MATH 161 TEAM HOMEWORK ASSIGNMENT #2, FALL 2015

(an adaptation of a University of Michigan problem set)

- **Due Date:** 19th October
- Remember to follow the guidelines from the "Doing Team Homework".
- Do not forget to rotate roles (scribe & reporter) and include a reporter's page with each new team assignment.
- Show ALL your work.

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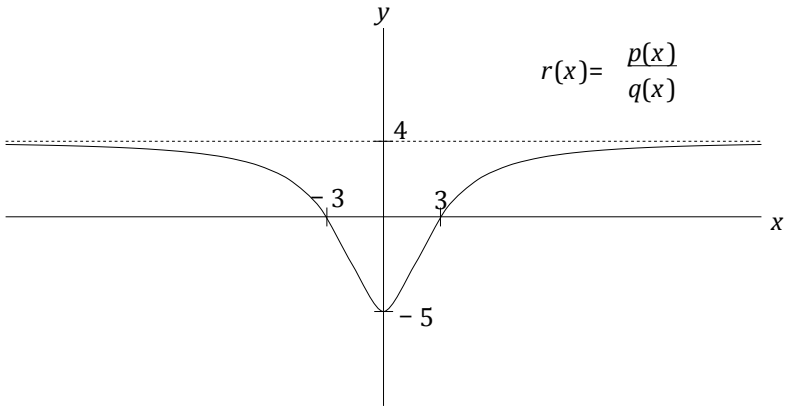
1. Below is the graph of a rational function)

$$r(x) = \frac{p(x)}{q(x)}$$

p(x) and $q(x)$ are both quadratic polynomials.

(a) Find possible formulas for $p(x)$ and $q(x)$. *Be sure to pay attention to any intercept(s) and asymptote(s).*



2. (a) Gilberte, Odette, and Albertine had so much fun with their little ice cream experiment that they decided to embark on a more ambitious project. They conducted a yearlong survey of all Loyola freshmen to determine the average freshman's daily ice cream consumption over the course of the year. They found that average daily ice cream consumption reaches a peak of 0.60 pints per day on May 1st, and a low of 0.10 pints per day on November 1st. Assume that the average daily ice cream consumption is periodic with a period of one year. Let $I(t)$ be a sinusoidal function modeling average ice cream consumption of Loyola freshman, in pints per day, t months after September 1st 2015. Write two formulas for the function $I(t)$ —one using the sine function, and one using the cosine function.

   (b) Gilbert, Odette, and Albertine's formula proved to be remarkably accurate from September 1st, 2015 to January 1st, 2017, but then there was a sudden cow plague that caused most of the cows in the Midwest to stop producing ice cream-quality milk, leading to an acute ice cream shortage. From this day on, daily ice cream consumption decayed exponentially. On March 1st 2017, it was down to 0.05 pints per day. Let $C(t)$ be a continuous function modeling average ice cream consumption of Loyola freshman, in pints per day, t months after September 1st 2015. Find a formula for $C(t)$ for $t \geq 0$.

   (c) Graph the function $C(t)$ from part (b).

   (d) Suppose that the smallest quantity of ice cream that a human can taste is 0.00001 pints. In which month did a Loyola student eating an average amount of ice cream stop being able to taste it?

3. Suppose that f and h are functions that are continuous for all real numbers. Suppose $f(2) = 6$ and $f(8) = -12$, and let g be the function defined by.

$$g(x) = \frac{h(x)}{f(x)}$$

(a) Is it possible that $g(x)$ be defined at every point in the interval [2, 8]? (In other words, is it possible that the domain of $g(x)$ contains the interval [2, 8]?) Either give an example of $f(x)$ and $h(x)$ for which $g(x)$ is defined on this whole interval, or explain why $g(x)$ must be undefined at some point in the interval.

(b) Suppose now that $h(x) = x^2 - 16$. Is it possible that $\lim_{x \to a} g(x)$ exist for all values of a such that $2 \le a \le 8$? Either give an example of $f(x)$ for which the limit exists for all such a, or explain why the limit must not exist at some point in the interval.

(c) Finally, suppose instead that $h(x) = x^2 + 16$. Is it possible that $\lim_{x \to a} g(x)$ exist for all values of a such that $2 \le a \le 8$? Either give an example of $f(x)$ for which the limit exists for all such a, or explain why the limit must not exist at some point in the interval.

4. On Friday afternoon, Yvette, a Loyola student, rode her bike along Devon Ave in the direction of Tiffin's Indian Kitchen. Her position s at various points in time is shown in the table below. Her position s is measured in yards along Devon Ave with $s = 0$ corresponding to Devon Hardware. The positive s-direction is East (toward the lake).

t (seconds after 1 pm)	0	30	60	90	120	150	180
s (yards)	0	−35.2	−80.8	−92.3	−12.4	−16.3	−80.5

(a) What was Yvette's average velocity between 1 pm and 1:01 pm? Between 1:01 pm and 1:02 pm? What is the meaning of the sign of your answers?

(b) Estimate Yvette's instantaneous velocity at 1:02 pm.

(c) Give a possible explanation, consistent with the information in the table, for what Yvette was doing between 1 pm and 1:03 pm.