Each problem is worth 10 points. For full credit provide complete justification for your answers.

Use the graph of $g(x)$ at the bottom of the page for problems 1 and 2:

1. Find the following limits:
    a) $\lim\limits_{x \to -1^-} g(x)$
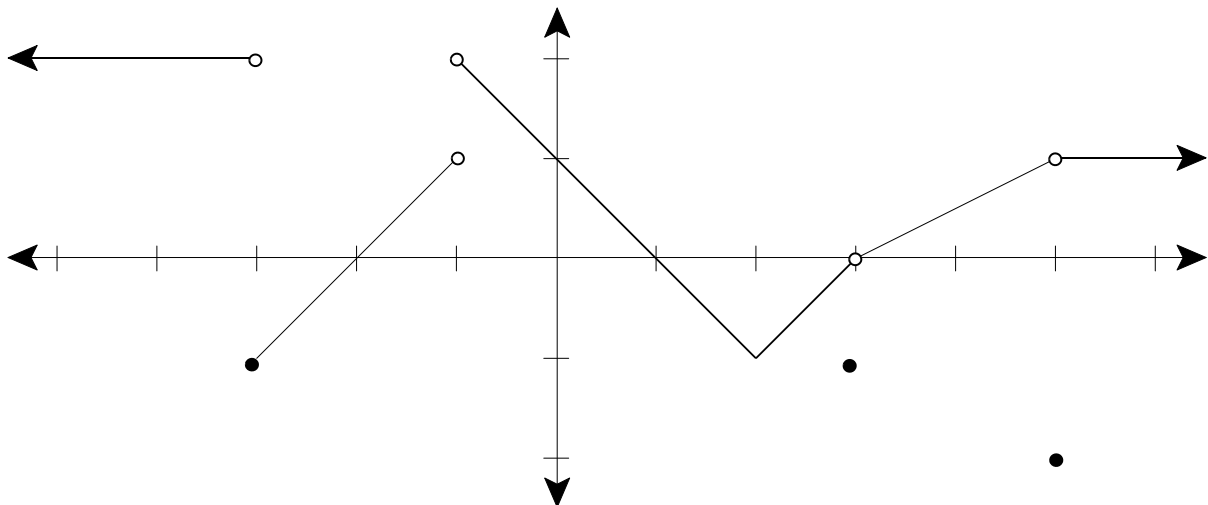
    b) $\lim\limits_{x \to -1^+} g(x)$

    c) $\lim\limits_{x \to -1} g(x)$

    d) $\lim\limits_{x \to 5^+} g(x)$

    e) $\lim\limits_{x \to 3^-} g(x)$

    f) $\lim\limits_{x \to 3} g(x)$

2. For which values of x does the function fail to be continuous?

3. Evaluate $\displaystyle\lim_{x\to 3}\frac{x^2-9}{x-3}$

4. [Stewart 1.3] If a rock is thrown upwards on the planet Mars with a velocity of 10m/s, its height in meters t seconds later is given by $y = 10t - 1.86t^2$. Find the average velocity of the rock over the following time intervals:
   a) [1,2]

   b) [1,1.5]

   c) [1,1.1]

   d) [1,1.01]

5. Provide a justification on each line for the corresponding equality:

$$\lim_{x \to 2} \frac{x^2 - 9}{x - 3} = \frac{\lim_{x \to 2}\left(x^2 - 9\right)}{\lim_{x \to 2}\left(x - 3\right)}$$ _____

$$= \frac{\lim_{x \to 2} x^2 - \lim_{x \to 2} 9}{\lim_{x \to 2} x - \lim_{x \to 2} 3}$$ _____

$$= \frac{\left(\lim_{x \to 2} x\right)^2 - \lim_{x \to 2} 9}{\lim_{x \to 2} x - \lim_{x \to 2} 3}$$ _____

$$= \frac{2^2 - \lim_{x \to 2} 9}{2 - \lim_{x \to 2} 3}$$ _____

$$= \frac{2^2 - 9}{2 - 3}$$ _____

$$= \frac{5}{1}$$

6. a) Evaluate $\displaystyle \lim_{x \to \infty} \frac{2x^2 + 7}{(x-1)(x^2+x)}$.

b) Evaluate $\displaystyle \lim_{x \to 1^-} \frac{2x^2 + 7}{(x-1)(x^2+x)}$.

7. Biff is a calculus student at Enormous State University, and he's having some trouble. Biff says "Well, crap. Our Calc class I guess makes a pretty big deal about limits, even though I never saw those in high school at all, which is pretty unfair if you ask me. But so I was trying to figure them out, and the TA said something about it being like speed limits, I guess? So there was this function e^{-x} that we were s'posed to say the limit of, but it looked to me like the graph was coming down towards 0, right? But with a speed limit, like, you're not allowed to go above it, right? So is it okay for 0 to be the limit even if it goes down to that, instead of getting up to it?"

Help Biff by explaining as clearly as you can the answer to his questions.

8. Evaluate $\lim\limits_{x \to \infty}\left(\sqrt{4x^2 + x} - 2x\right)$. Be sure to provide good justification for your conclusion.

9. Evaluate $\displaystyle\lim_{h\to 0}\frac{(h-1)^3+1}{h}$.

10. Jon is trying to produce a function of the form $f(x) = \begin{cases} x^2 & \text{for } x \le 2 \\ 4x + c & \text{for } x > 2 \end{cases}$ for some value of c that makes the graph continuous. Is this possible? If so, what should the value of c be?

Extra Credit (5 points possible):

Evaluate $\lim_{x \to -\infty} \left(\sqrt{4x^2 + x} - 2x \right)$. Be sure to provide good justification for your conclusion.