MATH 120D
Exam 1
Version 1
October 24, 2002

Name ________________________________

Section ____________________

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- You are allowed to use a calculator and one sheet of notes.
- Complete all questions.
- Show all your work and clearly indicate your final answer.
- When rounding is necessary, round your **final answer** to two digits after the decimal.
- Give answers with appropriate units.
- Raise your hand if you have a question.
- You have 50 minutes to complete the exam.

GOOD LUCK!
1. (10 points) Two bicyclists, one on a blue bicycle and one on a red bicycle, travel in the same direction on a straight road. They pass a tree at the side of the road at exactly the same instant. The blue bicycle’s speed $t$ seconds after passing the tree is given by the quadratic function

$$b(t) = -0.18t^2 + 3.6t + 14.$$  

The red bicycle’s speed is given by a linear function. As they pass the tree, the red bicycle travels 12 feet per second; fifteen seconds later, the two bicycles have the same speed. The graph of each bicycle’s speed is shown below.

(a) Compute $r(5)$, the red bicycle’s speed 5 seconds after passing the tree.

(b) Find the time during these 15 seconds at which the difference between the speed of the bicycles is the greatest.
2. (10 points) An ant walks from point $A$ to point $B$ along a straight-line path given by the equation\[3x + 2y = 10.\]

(a) If the ant walks at a rate of 1.6 feet per second, compute how much time it takes for the ant to get from point $A$ to point $B$.

(b) Suppose there is a circular puddle of milk, centered at the origin, with radius 10. Give the $x$-coordinate of the point where the ant exits the puddle.
3. (12 points) The graph of a multi-part function $f(x)$ is shown below. The graph is made of line segments and one quarter of a circle.

(a) Give the multi-part rule that defines $f(x)$.

(b) What is the domain of the function $g(x) = \sqrt{f(x)}$?
(c) Again, here is the graph of $f(x)$.

Sketch the graph of $h(x) = f\left(\frac{1}{2}x\right) + 3$. Clearly label at least four points on your graph.
4. (10 points) Let \( f(x) = 3x^2 - 5x + 2 \).

(a) Assume \( h \neq 0 \) and compute

\[
\frac{f(x + h) - f(x)}{h}.
\]

Simplify as much as possible.

(b) Assume \( a \neq 0 \) and compute

\[
\frac{f(2a) - f(a)}{a}.
\]

Simplify as much as possible.
5. (8 points) Let $f(x) = x + 2$ and $g(x) = |x|$. 

(a) True or False? (circle one)

T F $f(f(x)) = f(x)$ for all values of $x$.

T F $g(g(x)) = g(x)$ for all values of $x$.

(b) Recall the multi-part rule for the absolute value function:

$$g(x) = |x| = \begin{cases} 
-x & \text{if } x < 0 \\
 x & \text{if } x \geq 0 
\end{cases}$$

Write out the multi-part rules for:

i. $f(g(x))$

ii. $g(f(x))$