

1. Complete each exercise for the functions  $f$  and  $g$  where they are defined by

$$f(x) = 3x^2 + 4x - 4 \text{ and } g(x) = 14 - 3x - 5x^2.$$

- (a) Do each of the following.
- Define each of the functions  $f$  and  $g$ .
  - Define a function for the sum of  $f$  and  $g$ .
  - Define a function for the quotient of  $f$  and  $g$  where  $g$  is the divisor. Simplify.
  - Define a function for the composition  $f \circ g$ . Evaluate and simplify it.
- (b) Find the exact value of  $f$ ,  $g$ , the sum, the quotient, and the composition when  $x = 3\sqrt{2}$ . Simplify all of the answers.
- (c) Evaluate  $f(x^2)$ ,  $g(2t + 3)$ , and  $f(a + h)$ . Simplify each.
- (d) Graph both  $f$  and  $g$  on the same coordinate plane where  $x \in [-3, 2]$ . Use standard crossed axes, make each curve a different solid color, show gridlines, show a title and legend, make the legend refer to the functions, and make the coordinate plane as wide as the paper. Use the Point Probe to estimate the intersection points of the graph (give the intersection points in a sentence).
- (e) Evaluate each of the following limits.
- $\lim_{x \rightarrow 0} \frac{f(x)}{g(x)}$
  - $\lim_{h \rightarrow 0} \frac{f(x + h) - f(x)}{h}$

2. The 2004 Minnesota State Income Tax Schedule for the filing status of Married filing jointly or Qualifying widow(er):

| Taxable income is over | But not over | Amount of Tax   | Of the amount over |
|------------------------|--------------|-----------------|--------------------|
| \$0                    | \$28,420     | 5.35%           | \$0                |
| \$28,420               | \$112,910    | \$1,520 + 7.05% | \$28,420           |
| \$112,910              | or over      | \$7,475 + 7.85% | \$112,910          |

- (a) Define the tax function in terms of a piecewise defined function. Call it  $\text{Tax}(x)$ .  
*Did you consider negative income?*
- (b) Find the amount of tax owed on taxable income of \$15,000, \$50,000, and \$120,000. Show the results in normal notation for a dollar amount.
- (c) Graph the tax function with an appropriate scale, label the axes, and title the graph. Use boxed axes, show at least some negative income, and choose an appropriate maximum income.
- (d) How many line segments are there in the graph? What does the slope of each line segment represent?

3. The voltage  $V$  produced by an AC generator is

$$V = 220 \sin(120\pi t).$$

- (a) Approximate the voltage for  $t = 1/240$ .
- (b) Load the LinearAlgebra package. Then create two lists. One for the times  $t = .001, .002, .003, \dots, .01$  and the other for the voltages at these times. Create a matrix with ten rows and two columns with the first column the times and the second column the voltages, and approximate to five decimal places.
- (c) Graph the voltage function for the interval  $t \in [0, 0.25]$ .