

Exam 1 Calc 1 9/13/2019

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) $\lim_{x \rightarrow -3^-} g(x)$

b) $\lim_{x \rightarrow -3^+} g(x)$

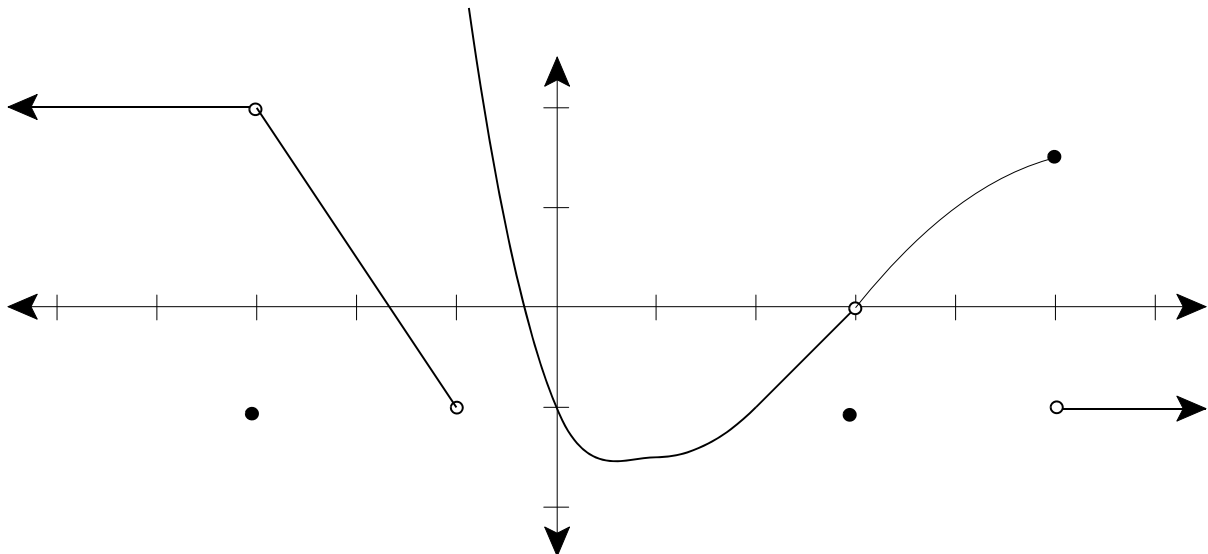
c) $\lim_{x \rightarrow -3} g(x)$

d) $\lim_{x \rightarrow 5^+} g(x)$

e) $\lim_{x \rightarrow 5^-} g(x)$

f) $\lim_{x \rightarrow 5} g(x)$

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



3. Evaluate $\lim_{x \rightarrow 5} \frac{x^2 - 25}{x - 5}$.

4. Let $f(x) = \frac{\sin x}{x}$. **Make sure your calculator is in radian mode.** Give answers accurate to at least 8 decimal places.

a) What is $f(0.1)$?

b) What is $f(0.01)$?

c) What is $f(0.001)$?

d) What is $\lim_{x \rightarrow 0^+} f(x)$?

5. An aid organization is building wells in remote areas, and then maintaining them, in order to improve the standard of living for people in the region. A well initially costs \$10,000 for materials, and then on average \$500 each year for maintenance after the first year. The company plans to have \$400,000 per year to devote to the project. Let $w(t)$ express the number of wells that can be provided altogether after t years.

a) What is $w(1)$?

b) What is $w(2)$?

c) What is $\lim_{t \rightarrow \infty} w(t)$?

6. Evaluate $\lim_{x \rightarrow \infty} (\sqrt{9x^2 + x} - 3x)$.

7. Biff is a calculus student at Enormous State University, and he's having some trouble. Biff says "Well, crap. Calc is totally killing me. I thought it would be easy because of multiple choice, right? But it's like they're all trick questions. There was this one, like, for how many different inputs closer and closer to something do you have to get outputs closer and closer to something for you to know that's what the limit is, right? So I said 3 because that's how many they used in the online homework, so that's pretty simple, right? But they said it's none of the above, which is pretty much crap, because it's gotta be *something*, right?"

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

8. Evaluate $\lim_{h \rightarrow 0} \frac{(5+h)^2 - 5^2}{h}$.

9. A capacitor is charged to power a phone camera's flash, with the electric charge given by $Q(t) = Q_0(1 - e^{-t/a})$, where Q_0 and a are positive constants determined by the design of the phone. Evaluate $\lim_{t \rightarrow \infty} Q(t)$. Be sure to provide good justification for your conclusion.

10. A car is driving down the highway at night when suddenly a tyrannosaurus appears in the middle of the road ahead. The driver immediately hits the brakes, and the distance between the car and dinosaur is given by $d(t) = 7.5t^2 - 90t + 240$ for values of t between 0 and 4.

Give answers accurate to at least 8 decimal places.

a) Find the average velocity of the car over the interval $[3.5, 4]$.

b) Find the average velocity of the car over the interval $[3.9, 4]$.

c) Find the average velocity of the car over the interval $[3.99, 4]$.

d) Estimate the car's instantaneous velocity at $t = 4$.

Extra Credit (5 points possible):

Evaluate $\lim_{x \rightarrow -\infty} (\sqrt{9x^2 + x} - 3x)$. Be sure to provide good justification for your conclusion.