1. The graph of a function $f$ is drawn on the right.

Find the following:

$$
\begin{align*}
\lim_{x \to -2} f(x) & = \infty \\
\lim_{x \to 0} f(x) & = \infty \\
\lim_{x \to -2} f(x) & = -2 \\
\lim_{x \to 0} f(x) & = 1 \\
\lim_{x \to -2} f(x) & = 0 \\
\lim_{x \to 0} f(x) & = 0 \\
\lim_{x \to -2} f(x) & = -2 \\
\lim_{x \to 0} f(x) & = 2 \\
\end{align*}
$$

2. Sketch the graph of an example of a single function which satisfies all of the following conditions:

(a) $\lim_{x \to -2} f(x) = -2$; (b) $\lim_{x \to 0} f(x) = 1$; (c) $f(0) = -1$; (d) $\lim_{x \to -2} f(x) = \infty$;

(e) $\lim_{x \to 0} f(x) = -\infty$; (f) $\lim_{x \to 0} f(x) = 3$; (g) $\lim_{x \to -2} f(x) = 4$.

3. Do not use your calculator. Let $f(x) = \frac{x^2}{(x-2)(x+1)}$. Find the following:

(a) $\lim_{x \to -2} f(x)$; (b) $\lim_{x \to 0} f(x)$; (c) $\lim_{x \to -2} f(x)$; (d) $\lim_{x \to 0} f(x)$; (e) $\lim_{x \to -2} f(x)$;

(f) $\lim_{x \to -2} f(x)$; (g) $\lim_{x \to 0} f(x)$. (h) Sketch the graph of $y = f(x)$.

4. Use the Intermediate Value Theorem to show that there is a solution to the equation $e^{-x^2} = x$ somewhere in the interval $(0, 1)$.

5. For the graph on the right, arrange the following numbers in increasing order:

$f'(1); f'(2); f'(3); \frac{f(4) - f(2)}{2}; \frac{f'(4) - f'(2)}{2}; \frac{f'(3)}{2}; \frac{f'(4)}{2}; \frac{f'(5)}{2}; \frac{f'(3)}{2}; \frac{f'(4)}{2}; \frac{f'(5)}{2}$.
6. If you take a 5 year $20,000 loan to buy a car, the total cost ($C$) of the loan is a function of ($r$), the annual interest rate that you are charged. I.e., $C = f(r)$.

(a) What does $f(6) = 26,000$ mean? What are the units?
(b) What does $f'(6) = 1200$ mean? What are the units?
(c) Use (a) and (b) to approximate $f(6.25)$.
(d) What is $f(0)$?

7. The graph of a function $f$ is drawn on the right. Draw the graph of $f'$.

8. (a) If the tangent line to the curve $y = f(x)$ at the point $(3, 2)$ also goes through the point $(4, 4)$, find $f(3)$ and $f'(3)$.
(b) Make a careful sketch of the graph for $f(x) = \cos(x)$. Below it sketch a graph for $y = f'(x)$. Guess a formula for $f'(x)$.

9. (a) Label, on the graph to the right, $f(x)$; $f(x + h)$; $f(x + h) - f(x); h$.
(b) What is $\frac{f(x + h) - f(x)}{h}$?
(c) Give the definition for $f'(x)$.
(d) Use your definition in (c) to find $f'(x)$ if $f(x) = \frac{1}{x}$.

10. The table below gives $C(t)$, the total value of U.S. currency in circulation (in billions of dollars) as a function of time $t$ (years).
(a) Find the average rate of change of the currency over the time interval [1980, 2000].
(b) Give an estimate for the value of $C'(1990)$.

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<tbody>
<tr>
<td>$C(t)$</td>
<td>130</td>
<td>187</td>
<td>272</td>
<td>409</td>
<td>568</td>
</tr>
</tbody>
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\[
\text{ave rate of change} = \frac{438 - 219}{2000 - 1980} = \frac{219}{20} = 10.95 \text{ billion $/yr}$
\]

\[
\text{instant rate of change at 1990} \approx \frac{409 - 272}{1995 - 1990} - \frac{130 - 187}{1985 - 1980} = \frac{22.5}{20} = 1.125 \text{ billion $/yr}$