

Name \_\_\_\_\_

- No calculators are allowed.
- Show sufficient work to justify your answer.

1. (10 points) Suppose that  $f(x) = \sqrt{x-3}$  and  $g(x) = x^2 + 3$ .

(a) Find a *simplified* formula for  $(f \circ g)(x)$  and state its domain.

(b) Find a *simplified* formula for  $(g \circ f)(x)$  and state its domain.

2. (10 points) Solve for  $x$  in each of the following equations.

(a)  $5e^x - 2 = 3e^x + 6$

(b)  $\ln(x^5) - \ln(x^2) = 15$

3. (12 points) Sketch a graph for each of the following functions, including the coordinates for all  $x$ -intercepts and  $y$ -intercepts, and all horizontal and vertical asymptotes.

(a)  $y = 2 + e^{-x}$

(b)  $y = \frac{1}{x - 3}$

(c)  $y = \ln(x - 2)$

4. (24 points) Evaluate the following limits.

$$(a) \lim_{x \rightarrow 1} \left(1 + \frac{1}{x}\right)^x$$

$$(b) \lim_{x \rightarrow +\infty} \left(1 + \frac{1}{x}\right)^x$$

$$(c) \lim_{x \rightarrow +\infty} e^{1/x^2}$$

$$(d) \lim_{x \rightarrow +\infty} \frac{\sqrt{x}}{\ln x}$$

$$(e) \lim_{x \rightarrow 8^+} \frac{1}{x - 8}$$

$$(f) \lim_{x \rightarrow 1^-} \frac{\sqrt{x}}{\ln x}$$

$$(g) \lim_{x \rightarrow +\infty} \frac{1 - 4x^2}{1 - 2x^2}$$

$$(h) \lim_{x \rightarrow -2} \frac{x^2 - 4}{x^2 + 5x + 6}$$

5. (8 points) Let  $f(x) = 4x^2 - 5$ . Use the definition of a derivative as a limit to show that  $f'(x) = 8x$ . Show each step in your calculation and be sure to use proper terminology.

6. (6 points) Find  $\frac{dw}{dt}$  given that  $w = \frac{6}{\sqrt{t}}$

7. (6 points) Find  $f'(x)$  given that  $f(x) = x^2 \sin x$

8. (6 points) Find  $g'(x)$  given that  $g(x) = \frac{x^2 + 1}{x^3}$

9. (6 points) Find  $\frac{dy}{dx}$  given that  $y = 4 + 5 \sec x$

10. (6 points) Evaluate  $f''(1)$  given that  $f(x) = x^3 + \frac{1}{x}$

11. (6 points) Find the equation of the line which is tangent to the graph of  $f(x) = 2 \cos x$  at  $x = \frac{\pi}{2}$ . Write your final answer in the simplified form  $y = mx + b$ .