Please show all your work! Answers without supporting work will not be given credit. Write answers in spaces provided. You have 1 hour and 50 minutes to complete this exam.

Name: $\qquad$

1. Calculate the following limits. If a limit is $\infty$ or $-\infty$, please say so. Make sure you show all your work and justify all your answers.
(a) $\lim _{x \rightarrow 3} \frac{\sqrt{x+1}-2}{x-3}$
$\qquad$
(b) $\lim _{x \rightarrow 0} \frac{\sin (4 x)}{8 x}$

## Answer:

2. Use the $\varepsilon-\delta$ definition of limit to prove that

$$
\lim _{x \rightarrow 2} x^{2}-3 x+2=0
$$

3. If $h(x)=\sqrt{x^{2}+2}-1$, find a non-trivial decomposition of $h$ into $f$ and $g$ such that $h=f \circ g$.

$$
\begin{aligned}
& f(x)= \\
& g(x)=\square
\end{aligned}
$$

4. Find the first two derivatives of the function $f(x)=x^{2} \cos (x)$. Simplify your answers as much as possible. Show all your work.

$$
f^{\prime}(x)=
$$

$\qquad$
$f^{\prime \prime}(x)=$ $\qquad$
5. Find the derivative of the function $f(x)=\int_{x^{2}}^{2} \frac{\cos (t)}{t} d t$.

## Answer:

6. Set up, but do not evaluate, the integral for the volume of the solid obtained by rotating the area between the curves $y=x$ and $y=\sqrt{x}$ about the $x$-axis.
