Answer all of the following questions. Use the backs of the question papers for scratch paper. Additional sheets are available if necessary. No books or notes may be used. When answering these questions, please be sure to 1) check answers when possible, 2) clearly indicate your answer and the reasoning used to arrive at that answer (**unsupported answers may receive NO credit**), and 3) label all variables and equations.

If you use your calculator to solve an equation or produce a graph, please indicate this on your test paper. Otherwise the answer will be assumed to be "unsupported".

Name _____

Section _____

Question	Score	Total
1		20
2		15
3		10
4		10
5		20
6		10
7		15
Total		100

1. (20 points) For each of the following limits, determine if it exists. If the limit exists, give its value and use the limit laws or the squeeze theorem to explain how you obtained your result. If the limit does not exist, determine if the limit is $+\infty$ or $-\infty$ or if it does not exist and is not $+\infty$ or $-\infty$.

(a) $\lim\limits_{x \to 0} x^2 \sin(1/x)$

(b) $\lim\limits_{x \to 2} \dfrac{x^2 + 4}{x^2 - 4}$

(c) $\lim\limits_{x \to 2} \dfrac{x^2 - 4}{x - 2}$

2. (15 points)

    (a) State the intermediate value theorem.

    (b) Prove that the equation $e^x = \sin x$ has a solution.

3. (10 points) Find a rational function which satisfies

$$\lim_{x \to \infty} f(x) = 2 \qquad \text{and} \qquad \lim_{x \to 3} f(x) = -\infty.$$

4. (10 points) If the price of tobacco is $\$p$ per pound, then a farmer produces $Q(p)$ pounds of tobacco.

   (a) What are the units for $Q'(p)$?

   (b) If $p = 2$, do you expect that $Q'(p) > 0$, $Q'(p) = 0$ or $Q'(p) < 0$? Why?

5. (20 points)

   (a) If $f(x) = \sqrt{x+4}$, use the definition of the derivative to find $f'(x)$. Give the domain of the $f'(x)$.

   (b) Write out the equation of the tangent line to the graph of $f(x)$ at $x = 0$.

   (c) Use the tangent line to approximate $\sqrt{4.1}$ and $\sqrt{3.8}$.

6. (10 points) Below is the graph of f'. On the same axes, sketch two possibilities for the graph of f.

7. (15 points) Below are the graphs of three functions, g_1, g_2 and g_3. These are the graphs of a function f and its first two derivatives f' and f''. Which function is f, f' and f''? Explain how you arrived at your answer.