$f(x) = 3x + 2$ $g(x) = 4 - 5x$

✓ d) $(f \circ g)(x) = f(g(x))$

$3(4-5x)+2$

$12-15x+2$

$-15x+14$

✓ e) $(g \circ f)(x) = g(f(x))$

$4-5(3x+2)$

$4-15x-10$

$-15x-6$

✓ f) $f^{-1}(x)$

① replace $f(x)$ w/ y $y = 3x+2$

② switch x and y $x = 3y+2$

③ solve for y $x-2 = 3y$

$\frac{x-2}{3} = y$

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

✓ g) $(f \circ f^{-1})(x) = f(f^{-1}(x))$

$3\left(\frac{1}{3}x - \frac{2}{3}\right)+2$

$x - \frac{6}{3} + 2$

$x-2+2$

$= x$

Finding Zeros of a Polynomial

Descartes's Rule of Signs

1. Look at $f(x)$ and count the number of sign changes. Starting with that number, count down to zero by 2's → those are the possible amounts of positive real roots
2. Look at $f(-x)$ (change all of the signs) and count the number of sign changes. Starting with that number, count down to zero by 2's → those are the possible amounts of negative real roots

Rational Zeros Test to Find the Possible Zeros

Possible rational zeros: $\frac{p}{q}$ where p = factors of the constant term and q = factors of the leading coefficient

Testing the Possible Zeros

*once you break down the polynomial into a 4 piece polynomial, you can factor by grouping to solve

It is easiest to first plug in the easy numbers, like 1 and -1, into the function to see if the answer is zero, meaning it is in turn a zero of the polynomial. Once you have found a rational zero, you can use synthetic division to break the polynomial down and find the remaining zeros.

✓ Ex) Find the zeros of $x^4 - x^3 + x^2 - 3x - 6$ $x = -1, 2, \pm\sqrt{3}i$

① Try 1 → Doesnt work

Try -1 → works!! (=s zero)

② polynom div → use $(x+1)$

$$\begin{array}{r} x^3 - 2x^2 + 3x - 6 \\ x+1 \overline{\smash{)} x^4 - x^3 + x^2 - 3x - 6} \\ -(x^4 + x^3) \\ \hline -2x^3 + x^2 - 3x - 6 \\ +(+2x^3 + 2x^2) \\ \hline 3x^2 - 3x - 6 \\ -(3x^2 + 3x) \\ \hline -6x - 6 \end{array}$$

synthetic → use -1

$$\begin{array}{r|rrrrr} -1 & 1 & -1 & 1 & -3 & -6 \\ & & -1 & 2 & -3 & 6 \\ \hline & 1 & -2 & 3 & -6 & 0 \end{array}$$

$x^3 - 2x^2 + 3x - 6$

$x^2(x-2) + 3(x-2)$

$(x^2+3)(x-2)$

$x^2+3=0$ $x-2=0$

$x^2 = -3$ $x = 2$

$x = \pm\sqrt{-3}$

$x = \pm\sqrt{3}i$