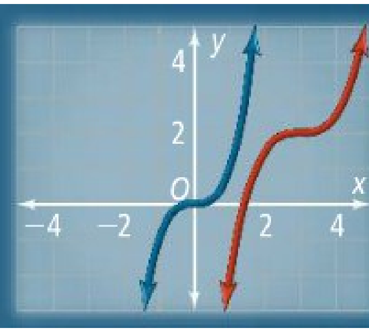
Aim: How do we transform polynomial equations? (Section 5-9)

Do Now:

The graph of the parent cubic function $f(x) = x^3$ is one of the graphs at the right. The other graph is a transformation g of the parent function. What is an equation for g? How do you know?



I – Transformations

1- **Essential Understanding** The graph of the function $y = af(x - h) + k$ is a vertical stretch or compression by the factor $|a|$, a horizontal shift of h units, and a vertical shift of k units of the graph of $y = f(x)$.

2- Example: Transforming $y = x^3$

What is an equation of the graph of $y = x^3$ under a vertical compression by the factor $\frac{1}{2}$ followed by a reflection across the x-axis, a horizontal translation 3 units to the right, and then a vertical translation 2 units up?

3- Additional Exercises (to be completed by you and your partner)

Determine the cubic function that is obtained from the parent function $y = x^3$ after each sequence of transformations.

1. a vertical stretch by a factor of 2
a vertical translation 5 units down;
and a horizontal translation 3 units left
To start, multiply by 2 to stretch. $y = 2x^3$

2. a reflection across the x-axis;
a vertical translation 6 units up;
and a horizontal translation 4 units right

3. a vertical stretch by a factor of 3;
a reflection across the x-axis;
and a horizontal translation 6 units left

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II- Finding Zeros of a Transformed Cubic Function

1- **Multiple Choice** If a, h, and k are real numbers and $a \neq 0$, how many distinct real zeros does $y = -a(x-h)^3 + k$ have?

(A) 0 (B) 1 (C) 2 (D) 3

2- Additional Exercises (to be completed by you and your partner)

Find all the real zeros of each function.

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

b. $y = -5(x-2)^3 + 20$

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

d. $y = 5(-x+1)^3 + 10$

Note: Not all polynomial equations are the "offspring" of a parent function -

The graph of the cubic function $y = x^3 - 2x^2 - 5x + 6$ has three x-intercepts. You cannot obtain this function or others like it by transforming the parent cubic function $y = x^3$ using stretches, reflections, and translations.

III - Constructing a Quartic Function with Two Real Zeros

1- Two methods – by transformation and by Algebra

2- Find a quartic function with the given *x*-values as its only real zeros.

a. $x = 1$ and $x = 4$

To start, use the Factor Theorem to write the equation of a quartic with real roots at 1 and 4 and complex zeros where *Q*(*x*) has zeros.

$$y = (x - 1)(x - 4) \cdot Q(x)$$

b. $x = -2$ and $x = -5$

c. $x = -3$ and $x = 2$

Note: There could be many different answers to the problems since we can use any quartic equation for Q(x).

IV – Power functions

1-

Definition

A **power function** is a function of the form $y = a \cdot x^b$, where a and b are nonzero real numbers.

Examples

$y = 0.5x^6$ $y = \frac{1}{2}x^2$

$y = -4x^{\frac{2}{3}}$ $y = x^{0.25}$

2- If $y = ax^b$ describes y as a power function of x, then y *varies directly with*, or *is proportional to*, the bth power of x. The constant a is the **constant of proportionality**.

3- You are swinging a bucket in a circle at a velocity of 8.2 ft/sec. The radius of the circle you are making is 1.5 ft. The acceleration is equal to one over the radius times the velocity squared.

a. What is the acceleration of the bucket?

b. What is the velocity if the acceleration is 28 ft/sec^2?