Solve the following quadratic equations (if possible.)

1. $x^2 + 4x - 21 = 0$
2. $x^2 - 9x + 8 = 0$
3. $2x^2 - 5x - 18 = 0$
4. $x^2 + x + 5 = 0$
5. $x^2 - 2x - 7 = 0$

6. Consider the functions for a line and a parabola given by:

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

For the line, find the x and y-intercepts and the slope of the line.

For the parabola, find the x and y-intercepts and the vertex.

Find the points of intersection of this parabola and line. Create a graph of these curves.

7. A ball is thrown vertically with a velocity of 48 ft/sec from a platform that is 64 ft in the air. The height of the ball satisfies the equation:

$$h(t) = 64 + 48t - 16t^2.$$

Find the maximum height of the ball in feet, then determine when the ball hits the ground (seconds). Sketch a graph of the flight of the ball.

8. Acetic acid arises in the bacterial breakdown of many fruits often resulting in vinegar. The equilibrium constant (ionization constant) for acetic acid is $K_a = 1.75 \times 10^{-5}$. Use the information developed in the text for formic acid as a guide to determine the concentration of $[H^+]$ and pH of 0.1N and 1N solutions of acetic acid.

9. A rectangle with a length x and width y has a perimeter of 40 cm.

a. Write an expression for the width y as a function of the length x, using this information.

b. The area of a rectangle is $A = xy$. Substitute the expression for y into this formula for the area to produce a function of the area as a function of x alone.

c. Determine what value of x produces the largest area and find that maximum area.

d. What curve is produced by $A(x)$?

10. For animals that reproduce seasonally, we find that their population satisfies a difference equation

$$P_{n+1} = P_n + g(P_n),$$

where P_n is the population in the n^{th} season and $g(P)$ (in individuals per generation) is the growth rate of the population. This equation simply says that the population in the next

generation is equal to the population of the previous generation plus the net growth of the population over the last season.

a. Suppose that the growth rate $g(P)$ satisfies the quadratic equation

$$g(P) = 0.02P - 0.000025P^2.$$

The population is at equilibrium when the growth rate is zero. Find the equilibrium populations.

b. The growth rate is at a maximum at the vertex of parabola. Find the population that produces this maximum growth rate P_{max} and what that growth rate is $g(P_{max})$.