Name: _____

- You have fifty minutes to complete this mock exam.

1. If $f(x) = \sqrt{1-x}$ and $g(x) = \ln(x-1)$, find the domain of the composition $(f \circ g)(x)$.

2. (a) State the Intermediate Value Theorem.
   (b) Prove that the equation $x^{\frac{3}{2}} = x^{\frac{1}{2}} + 1$ has at least one real solution.

3. If

$$f(x) = \begin{cases} \ln\left(x^2 - 2x + 4\right) & \text{if } x < 1 \\ C\cos(\pi x) & \text{if } x \geq 1 \end{cases},$$

find the value of C that makes f continuous everywhere.

4. Find the inverse of the function $f(x) = e^{x^3+1}$.

5. If the point $(-2, \pi)$ is on the graph of an even function, what other point must be on its graph?

6. If $\cos\theta = 0.8$ and $-\frac{\pi}{2} \leq \theta \leq 0$, compute $\tan\theta$.

7. Evaluate

$$\lim_{\theta \to 0} \theta^2 \cos\left(\frac{e^\theta + 12}{\theta^8}\right).$$

8. Evaluate the following limits.

(a) $\lim_{x \to 1} \dfrac{x^2 + 2x - 3}{x - 1}$

(b) $\lim_{x \to \infty} \dfrac{2x^2 + 5}{\sqrt{9x^4 + 2x + 6}}$

(c) $\lim_{x \to \frac{1}{2}^+} \dfrac{\ln x}{2x - 1}$

(d) $\lim_{x \to \infty} \tan^{-1} x$

9. Use the limit definition to compute the following derivatives.

   (a) $f'(1)$, where $f(x) = x^2 + x + 1$

   (b) $g'(x)$, where $g(x) = \sqrt{x+3}$

   (c) $h'(0)$, where $h(\theta) = \sin\theta$.