V63.0005.002, Spring 2002
Mathematical Thinking
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Midterm 2

Answer as many questions as you can. Write your solutions in the blue test booklet, showing enough work to demonstrate how you arrived at the answers. You may do the problems in any order you wish. You're also encouraged to use scrap paper, but it will not be graded.

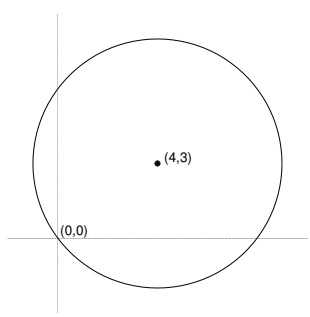
1. [21 points] Solve each inequality and graph the solution on the real number line.
   (a) $x^2 \geq -5x - 6$
   (b) $\left|\dfrac{4x-3}{2}\right| \leq \dfrac{1}{2}$
   (c) $4(y-1) + 2 > 3y + 8 - 2y$

2. [12 points] Graph the set of points (x, y) in the plane that satisfy $\dfrac{x}{5} + \dfrac{y}{4} < 1$.

3. [15 points] Tickets at the Angelika Film Center on Houston Street cost \$9 for adults and \$6 for senior citizens. Suppose an early afternoon showing of "Amadeus: Director's Cut" on Tuesday sold 36 tickets, earning a total of \$306. How many senior citizens bought tickets?

4. Albert tosses a coin up into the air. The height of the coin in feet above the ground after t seconds is given by
$$h(t) = 16t - 16t^2 + 4.$$
   Here $t = 0$ represents the moment at which the coin is tossed.
   (a) [5 points] How high above the ground is Albert's hand at the moment he tosses the coin?
   (b) [8 points] When will the coin hit the ground? (Be sure your answer to this question makes sense.)
   (c) [8 points] How high will the coin go before it falls, and when will it reach this height?
   (d) [5 points] Graph the function $h(t)$. Label three points on the graph (if you did the first three parts of this problem, this should be easy).

5. [12 points] The picture below shows a circle that passes through the origin and has its center at $(4, 3)$.



   Find an equation whose graph is this circle. (Hint: you need to figure out the radius first.)

6. [14 points] Solve each equation.
   (a) $|5x + 2| = |4x + 7|$
   (b) $(x + 1) + 6\sqrt{x + 1} - 7 = 0$

7. [EXTRA CREDIT, 5 points] Sketch a graph of the function $f(x) = -3 - \frac{1}{2}\sqrt{x - 1}$. Hint: what is $f^{-1}(x)$?