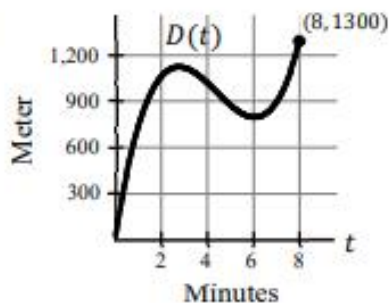


AP Calculus – 1.1 Notes – Exploring Rates of Change & Defining Limits

Can Change occur at an instant?

1. Mr. Brust's distance from his house is modeled by the function $D(t)$. While riding his bike to the store, he realizes he dropped his wallet and turns around to find it. After finding his wallet, he finishes his ride to the store.



- a. What is his average speed (rate of change) for his trip to the store if he arrives after 8 minutes?
- b. What was his average rate of change between 2 and 6 minutes?
- c. What was his average rate of change between 2 and 3 minutes?

Is it possible to know how fast he was going at an instant?

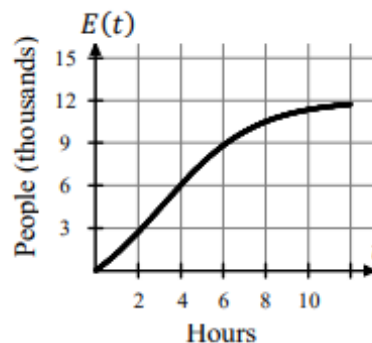
- d. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 2$.
- e. Give a rough estimate of the instantaneous rate of change at $t = 2$.

2. $b(t)$ represents the buffalo population in the United States where t is measured in years since 1800.

- a. What does $b(90)$ represent?
- b. What does $\frac{b(50)-b(0)}{50-0}$ represent?

- c. What does $\frac{b(32)-b(31.999)}{32-31.999}$ represent?

3. The number of people who have entered an amusement park is modeled by the function E , where $E(t)$ gives the number of people in thousands who have entered the park and t gives the number of hours since 10:00 a.m. for $0 \leq t \leq 11$. The graph of the function E is shown to the right.



- a. Draw a tangent line at $t = 3$.
- b. Give a rough estimate of the instantaneous rate of change at $t = 3$.
- c. Give an example of how to calculate a rate of change that would give a close estimate to the instantaneous rate of change at $t = 6$.

4. A basketball player's free throw attempts can be modeled by f , where $f(g)$ is the total number of made free throws during the season and g is the number of games for $0 \leq g \leq 82$.

- a. What does $f(50)$ represent?
- b. What does $\frac{f(50)-f(0)}{50-0}$ represent?
- c. What does $\frac{f(50)-f(49.999)}{50-49.999}$ represent?

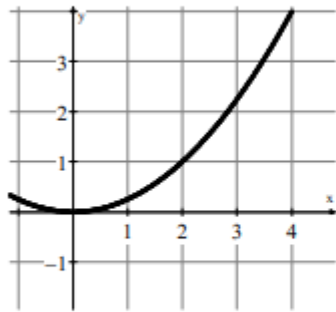
Definition: **The Limit** is the y-value that a function or graph approaches as the x-value moves closer to a given constant

Defining Limits:

Function Value is finding the location of the y-value of the graph at a specific x-value.

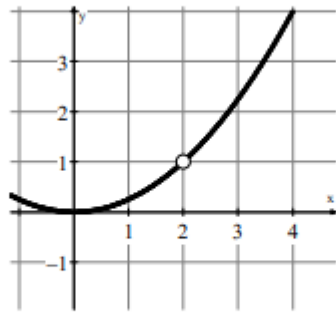
Limits

As x approaches ____, $f(x)$ approaches ____.



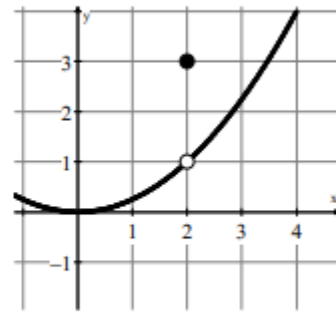
$$\lim_{x \rightarrow 2} f(x) =$$

$$f(2) =$$



$$\lim_{x \rightarrow 2} f(x) =$$

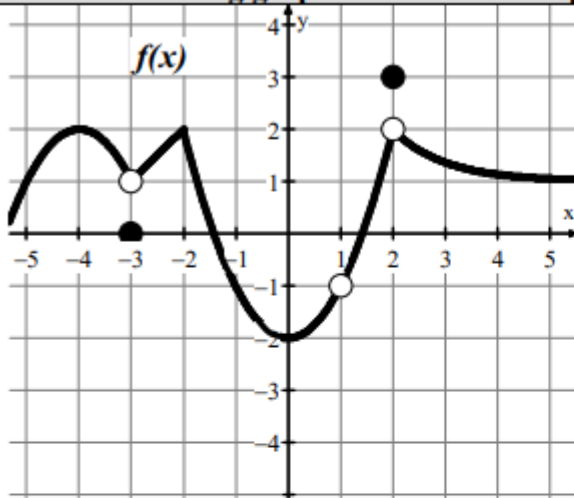
$$f(2) =$$



$$\lim_{x \rightarrow 2} f(x) =$$

$$f(2) =$$

Use the following graph to evaluate each problem.



1. $\lim_{x \rightarrow 1} f(x) =$

2. $f(-3) =$

3. $\lim_{x \rightarrow 2} f(x) =$

4. $f(2) =$

5. $f(1) =$

6. $f(-2) =$

7. $\lim_{x \rightarrow 0} f(x) =$

8. $\lim_{x \rightarrow -3} f(x) =$

9. Give an interpretation of the statement $\lim_{x \rightarrow 7} f(x) = 10$

A limit does NOT tell us the value of $f(x)$. It just tells us what the function approaches!

True or false? $f(1) = \lim_{x \rightarrow 1} f(x)$ in all cases.

True or false? $f(1) \neq \lim_{x \rightarrow 1} f(x)$ in all cases.

Practice Problems:

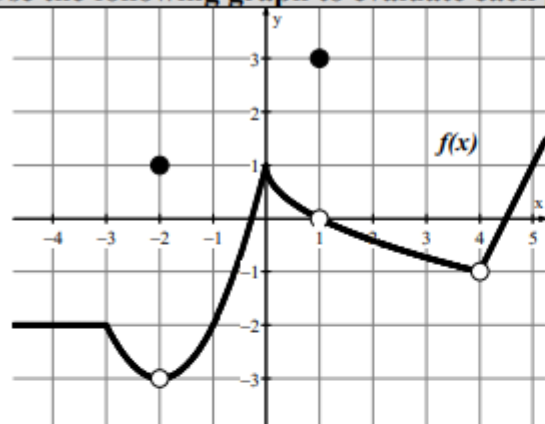
Give an interpretation of each statement.

1. $\lim_{x \rightarrow 1} f(x) = 9$

2. $\lim_{x \rightarrow -2} f(x) = 3$

3. $\lim_{x \rightarrow 4} f(x) = -8$

Use the following graph to evaluate each problem.



4. $f(-2) =$

5. $\lim_{x \rightarrow 1} f(x) =$

6. $\lim_{x \rightarrow -2} f(x) =$

7. $\lim_{x \rightarrow 0} f(x) =$

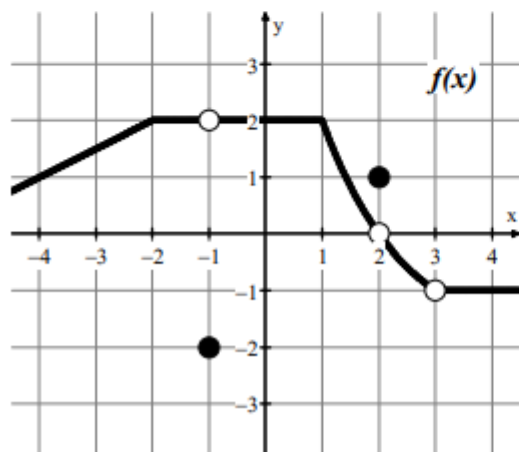
8. $f(4) =$

9. $\lim_{x \rightarrow 4} f(x) =$

10. $\lim_{x \rightarrow -4} f(x) =$

11. $f(1) =$

Use the following graph to evaluate each problem.



12. $\lim_{x \rightarrow -1} f(x) =$

13. $\lim_{x \rightarrow 3} f(x) =$

14. $f(2) =$

15. $\lim_{x \rightarrow -2} f(x) =$

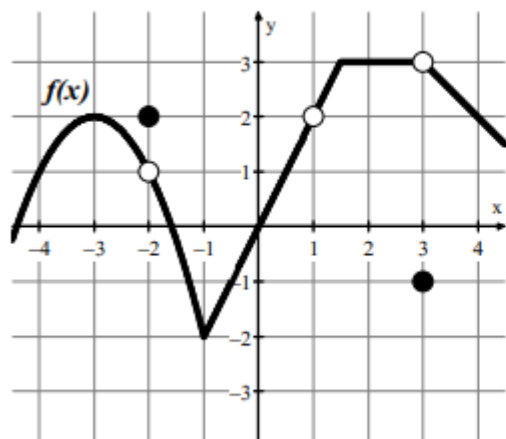
16. $\lim_{x \rightarrow 1} f(x) =$

17. $f(3) =$

18. $f(-1) =$

19. $\lim_{x \rightarrow 2} f(x) =$

Use the following graph to evaluate each problem.



20. $\lim_{x \rightarrow 2} f(x) =$

21. $f(1) =$

22. $\lim_{x \rightarrow 3} f(x) =$

23. $\lim_{x \rightarrow -2} f(x) =$

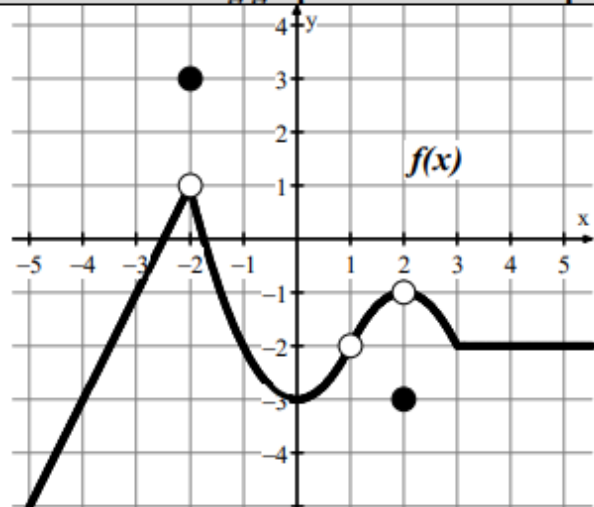
24. $\lim_{x \rightarrow 1} f(x) =$

25. $f(-2) =$

26. $\lim_{x \rightarrow -3} f(x) =$

27. $f(3) =$

Use the following graph to evaluate each problem.



28. $\lim_{x \rightarrow -2} f(x) =$

29. $\lim_{x \rightarrow 1} f(x) =$

30. $\lim_{x \rightarrow 2} f(x) =$

31. $f(-2) =$

32. $f(1) =$

33. $\lim_{x \rightarrow 0} f(x) =$

34. $\lim_{x \rightarrow -4} f(x) =$

35. $f(2) =$

36. Let f be a function that is defined for all real numbers x . Of the following, which is the best interpretation of the statement $\lim_{x \rightarrow 4} f(x) = 8$.

- (A) The value of the function f at $x = 4$ is 8.
- (B) The value of the function f at $x = 8$ is 4.
- (C) As x approaches 4, the values of $f(x)$ approach 8.
- (D) As x approaches 8, the values of $f(x)$ approach 4.

37. Let f be a function that is defined for all real numbers x . Of the following, which is the best interpretation of the statement $\lim_{x \rightarrow -1} f(x) = 2$.

- (A) As x approaches 2, the values of $f(x)$ approach -1 .
- (B) The value of the function f at $x = -1$ is 2.
- (C) The value of the function f at $x = 2$ is -1 .
- (D) As x approaches -1 , the values of $f(x)$ approach 2.