October 7, 1999 **Name** _____

The first five problems counts 6 points each and the others count as marked.
Multiple choice section. Circle the correct choice. You do not need to show your work on these problems.

1. Consider the function f defined by:

$$f(x) = \begin{cases} |x+2| & \text{if } x \leq 0 \\ 5 - x^2 & \text{if } x > 0 \end{cases}$$

Find the three solutions to $f(x) = 1$ and compute their sum.

(A) -4 **(B)** -2 **(C)** 0 **(D)** 2 **(E)** 6

2. Let $f(x) = 1/x$. What is the vaule of $\dfrac{f(x+2) - f(x)}{2}$?

(A) $-\dfrac{1}{x(x+2)}$ **(B)** $\dfrac{1}{x(x+2)}$ **(C)** $\dfrac{x}{x+2}$ **(D)** $-\dfrac{x}{x+2}$ **(E)** $x+2$

3. Let $f(x) = \sqrt{2x}$. What is the value of $f(x+1) - f(x)$ in terms of x?

(A) $\dfrac{2}{\sqrt{2x+2} + \sqrt{2x}}$ **(B)** $\dfrac{2}{\sqrt{2x+1} + \sqrt{2x}}$ **(C)** $\dfrac{1}{\sqrt{2x+1}}$

(D) $\sqrt{2x+2}$ **(E)** $\sqrt{2x+2} - x$

4. Suppose the point $(2, 5)$ belongs to the graph of a function g and $g'(2) = 4$. What is the y-intercept of the line tangent to the graph of g at the point $(2, 5)$?

(A) -8 **(B)** -3 **(C)** 3 **(D)** 8 **(E)** 13

5. The line tangent to the graph of a function h at the point $(3, 7)$ has a y-intercept of 10. What is $h'(3)$?

(A) -7 **(B)** -4 **(C)** -1 **(D)** 1 **(E)** $17/3$

On all the following questions, **show your work.**

6. (20 points) Let

$$f(x) = \begin{cases} 2x - 3 & \text{if } x \leq 4 \\ 6 - x & \text{if } x > 4 \end{cases}$$

and let $g(x) = 2x$.

(a) Compute each of the following

i. $f \circ g(1)$

ii. $f \circ g(2)$

iii. $f \circ g(3)$

iv. $f \circ g(3.5)$

(b) Find a symbolic representation of the composition $f \circ g(x)$, and simplify the representation.

7. (25 points) Compute the limits requested.

   (a) $\lim_{h\to 0} \dfrac{\sqrt{2+h}-\sqrt{2}}{h}$

   (b) $\lim_{x\to 3} \dfrac{x-3}{x^3-27}$

   (c) $\lim_{h\to 0} \dfrac{\frac{1}{3+h}-\frac{1}{3}}{h}$

   (d) $\lim_{x\to\infty} \dfrac{2x^3-2x^2+7}{4x^3-10x^2+x-27}$

   (e) $\lim_{x\to-\infty} \dfrac{|x|-3}{3x+5}$

8. (25 points) Find the following derivatives.

   (a) $\frac{d}{dx}\sqrt{2x^3 - 5x + 7}$

   (b) $\frac{d}{dx}(2x - 1) \cdot (3x^2 + 4x)$

   (c) $\frac{d}{dx}\frac{2x^2-1}{3x+2}$

   (d) $\frac{d}{dx}\sqrt{x^2 - 2x + 1}$

   (e) $\frac{d}{dx}(x^3 + 3x^2 + 3x + 1)^{1/3}$

9. (20 points) Let $f(x) = \frac{1}{x} + x$.

   (a) Compute $f(3.1)$

   (b) Compute $f(3 + h)$

   (c) Compute $\frac{f(3+h)-f(3)}{h}$ and simplify, assuming $h \neq 0$.

   (d) Take the limit of the expression in (c) as h approaches 0 to find $f'(3)$.

   (e) What is the slope of the line tangent to f at the point $(3, 3\frac{1}{3})$.

   (f) Find an equation for the line tangent to the graph of f at the point $(3, 3\frac{1}{3})$.