## Exam 1

Answer all 11 questions for a total of 100 points. Write your solutions in the accompanying blue book, and put a box around your final answers. If you solve the problems out of order, please skip pages so that your solutions stay in order. Good luck!

1. (6 points) Use interval notaton to describe the domain of the function $f(x)=\frac{\sqrt{3 x+4}}{x^{2}-x}$.
2. Let $f(x)=x^{3}+2 x$ and let $g(x)=1-\sqrt{x}$.
(a) (4 points) Find $f(g(x))$.
(b) (4 points) Find $g(f(x))$.
3. ( 6 points) Give an equation for the line that passes through the points $(-1,-2)$ and $(4,3)$.
4. (6 points) Make a rough sketch of the graph $y=2^{x}-4$. Label the $x$-intercept, $y$-intercept, and horizontal asymptote.
5. (a) (4 points) Evaluate $\log _{16} 4$.
(b) (6 points) Solve $\ln (x-1)=\ln (x)-1$.
6. The population $P$ of a bacteria $t$ days after being placed in an ideal environment is given by an exponential function $P(t)=C \cdot a^{t}$, for some constants $C$ and $a$.
(a) (6 points) If the population after 5 days is 6,000 and the population after 10 days is 48,000 , find the exponential function $P(t)$.
(b) (4 points) When will the population reach 750,000 ? Leave your answer as a logarithmic expression.
7. Use the graph below to answer the following questions. If a limit does not exist, write DNE.

(a) (2 points) $\lim _{x \rightarrow 1^{-}} f(x)$
(b) (2 points) $\lim _{x \rightarrow 1^{+}} f(x)$
(c) (2 points) $\lim _{x \rightarrow 1} f(x)$
(d) (4 points) Is $f$ continuous at $x=2$ ? Why or why not?
8. Calculate each of the following limits. If a limit does not exist, write DNE.
(a) (6 points) $\lim _{x \rightarrow-1} \frac{x^{2}+2 x+1}{x^{4}-1}$
(b) $\left(6\right.$ points) $\lim _{x \rightarrow 1} \frac{\frac{1}{4}+\frac{1}{x}}{4+x}$
9. Let $f(x)=\sqrt{16-x}$.
(a) (4 points) Find the average rate of change in $f$ over the interval $[7,12]$.
(b) (8 points) Find the instantaneous rate of change in $f$ when $x=7$. That is, find $f^{\prime}(7)$.

Note: for this question you must calculate $f^{\prime}(7)$ as a limit.
10. (8 points) Let $f(x)=2 x^{2}+5 x$. Find $f^{\prime}(x)$.

Note: for this question you must calculate $f^{\prime}(x)$ as a limit.
11. Use the graph of $f^{\prime}(x)$ below to answer the following questions about $f(x)$.

(a) (4 points) On what interval(s) is $f(x)$ increasing/decreasing?
(b) (4 points) On what interval(s) is $f(x)$ concave up/down?
(c) (4 points) How many local minimums does $f(x)$ have?

