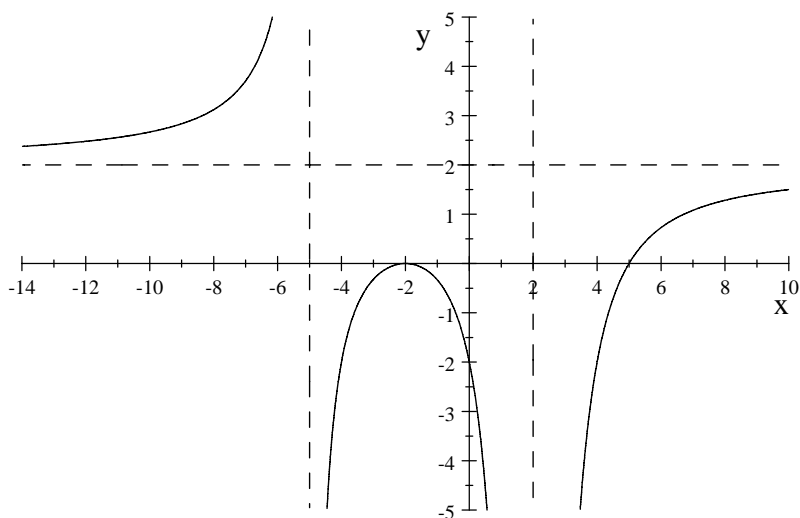


MAC 1147 Trigonometry & Precalculus Algebra
 Problem Set 1 – Due Thursday, June 17th, at 2:00 PM

Directions: You will work on these in groups of three students. Groups may not consult with other groups' members regarding these items. The only consultation permitted is with the professor of the course. All work must be clear, complete, and concise. **Your work and answers for each section must be independent of this sheet—a person reading your work should not have to consult this sheet to determine what you are doing or what you are trying to find.** All final answers must be clearly indicated as such. All graphs are to be manually drawn on graph paper and are to be large, neat, and clear. You will be graded on presentation as well as correctness—neatness and organization counts! Unless otherwise indicated, give exact answers, or give answers correct to three significant figures as appropriate. A cover sheet must be stapled to a single copy of your group's work, and the work is due on **Thursday, June 17th, at 2:00 PM.** Do not place your group's work in a binder, folder, or report cover. Work turned in after this deadline will receive at least one letter grade deduction or may not be accepted at all, and each member will receive a score of zero for the item.

- 1) For the function $f(x) = 10x^6 - 31x^5 + 75x^4 + 699x^3 + 179x^2 - 872x + 240$, find ALL the solutions, real and imaginary, of the equation $f(x) = -60$. (Be careful—note that this is NOT the equation $f(x) = 0$!) Use the techniques from Chapter 4 (e.g., Descartes Rule of Signs, the Rational Zero Theorem, the Remainder and Factor Theorems, etc.) to do this.

- 2) Consider the following graph:



Find a rational function that might have the graph given above. Justify each part of the function generated by the various graphical features.

- 3) Find the partial fraction decomposition of $\frac{4x^7 - 20x^6 + 8x^5 - 37x^4 + 7x^3 - 33x^2 + 19x + 8}{x^5 - 5x^4 + 2x^3 - 10x^2 + x - 5}$.
 (Hint: $x = 5$ is a zero of the denominator.)

- 4) A fast-food restaurant wants a special container to hold coffee. The restaurant wishes the container to quickly cool the coffee from 200°F to 130°F and keep the liquid between 110° and 130°F as long as possible. The restaurant has three containers to select from:

The **CentiKeeper Company** has a container that reduces the temperature of a liquid from 200°F to 100°F in 30 minutes by maintaining a constant temperature of 70°F .

The **TempControl Company** has a container that reduces the temperature of a liquid from 200°F to 110°F in 25 minutes by maintaining a constant temperature of 68°F .

The **Hot-n-Cold Company** has a container that reduces the temperature of a liquid from 200°F to 120°F in 20 minutes by maintaining a constant temperature of 72°F .

You need to recommend which container the restaurant should purchase.

- Use Newton's Law of Cooling to find the functions $C(t)$, $T(t)$, and $H(t)$, respectively, for each of the containers above relating the temperature of the liquid over time. (That is, the independent variable is time in minutes and the dependent variable is temperature in degrees Fahrenheit.)
- How long does it take each container to lower the coffee temperature from 200°F to 130°F ?
- How long will the coffee temperature in each container remain between 110°F and 130°F ? This temperature is considered the optimal drinking temperature.
- Make a Very Large Graph with all three functions on a single set of axes. Color code each graph, and include a legend to identify each graph by color. To clearly show each cup's temperature changes from 130°F to 110°F , use $x \in [15, 26]$ and $y \in [105, 135]$ to clearly show each cup's temperature changes from 130°F to 110°F .
- Disregarding cost of the cups, which company would you recommend to the restaurant? Why?
- A marketing company, through extensive research and polling, has determined that for each 30-second loss of time that the coffee is hot (i.e., its temperature is between 130°F and 110°F), sales decrease by 150 units. For example, if the restaurant sells 4,000 cups of coffee in cups that keep the coffee hot for 12 minutes, then if the store changes to a cup that only keeps the coffee hot for 9 minutes, sales would decrease by 750 units, so they'd only sell 3,250 cups of coffee in the same time period.
 - Use the data in the example above to write a linear function $S(t)$ that describes the number of expected sales in one month as a function of the time t that the coffee stays hot.
 - Find the number of expected sales for the CentiKeeper, TempControl, and Hot-n-Cold cups.
 - Suppose CentiKeeper charges a base fee of \$75 and \$29.95 per 1000 cups, TempControl charges a base fee of \$60 and \$32.00 per 1000 cups, and Hot-n-Cold charges a base fee of \$35 and \$44.00 per 1000 cups. Would cost considerations cause you to change your recommendation from part (e) above? Justify your conclusion with a specific cost argument.