

1. Let

$$f(x) = \begin{cases} x + 2 & x < -1 \\ 2 & x = -1 \\ x^2 & -1 < x < 1 \\ 1 & x \geq 1. \end{cases}$$

- (a) Sketch the graph of the f .
- (b) Determine the values of a for which $\lim_{x \rightarrow a} f(x)$ exists.
- (c) Determine the values of a at which f is continuous.
- (d) Determine the values of a at which $f'(a)$ exists.
- (e) Find $f(f(-3))$.

2. Evaluate the limit, if it exists.

(a) $\lim_{x \rightarrow -1} \frac{\sqrt{x+2}}{x^2+1}$

(b) $\lim_{t \rightarrow 1} \frac{3t^2 - 3t}{2t^2 - 2}$

(c) $\lim_{\theta \rightarrow 0} \frac{3\theta}{\tan(2\theta)}$

(d) $\lim_{s \rightarrow -\infty} \frac{2 + s - 3s^2}{3 + 4s^2}$

(e) $\lim_{y \rightarrow \infty} \frac{2}{\sqrt{y^2+1} - y}$

3. Let $f(x) = (1+x)^2$.

- (a) Use the definition of derivative to find $f'(0)$.
- (b) Find an equation of the tangent line to the graph of f at $(0, 1)$.
- (c) Find the linear approximation of f at $x = 0$.
- (d) Use (c) to approximate $(0.98)^2$.

4. Find the *second* derivative of the function.

- (a) $f(x) = x^3 + 2\sqrt{x} - \frac{1}{x^2}$
- (b) $g(\theta) = 2\theta \sin(\theta)$
- (c) $h(t) = \sqrt{t^2 + 1}$

5. Find y' at $(-2, -2)$ by implicit differentiation.

$$y^2 - x^3 = 3xy$$

6. Two cars start moving from the same point. One travels south at 30 mi/h and the other travels west at 40 mi/h. At what rate is the distance between the cars increasing after an hour?