Each problem is worth 10 points. There are 10 problems. The first four problems are multiple choice but you must show work or give some explanation to get credit.

1. Find the limit $\lim_{x \to -3} \left( \frac{x+3}{x^2+4x+3} \right)$. Show work. Encircle correct answer.

   $(a)$ 2 $(b)$ $-2$ $(c)$ $\frac{1}{2}$ $(d)$ $\frac{-1}{2}$ $(e)$ $\frac{3}{2}$ $(f)$ 0 $(g)$ 1 $(h)$ none of the previous

2. Find the limit $\lim_{v \to 2} \left( \frac{v^3-8}{v^4-16} \right)$. Show work. Encircle correct answer.

   $(a)$ 3 $(b)$ $-3$ $(c)$ $\frac{3}{8}$ $(d)$ $\frac{-3}{16}$ $(e)$ $\frac{3}{2}$ $(f)$ 0 $(g)$ 1 $(h)$ none of the previous

3. Find the limit $\lim_{x \to 0^-} \left( \frac{1}{x^{5/3}} \right)$. Show. Encircle correct answer.

   $(a)$ $\infty$ $(b)$ $-\infty$ $(c)$ $\frac{1}{2}$ $(d)$ $\frac{-1}{2}$ $(e)$ $\frac{3}{2}$ $(f)$ 0 $(g)$ 1 $(h)$ none of the previous

4. (Finding $\delta$ algebraically)
   Let $f(x) = \sqrt{x-7}$, $L = 4$, $x_0 = 23$, $\epsilon = 1$. Find (the largest possible) $\delta > 0$ such that $0 < |x - x_0| < \delta \implies |f(x) - L| < \epsilon$. Show work. Encircle correct answer:

   $(a)$ 2 $(b)$ 8 $(c)$ $\frac{1}{2}$ $(d)$ $\frac{1}{9}$ $(e)$ 9 $(f)$ 6 $(g)$ 7 $(h)$ none of the previous

5. Explain why the equation $x^5 + x - 3 = 0$ has at least one solution.

6. Use the definition of the derivative to find the slope of the tangent to $y = \sqrt{x+1}$ at $x = 9$. Show all work. You must use the definition to get credit for your answer.

slope =

7. Find the derivative of $y = \dfrac{x^2 - 1}{x^2 + 1}$. Show work.

$y' =$

8. Find the first and second derivatives for $y = x^2 + \dfrac{1}{x^2}$. Show work.

$y' =$

$y'' =$

9. Find the first and second derivatives for $y = \dfrac{(x^2 + x)(x^2 - x + 1)}{x^4}$. Show work.

$y' =$

$y'' =$

10. A rock is blasted straight upward from ground level with a velocity of 160 ft/sec. The height $s = -16t^2 + 160t$ at time $t$ until it hits the ground. The maximim height in feet attained is (Show all work.)

max height =

End of Exam