BIG PICTURE of this Unit

- How can we extend our algebra skills to interchange between standard and factored form of polynomial equations? (i.e. synthetic division, factoring)
- Can we use our new polynomial algebra skills in order to find a method for solving EVERY polynomial equation (especially those that don't factor?)
- How can use the equation of a polynomial to analyze for key features of a graph of a polynomial (i.e. end behavior, multiplicity of roots, optimal points, intervals of increase/decrease).
- When and how can polynomial functions be used to model real world scenarios?

1. Connecting to function concepts from previous units, use DESMOS to graph the following functions and their inverses: {4,18}

   a. Graph $f(x)=x^2,\ g(x)=x^4,\ \ h(x)=x^6$ and their inverses.

   b. Graph $f(x)=x^1,\ g(x)=x^3,\ \ h(x)=x^5$ and their inverses.

   c. Determine the equation of the inverse functions for $f(x)=x^3,\ g(x)=x^4,\ \ h(x)=x^5,\ \ k(x)=x^6$

2. Connecting to function concepts from previous units, use DESMOS and your TI-84 to graph the following functions and investigate the following transformations: {4,18}

   a. Graph the parent function of $f(x)=x^3$.

   b. Now, graph $h(x)=f(x-3)$ (that is, graph $h(x)=(x-3)^3$) and explain what transformation(s) were applied to $f(x)=x^3$.

   c. Now, graph $h(x)=f(x-3)-2$ (that is, graph $h(x)=(x-3)^3-2$) and explain what transformation(s) were applied $f(x)=x^3$.

   d. Now, graph $h(x)=-\frac{1}{2}f(x-3)-2$ (that is graph $h(x)=-\frac{1}{2}(x-3)^3-2$) and explain what transformation(s) were applied $f(x)=x^3$.

   e. Rewrite the equation for $h(x)=-\frac{1}{2}(x-3)^3-2$ in standard form.

   f. Now, use DESMOS only, to graph the inverse of $h(x)=-\frac{1}{2}(x-3)^3-2$. Is the inverse a function? Why or why not?

3. (CA) Find the domain interval(s) in which $P(x) = -4x^4 - 6x^3 + 28x^2 + 18x - 36$ is increasing. {1,4}

4. (CI) Factor the following cubic polynomials, given the information about one of the factors {10,11,13}

   a. Factor completely $P(x) = 4x^3 - 2x^2 - 6x - 2$, given that $p(-0.5) = 0$

   b. Factor $P(x) = 2x^3 - x^2 - 7x + 6$ completely, knowing that when $P(x)$ is divided by $x - 1$, there is no remainder.

   c. Factor $P(x) = -4x^4 - 6x^3 + 28x^2 + 18x - 36$ completely, knowing that BOTH $p(1) = 0$ and $p(2) = 0$.

5. (CI) Working with the function $f(x) = \dfrac{3x-2}{x-2}$, answer the following analysis questions: {7,18}

   a. Determine the equation(s) of the vertical and horizontal asymptotes and hence detemine the domain and range of $f(x) = \dfrac{3x-2}{x-2}$.

   b. Find the x-intercept and y-intercept of $y = f(x)$.

   c. Given your work in Q(a) and Q(b), sketch the function.

   d. Show that $\dfrac{3x-2}{x-2} = 3 + \dfrac{4}{x-2}$.

   e. Hence (given your work in Q(d)), state how the function $f(x) = \dfrac{3x-2}{x-2}$ has been transformed from its parent function of $y = \dfrac{1}{x}$.

   f. Determine the equation of the inverse of $f(x) = \dfrac{3x-2}{x-2}$.

   g. (HL QUESTION) Verify that your equation of the inverse is correct by composing $f \circ f^{-1}(x)$.

6. (CA) Solve the following inequalities: {4,15}

   a. Find the domain interval(s) in which $-x^3 - 2x^2 + 4x + 5 > 0$.

   b. Find the domain interval(s) in which $0 < x^4 - 3x^3 + 3x^2 - 3x + 2$.

   c. Find the domain interval(s) in which $\dfrac{2x-3}{3x+5} > 0$.

7. (CI) The equation of a polynomial is $f(x) = -2(x+2)^3(2x-1)^2(x+5)$. Determine: {1,6}

   a. State the end behaviour of $y = f(x)$.

   b. State the zeroes of $y = f(x)$

   c. Sketch $y = f(x)$, showing the correct behaviour of the function at the zeroes and at the "ends".