n - 1$

$D_1 = a$

$D_2 = 2a$

$D_3 = 6a$

$D_4 = ?$

In general, the level of the common difference is equal to the degree of the power sequence.

Definition: $n! = n(n-1)(n-2)(n-3)...(3)(2)(1)$ [e.g. $5! = (5)(4)(3)(2)(1)$]

If m is the degree of a power sequence, then $D_m = m!a$

e.g if the sequence is quartic, then $D_4 = 4!a = (4)(3)(2)(1)a = 24a$.

$y = ax^4 + bx^3 + cx^2 + dx + e$

$4 \times 3 \times 2 \times 1 = 24$

Warm Up

1. During the power dive of a plane during a stunt show the following heights above the ground at particular times were plotted in the table below:

Time (sec)	0	1	2	3	4	5
Height (m)	80	71	64	59	56	55

0	1	2	3
80	71	64	59

4	5
56	55

(a) Determine what type of model that this data would follow. Justify your choice! [2]

$\Delta_1: -9, -7, -5, -3, -1$

$\Delta_2: 2, 2, 2, \ldots$

(b) Determine a function $h(t)$ that expresses the height of the plane above the ground at any time t seconds. [2]

$h = 1t^2 - 10t + 80$

(c) What is the closest that the plane will come to the ground? __________ [1]

(d) Determine the height of the plane after 10.8 seconds: 88.64 m [1]

Quadratic Functions

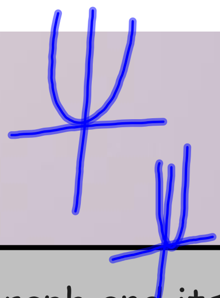
$$y = ax^2 + bx + c$$ (Parabola)

where "a" and "b" are **coefficients** and "c" is a **constant**

- The functions is said to have a degree of 2 (highest exponent)
- There are 3 forms of a quadratic equation...

GENERAL	STANDARD	TRANSFORMATIONAL
$y = ax^2 + bx + c$	$y = a(x-h)^2 + k$	$\frac{1}{a}(y-k) = (x-h)^2$

where **"a"** is the **vertical stretch factor**
"**h**" is the **horizontal translation**
"**k**" is the **vertical translation**



Mapping Notation - a notation that describes how a graph and its standard image are related.

For Quadratic Functions... $y = a(x-h)^2 + k$

opposites

$$(x, y) \Rightarrow (x + h, ay + k)$$

$y = x^2$

Where the first point from the graph y = x² maps onto a point in the image graph.

Transformations of the Quadratic Function in Standard Form

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

Direction of Opening: ("Look at the sign of the stretch factor")

- If $a > 0$, then the graph opens upward.
- If $a < 0$, then the graph opens downward.

$y = -3x^2 + x - 7$

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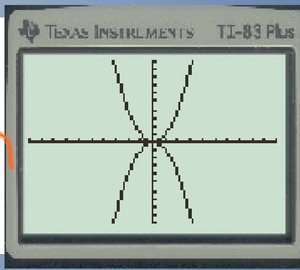
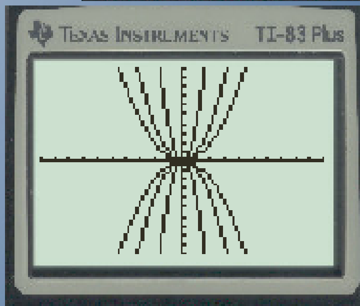


Vertical Stretch: ("Look at the magnitude of the stretch factor")

- If $|a| > 1$, then the graph becomes narrower.
- If $|a| = 1$, then the graph stays the same.
- If $0 < |a| < 1$, then the graph becomes wider.

$y = \frac{1}{3}x^2$

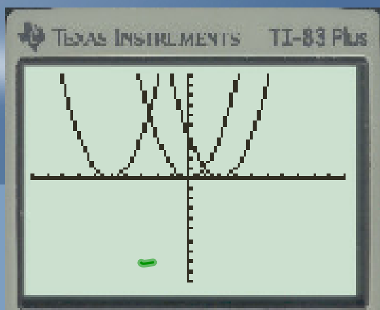


$y = x^2$

$y = (x+2)^2$

Horizontal Translation: ("Think opposite")

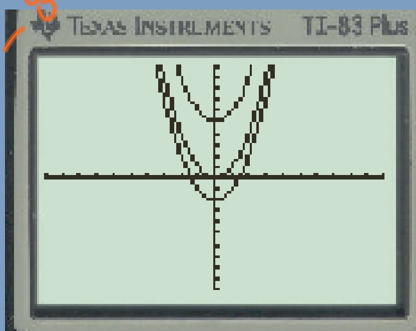
- If $h > 0$, then the graph moves to the right h units.
- If $h = 0$, then the graph does not move horizontally.
- If $h < 0$, then the graph moves to the left h units.



$y = x^2 - 8$

Vertical Translation: ("Exactly the same")

- If $k > 0$, then the graph moves upward k units.
- If $k = 0$, then the graph does not move vertically.
- If $k < 0$, then the graph moves downward k units.



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

Shape: Parabola

Dir. of opening: Down

Hor. Trans.: Left "5"

Ver. Shift: Up 2

Mapping Rule: $(x, y) \rightarrow (x-5, -3y+2)$

$y = x^2$

x	y
0	0
1	1
-2	4

vertex

$\longrightarrow$

x	y
-5	2
-4	-1