AP Calculus AB   Chapter 1 Limits Review   Name:________________

1. $g(x) = \begin{cases} x+5, x<2 \\ 11, x=2 \\ 2x-1;\ 2<x<5 \\ 20, x=5 \\ x+4, x>5 \end{cases}$ Find the following :

a) $\lim_{x\to-\infty} g(x) =$	b) $\lim_{x\to 2^-} g(x) =$	c) $\lim_{x\to 2^+} g(x) =$
d) $\lim_{x\to 2} g(x) =$	e) $\lim_{x\to 5^-} g(x) =$	f) $\lim_{x\to 5^+} g(x) =$
g) $\lim_{x\to 5} g(x) =$	h) $\lim_{x\to 6^+} g(x) =$	i) $\lim_{x\to\infty} g(x) =$

Use Continuity conditions to justify whether f(x) is continuous or discontinuous . If discontinuous, identify type of discontinuity

2) $f(x) = \begin{cases} x^2+5, x\geq 3 \\ x^2-2, x<3 \end{cases}$

3) Find the k value that will make the function f(x) continuous.

b) $f(x) = \begin{cases} \frac{x^2+x-6}{x+3}, & x \neq -3 \\ k, & x = -3 \end{cases}$

PAST AP FREE-RESPONSE PROBLEMS COVERED BY THIS CHAPTER

Note: These and other questions can be found at apcentral.com.
2003 AB 6a
2006 BC 3c
2008 AB 6d

MULTIPLE-CHOICE QUESTIONS

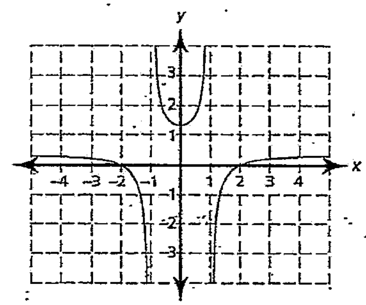
A calculator may not be used on the following questions.

1. Evaluate the limit, if it exists: $\lim_{x\to 2}\frac{x^2+x-6}{2-x}$.
   (A) 5
   (B) 3
   (C) -3
   (D) -5
   (E) The limit does not exist.

2. Evaluate the limit, if it exists: $\lim_{x\to 9}\frac{\sqrt{x-5}-2}{x-9}$.
   (A) $\frac{1}{4}$
   (B) $-\frac{1}{4}$
   (C) 1
   (D) 0
   (E) The limit does not exist.

3. Evaluate the limit, if it exists: $\lim_{x\to 2}\frac{\frac{1}{x}-\frac{1}{2}}{x-2}$.
   (A) $\frac{1}{4}$
   (B) $-\frac{1}{4}$
   (C) 1
   (D) -1
   (E) The limit does not exist.

4) For what value of k is the function $f(x)=\begin{cases}\frac{2x^2+5x-3}{x^2-9}, & x\neq -3\\ k, & x=-3\end{cases}$ continuous at $x=-3$?
   (A) $-\frac{7}{6}$
   (B) $-\frac{5}{6}$
   (C) 0
   (D) $\frac{5}{6}$
   (E) $\frac{7}{6}$



5) The function $g(x)$ is shown in the graph above and is of the form $g(x)=\frac{x^2+a}{bx^2-3}$. Which of the following could be the values of the constants a and b?
   (A) $a=-2,\ b=-1$
   (B) $a=-2,\ b=-3$
   (C) $a=-4,\ b=3$
   (D) $a=-4,\ b=-3$
   (E) $a=4,\ b=3$

6) Identify the vertical asymptotes for $f(x)=\frac{x^2+3x-4}{x^2+x-2}$.
   (A) $x=-2, x=1$
   (B) $x=-2$
   (C) $x=1$
   (D) $y=-2, y=1$
   (E) $y=-2$

2

3

AP Calculus AB Chapter 1 Limits Review Name: KEY

1. $g(x) = \begin{cases} x \pm 5, x < 2 \\ 11, x = 2 \\ 2x-1,\ 2<x<5 \\ 20, x=5 \\ x+4, x>5 \end{cases}$ Find the following :

a) $\lim_{x\to-\infty} g(x) =$ $\lim_{x\to-\infty} \frac{x+5}{1} = \boxed{-\infty}$	b) $\lim_{x\to2^-} g(x) =$ $\lim_{x\to2^-} x+5 = \boxed{7}$	c) $\lim_{x\to2^+} g(x) =$ $\lim_{x\to2^+} 2x-1 = \boxed{3}$
d) $\lim_{x\to2} g(x) =$ $\lim_{x\to2^-} g(x) \neq \lim_{x\to2^+} g(x)$ $\boxed{DNE}$	e) $\lim_{x\to5^-} g(x) =$ $\lim_{x\to5^-} 2x-1 = \boxed{9}$	f) $\lim_{x\to5^+} g(x) =$ $\lim_{x\to5^+} x+4 = \boxed{9}$
g) $\lim_{x\to5} g(x) =$ $\boxed{9}$	h) $\lim_{x\to6^+} g(x) =$ $\lim_{x\to6^+} x+4 = \boxed{10}$	i) $\lim_{x\to\infty} g(x) =$ $\lim_{x\to\infty} \frac{x+4}{1} = \boxed{+\infty}$

Use Continuity conditions to justify whether f(x) is continuous or discontinuous. If discontinuous, identify type of discontinuity

2) $f(x) = \begin{cases} x^2+5, x \geq 3 \\ x^2-2, x<3 \end{cases}$

i) $f(3) = 3^2+5 = 14$

ii) $\lim_{x\to3^-} x^2-2 = 7$ $\lim_{x\to3^+} x^2+5 = 14$ Since $\lim_{x\to3^-} f(x) \neq \lim_{x\to3^+} f(x)$

$\lim_{x\to3} f(x) = DNE$

Nonremovable discontinuity since limit does not exist at $x=3$

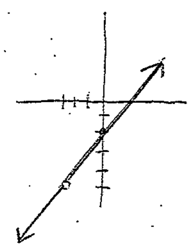
3) Find the k value that will make the function f(x) continuous.

b) $f(x) = \begin{cases} \frac{x^2+x-6}{x+3}, & x \neq -3 \\ k, & x = -3 \end{cases}$

i) $f(-3) = k$

ii) $\lim_{x\to-3} \frac{x^2+x-6}{x+3} = \frac{0}{0}$ $\lim_{x\to-3} \frac{\cancel{(x+3)}(x-2)}{\cancel{(x+3)}} = -5$

iii) $f(-3) = \lim_{x\to-3} f(x)$, $\boxed{k=-5}$



PAST AP FREE-RESPONSE PROBLEMS COVERED BY THIS CHAPTER

Note: These and other questions can be found at apcentral.com.
2003 AB 6a
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MULTIPLE-CHOICE QUESTIONS

A calculator may not be used on the following questions.

1. Evaluate the limit, if it exists: $\lim_{x\to2} \frac{x^2+x-6}{2-x}$. $\lim_{x\to2} \frac{(x+3)\cancel{(x-2)}}{-\cancel{(x-2)}} = \frac{5}{-1} = \boxed{-5}$
   (A) 5
   (B) 3
   (C) -3
   (D) -5
   (E) The limit does not exist.

2. Evaluate the limit, if it exists: $\lim_{x\to9} \frac{\sqrt{x-5}-2}{x-9} \cdot \frac{(\sqrt{x-5}+2)}{(\sqrt{x-5}+2)} = \lim_{x\to9} \frac{x-5-4}{(x-9)(\sqrt{x-5}+2)}$
   $= \lim_{x\to9} \frac{\cancel{(x-9)}}{\cancel{(x-9)}(\sqrt{x-5}+2)} = \frac{1}{\sqrt{4}+2} = \boxed{\frac{1}{4}}$
   (A) $\frac{1}{4}$
   (B) $-\frac{1}{4}$
   (C) 1
   (D) 0
   (E) The limit does not exist.

3. Evaluate the limit, if it exists: $\lim_{x\to2} \frac{\frac{1}{x}-\frac{1}{2}}{x-2}$. $\frac{\frac{2-x}{2x}}{x-2} \cdot \frac{\frac{1}{x-2}}{\frac{1}{x-2}}$ $= \lim_{x\to2} \frac{-\cancel{(x-2)}}{2x\cancel{(x-2)}} = \boxed{\frac{-1}{4}}$
   (A) $\frac{1}{4}$
   (B) $-\frac{1}{4}$
   (C) 1
   (D) -1
   (E) The limit does not exist.

(4)

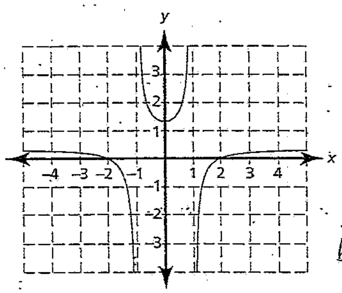
4) For what value of k is the function $f(x)=\begin{cases}\frac{2x^2+5x-3}{x^2-9}, & x\neq -3\\ k, & x=-3\end{cases}$ continuous at $x=-3$?

i) $f(-3)=k$

(A) $-\frac{7}{6}$
(B) $-\frac{5}{6}$
(C) 0
(D) $\frac{5}{6}$
$\boxed{\text{(E) } \frac{7}{6}}$

ii) $\lim_{x\to -3}\frac{(2x-1)\cancel{(x+3)}}{\cancel{(x+3)}(x-3)} = \frac{-6-1}{-3-3} = \frac{-7}{-6} = \boxed{\frac{7}{6}}$

iii) $f(-3)=\lim_{x\to -3} f(x)$, $k=7/6$



x-int: $(-2,0)\ (2,0)$
V.A: $x=-1,\ x=1$

$x^2+a=0$ at $x=2$
$2^2+a=0$ $\boxed{a=-4}$
$bx^2-3=0$: at $x=1,\ x=-1$
$b(1)^2-3=0$ $\boxed{b=3}$

5) The function $g(x)$ is shown in the graph above and is of the form $g(x)=\frac{x^2+a}{bx^2-3}$. Which of the following could be the values of the constants a and b?

(A) $a=-2,\ b=-1$
(B) ~~$a=-2,\ b=-3$~~
$\boxed{\text{(C) } a=-4,\ b=3}$
(D) ~~$a=-4,\ b=-3$~~
(E) $a=4,\ b=3$

$\boxed{g(x)=\frac{x^2-4}{3x^2-3}}$

6) Identify the vertical asymptotes for $f(x)=\frac{x^2+3x-4}{x^2+x-2}$.

$\frac{\cancel{(x-1)}(x+4)}{\cancel{(x-1)}(x+2)}$

(A) ~~$x=-2,\ x=1$~~
$\boxed{\text{(B) } x=-2}$
(C) $x=1$
(D) $y=-2,\ y=1$
(E) $y=-2$

$\boxed{x=-2}$

AP Calculus AB Chapter 1 Limits Review WS #2 Name:____________________

1. $g(x) = \begin{cases} \frac{x+5}{2x-4}, x < 2 \\ 12, x = 2 \\ 2x-5,\ 2 < x < 5 \\ 20, x = 5 \\ \frac{-x^2+4}{5-x}, x > 5 \end{cases}$ Find the following :

a) $\lim\limits_{x\to-\infty} g(x) =$	b) $\lim\limits_{x\to2^-} g(x) =$	c) $\lim\limits_{x\to2^+} g(x) =$
d) $\lim\limits_{x\to2} g(x) =$	e) $\lim\limits_{x\to5^-} g(x) =$	f) $\lim\limits_{x\to5^+} g(x) =$
g) $\lim\limits_{x\to5} g(x) =$	h) $\lim\limits_{x\to3^+} g(x) =$	i) $\lim\limits_{x\to\infty} g(x) =$

Use Continuity conditions to justify whether f(x) is continuous or discontinuous . If discontinuous, identify type of discontinuity

2) $f(x) = \begin{cases} 2x^2+5, x \geq 3 \\ 2^x,\quad x < 3 \end{cases}$

3) Find the horizontal asymptote(s) of
$f(x) = \frac{-2x-5}{\sqrt{6x^2+11x-30}}$

4) Find $\lim\limits_{x\to3} \frac{\sqrt{x+1}-2}{x-3}$

5) Let f(x) = $\begin{cases} \frac{x^2-9}{x-3}, & x \neq 3 \\ 6, & x = 3 \end{cases}$ Which of the following is true? (Circle all that apply)

I. $\lim\limits_{x\to3} f(x)$ does not exist

II. f is continuous at x = 3

III. The line x = 3 is a vertical asymptote:

(6)

6. Let f(x) = $\begin{cases} \frac{x^2-7x+10}{x^2-25} & , x^2 \neq 25 \\ A & , x = 5 \\ B & , x = -5 \end{cases}$

a) Are the lines x = 5 and x = -5 vertical asymptotes? Justify answer

b) Identify all horizontal asymptotes. Justify answer

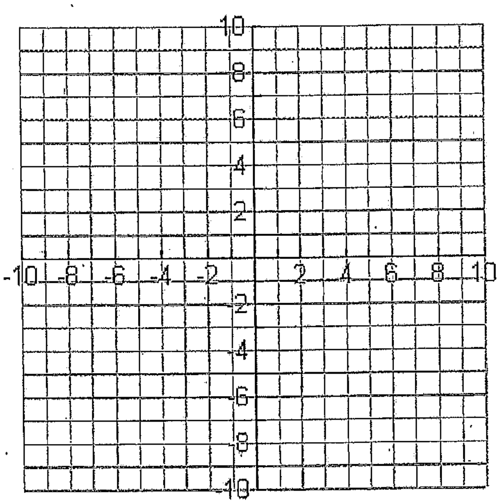
c) Is there a value of A that makes f continuous at x = 5?

d) Is there a value of B that makes f continuous at x = -5

x	1	3	5	8
f(x)	-2	4	10	6

7. If f is continuous on [1,8] and some values of f are given in the table above, which of the following must be true? Circle all that apply.

I. f(x) = -3 has a solution in [1,8]   II. f(x) = 0 has a solution in [1,8]   iii. f(x) = 9 has a solution in [1,8]



8) Find value of given quantity

a) $\lim_{x\to-\infty} h(x) = -6$

b) $\lim_{x\to-4^-} h(x) = -3$

c) $\lim_{x\to-2} h(x) = 1$

d) $h(0) = 2$

e) $\lim_{x\to0^-} h(x) = 2$

f) $\lim_{x\to0} h(x) = DNE$

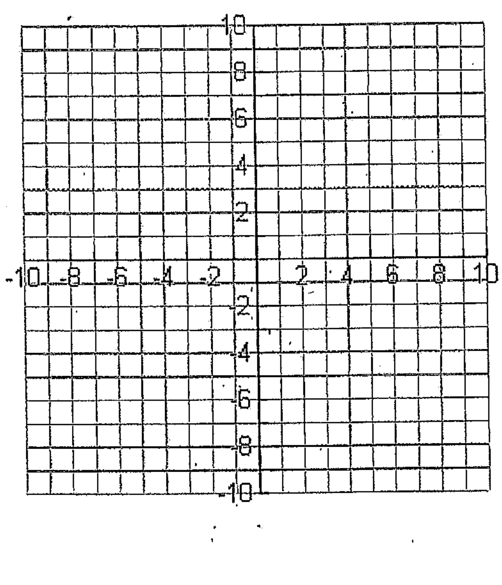
g) $\lim_{x\to3^+} h(x) = -4$

h) $\lim_{x\to4} h(x) = -\infty$

i) $\lim_{x\to8} h(x) = 3$

j) $\lim_{x\to\infty} h(x) = 8$

9) Sketch graph of function satisfying the given values:



a) $\lim_{x\to-\infty} f(x) = 8$

b) $f(-5) = 3$

c) $\lim_{x\to-5} f(x) = DNE$

d) $\lim_{x\to1^-} f(x) = 3$

e) $\lim_{x\to1^+} f(x) = -4$

f) $\lim_{x\to3} f(x) = +\infty$

g) $\lim_{x\to+\infty} f(x) = -4$

AP Calculus AB Chapter 1 Limits Review #2 Name: Solution Key

1. $g(x) = \begin{cases} \frac{x+5}{2x-4}, x < 2 \\ 12, x = 2 \\ 2x-5, \ 2 < x < 5 \\ 20, x = 5 \\ \frac{-x^2+4}{5-x}, x > 5 \end{cases}$ Find the following :

Correction

a) $\lim_{x\to-\infty} g(x) =$ $\boxed{1/2}$	b) $\lim_{x\to2^-} g(x) =$ $\boxed{-\infty}$	c) $\lim_{x\to2^+} g(x) =$ $\cancel{\boxed{+\infty}}$ $\boxed{-1}$
d) $\lim_{x\to2} g(x) =$ $\boxed{\text{DNE}}$	e) $\lim_{x\to5^-} g(x) =$ $\boxed{5}$	f) $\lim_{x\to5^+} g(x) =$ $\boxed{+\infty}$
g) $\lim_{x\to5} g(x) =$ $\boxed{\text{DNE}}$	h) $\lim_{x\to3^+} g(x) =$ $\boxed{1}$	i) $\lim_{x\to\infty} g(x) =$ $\boxed{+\infty}$

Use Continuity conditions to justify whether f(x) is continuous or discontinuous . If discontinuous, identify type of discontinuity

2) $f(x) = \begin{cases} 2x^2+5, x \ge 3 \\ 2^x, \ x < 3 \end{cases}$

i) $f(3) = 2(3)^2+5 = 23$

ii) $\lim_{x\to3^-} 2^x = 8$ and $\lim_{x\to3^+} 2x^2+5 = 23$ so $\lim_{x\to3} f(x) = \text{DNE}$

Nonremovable discontinuity at $x=3$

3) Find the horizontal asymptote(s) of $f(x) = \frac{-2x-5}{\sqrt{6x^2+11x-30}}$

$\boxed{y = \pm\frac{2}{\sqrt{6}}}$

$\lim_{x\to+\infty} \frac{-2x-5}{\sqrt{6x^2+11x-30}} = \boxed{\frac{-2}{\sqrt{6}}}$

$\lim_{x\to-\infty} \frac{-2x-5}{-\sqrt{6x^2+11x-30}} = \frac{-2}{-\sqrt{6}} = \boxed{\frac{2}{\sqrt{6}}}$

4) Find $\lim_{x\to3} \frac{\sqrt{x+1}-2}{x-3} \cdot \frac{\sqrt{x+1}+2}{\sqrt{x+1}+2}$

$\lim_{x\to3} \frac{x+1-4}{(x-3)(\sqrt{x+1}+2)}$

$\lim_{x\to3} \frac{(\cancel{x-3})}{(\cancel{x-3})(\sqrt{x+1}+2)}$ $\boxed{\frac{1}{4}}$

5) Let $f(x) = \begin{cases} \frac{x^2-9}{x-3}, & x \ne 3 \\ 6, & x = 3 \end{cases}$ Which of the following is true? (Circle all that apply)

$\frac{x^2-9}{x-3} = \frac{(\cancel{x-3})(x+3)}{(\cancel{x-3})}$ $\lim_{x\to3} x+3 = \boxed{6}$

~~I.~~ $\lim_{x\to3} f(x)$ does not exist

II. f is continuous at x = 3

~~III.~~ The line x = 3 is a vertical asymptote:

i) $f(3) = 6$

ii) $\lim_{x\to3} \frac{x^2-9}{x-3} = 6$

iii $\lim_{x\to3} f(x) = f(3)$

All continuity condition passes.

8

6. Let f(x) = $\begin{cases} \frac{x^2-7x+10}{x^2-25} & , x^2 \neq 25 \\ A & , x = 5 \\ B & , x = -5 \end{cases}$

$\frac{(\cancel{x-5})(x-2)}{(\cancel{x-5})(x+5)}$

a) Are the lines x = 5 and x = -5 vertical asymptotes? Justify answer

At x=5 is a hole since factor cancels in denominator
At x=-5, vertical asymptote

b) Identify all horizontal asymptotes. Justify answer $\lim_{x\to-\infty} f(x) = 1$ $\lim_{x\to+\infty} f(x) = 1$

c) Is there a value of A that makes f continuous at x = 5? yes, $\lim_{x\to5} \frac{x-2}{x+5} = \boxed{\frac{3}{10}}$ so let $A = 3/10$

d) Is there a value of B that makes f continuous at x = -5 No, since nonremovable discontinuity at x=-5

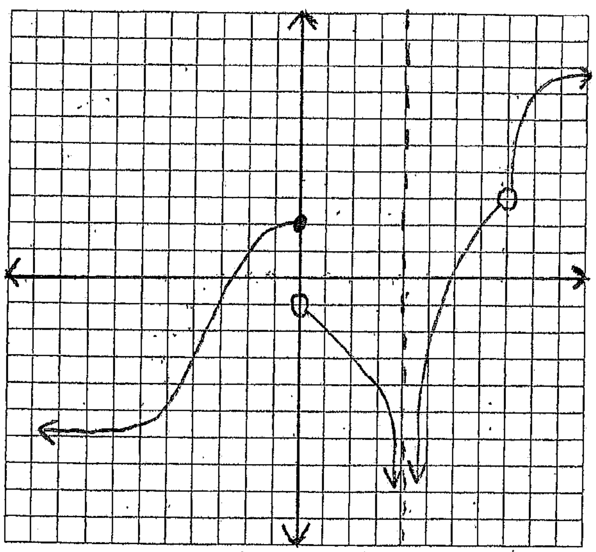
x	1	3	5	8
f(x)	-2	4	10	6

7. If f is continuous on [1,8] and some values of f are given in the table above, which of the following must be true? Circle all that apply.

I. f(x) = -3 has a solution in [1,8] II. f(x) = 0 has a solution in [1,8] iii) f(x) = 9 has a solution in [1,8]

By IVT, since f(1)<0<f(8), c exists in [1,8]

By IVT, since f(1)<9<f(5), c exists in [1,5] therefore would exist in [1,8]



8) Find value of given quantity

a) $\lim_{x\to-\infty} h(x) = -6$

b) $\lim_{x\to-4^-} h(x) = -3$

c) $\lim_{x\to-2} h(x) = 1$

d) $h(0) = 2$

e) $\lim_{x\to0^-} h(x) = 2$

f) $\lim_{x\to0} h(x) =$ DNE

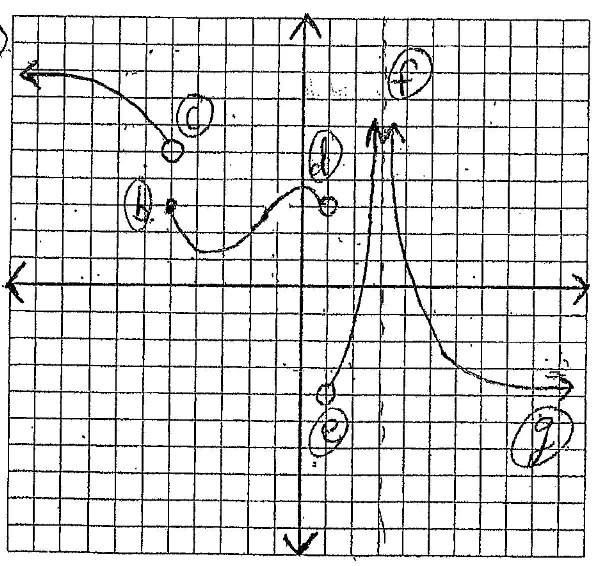
g) $\lim_{x\to3^+} h(x) = -4$

h) $\lim_{x\to4} h(x) = -\infty$

i) $\lim_{x\to8} h(x) = 3$

j) $\lim_{x\to\infty} h(x) = 8$

9



Sketch graph of function satisfying the given values:

a) $\lim_{x\to-\infty} f(x) = 8$

b) $f(-5) = 3$

c) $\lim_{x\to-5} f(x) =$ DNE

d) $\lim_{x\to1^-} f(x) = 3$

e) $\lim_{x\to1^+} f(x) = -4$

f) $\lim_{x\to3} f(x) = +\infty$

g) $\lim_{x\to+\infty} f(x) = -4$

Ch. 1 Limits **Steps for Important Concepts**

I. Algebraic Steps Evaluating Limits Approaching a Real Number $\lim_{x\to c} f(x)$

1. Plug in argument x-value (Ignore one-sided limit for now)
2. Find the Limit (plug in/ reduce if $\frac{0}{0}$, re-evaluate)
3. If Limit DNE (does not exist), then evaluate further ONLY IF one-sided limit)
4. Choose between $+\infty$ and $-\infty$
5. Plug in the appropriate decimal value to determine $+\infty$ or $-\infty$

II. Algebraic Steps Evaluating Limits Approaching Infinity $\lim_{x\to\infty} f(x)$ *or* $\lim_{x\to-\infty} f(x)$

1. Compare degrees between numerator vs. denominator
   a. If Numerator < Denominator $\lim_{x\to\infty} f(x) = \lim_{x\to-\infty} f(x) = 0$
   b. If Numerator = Denominator $\lim_{x\to\infty} f(x) = \lim_{x\to-\infty} f(x)$ = ratio of coefficients
   c. If Numerator > Denominator, then $\lim_{x\to\infty} f(x) = \pm\infty$ *or* $\lim_{x\to-\infty} f(x) = \pm\infty$

   (Plug in a large positive or large negative value to help you determine the sign at infinity)

III. Continuity Conditions

1. f(c) is defined (point exists on the graph)
2. The $\lim_{x\to c} f(x)$ exists $\left[\lim_{x\to c^+} f(x) = \lim_{x\to c^-} f(x)\right]$
3. f(c) $= \lim_{x\to c} f(x)$

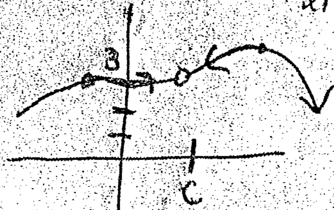
- If function passes all 3 conditions , the function has continuity at x = c
- If condition #2 FAILS, the function has **nonremovable** discontinuity at x = c
- If function PASSES condition #2 and FAILS condition #3, the function has **removable** discontinuity at x = c

IV. Intermediate Value Theorem (IVT) Steps

1. Test and determine continuity on closed interval [a, b]
2. Find the y-value at the endpoints , f(a) and f(b)
3. Confirm that f(c) is between f(a) and f(b) [example: f(a) < f(c) < f(b)]
4. Find the c-value (find the x-value by plugging the y-value given at the start of problem into the function)

   *Make sure c-value(s) are inside the interval [a,b]. c-values that are outside the interval [a,b] are excluded.

If hole in graph, one-sided limits are same as the full limit

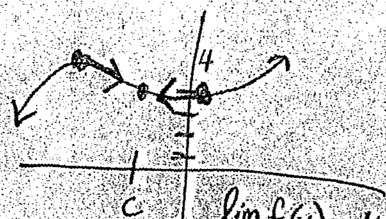


$\lim_{x \to c^-} f(x) = 3$

$\lim_{x \to c^+} f(x) = 3$

$\lim_{x \to c} f(x) = 3$

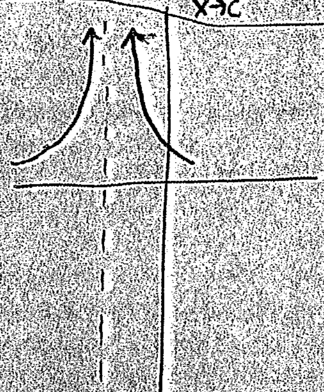
If function is continuous, one-sided limits are same as the full limit



$\lim_{x \to c^-} f(x) = 4$

$\lim_{x \to c^+} f(x) = 4$

$\lim_{x \to c} f(x) = 4$

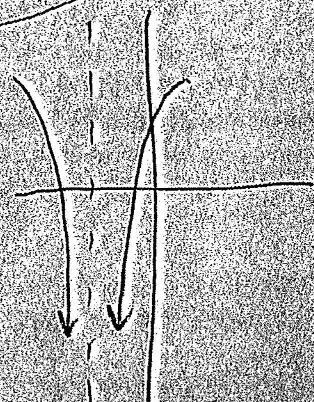


limit dne ($+\infty$)

$\lim_{x \to c^-} f(x) = +\infty$

$\lim_{x \to c^+} f(x) = +\infty$

$\lim_{x \to c} f(x) = \text{dne}$ ($+\infty$)

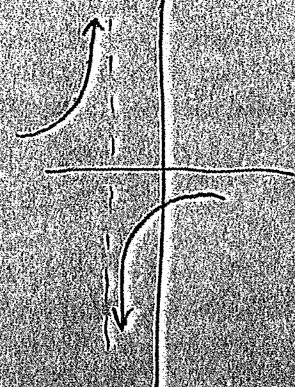


limit dne ($-\infty$)

$\lim_{x \to c^-} f(x) = -\infty$

$\lim_{x \to c^+} f(x) = -\infty$

$\lim_{x \to c} f(x) = \text{dne}$ ($-\infty$)

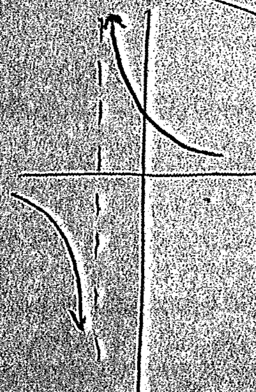


limit dne

$\lim_{x \to c^-} f(x) = +\infty$

$\lim_{x \to c^+} f(x) = -\infty$

$\lim_{x \to c} f(x) = \text{dne}$



limit dne

$\lim_{x \to c^-} f(x) = -\infty$

$\lim_{x \to c^+} f(x) = +\infty$

$\lim_{x \to c} f(x) = \text{dne}$

1. $g(x) = \begin{cases} \frac{9-x^2}{x^2-16}, & x < -4 \\ 2-x, & x = -4 \\ \frac{-x^2}{x+2}, & x > -4 \end{cases}$ Given the piecewise function, find the following:

a. $\lim_{x\to -4^-} g(x) =$	b. $\lim_{x\to -\infty} g(x) =$	c. $\lim_{x\to -4^+} g(x) =$	d. $\lim_{x\to -4} g(x) =$	e. $\lim_{x\to \infty} g(x) =$

1b) Step through continuity conditions for #1 .Then state reason for discontinuity and identify the type of discontinuity. (at $x = -4$)

2. Find the horizontal asymptote(s) of $f(x) = \frac{-x-5}{\sqrt{4x^2+12x-30}}$

3. Show whether Intermediate Value Theorem applies. Then find c. (Go through conditions!).
$f(x) = \frac{x}{x-3}$; [4, 8] $f(c) = 2$ c = ____________

4. Find values for below:

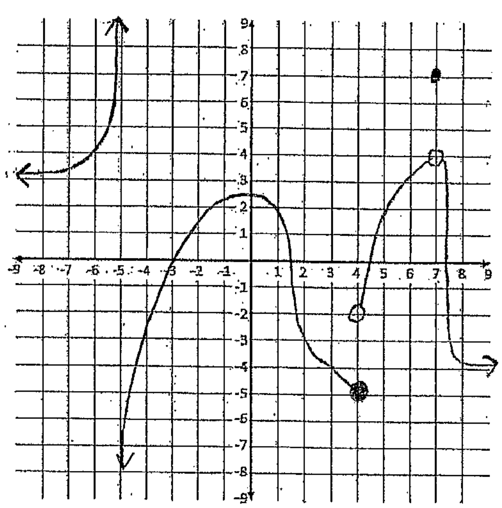
a. $\lim_{x\to -5^-} g(x) =$

b. $\lim_{x\to -\infty} g(x) =$

c. $\lim_{x\to 4^+} g(x) =$

d. $\lim_{x\to 7} g(x) =$

e. $\lim_{x\to \infty} g(x) =$



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Calculus AB 1.4, 1.5, 3.5 Quiz Review Session Solution Key

1. $g(x) = \begin{cases} \frac{9-x^2}{x^2-16}, & x < -4 \\ 2-x, & x = -4 \\ \frac{-x^2}{x+2}, & x > -4 \end{cases}$ Given the piecewise function, find the following:

a. $\lim_{x\to -4^-} g(x) =$

$\lim_{x\to -4^-} \frac{9-x^2}{x^2-16}$

$\lim_{x\to -4^-} \frac{9-x^2}{(x-4)(x+4)} = \frac{9-(-4.1)^2}{(\ )(\ )} = \frac{-}{(-)(-)}$

$= \boxed{-\infty}$

b. $\lim_{x\to -\infty} g(x) =$

$\lim_{x\to -\infty} \frac{9-x^2}{x^2-16} = \boxed{-1}$

c. $\lim_{x\to -4^+} g(x) =$

$\lim_{x\to -4^+} \frac{-x^2}{x+2} = \frac{-16}{-2} = \boxed{8}$

d. $\lim_{x\to -4} g(x) =$

$\lim_{x\to -4^-} f(x) \neq \lim_{x\to -4^+} f(x)$

$\boxed{DNE}$

e. $\lim_{x\to\infty} g(x) =$

$\lim_{x\to\infty} \frac{-x^2}{x+2} = \frac{-}{+}$

$= \boxed{-\infty}$

1b) Step through continuity conditions for #1. Then state reason for discontinuity and identify the type of discontinuity.

i) $f(-4) = 6$

ii) $\lim_{x\to -4^-} f(x) \neq \lim_{x\to -4^+} f(x)$

Nonremovable discontinuity since $\lim_{x\to -4} f(x) = DNE$

2. Find the horizontal asymptote(s) of $f(x) = \frac{-x-5}{\sqrt{4x^2+12x-30}}$

$\lim_{x\to +\infty} \frac{-x-5}{\sqrt{4x^2+12x-30}} = \frac{-1}{\sqrt{4}} = \frac{-1}{2}$

$\lim_{x\to -\infty} \frac{-x-5}{\sqrt{4x^2+12x-30}} = \lim_{x\to -\infty} \frac{-x-5}{-\sqrt{4x^2+12x-30}} = \frac{-1}{-\sqrt{4}} = \frac{1}{2}$

$\boxed{\text{H.A. at } y = -\tfrac{1}{2} \text{ and } y = \tfrac{1}{2}}$

3. Show whether Intermediate Value Theorem applies. Then find c. (Go through conditions!).

$f(x) = \frac{x}{x-3}$; [4, 8], $k = 2$ $c =$ 6

i) $f(x)$ continuous on interval [4, 8]

ii) $f(4) = 4$

$f(8) = \frac{8}{8-3} = \frac{8}{5} = 1.6$

$\frac{x}{x-3} = \frac{2}{1}$ $2(x-3) = x$

$2x - 6 = x$

$x = 6$ so $\boxed{c = 6}$

Since $f(8) < f(c) < f(4)$ IVT applies and c exists in interval.

4. Find values for below:

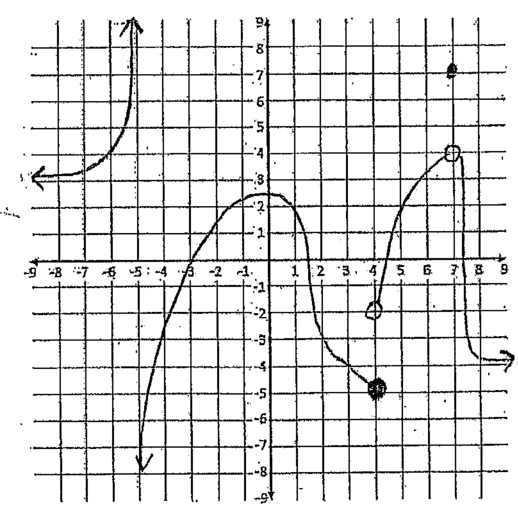
a. $\lim_{x\to -5^-} g(x) = +\infty$

b. $\lim_{x\to -\infty} g(x) = 3$

c. $\lim_{x\to 4^+} g(x) = -2$

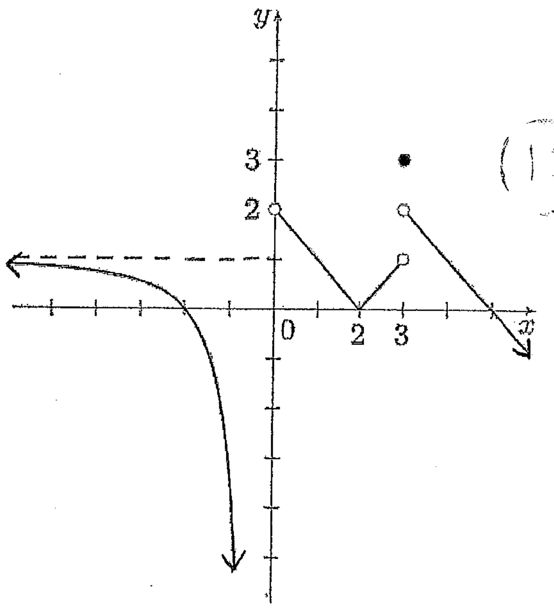
d. $\lim_{x\to 7} g(x) = 4$

e. $\lim_{x\to\infty} g(x) = -4$



Calculus AB 1.4-3.5 Morning Quiz Review

1. Use the graph of the function $f(x)$ to answer each question.
Use ∞, $-\infty$ or DNE where appropriate.



(a) $f(0) =$

(b) $f(2) =$

(c) $f(3) =$

(d) $\lim_{x \to 0^-} f(x) =$

(e) $\lim_{x \to 0} f(x) =$

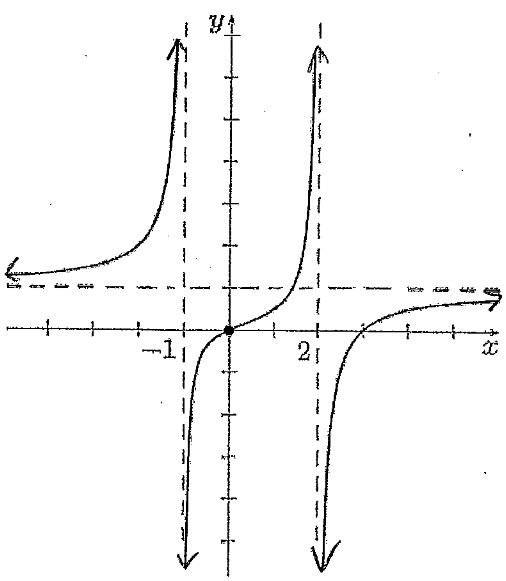
(f) $\lim_{x \to 3^+} f(x) =$

(g) $\lim_{x \to 3} f(x) =$

(h) $\lim_{x \to -\infty} f(x) =$

1b) Step through continuity conditions to determine if f(x) is continuous at x = 3. If discontinuous, determine type of discontinuity

2. Use the graph of the function $f(x)$ to answer each question.
Use ∞, $-\infty$ or DNE where appropriate.



(a) $f(0) =$

(b) $f(2) =$

(c) $f(3) =$

(d) $\lim_{x \to -1^+} f(x) =$

(e) $\lim_{x \to 0} f(x) =$

(f) $\lim_{x \to 2^+} f(x) =$

(g) $\lim_{x \to \infty} f(x) =$

(14)

3. Determine the horizontal asymptote(s) of $y = \dfrac{-4x^{\frac{2}{3}}+15}{\sqrt[3]{5x^2-23}}$

4. Step through continuity conditions. If discontinuous, Show work to determine type of discontinuity

a) $f(x) = \begin{cases} -2x+3 & x > -4 \\ 4x-1 & x = -4 \\ \frac{5x-1}{2x} & x < -4 \end{cases}$ at x = -4

b) $g(x) = \begin{cases} \frac{x^2-4}{x+2} & x \neq -2 \\ 3x+2 & x = -2 \end{cases}$

Answer the following questions for the piecewise defined function $f(t)$ described on the right hand side.

(a) $f(-3/2) =$

(b) $f(2) =$

(c) $f(1) =$

(d) $\lim_{t \to -2} f(t) =$

(e) $\lim_{t \to -1^+} f(t) =$

(f) $\lim_{t \to 2} f(t) =$

(g) $\lim_{t \to 0} f(t) =$

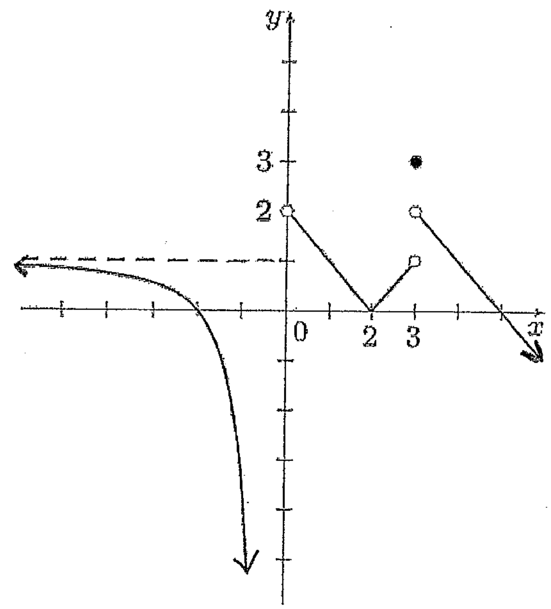
(h) $\lim_{t \to 0^-} f(t) =$

$$f(t) = \begin{cases} t^2 & \text{for } t < -2 \\ \dfrac{t+6}{t^2-t} & \text{for } -1 < t < 2 \\ 3t-2 & \text{for } t \geq 2 \end{cases}$$

Calculus AB 1.4-3.5 Morning Quiz Review

Key 15

1. Use the graph of the function $f(x)$ to answer each question.
   Use ∞, $-\infty$ or DNE where appropriate.



(a) $f(0) =$ DNE

(b) $f(2) = 0$

(c) $f(3) = 3$

(d) $\lim_{x \to 0^-} f(x) = -\infty$

(e) $\lim_{x \to 0} f(x) =$ DNE

(f) $\lim_{x \to 3^+} f(x) = 2$

(g) $\lim_{x \to 3} f(x) =$ DNE

(h) $\lim_{x \to -\infty} f(x) = 1$

1b) Step through continuity conditions to determine if f(x) is continuous at x = 3. If discontinuous, determine type of discontinuity

i) $f(3) = 3$

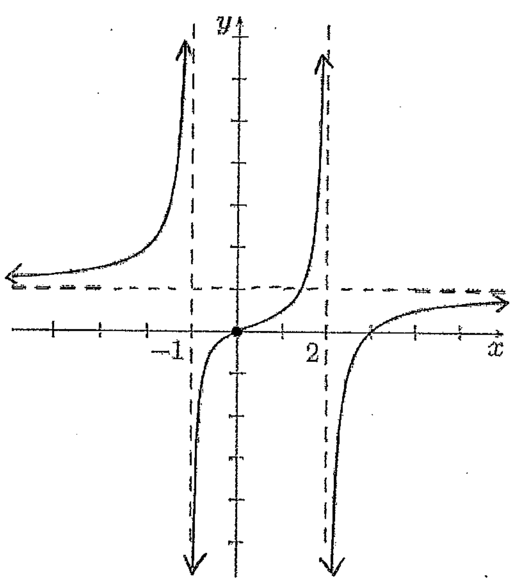
ii) $\lim_{x \to 3^-} f(x) = 1$

$\lim_{x \to 3^+} f(x) = 2$

since $\lim_{x \to 3^-} f(x) \neq \lim_{x \to 3^+} f(x)$, $\lim_{x \to 3} f(x) =$ DNE

nonremovable discontinuity at $x=3$

2. Use the graph of the function $f(x)$ to answer each question.
   Use ∞, $-\infty$ or DNE where appropriate.



(a) $f(0) = 0$

(b) $f(2) =$ DNE

(c) $f(3) = 0$

(d) $\lim_{x \to -1^+} f(x) = -\infty$

(e) $\lim_{x \to 0} f(x) = 0$

(f) $\lim_{x \to 2^+} f(x) = -\infty$

(g) $\lim_{x \to \infty} f(x) = 1$

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3. Determine the horizontal asymptote(s) of $y = \dfrac{-4x^{\frac{2}{3}}+\cancel{15}}{\sqrt[3]{5x^2\cancel{-23}}}$

$$\lim_{x\to\infty} \frac{-4x^{2/3}}{\sqrt[3]{5}\,x^{2/3}} = \frac{-4}{\sqrt[3]{5}}$$

$$\lim_{x\to-\infty} \frac{-4x^{2/3}}{\sqrt[3]{5x^{2/3}}} = -\left(\frac{-4x^{2/3}}{\sqrt[3]{5x}^{2/3}}\right) = \frac{4}{\sqrt[3]{5}}$$

$\boxed{\text{H.A. at } y = \frac{-4}{\sqrt[3]{5}},\ y = \frac{4}{\sqrt[3]{5}}}$

4. Step through continuity conditions. If discontinuous, Show work to determine type of discontinuity

a) $f(x) = \begin{cases} -2x+3 & x > -4 \\ 4x-1 & x = -4 \\ \frac{5x-1}{2x} & x < -4 \end{cases}$ at x = -4

i) $f(-4) = -16-1 = -17$

ii) $\lim_{x\to-4^-} \frac{5x-1}{2x} = \frac{-21}{-8} = 21/8$

$\lim_{x\to-4^+} -2x+3 = -5$

Since $\lim_{x\to-4^+} f(x) \neq \lim_{x\to-4^-} f(x)$, $\lim_{x\to-4} f(x) = DNE$, nonremovable discontinuity at $x=-4$

b) $g(x) = \begin{cases} \frac{x^2-4}{x+2} & x \neq -2 \\ 3x+2 & x = -2 \end{cases}$ at $x=-2$

i) $g(-2) = -4$

ii) $\lim_{x\to-2} \frac{x^2-4}{x+2} = \lim_{x\to-2} \frac{\cancel{(x+2)}(x-2)}{\cancel{(x+2)}} = -4$

iii) $g(-2) = \lim_{x\to-2} g(x) = -4$

All 3 conditions pass, $g(x)$ continuous at $x=-2$

Answer the following questions for the piecewise defined function $f(t)$ described on the right hand side.

(a) $f(-3/2) =$ DNE

(b) $f(2) = 4$ $\quad 3(2)-2 = 4$

(c) $f(\ 1\ ) =$ DNE $\quad$ c) $\frac{1+6}{1^2-1} = \frac{7}{0}$

(d) $\lim_{t\to-2} f(t) =$ DNE

(e) $\lim_{t\to-1^+} f(t) = 5/2$

(f) $\lim_{t\to2} f(t) = 4$

(g) $\lim_{t\to0} f(t) =$ DNE

(h) $\lim_{t\to0^-} f(t) = +\infty$

$$f(t) = \begin{cases} t^2 & \text{for } t < -2 \\ \dfrac{t+6}{t^2-t} & \text{for } -1 < t < 2 \\ 3t-2 & \text{for } t \geq 2 \end{cases}$$

f) $\lim_{x\to2^-} \frac{t+6}{t^2-t} = \frac{8}{2} = 4$

$\lim_{x\to2^+} 3t-2 = 4$

$\lim_{x\to2} f(x) = 4$

$\lim_{t\to0^-} \frac{t+6}{t^2-t} = \frac{6}{0}$ $+\infty$ or $-\infty$

$\lim_{t\to0^-} \frac{-0.1+6}{(-0.1)^2-(-0.1)} = \frac{+}{+} = \boxed{+\infty}$

Limits - Piecewise
Practice Problems

1)

$$f(x) = \begin{cases} \dfrac{x+2}{x^2-4}, & x < -4 \\ x+3 & -4 \le x < 3 \\ \dfrac{x^3}{x-5} & x \ge 3 \end{cases}$$

a) $\lim\limits_{x \to -\infty} f(x)$

b) $\lim\limits_{x \to -4^-} f(x)$

c) $\lim\limits_{x \to -4^+} f(x)$

d) $\lim\limits_{x \to 4} f(x)$

e) $\lim\limits_{x \to 5^+} f(x)$

f) $\lim\limits_{x \to \infty} f(x)$

g) $\lim\limits_{x \to -4} f(x)$

h) $f(-4)$

18 Limits Piecewise problems

Use continuity conditions to determine if continuous. If discontinuous, determine if removable/nonremovable

2) $f(x) = \begin{cases} x^2 - 3, & x \geq 4 \\ \dfrac{x+1}{x^2+1}, & x < 4 \end{cases}$

3) $g(x) = \begin{cases} \dfrac{x^2-1}{x+1}, & x \neq -1 \\ 3, & x = -1 \end{cases}$

Limits - Piecewise
Practice Problems

Key

1)

$$f(x) = \begin{cases} \frac{x+2}{x^2-4}, & x < -4 \\ x+3 & -4 \leq x < 3 \\ \frac{x^3}{x-5} & x \geq 3 \end{cases}$$

a) $\lim_{x \to -\infty} f(x)$

b) $\lim_{x \to -4^-} f(x)$

c) $\lim_{x \to -4^+} f(x)$

d) $\lim_{x \to 4} f(x)$

e) $\lim_{x \to 5^+} f(x)$

f) $\lim_{x \to \infty} f(x)$

g) $\lim_{x \to -4} f(x)$

h) $f(-4)$

a) $\lim_{x \to -\infty} \frac{x+2}{x^2-4} = 0$

b) $\lim_{x \to -4^-} \frac{x+2}{x^2-4} = \frac{-2}{12} = -\frac{1}{6}$

c) $\lim_{x \to -4^+} x+3 = -1$

d) $\lim_{x \to 4} \frac{x^3}{x-5} = \frac{64}{-1} = -64$

e) $\lim_{x \to 5^+} \frac{x^3}{x-5} = \frac{125}{0} \rightarrow$ DNE $\nearrow +\infty$, $\searrow -\infty$

$\frac{(5.1)^3}{5.1-5} = \frac{+}{+} = \boxed{+\infty}$

f) $\lim_{x \to \infty} \frac{x^3}{x-5} = \boxed{+\infty}$

g) $\lim_{x \to -4} f(x) = \boxed{\text{DNE}}$

$\hookrightarrow \lim_{x \to -4^-} f(x) = -1/6$

$\hookrightarrow \lim_{x \to -4^+} f(x) = -1$

$\lim_{x \to -4^-} f(x) \neq \lim_{x \to -4^+} f(x)$

h) $(-4) = \boxed{-1}$

(20) Limits Piecewise problems

$\boxed{\text{KEY}}$

Use continuity conditions to determine if continuous. If discontinuous, determine if removable/nonremovable

2) $f(x)=\begin{cases} x^2-3 & , x\geq 4 \\ \frac{x+1}{x^2+1} & , x<4 \end{cases}$

2) i) $f(4)=16-3=13$

ii) $\lim\limits_{x\to 4^-}\frac{x+1}{x^2+1}=\frac{5}{17}$

$\lim\limits_{x\to 4^+} x^2-3=13$

Since $\lim\limits_{x\to 4^-} f(x)\neq \lim\limits_{x\to 4^+} f(x)$

$\lim\limits_{x\to 4} f(x)=$ DNE,

Nonremovable discontinuity at $x=4$

3) $g(x)=\begin{cases} \frac{x^2-1}{x+1} & , x\neq -1 \\ 3 & , x=-1 \end{cases}$

3) i) $f(-1)=3$

ii) $\lim\limits_{x\to -1}\frac{x^2-1}{x+1}=\lim\limits_{x\to -1}\frac{\cancel{(x+1)}(x-1)}{\cancel{x+1}}=-2$

iii) $f(-1)\neq \lim\limits_{x\to -1} f(x)$

Removable discontinuity at $x=-1$

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Limits Chapter 1 Morning Test Review #3

1. $$\lim_{x \to 0} \frac{\sqrt{2+x} - \sqrt{2}}{x}$$

2. For $x \neq 4$, the function h(x) is equal to $\frac{x^2+x-20}{x-4}$. What value should be assigned to h(4) to make h(x) continuous at $x = 4$?

3. Given $f(x) = \begin{cases} x^2 - 2, & \text{if } x \leq 0 \\ 3x + k, & \text{if } x > 0 \end{cases}$

Find the value for the constant k that will make the function continuous at x = 0.

4. (OMIT)

Determine the values of a and b so that $f(x)$ is everywhere continuous. Justify your answer.

$$f(x) = \begin{cases} 5bx - 6a & , \text{if } x < -2 \\ -3b - 4ax & , \text{if } x = -2 \\ 5x - 1 & , \text{if } x > -2 \end{cases}$$

5. Let f be a continuous function. Selected values of f are given in the table below.

x	1	2	3	5	8
$f(x)$	-2	3	1	-5	7

What is the least number of solutions does the equation $f(x) = \frac{1}{2}$ have on the closed interval [1, 8]?

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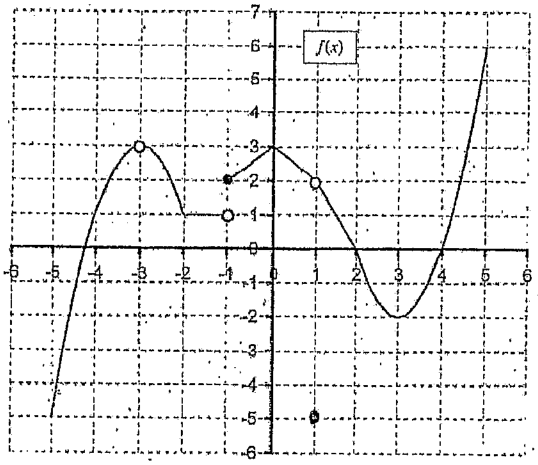
6.



$\lim\limits_{x\to -3^-} f(x) =$ b) $\lim\limits_{x\to -3^+} f(x) =$ c) $\lim\limits_{x\to -3} f(x) =$

$\lim\limits_{x\to -1^-} f(x) =$ e) $\lim\limits_{x\to -1^+} f(x) =$ f) $\lim\limits_{x\to -1} f(x) =$

Use continuity conditions to justify if graph is continuous at x = 1. Determine the type of discontinuity.

7. Find the value of k that makes f(x) continuous for all real numbers if:

$$g(x) = \begin{cases} \dfrac{x^2+x-6}{x+3}, & x \neq -3 \\ k, & x = -3 \end{cases}$$

8.

Find $A = \lim\limits_{x\to 3^+} \dfrac{x(x+1)}{3-x}$ and $B = \lim\limits_{x\to\infty} \dfrac{(x^2+2)(3x^2-5)}{x^4+6}$.

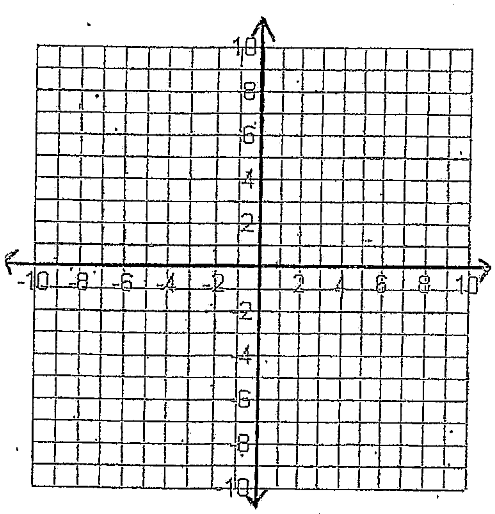
a) $A = -\infty$ and $B = -\dfrac{5}{3}$

b) $A = 0$ and $B = 0$

c) $A = \infty$ and $B = \infty$

d) $A = -\infty$ and $B = 3$

9. Evaluate $\lim\limits_{x\to 0} \dfrac{3-\sqrt{x+9}}{x}$



9) Sketch graph satisfying the given values:

a) $\lim\limits_{x\to -\infty} h(x) = -\infty$

b) $\lim\limits_{x\to -4^-} h(x) = -3$

c) $\lim\limits_{x\to -4^+} h(x) = 1$

d) $h(6) =$ undefined

e) $\lim\limits_{x\to 0^-} h(x) = -\infty$

f) $\lim\limits_{x\to 0} h(x) =$ DNE

g) $\lim\limits_{x\to 3^+} h(x) = -4$

h) $\lim\limits_{x\to 4} h(x) = -\infty$

i) $\lim\limits_{x\to 6} h(x) = 3$

j) $\lim\limits_{x\to \infty} h(x) = -2$

Limits Chapter 1 Morning Test Review #3

Key

1. $\lim\limits_{x\to 0}\dfrac{\sqrt{2+x}-\sqrt{2}}{x}$

$\frac{\sqrt{2}-\sqrt{2}}{0}\to\frac{0}{0}\to$ Limit does exist

$\lim\limits_{x\to 0^-}\left(\dfrac{\sqrt{2+x}-\sqrt{2}}{x}\right)\left(\dfrac{\sqrt{2+x}+\sqrt{2}}{\sqrt{2+x}+\sqrt{2}}\right)$

$\lim\limits_{x\to 0^-}\dfrac{\cancel{2}+\cancel{x}-\cancel{2}}{\cancel{x}(\sqrt{2+x}+\sqrt{2})}=\dfrac{1}{\sqrt{2}+\sqrt{2}}=\boxed{\dfrac{1}{2\sqrt{2}}}$

2. For $x\neq 4$, the function h(x) is equal to $\frac{x^2+x-20}{x-4}$. What value should be assigned to h(4) to make h(x) continuous at x = 4?

*continuity conditions

i) $h(4)=K$

ii) $\lim\limits_{x\to 4}\dfrac{x^2+x-20}{x-4}$ $\frac{0}{0}$ $\lim\limits_{x\to 4}\dfrac{(x+5)\cancel{(x-4)}}{\cancel{(x-4)}}\to 4+5=9$

iii) $h(4)=\lim\limits_{x\to 4}h(x)\to\boxed{K=9}$

3. Given $f(x)=\begin{cases}x^2-2, & \text{if } x\le 0\\ 3x+k, & \text{if } x>0\end{cases}$ $c=0$

Find the value for the constant k that will make the function continuous at x = 0.

i) $f(0)=0^2-2=-2$

ii) $\lim\limits_{x\to 0^-}x^2-2=-2$

$\lim\limits_{x\to 0^+}3x+k=3(0)+k=K$

$\boxed{K=-2}$

4. OMIT

Determine the values of a and b so that $f(x)$ is everywhere continuous. Justify your answer.

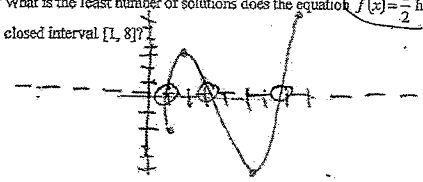
$f(x)=\begin{cases}5bx-6a & ,\text{ if } x<-2\\ -3b-4ax & ,\text{ if } x=-2\\ 5x-1 & ,\text{ if } x>-2\end{cases}$

5. Let f be a continuous function. Selected values of f are given in the table below.

x	1	2	3	5	8
$f(x)$	−2	3	1	−5	7

What is the least number of solutions does the equation $f(x)=\frac{1}{2}$ have on the closed interval [1, 8]?

$y=\frac{1}{2}$ how many times (IVT)



3 times due to IVT

Ex. 5b

x-values target y-value

$f(x)=x^2-5$

$[-1,3]$ $f(c)=1$

f(x) continuous $[-1,3]$

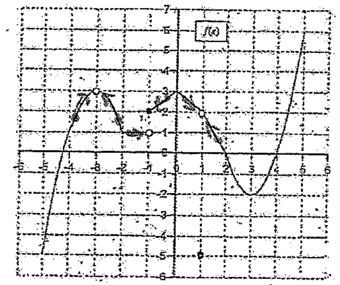
$f(-1)=(-1)^2-5=-4$ y-values

$f(3)=3^2-5=4$

By IVT, since $f(-1)=-4<1<4=f(3)$

$f(c)=1$ on $[-1,3]$

6.



$\lim\limits_{x\to -3^-}f(x)=3$ $\lim\limits_{x\to -3^+}f(x)=$

$\lim\limits_{x\to -3}f(x)=3$ b) $\lim\limits_{x\to -3^+}f(x)=3$ c) $\lim\limits_{x\to -3}f(x)=3$

$\lim\limits_{x\to 1^-}f(x)=1$ e) $\lim\limits_{x\to 1^+}f(x)=2$ f) $\lim\limits_{x\to 1}f(x)=$ dne

Use continuity conditions to justify if graph is continuous at x = 1. Determine the type of discontinuity.

i) $f(1)=-5$

ii) $\lim\limits_{x\to 1}f(x)=1$

iii) $f(1)\neq\lim\limits_{x\to 1}f(x)$

Removable discontinuity at $x=1$

7. Find the value of K that makes f(x) continuous for all real-numbers if:

graph

$g(x)=\begin{cases}\dfrac{x^2+x-6}{x+3}, & x\neq -3\\ k & , x=-3\end{cases}$

point

i) $g(-3)=K$

ii) $\lim\limits_{x\to -3}\dfrac{x^2+x-6}{x+3}\to\frac{0}{0}$ $\lim\limits_{x\to -3}\dfrac{\cancel{(x+3)}(x-2)}{\cancel{(x+3)}}=-3-2=-5$

iii) $g(-3)=\lim\limits_{x\to -3}g(x)$ $\boxed{K=-5}$

8. Find $A=\lim\limits_{x\to 3^+}\dfrac{x(x+1)}{3-x}$ and $B=\lim\limits_{x\to\infty}\dfrac{(x^2+2)(3x^2-5)}{x^4+6}$.

a) $A=-\infty$ and $B=-\frac{5}{3}$

b) $A=0$ and $B=0$

c) $A=\infty$ and $B=\infty$

d) $A=-\infty$ and $B=3$

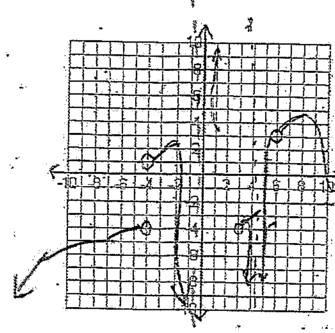
* Work shown on next page

9. Evaluate $\lim\limits_{x\to 0}\dfrac{3-\sqrt{x+9}}{x}$ $\to\dfrac{3-\sqrt{9}}{0}=\dfrac{0}{0}$

$\lim\limits_{x\to 0}\left(\dfrac{3-\sqrt{x+9}}{x}\right)\left(\dfrac{3+\sqrt{x+9}}{3+\sqrt{x+9}}\right)$

$\cancel{9}-x-\cancel{9}$

$\lim\limits_{x\to 0}\dfrac{9-(x+9)}{x(3+\sqrt{x+9})}\to\lim\limits_{x\to 0}\dfrac{\cancel{x}(-1)}{\cancel{x}(3+\sqrt{x+9})}=\boxed{\dfrac{-1}{6}}$



9) Sketch graph satisfying the given values

a) $\lim\limits_{x\to -\infty}h(x)=-\infty$ f) $\lim\limits_{x\to 0}h(x)=$ DNE

b) $\lim\limits_{x\to -4}h(x)=-3$ g) $\lim\limits_{x\to 3^+}h(x)=-4$

c) $\lim\limits_{x\to 4^-}h(x)=1$ h) $\lim\limits_{x\to 4}h(x)=-\infty$ (VA)

d) $h(6)=$ undefined i) $\lim\limits_{x\to 6}h(x)=3$

e) $\lim\limits_{x\to 0^-}h(x)=-\infty$ j) $\lim\limits_{x\to\infty}h(x)=-2$ HA

2) * step thru continuity conditions

i) $h(4) = K$

ii) $\lim_{x\to 4} \frac{x^2+x-20}{x-4}$ $\frac{0}{0}$ $\rightarrow \lim_{x\to 4} \frac{(x+5)\cancel{(x-4)}}{\cancel{(x-4)}} = 4+5 = \boxed{9}$

iii) $h(4) = \lim_{x\to 4} f(x)$ $\boxed{K=9}$

8) $\lim_{x\to 3^{+}} \frac{x(x+1)}{3-x} \rightarrow \frac{3(3+1)}{3-3} = \frac{12}{0} \rightarrow VA \rightarrow$ limit dne

test $x=3.1$ | $\frac{3.1(3.1+1)}{3-3.1} = \frac{+}{-} = \boxed{-\infty}$

6) $\lim_{x\to\infty} \frac{(x^2+2)(3x^2-5)}{x^4+6} \rightarrow \lim_{x\to\infty} \frac{3x^4+1x^2-10}{1x^4+6} = \boxed{3}$

10) $\lim_{x\to\infty} \frac{\sqrt{x+1000}}{3^x}$

Comparative growth rates
$L < R < P < E$

$\frac{\text{Rad}}{\text{Exponent}} = \boxed{0}$

$\lim_{x\to\infty} \frac{3^x}{\sqrt{x+1000}}$ $\frac{\text{Exp}}{\text{Rad}}$ $\nearrow \boxed{+\infty}$ $\searrow -\infty$

test
$x=100$

Unit 1 Limits Test Topics

1) Evaluate Limits Algebraically (Real #'s, Approaching Infinity, One-Sided limits)
2) Evaluating Limits Algebraic with hole in graph: Apply methods of Factoring, Conjugates, and/or Common Denominator
3) Identify limits and order pairs from a graph
4) Sketch a function graph given limit properties.
5) Use Continuity conditions with a piecewise function to determine continuity/discontinuity (and categorize the type of discontinuity)
6) Apply Intermediate Value Theorem to guarantee a value
7) Find Horizontal Asymptotes (Radical in denominator) ex. $f(x) = \frac{3x}{\sqrt{5x^2-4}}$
8) Comparative Growth Rate: example: $\lim_{n \to \infty} \frac{e^{2x}}{\sqrt{2x+1000}}$