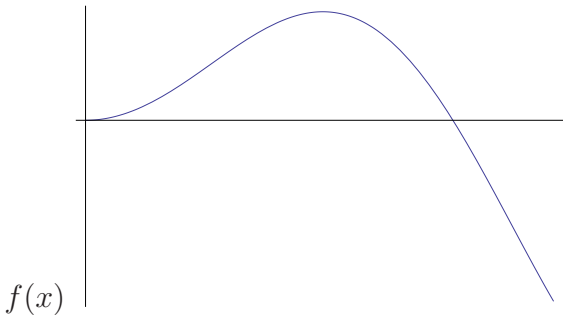
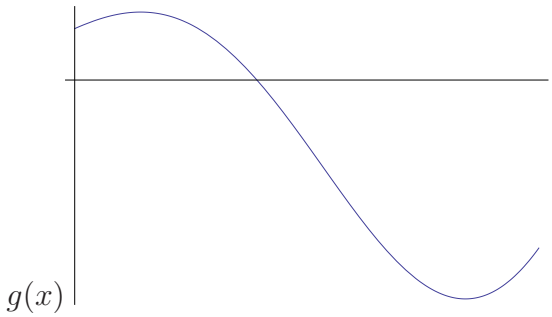
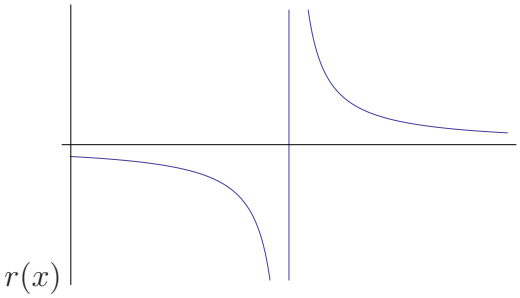
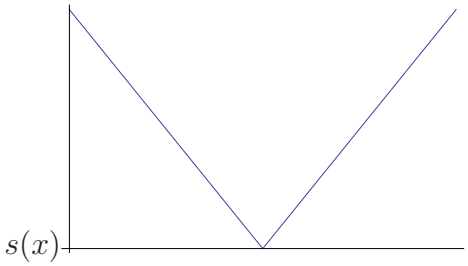
1. Each derivative graph below is the derivative of one the functions whose graph is below. Label each derivative graph according to the function. So for example, when you find the graph of $f'(x)$, label it as $f'(x)$.

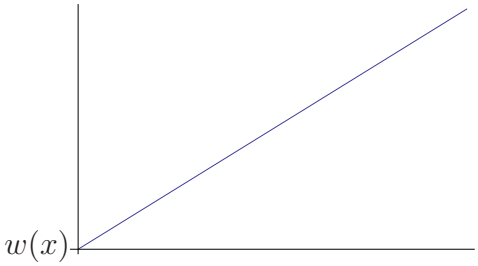
   Function graphs

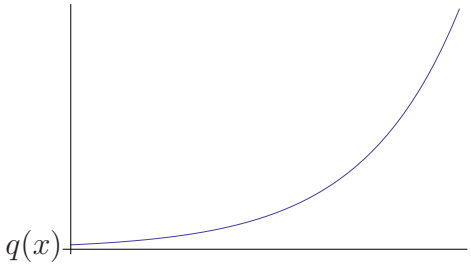




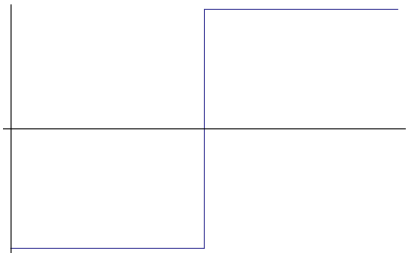


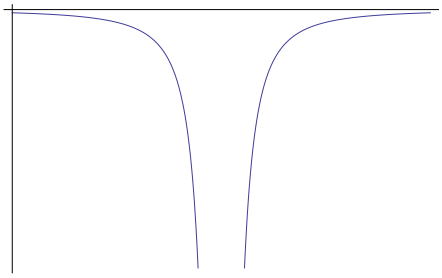


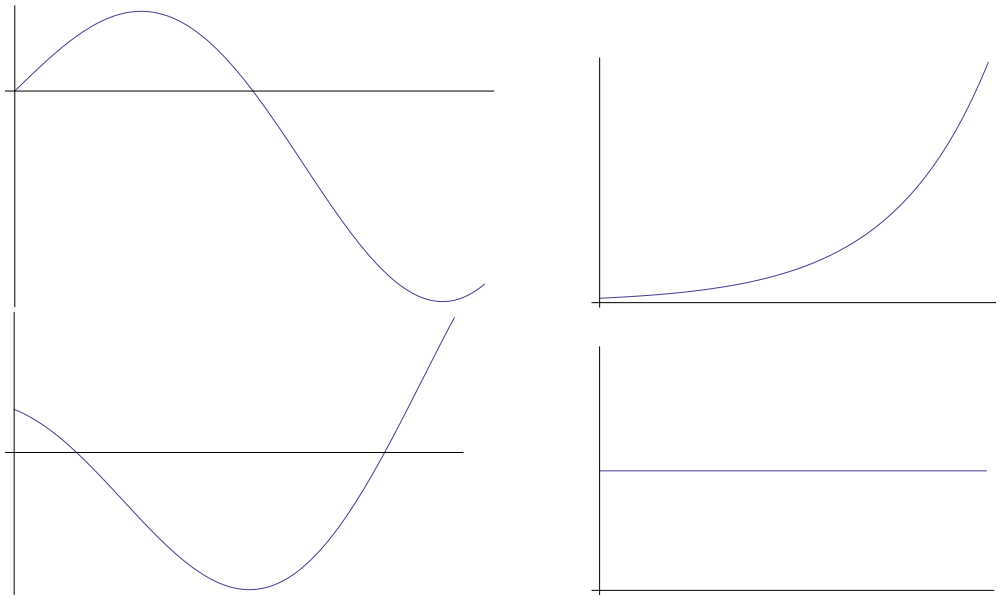




   Derivative graphs







2. For each of the functions in Exercise 1, sketch a plot of its second derivative.

3. Two cards are drawn from a standard deck of 52 cards, a first card and a second card.

   a) Assuming that the first card is replaced before the second is drawn (with replacement), count how many possible outcomes there are. Show how to get your answer by using the basic counting principle and then show how to get your answer using functions. (Hint: When using functions, think of functions with domain $\{1, 2\}$.)

   b) Now suppose you do not replace the first card before the second is drawn. How many different ways can the cards be drawn? Explain your answer using the basic counting principle and then using functions.

4. Now suppose that several cards are drawn from a standard deck of 52 cards and the outcome is an ordered list of the cards drawn.

   a) How many different ways can three cards be drawn if you replace the cards before drawing the next? Again, explain your answer in two ways.

   b) How many different ways can three cards be drawn if you do not replace the cards before drawing the next? Explain your answer in two ways.

   c) How many different ways can n cards be drawn if you replace the cards before drawing the next? Explain in two different ways.

d) How many different ways can n cards be drawn if you do not replace the cards before drawing the next? Explain in two different ways.

5. Two cards are drawn without replacement from a standard deck and the outcome is an ordered list of the two cards drawn.

   a) How many possible outcomes are there if the first card is a club and the second card is not a club?

   b) How many possible outcomes are there if the first card is a club and the second card is a club?

   c) How many possible outcomes are there if the first card is a club?

   d) How many possible outcomes are there if the two cards are from different suits?

6. Let $f(x) = x^2 + 3x + 10$.

   a) Sketch a graph of $f(x)$

   b) Explain geometrically how you know whether $f(x)$ has any real roots.

   c) Find all the complex numbers $x = a + bi$ where $f(x)$ is a real number. Show your derivation.

d) Find all the complex numbers $x = a + bi$ where $f(x)$ is an imaginary number.

e) Describe geometrically the three dimensional graph of $f(x)$ when you restrict the domain to the complex values of x where $f(x)$ is real. Do your best at sketching this graph.

7. What is the difference in saying that f is a function between A and B and saying that f is a function from A to B?

8. Suppose that A has 5 elements, B has 4 elements, and C has 7 elements. Answer the following questions.

   a) How many functions are there from A to B?

   b) How many functions are there from C to B?

   c) How many injective functions are there from A to B?

   d) How many injective functions are there form B to A?

   e) How many injective functions are there from C to $A \cup B$ assuming that A and B have no elements in common?

f) How many surjective functions are there from A to C?

9. Give the formal definition of a function between A and B.

10. Does the following statement say that $f : A \to B$ is injective? "For each $a \in A$, there is exactly one $b \in B$ with $f(a) = b$." Explain why or why not.

11. Give the formal definition of

a) a circle.

b) an ellipse.

c) a hyperbola.

d) a parabola.

12. Show the derivation of the equation of a parabola with focus $(p, 0)$ and directrix $x = -p$.

13. Show the derivation of the equation of an ellipse with foci $(0, c), (0, -c)$ and through the point $(0, a)$.

14. For each relation below, identify the type of conic section the graph represents.

    a) $x^2 + 4x + y^2 + 6x = 12$

    b) $x^2 - 4y^2 = 16$

    c) $3x^2 + 6x + 5y^2 + 10y = 100$

    d) $3x^2 + 6x - 5y^2 + 10y = 100$