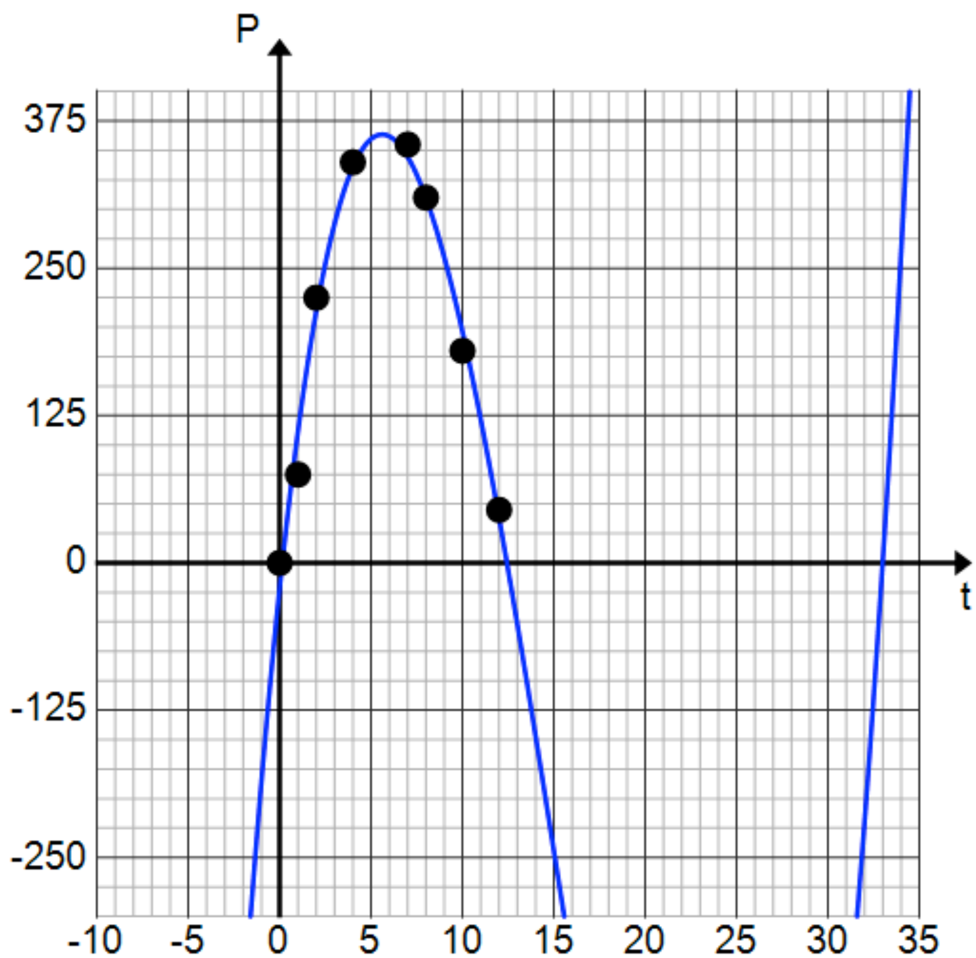
BIG PICTURE of this Unit

- 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. The owners of Dizzy Lizzy's, an amusement park, are studying the wait time at their most popular roller coaster. The table below shows the number of people standing in line for the roller coaster t hours after Dizzy Lizzy's opens. {8}

| ***t* (hours)** | *0* | *1* | *2* | *4* | *7* | *8* | *10* | *12* |
|---|---|---|---|---|---|---|---|---|
| ***P* (people in line)** | *0* | *75* | *225* | *345* | *355* | *310* | *180* | *45* |

Jaylon made a scatterplot and decided that a cubic function should be used to model the data. His scatterplot and curve are shown below.



a. Do you agree that a cubic polynomial function is a good model for this data? Explain.

b. What information would Dizzy Lizzy's be interested in learning about from this graph? How could they determine the answer?

c. Estimate the time at which the line is the longest. Explain how you know.

d. Estimate the number of people in line at that time. Explain how you know.

e. Estimate the $t$-intercepts of the function used to model this data.

f. Use the $t$-intercepts to write a formula for the function of the number of people in line, $f$, after $t$ hours.

g. Use the relative maximum to find the leading coefficient of $f(t)$. Explain your reasoning.

h. What would be a reasonable domain for your function $f(t)$? Why?

i. Use your function $f(t)$ to calculate the number of people in line 10 hours after the park opens.

j. Comparing the value calculated above to the actual value in the table, is your function $f(t)$ an accurate model for the data? Explain.

k. Use the regression feature of a graphing calculator to find a cubic function, g(t), to model the data.

l. Graph the function $f(t)$ you found and the function $g(t)$ produced by the graphing calculator. Use the graphing calculator to complete the table. Round your answers to the nearest integer.

| ***t*** **(hours)** | *0* | *1* | *2* | *4* | *7* | *8* | *10* | *12* |
|---|---|---|---|---|---|---|---|---|
| ***P*** **(people in line)** | *0* | *75* | *225* | *345* | *355* | *310* | *180* | *45* |
| ***f(t)*** **(your equation)** | | | | | | | | |
| ***g(t)*** **(regression eqn.)** | | | | | | | | |

m. Based on the results from the table, which model was more accurate at $t$ = 2hours? $t$ = 10 hours?

2. The number of students, N(t), at CAC who have had absences due to illnesses t days after Feb 1, can be modeled by the formula $N(t) = 500 - \dfrac{450}{1+0.3t}$ for $t \geq 0$. {4,8}

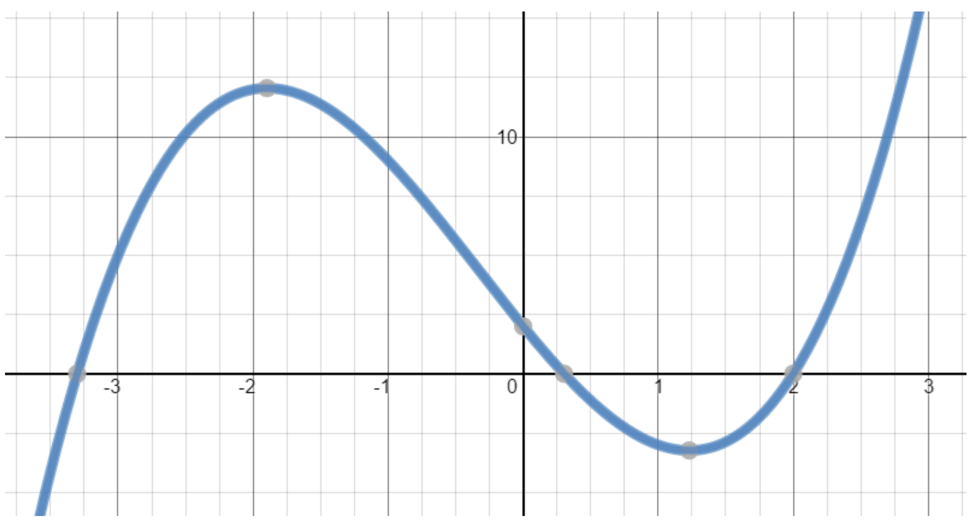
   a. Find and interpret $N(0)$.

   b. How long will it take until 300 students will have had the flu?

   c. Determine the behavior of $N$ as $t \to \infty$. Interpret this result graphically and within the context of the problem.

   d. Include a sketch of the graph in your solution.

3. Determine the exact value of all roots of the polynomial $A(x) = x^3 + x^2 - 7x + 2$, given the following graph of $A(x)$ {5,6}




4. Complete the [MATCHING EXERCISE](http://mrsantowski.tripod.com/2016IntegratedMath3/Homework/MATCHING_Graphs_and_Equations_of_Polynomials.pdf) (found at http://mrsantowski.tripod.com/2016IntegratedMath3/Homework/MATCHING_Graphs_and_Equations_of_Polynomials.pdf

   You will have 6 equations in standard form, 6 equations in factored form and six graphs. Record your answers on this chart. {5,6}

| | | | | | | |
|---|---|---|---|---|---|---|
| Graph | | | | | | |
| Eqn (factored) | | | | | | |
| Eqn (standard) | | | | | | |

5. The function $v(t) = 0.05t^3 - 1.35t^2 + 7.6t + 49$ describes the value (in $US per gram) of a precious metal over an 18 month period. {4,8}

   a. What does the *y*-intercept mean?

   b. During which month did the metal achieve its greatest value?

   c. During which months has the value of the metal been decreasing?

   d. Determine the lowest value since then.

   e. Describe the value of the metal over the last ten months.

   f. If the function continues to model the value of the precious metal, when will the value first exceed its previous greatest value?

6. Given the following graph: {1,5,6}

   a. Estimate domain interval in which the function is increasing

   b. Estimate the domain interval in which the function is decreasing.

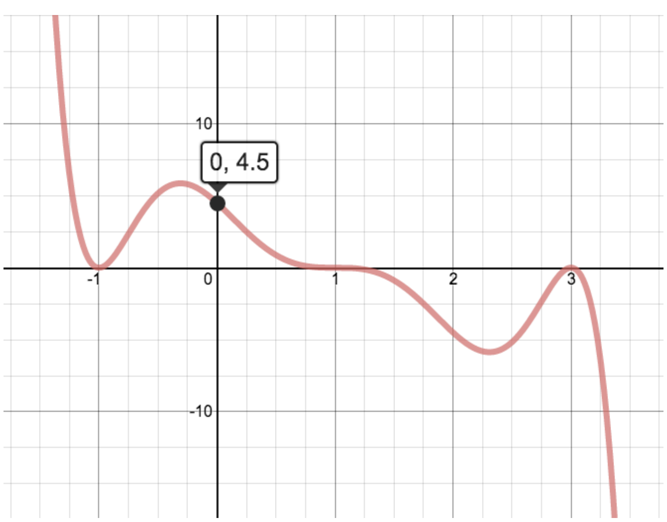
   c. State the end behaviours

   d. Determine the degree of the polynomial

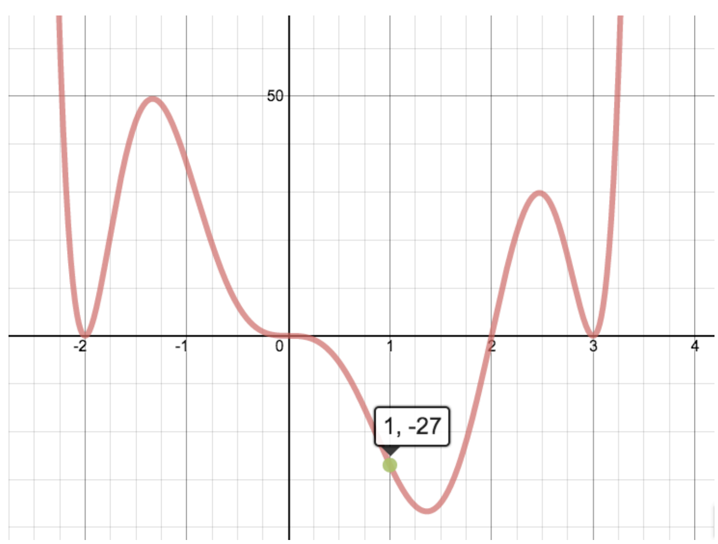
   e. Determine the sign of the leading coefficient

   f. Write the equation in factored form

a.




b.



7. Determine the equation of the inverse of the following rational functions:

   a. $y = \dfrac{2x-3}{x+1}$ b. $y = \dfrac{x+4}{2x-1}$

**Higher Level Questions for More Complex Concepts OR an EXTENSION of basic concepts involved with Polynomial and Rational Functions.**

1. (CI) Given the following info about the roots of a polynomial, write the equation of the polynomial in standard form.
   a. A cubic equation has a double root of 3 and has a zero at x = -6. If the y-intercept is -27, determine the equation of the cubic.
   b. Two roots of a cubic polynomial are 2 and $\frac{1}{2}(1-\sqrt{5})$. Determine the general equation of the family of cubics with these roots.
   c. Two roots of a cubic polynomial are 2 and $1-2i$ and it passes through (5, -180)
   d. Two roots of a fourth degree polynomial are $1+i$ and $3-2i$ . Determine the general equation of the family of quartics with these roots.

2. (CI) Since you now understand the "derived function" and where it comes from, you will work with the function $y = 2x^3 - \frac{3}{2}x^2 - 3x - 4$:
   a. Determine the equation of the line that is tangent to the curve at x = -1.
   b. Determine the other intersection point(s) of the tangent line with the cubic.