Part 1: Read each problem. Write a sentence or two about the approach you might take to solve each problem. Draw a picture to illustrate the scenario. Write a formula that might be needed to help set up or solve the problem.

1. Assume a, b, c, d, e, and f are real constants for the following questions.

   (A) Can the graph of $f(x) = \dfrac{ax+b}{cx+d}$ cross its horizontal asymptote where $ax+b \neq cx+d$? If yes, then where?

   (B) Can the graph of $g(x) = \dfrac{ax^2 + bx + c}{dx^2 + ex + f}$ cross its horizontal asymptote where
   $ax^2 + bx + c \neq dx^2 + ex + f$? If yes, then where?

   (C) Can a rational function cross its vertical asymptote? Explain.

   (D) Can a rational function cross its horizontal asymptote? Explain.

2. Suppose that the risk of having an accident on a very dangerous road while driving a car can be modeled using the (logistic) equation

$$R = \frac{A}{1 + be^{-rx}}$$

where R is the percent risk of having an accident, and x is the blood alcohol concentration, BAC, (also a percent).

(A) If we believe that the chance of accident goes to 100% for very large values of the BAC x, and that the risk for a sober driver on this road is $\frac{100}{61}$%, which of the parameters in the model can you determine?

(B) Suppose the risk for a driver with BAC of 0.08% (half of the extreme DUI threshold) is approximated to be 8.83%. What is the predicted risk for a driver at the extreme DUI threshold?

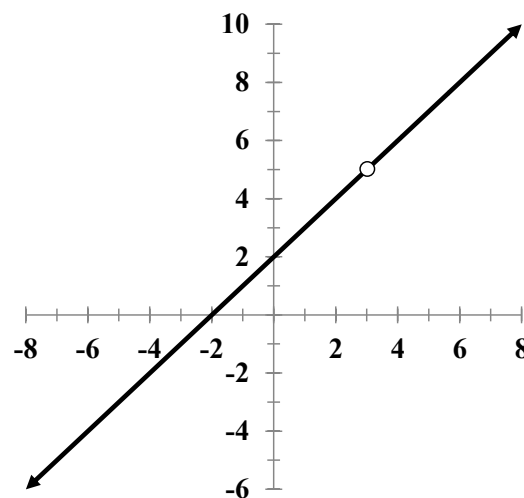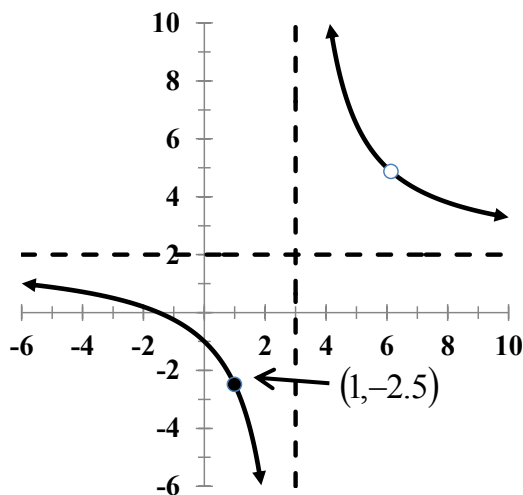(C) What BAC would correspond to a 50% chance of an accident? Does that seem plausible?

3. If $x = -2$ is a zero of $f(x)$ and $f(x) = x^3 - 3x^2 - kx + 12$, find the two other zeros, algebraically. Write $f(x)$ in complete factor form.

4. Determine a formula for the rational functions graphed below.

(A) *Note:* There is a hole in the graph at $x = 6$.

(B) *Note:* There is a hole in the graph at $x = 3$.

5. Let $g(x)$ be the rational function that has a slant asymptote $y = 2x + 1$, a vertical asymptote at $x = 3$ and one of its x-intercepts at $(4, 0)$. Determine a formula for $g(x)$ and use the formula to determine the other x-intercept and the y-intercept.

6. A quadratic function $Q(x)$ passes through the points $(1,2)$ and $(-3,6)$.

(A) Write an expression for $Q(x)$ if $(1,2)$ is the vertex.

(B) Write an expression for $Q(x)$ if $(-3,6)$ is the vertex.

(C) Write an expression for $Q(x)$ if the graph is symmetric with respect to the y-axis.

(D) Write an expression for $Q(x)$ if $Q(x)$ has a zero at $x = 2$

7. The following statements about $f(x)$ are true:
   $f(x)$ is a polynomial function.
   $f(x) = 0$ at exactly four different values of x.
   $f(x) \to -\infty$ as $x \to \pm\infty$.

For each of the following statements decide if the statement is <u>Always true</u>, <u>Never true</u> or <u>Sometimes true.</u>
For <u>Always true</u> and <u>Never true,</u> justify your answer. If <u>Sometimes true</u> give an example of when it could
be true and when it might not be true.

(A) $f(x)$ is an odd function.

(B) $f(x)$ is an even function.

(C) $f(x)$ is a fourth degree polynomial.

(D) $f(x)$ is a fifth degree polynomial.

(E) $f(-x) \to -\infty$ as $x \to \pm\infty$.

(F) $f(x)$ is a 1-1 function.

(G) The lead coefficient is -0.001.

8. $g(t) = -2(t - a)^2(t - b)(t - c)$ where $a < b < 0 < c$. What is the vertical intercept? What are the
   horizontal intercepts? On what interval(s) is/are $g(t) > 0$?

9. Consider the function in graph given below. Find the coordinates of C in terms of b.