You may not use cell phones, books, notes, **or calculators** during the exam. Solutions must be written in your exam book; cross out any work you do not want graded. You are required to **sign your exam book**; with your signature, you pledge that you have neither given nor received assistance on this exam.

Since we have not yet covered it in the lectures, **do not** use l'Hospital's rule to compute limits on this exam.

1. (15 points) Evaluate the following expressions:

$$\text{(a)}\quad \frac{2\ln(6) - \ln(36)}{\ln(7)} \qquad\qquad \text{(b)}\quad \sec\left(\frac{11\pi}{6}\right)$$

Solve the following equation for x: (c) $e^{3x} = 3e^{4x}$

Indicate the *domain* of each of the following functions:

$$\text{(d)}\quad f(x) = \ln(1 - x) \qquad\qquad \text{(e)}\quad g(s) = \frac{1}{\sqrt{s^2 - 1}}$$

2. (8 points) In your blue book, sketch the graphs for the following functions on the indicated domain. Clearly label all points at which the nature of the graph changes as well as all x-intercepts and all vertical asymptotes.

(a) $y = \sin(2x) + 1/2$ on the interval $0 \le x \le \pi$.

(b) $y = \tan(x/2)$ on the interval $0 \le x \le \pi$.

3. (10 points) Consider the function $h(x) = \begin{cases} \dfrac{4x - 7}{4} & \text{for } x \le 2 \\[2mm] \dfrac{1}{x + 2} & \text{for } x > 2 \end{cases}$

(a) Graph $h(x)$.

(b) Compute $\lim\limits_{x \to 2^+} h(x)$ and $\lim\limits_{x \to 2^-} h(x)$. Is $h(x)$ a continuous function on the interval $(-\infty, \infty)$? Explain.

(c) Is $h(x)$ differentiable at $x = 2$? Explain.

4. (10 points) Evaluate the following limits:

(a) $\lim\limits_{t \to 4} \dfrac{2t - 8}{2 - \sqrt{t}}$

(b) $\lim\limits_{z \to \infty} \dfrac{2 - \cos(2z)}{3z}$ (**Hint:** use the *squeeze theorem*.)

5. (10 points) Consider the function
$$f(x) = \frac{1 + \sqrt{3x^6 + 1}}{x^3 - 1}$$

(a) Compute $\lim\limits_{x \to \infty} f(x)$ and $\lim\limits_{x \to -\infty} f(x)$. What are the horizontal asymptotes for the graph of $f(x)$?

(b) Find all vertical asymptotes of the graph of $f(x)$.

6. (8 points)

(a) Carefully state the LIMIT DEFINITION for the derivative $f'(x)$ of a function $f(x)$.

(b) USE THE LIMIT DEFINITION to find $f'(x)$ when $f(x) = \dfrac{1}{x+8}$.

7. (6 points) Suppose that $f(x)$ is a differentiable function with the properties that

$$f(2) = 3 \quad \text{and} \quad f'(2) = 1.$$

Find the following:

(a) $\dfrac{d}{dx} f(2x)\Big|_{x=1}$

(b) $g'(2)$ if $g(x) = e^{f(x)}$

8. (18 points) Compute the following: DON'T SIMPLIFY YOUR ANSWERS.

(a) $\dfrac{d}{dx}\left[\dfrac{x\sin(x)}{x+1}\right]$

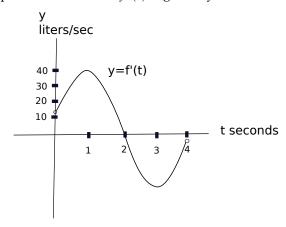(b) $\dfrac{d}{ds}\left[(s^{-2} + s^2)^{30}\right]$

(c) Find $\dfrac{dy}{dx}$ at $(1,0)$ if $x^2 + e^{-3y} = 4y + 1 + x$.

9. (7 points) Find the equation of the tangent line to the graph of the function

$$g(x) = 3\tan(x - 1) + 2\cos(x - 1)$$

at the point $(1, g(1))$.

10. (8 points) The quantity in liters of water in a reservoir t seconds after a certain valve is opened is given by the function $f(t)$. The graph of the derivative $f'(t)$ is given by the following:

Indicate whether the following statements are **True** or **False**. No partial credit. No justification required.

(a) There are 40 liters of water in the reservoir 1 second after the valve is opened.

(b) There is *more* water in the reservoir at time $t = 3$ seconds than at time $t = 4$ seconds.

(c) The *tangent line* to the graph of the function $f(t)$ at $t = 2$ is horizontal.

(d) The *secant line slope* $\dfrac{f(3.1) - f(3)}{0.1}$ is positive.

END OF EXAM.