1. True/False.
   (a) Every continuous function has a derivative.
   (b) If $f(x)$ and $g(x)$ have a derivative at $x = a$, then $h(x) = f(x)g(x)$ also has a derivative at $x = a$.
   (c) If $f(x)$ and $g(x)$ have a derivative at $x = a$, then $h(x) = \frac{f(x)}{g(x)}$ also has a derivative at $x = a$.
   (d) If $f(x)$ and $g(x)$ have a derivative at $x = a$, then $h(x) = f(g(x))$ also has a derivative at $x = a$.
   (e) If $f(x)$ is continuous at $x = a$, then $f(x)$ is differentiable at $x = a$.
   (f) If $f(x)$ is differentiable at $x = a$, then $f(x)$ is continuous at $x = a$.
   (g) If $f(0) = 12$, then $\lim_{x\to 0} f(x) = 12$.
   (h) If $f(0) = 12$ and $f(x)$ is continuous, then $\lim_{x\to 0} f(x) = 12$.
   (i) $\lim_{x\to 0} \frac{1}{x^2}$ does not exist.
   (j) $\lim_{x\to 0} \frac{1}{x^2} = \infty$.
2. Give an example of each of the following.
   (a) A function which has a removable discontinuity at $x = 0$.
   (b) A function which is continuous but not differentiable at $x = 0$.
   (c) A function for which $f'(x) = 2$ for all x and $f(1) = 1$.
   (d) Two different functions with the property that $f'(x) = f(x)$ for all x.
   (e) A function with the property that $f''(x) = f'(x)$ but $f'(x)$ is not the same as $f(x)$.
   (f) A function for which $f(x) \geq 0$ for all x and $f'(x) < 0$ for all x.
   (g) A function for which $f'(x)$ is not always zero but $f'(x) = 0$ for infinitely many x.
3. State the definition of each of the following.
   (a) $f(x)$ is continuous at $x = a$.

   (b) $f(x)$ has a removable discontinuity at $x = a$.

   (c) The derivative of $f(x)$ at $x = a$.

4. State the following theorems.
   (a) Squeeze Theorem

   (b) Intermediate Value Theorem

5. Evaluate. Answer with a number, $-\infty$, ∞, or "does not exist". Do not use L'Hopital's rule.

   (a) $f(x) = \begin{cases} x^2 & x \neq 0 \\ 4 & x = 0 \end{cases}$, $g(x) = 2x$. $\lim_{x\to 0} f(g(x))$

   (b) $f(x) = \begin{cases} x^2 & x \neq 0 \\ 4 & x = 0 \end{cases}$, $g(x) = 2x$. $f\left(\lim_{x\to 0} g(x)\right)$

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

   (d) $\lim_{x\to 1} \dfrac{1-\sqrt{x}}{1-x}$

   (e) $\lim_{x\to 0} x^{1/3}\sin(4/x)$

   (f) $\lim_{x\to 0} x^{1/2}\sin(4/x)$

   (g) $\lim_{x\to \pi^-} \csc(x)$

   (h) $\lim_{x\to -\infty} \dfrac{-x^2-4x+8}{3x^3}$

   (i) $\lim_{x\to -\infty} \dfrac{-x^2-4x+8}{3x^2}$

   (j) $\lim_{x\to 0^-} \dfrac{x^2-4x+8}{3x^3}$

   (k) $\lim_{x\to 0^+} \dfrac{x^2-4x+8}{3x^2}$

   (l) $\lim_{x\to 0} e^{1/x}$

   (m) $\lim_{x\to 0^-} e^{1/x}$

   (n) $\lim_{t\to 0} \dfrac{t}{\sin(2t)}$

   (o) $\lim_{x\to 0} \dfrac{\cos(4x^2)-1}{x^2}$

6. Find the derivative for each of the following functions.

   (a) $f(x) = \dfrac{e^x}{\cos(x)}$

   (b) $f(x) = x^2\cot(x)$

   (c) $f(x) = \dfrac{\ln(x)}{\cos(x^2)}$

   (d) $f(x) = \sec(e^{5\cos(x^2)})$

   (e) $f(x) = \tan\sqrt{x^2+1}$

   (f) $f(x) = 4x^2\sin(x)\sec(3x)$

   (g) $f(x) = (\csc(x))^4$

   (h) $f(x) = 3^{\tan(x)}$

   (i) $f(x) = (\cos(x))^{\sin(x)}$

7. Find $f''(x)$ for each of the following functions.

   (a) $f(x) = 2x^3 - 4x^2 + 5x + 2$

   (b) $f(x) = e^{\sin(x)}$