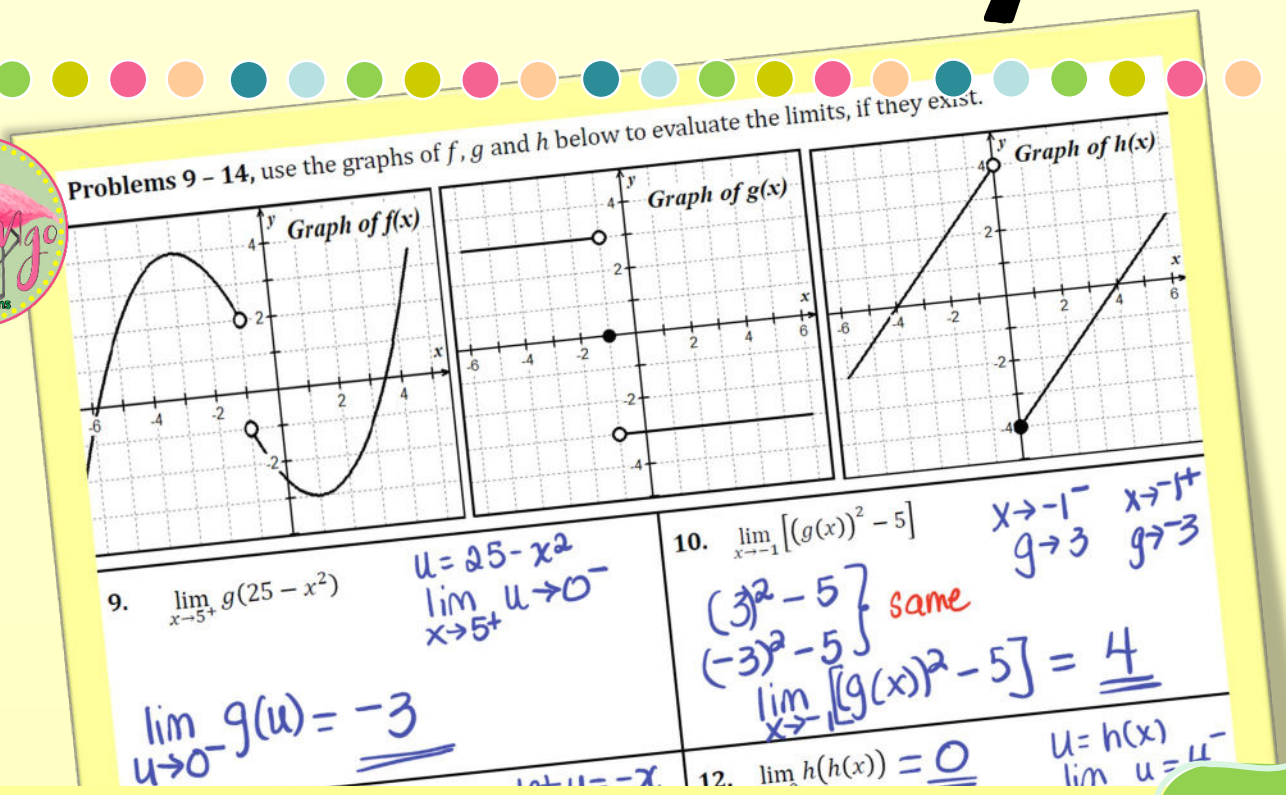
AP® Calculus

Limits and Continuity



Homework 1

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AP CALCULUS CURRICULUM

Scope and Sequence

Unit 1: Limits and Continuity

Lesson	Skills & Learning Objectives
[1.1] Concept of Instantaneous Rate of Change	❑ Interpret rate of change at an instant in terms of average rates of change
[1.2] Understanding Limits Graphically and Numerically	❑ Evaluate the limit, if it exists by graphical and numerical methods ❑ Find one-sided limits and general limits
[1.3] Properties of Limits	❑ Use properties of limits to evaluate graphically, numerically, and algebraically
[1.4] Limits of Composite Functions	❑ Evaluate the limit of composite functions, if it exists by graphical and numerical methods. ❑ Find one-sided limits and general limits of composite functions
[1.5] Finding Limits by Analytic Methods	❑ Evaluate limits analytically, including substitution, cancellation, rationalization, and special trig rules
[1.6] Limits of Transcendental Functions	❑ Evaluate limits of exponential and trigonometric functions
[1.7] Limits and Continuity	❑ Apply the definition of continuity to determine whether a function is continuous at a point
[1.8] Infinite Limits and Limits at Infinity	❑ Compare and contrast infinite limits and limits at infinity ❑ Use properties of infinite limits to find asymptotes and describe function behavior. ❑ Use relative rates of growth of power, logarithmic, and exponential functions to analyze limits
[1.9] Intermediate Value Theorem	❑ Understand and apply the Intermediate Value Theorem

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AP CALCULUS AB CURRICULUM

Scope and Sequence

SECTION	LESSON	DAYS
UNIT 1	**Limits and Continuity**	**23**
1–1	Concept of Instantaneous Rate of Change	1
1–2	Understanding the Limit	1
1–3	Properties of Limits	2
1-4	Limits of Composite Functions	1
1–5	Finding Limits Analytically	2
1–6	Limits of Transcendental Functions	2
1–7	Limits and Continuity	2
1–8	Infinite Limits and Limits at Infinity	2
1-9	Intermediate Value Theorem	2

AP CALCULUS BC CURRICULUM

Scope and Sequence

SECTION	LESSON	DAYS
UNIT 1	**Limits and Continuity**	**14**
1–1	Concept of Instantaneous Rate of Change	1
1–2	Understanding the Limit	1
1–3	Properties of Limits	1
1-4	Limits of Composite Functions	1
1–5	Finding Limits Analytically	1
1–6	Limits of Transcendental Functions	1
1–7	Limits and Continuity	2
1–8	Infinite Limits and Limits at Infinity	2
1-9	Intermediate Value Theorem	1

1.2 Understanding Limits Graphically & Numerically

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Problems 1 – 4, complete the table and use the result to estimate the limit. Graph the function and verify your result.

1. $\lim_{x \to 2} \frac{x-2}{2x^2-9x+10}$

x	1.99	1.999	2	2.001	2.01
$f(x)$					

2. $\lim_{x \to 0} \frac{\sin x}{x}$

x	-0.01	-0.001	0	0.001	0.01
$f(x)$					

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

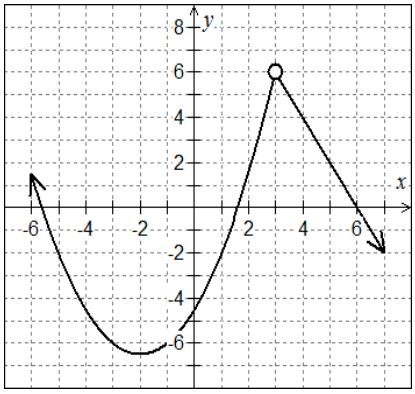
x	3.99	3.999	4	4.001	4.01
$f(x)$					

4. $\lim_{x \to 3} \frac{\sqrt{x+1}-2}{x-3}$

x	2.99	2.999	3	3.001	3.01
$f(x)$					

Problems 5 – 8, use the graph to find the limit, if it exists. If the limit does not exist, explain why.

5.



A. $\lim_{x \to -3} f(x)$

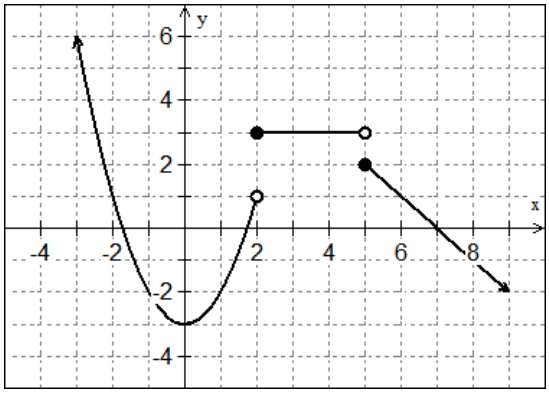
B. $\lim_{x \to -\infty} f(x)$

C. $\lim_{x \to 6} f(x)$

D. $\lim_{x \to 1} f(x)$

E. Does $\lim_{x \to 3} f(x)$ exist? Why or why not?

6.



A. $\lim_{x \to 0} f(x)$

B. $\lim_{x \to 2^-} f(x)$

C. $\lim_{x \to 4} f(x)$

D. $\lim_{x \to 5} f(x)$

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

F. $\lim_{x \to 7} f(x)$

Problems 17 – 22, Use the table of values below to find limits for the following:

$\boldsymbol{x}$	-2	3	6	c
$\boldsymbol{f(x)}$	5	0	1	$\lim\limits_{x\to c} f(x) = 6$
$\boldsymbol{g(x)}$	-3	-2	-4	$\lim\limits_{x\to c} g(x) = -2$
$\boldsymbol{h(x)}$	4	2	3	$\lim\limits_{x\to c} h(x) = 3$

17. $\lim\limits_{x\to c} f\big(g(x)\big)$

18. $\lim\limits_{x\to c} g\big(h(x)\big)$

19. $\lim\limits_{x\to c} \frac{g(f(x))}{h(g(x))}$

20. $\lim\limits_{x\to c} \frac{f(x)}{f(h(x))}$

21. $\lim\limits_{x\to c} f\left(g\big(h(x)\big)\right)$

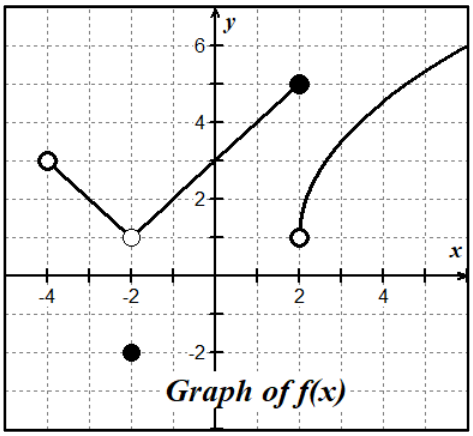
22. $\lim\limits_{x\to c}\ g\left(h\big(f(x)\big)\right)$

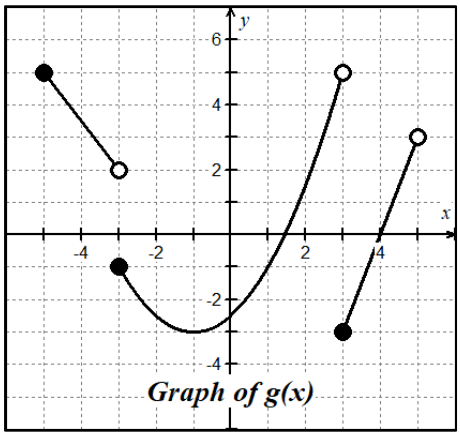
1.4 Limits of Composite Functions

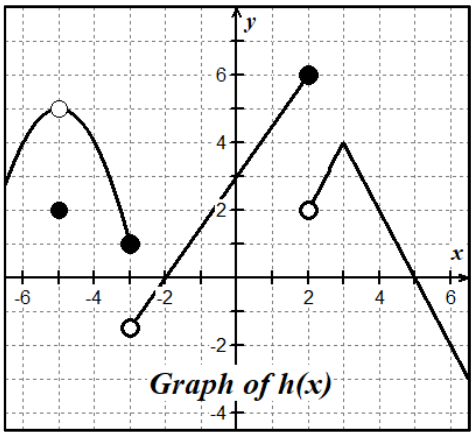
Name _____

Date _____ Period _____

Problems 1 – 8, Use the graphs of $f(x0, g(x)$ and $h(x)$ shown below to answer the following limit questions.







1. $\lim_{x \to -1} [f(x) + g(x)]$

2. $\lim_{x \to 0} [f(x) \cdot h(x)]$

3. $\lim_{x \to -2} f(h(x))$

4. $\lim_{x \to 1} \sqrt{f(x)}$

5. $\lim_{x \to 0} h(|x| + 3)$

6. $\lim_{x \to -5^+} \left[\frac{g(x)}{h(x)}\right]$

7. $\lim_{x \to -5} g(x + 2)$

8. $\lim_{x \to 2} f\sqrt{x + 3}$

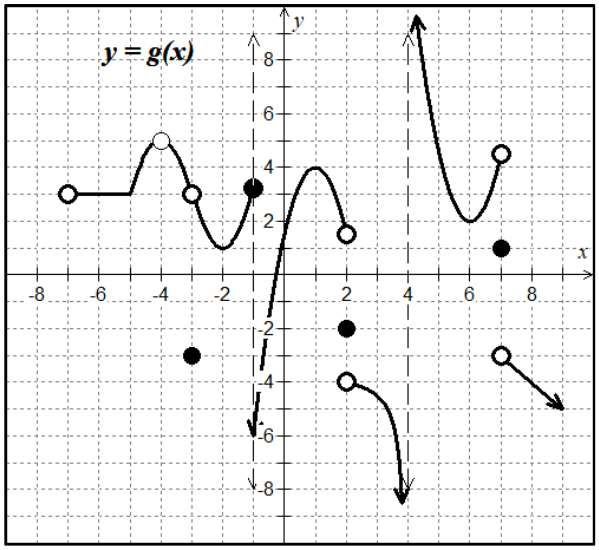
1.7 Limits and Continuity

Name _____

Date _____ Period _____

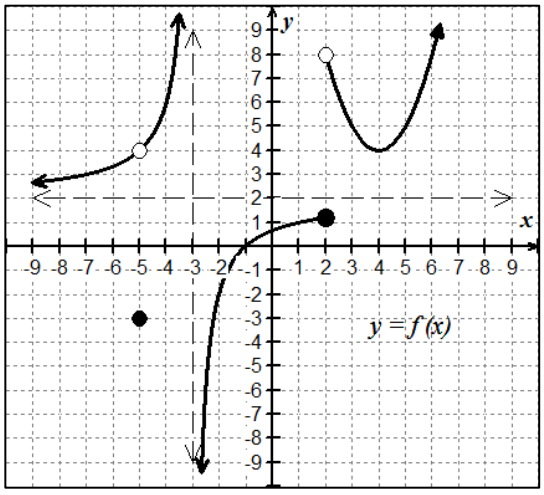
1. Use the graph of the function $y = g(x)$ shown below, to evaluate each of the following.

A. $\lim_{x\to -3} g(x) =$	**B.** $\lim_{x\to -1^-} g(x) =$
C. $\lim_{x\to -1^+} g(x) =$	**D.** $g(-1) =$
E. $\lim_{x\to -1} g(x) =$	**F.** $\lim_{x\to 4^+} g(x) =$
G. $\lim_{x\to 4^-} g(x) =$	**H.** $\lim_{x\to 7} g(x) =$
J. $g(7) =$	**K.** $\lim_{x\to 2^+} g(x) =$



2. Use the graph of the function $y = f(x)$ shown below, to evaluate each of the following.

A. On the interval $x \in (-\infty, \infty)$, list the largest intervals for which $f(x)$ is continuous.



B. Find the smallest value k, such that the function is continuous on (k, ∞)

C. Find the smallest value k, such that the function is continuous on $[k, \infty)$

D. Find the largest value of b such that $y = f(x)$ is continuous on $(-3, b]$ but not continuous in $(-3, b + 1]$. State all values of b that would work.

1.9 Intermediate Value Theorem

Name _____

Date _____ Period _____

Problems 1 – 13, Use the Intermediate Value Theorem to complete.

1. In the function $f(x) = x^3 - x - 1$, it can be shown that $f(1) = -1$ and $f(2) = 5$. Complete the table below to find an approximation for a solution of the interval $[1, 2]$.

x	1	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
$f(x)$											

2. Find the value of c guaranteed by the Intermediate Value Theorem. $f(x) = x^2 + 4x - 13$ on $[0, 4]$ such that $f(c) = 8$

3. Show that $g(x) = 2x^3 - 5x^2 - 10x + 5$ has a root somewhere in the interval $[-1, 2]$.

4. Between which of the following two values does the equation $3x^3 + 5x - 11 = 0$ have a solution?

(A) $[-2, -1]$ **(B)** $[0, 1]$ **(C)** $[-1, 0]$ **(D)** $[1, 2]$

9. The functions f and g are continuous. The function h is given by $h(x) = f(g(x)) - x$. The table below gives values of the functions. Explain why there must be a value c for $1 < c < 5$ such that $h(c) = -2$.

$\boldsymbol{x}$	1	2	3	4	5
$\boldsymbol{f(x)}$	0	9	7	-3	8
$\boldsymbol{g(x)}$	4	6	-4	1	3

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10. Given $f(x) = \frac{x}{x-3}$ on the interval $[-2, 2]$. Determine if the IVT applies. State why or why not. Then, find the value of c such that $f(c) = \frac{1}{3}$.

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11. Show that there is a value c with $0 < c < 2$ such that $x^2 + \cos \pi x = 4$. Then, use a graphing utility to find the approximate value of c.