- **1.** Sketch the graph y = f(x) of a function which has all of the following properties; do not worry about any *formula* for f(x):
- (a) f(0) = 3
- (b)  $\lim_{x\to 0} f(x) = 0$
- (c)  $\lim_{x \to -2^-} f(x) = 1$
- (d)  $\lim_{x \to -2^+} f(x) = -1$
- (e)  $\lim_{x\to 5^-} f(x)$  d.n.e.
- (f)  $\lim_{x \to 5^+} f(x) = -\infty$
- (g) the domain of *f* is  $(-\infty, \infty)$

**2.** Evaluate the limit, if it exists:

$$\lim_{h\to 0} \frac{(2+h)^3-8}{h} =$$

**3.** Evaluate the limit, if it exists:

$$\lim_{u \to 2} \frac{\sqrt{4u+1} - 3}{u-2} =$$

**4.** Evaluate the limit, if it exists:

$$\lim_{t \to 0} \left( \frac{1}{t\sqrt{1+t}} - \frac{1}{t} \right) =$$

**5.** Evaluate the limit, if it exists:

$$\lim_{x \to 3} \frac{\frac{1}{x} - \frac{1}{3}}{x - 3} =$$

6. Evaluate the limits, if they exist, and otherwise explain why they do not:(a)

$$\lim_{x \to 0^-} \left(\frac{1}{x} - \frac{1}{|x|}\right) =$$

(b)

$$\lim_{x \to 0^+} \left(\frac{1}{x} - \frac{1}{|x|}\right) =$$

7. *Challenge problem.* Consider the following function:

$$f(x) = \begin{cases} 1, & \text{if } x \text{ is rational} \\ 0, & \text{if } x \text{ is irrational} \end{cases}$$

Evaluate the limit  $\lim_{x\to 0} f(x)$  if it exists. If it does not exist, explain why.