

Name: _____

1. Use the definition of the limit to show that

$$\lim_{x \rightarrow 0^+} \sqrt{x} = 0$$

2. Find

$$\lim_{x \rightarrow \infty} \left(\frac{e^{3x} - 1}{e^{(x^2)} + 5} \right)$$

3. Show that

$$\lim_{x \rightarrow 0} \left(x^2 \sin \left(\frac{\pi}{x} \right) \right) = 0$$

4. List all discontinuities of

$$f(x) = \llbracket \cos x \rrbracket$$

(Hint: graph $\cos x$ and $\llbracket \cos x \rrbracket$ by hand, then list the discontinuities on your graph).

5. Use the definition of the derivative to find

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

6. Draw a possible graph of $f(x)$, assuming the following:

- $f'(x)$ is positive on $[0, 2]$ and negative everywhere else
- $f'(x)$ is increasing when $x < 1$ and decreasing when $x > 1$

7. State and prove the differentiation rule for constant functions.

8. Suppose the distance (in feet) from a beach house to the water line t hours after sunrise is given by

$$D(t) = 40 + 20 \cos\left(\frac{2\pi}{12}t\right)$$

Find the rate at which the water line is moving at noon, assuming sunrise is at 6:30 a.m.

9. Find y' if

$$e^y = e^x$$

10. Find

$$\frac{d}{dx} (\sec x)^{(\csc x)}$$

11. Approximate $e^{1/10}$ using local linear approximation. Perform all arithmetic by hand, and use a graph to illustrate whether your answer is an overestimate or an underestimate.

12. Find the dimensions of the parallelogram of perimeter 100 and base angle $\frac{\pi}{4}$ with maximum internal area. Use the fact that the area of a parallelogram is given by its width times its height.