

Section 1, Part B, Multiple Choice, Technology Permitted

10. $\lim_{x \rightarrow 1} \frac{x-1}{\sqrt{x}-1}$ is

- (A) 0. (B) 1.
(C) 2. (D) nonexistent.

Section 2, Part A, Free Response, Technology Permitted

11. The position function

$$s(t) = -4.9t^2 + 398$$

gives the height (in meters) of an object that has fallen from a height of 398 meters after t seconds.

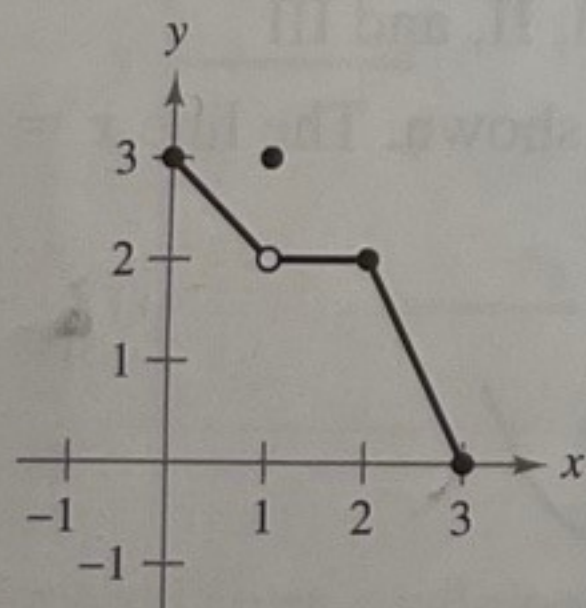
- (a) For $1 < t < 2$, explain why there must be a time t at which the height of the object is 382 meters above the ground.
(b) After how many seconds does the object hit the ground?
(c) Find

$$\lim_{t \rightarrow 3} \frac{s(t) - s(3)}{t - 3}$$

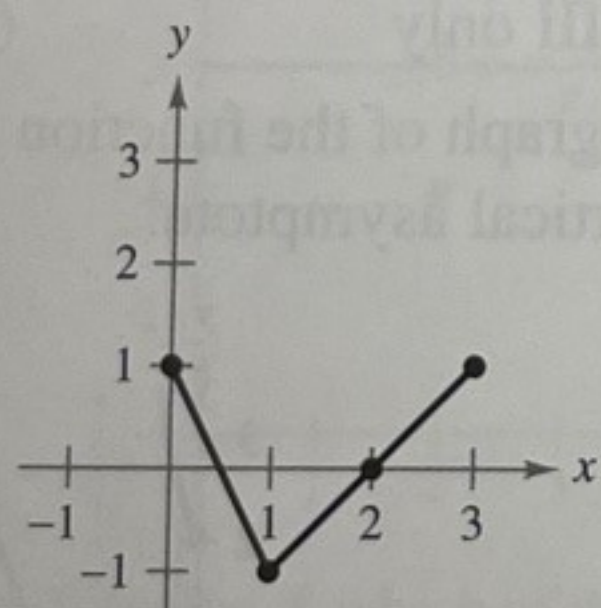
Show the work that leads to your answer. Include units.

Section 2, Part B, Free Response, No Technology

12.



Graph of f



Graph of g

The graphs of the functions f and g are shown above. Evaluate each limit using the graphs provided. Show the computations that lead to your answer.

- (a) $\lim_{x \rightarrow 1} [f(x) + 4]$
(b) $\lim_{x \rightarrow 3^-} \frac{5}{g(x)}$
(c) $\lim_{x \rightarrow 2} [f(x)g(x)]$
(d) $\lim_{x \rightarrow 3^-} \frac{f(x)}{g(x) - 1}$ (Assume that f and g are linear on the interval $[2, 3]$.)

13. Let f be the function defined by

$$f(x) = \begin{cases} \frac{1}{2}x, & x \neq 2 \\ 3, & x = 2 \end{cases}$$

- (a) Does $\lim_{x \rightarrow 2} f(x)$ exist? Justify your answer.
(b) Is f continuous at $x = 2$? Use the definition of continuity to explain your answer.
(c) Find $\lim_{x \rightarrow 2} [\sin(f(x))]$. If the limit does not exist, explain why not.

14. The function f is defined as $f(x) = \frac{x^2 + 5x + 6}{2x^2 + 7x + 3}$.

(a) State the value(s) of x for which f is not continuous.
(b) Evaluate $\lim_{x \rightarrow -3} f(x)$. Justify your answer.
(c) State the equation(s) for the vertical asymptote(s) of the graph of $y = f(x)$.

15. A hot cup of tea is placed on a counter and left to cool. The temperature (in degrees Fahrenheit) of the tea x minutes after the cup is placed on the counter is modeled by a continuous function $T(x)$ for $0 \leq x < 10$. The table shows $T(x)$ at various times x .

x	0	3	4	6	8	9
$T(x)$	180°	174°	172°	168°	164°	162°

- (a) Find $\lim_{x \rightarrow 4} T(x)$. Justify your answer.
(b) Use the data to find the average rate of change in the temperature of the tea for $3 \leq x \leq 8$. Include units in your final answer.
(c) Use the data to identify the shortest interval during which there must exist a time x for which the temperature of the tea is 166.5°. Justify your answer.
(d) Use the data to find the best estimate of the slope of the line tangent to the graph of T at $x = 8$.

16. Let a and b represent real numbers. Define

$$f(x) = \begin{cases} ax^2 + x - b, & x \leq 2 \\ ax + b, & 2 < x < 5. \\ 2ax - 7, & x \geq 5 \end{cases}$$

- (a) Find the values of a and b such that f is continuous on the entire real number line.
(b) Evaluate $\lim_{x \rightarrow 3} f(x)$.
(c) Let $g(x) = \frac{f(x)}{x-1}$. Evaluate $\lim_{x \rightarrow 1} g(x)$.