



# Calculus 1 Workbook

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Solving limits

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MATH

## SOLVING WITH SUBSTITUTION

- 1. What is the value of the limit?

$$\lim_{x \rightarrow 3} (-x^4 + x^3 + 2x^2)$$

- 2. What is the value of the limit?

$$\lim_{x \rightarrow 7} \frac{x^2 - 5}{x^2 + 5}$$

- 3. What is the value of the limit.

$$\lim_{x \rightarrow -2} \frac{x^3 - 5x^2 + 4x - 6}{x^2 + 7x + 6}$$

- 4. Evaluate the limit.

$$\lim_{y \rightarrow -2} \frac{|y - 5|}{y + 1}$$

- 5. Evaluate the limit.



$$\lim_{x \rightarrow 2} \left( \sin \left( \frac{\pi x}{4} \right) + \ln \left( \frac{2e}{x} \right) \right)$$

■ 6. Evaluate the limits  $\lim_{x \rightarrow -1} f(x)$  and  $\lim_{x \rightarrow 2} f(x)$ .

$$f(x) = \begin{cases} -3x + 5 & x < -1 \\ \frac{1}{2}x^2 - 3x + 1 & x \geq -1 \end{cases}$$



## SOLVING WITH FACTORING

- 1. What is the value of the limit?

$$\lim_{x \rightarrow -7} \frac{6x^3 + 42x^2}{2x^2 + 26x + 84}$$

- 2. What is the value of the limit?

$$\lim_{x \rightarrow 1} \frac{\sqrt[3]{x} - 1}{x - 1}$$

- 3. What is the value of the limit?

$$\lim_{x \rightarrow 0} \frac{(x + 3)^2 - 9}{x}$$

- 4. What is the value of the limit?

$$\lim_{x \rightarrow 7} \frac{x^3 - x^2 - 42x}{2x^2 - 20x + 42}$$

- 5. What is the value of the limit?



$$\lim_{x \rightarrow 8} \frac{x^2 + 2x - 80}{2x^3 - 24x^2 + 64x}$$

■ 6. What is the value of the limit?

$$\lim_{x \rightarrow 0} \frac{1}{x} \left( 1 - \frac{16}{(x-4)^2} \right)$$



## SOLVING WITH CONJUGATE METHOD

- 1. Use conjugate method to evaluate the limit.

$$\lim_{x \rightarrow 16} \frac{3(x - 16)}{\sqrt{x} - 4}$$

- 2. What is the value of the limit?

$$\lim_{x \rightarrow 0} \frac{\sqrt{x+3} - \sqrt{3}}{x}$$

- 3. What is the value of the limit?

$$\lim_{x \rightarrow 0} \frac{\sqrt{x^2 + 16} - 4}{x^2}$$

- 4. Use conjugate method to evaluate the limit.

$$\lim_{x \rightarrow 49} \frac{x - 49}{3(\sqrt{x} - 7)}$$

- 5. What is the value of the limit?



$$\lim_{x \rightarrow 1} \frac{4 - \sqrt{x + 15}}{2(x - 1)}$$

■ 6. What is the value of the limit?

$$\lim_{x \rightarrow 2} \frac{\sqrt{11 - x} - 3}{\sqrt{6 - x} - 2}$$



## INFINITE LIMITS AND VERTICAL ASYMPTOTES

- 1. What is the value of the limit?

$$\lim_{x \rightarrow 2} \frac{x^2 - x - 6}{-3x^2 - 3x + 18}$$

- 2. What is the value of the limit?

$$\lim_{x \rightarrow -1} \frac{x^2 + x - 6}{4x^2 + 16x + 12}$$

- 3. What is the value of the limit?

$$\lim_{x \rightarrow 3} \frac{1}{|x - 3|}$$

- 4. What is the value of the limit?

$$\lim_{x \rightarrow -4} \frac{\sqrt{x^2 - 1}}{x + 4}$$

- 5. What is the value of the limit?





$$\lim_{x \rightarrow 3} \frac{x^2 - 4x}{x^2 - 2x - 3}$$

■ 6. What is the value of the limit?

$$\lim_{x \rightarrow -2} \frac{x^2 - 16}{-x^2 + x + 6}$$



## LIMITS AT INFINITY AND HORIZONTAL ASYMPTOTES

- 1. What is the value of the limit?

$$\lim_{x \rightarrow \infty} \frac{3x^3 - 5x + 2}{9x^3 + 7x^2 - x}$$

- 2. What is the value of the limit?

$$\lim_{x \rightarrow -\infty} \frac{\sqrt[3]{x} + 1}{\sqrt{x} - 1}$$

- 3. What is the value of the limit?

$$\lim_{x \rightarrow \infty} \frac{x^3 + x^2 + 1}{1 + 2x}$$

- 4. What is the value of the limit?

$$\lim_{x \rightarrow -\infty} \frac{\sqrt{x^2 + 5}}{x + 4}$$

- 5. What is the value of the limit?



$$\lim_{x \rightarrow -\infty} \frac{19x + 21}{x^3 + 15x + 11}$$

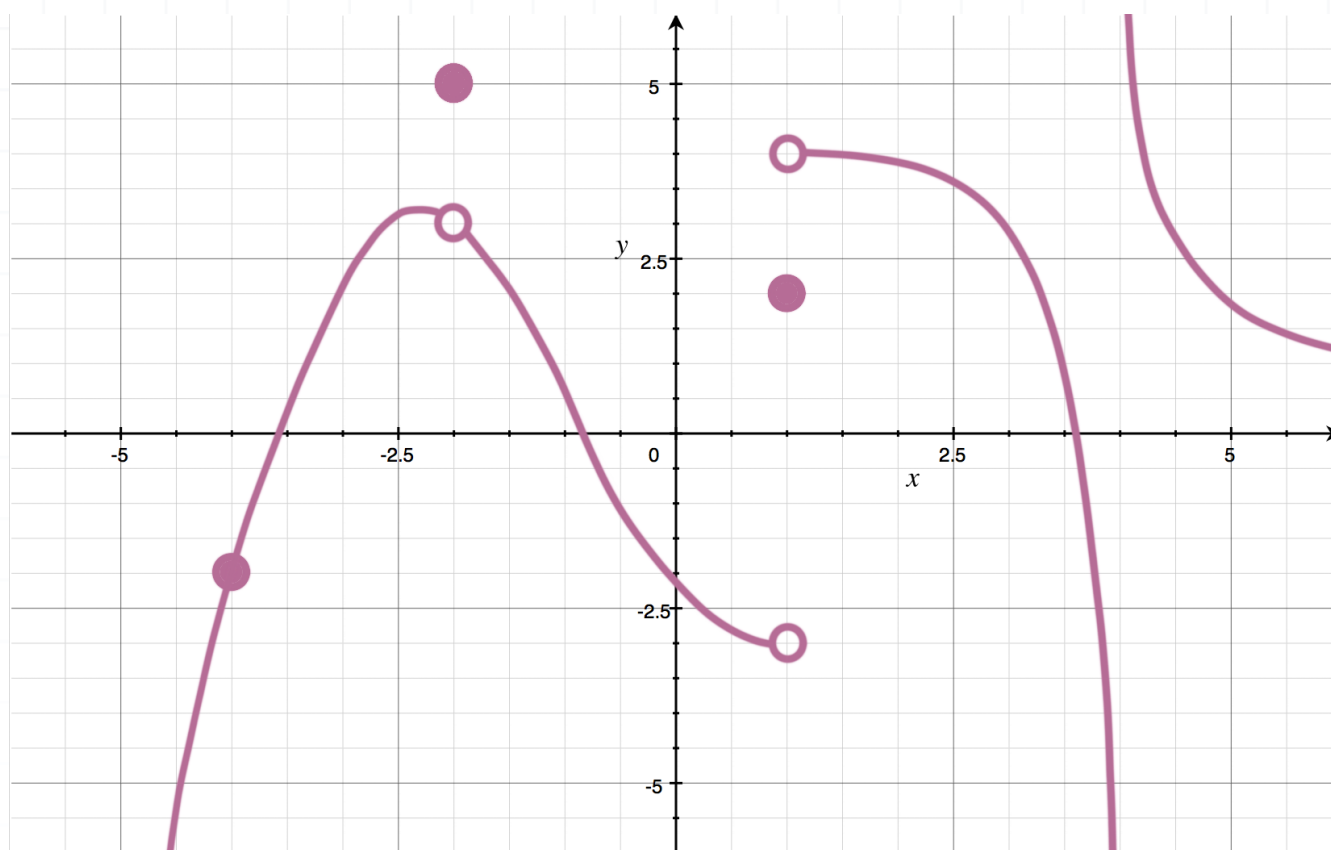
■ 6. What is the value of the limit?

$$\lim_{x \rightarrow \infty} (\sqrt{x^2 + 2x} - x)$$



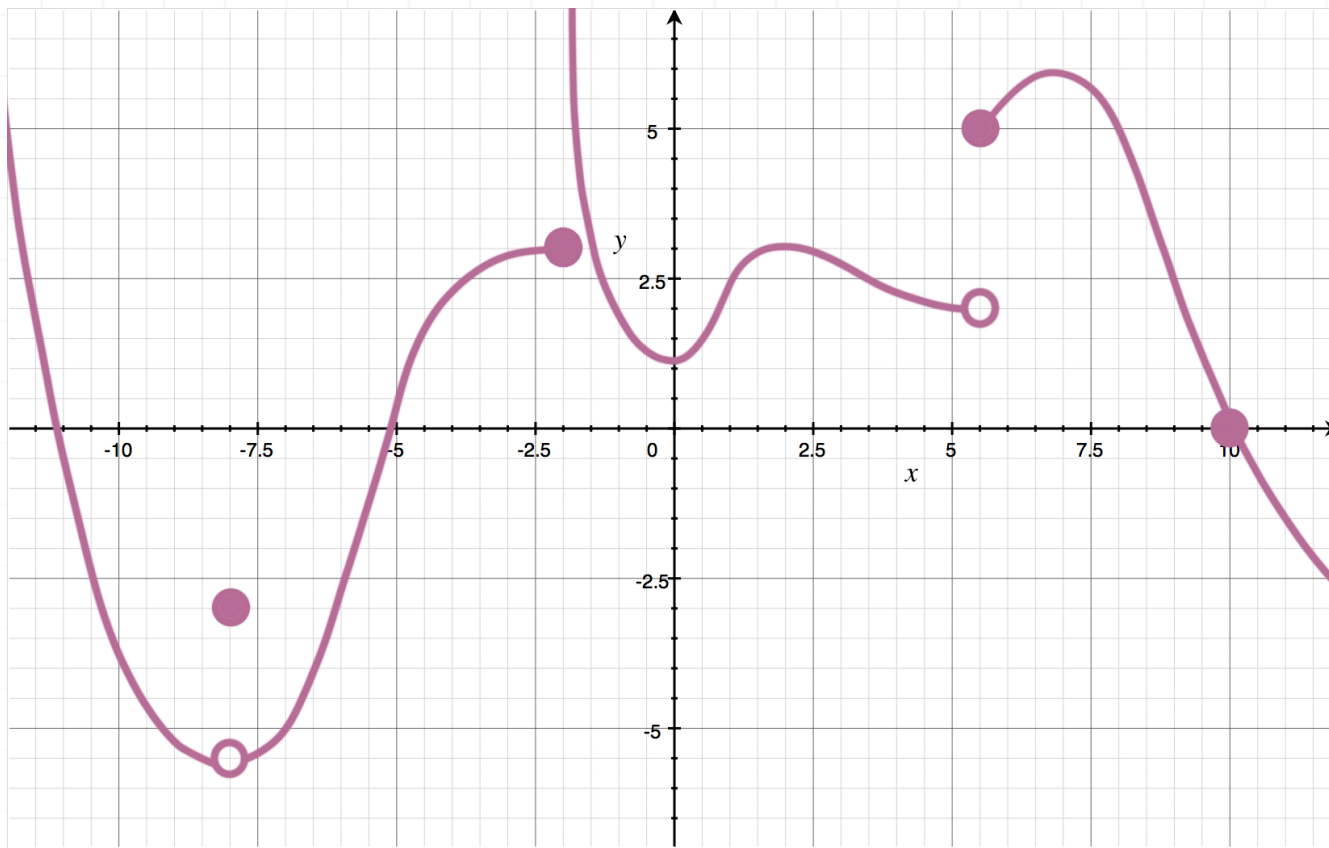
## CRAZY GRAPHS

- 1. Use the graph to find the value of  $\lim_{x \rightarrow 1} f(x)$ .

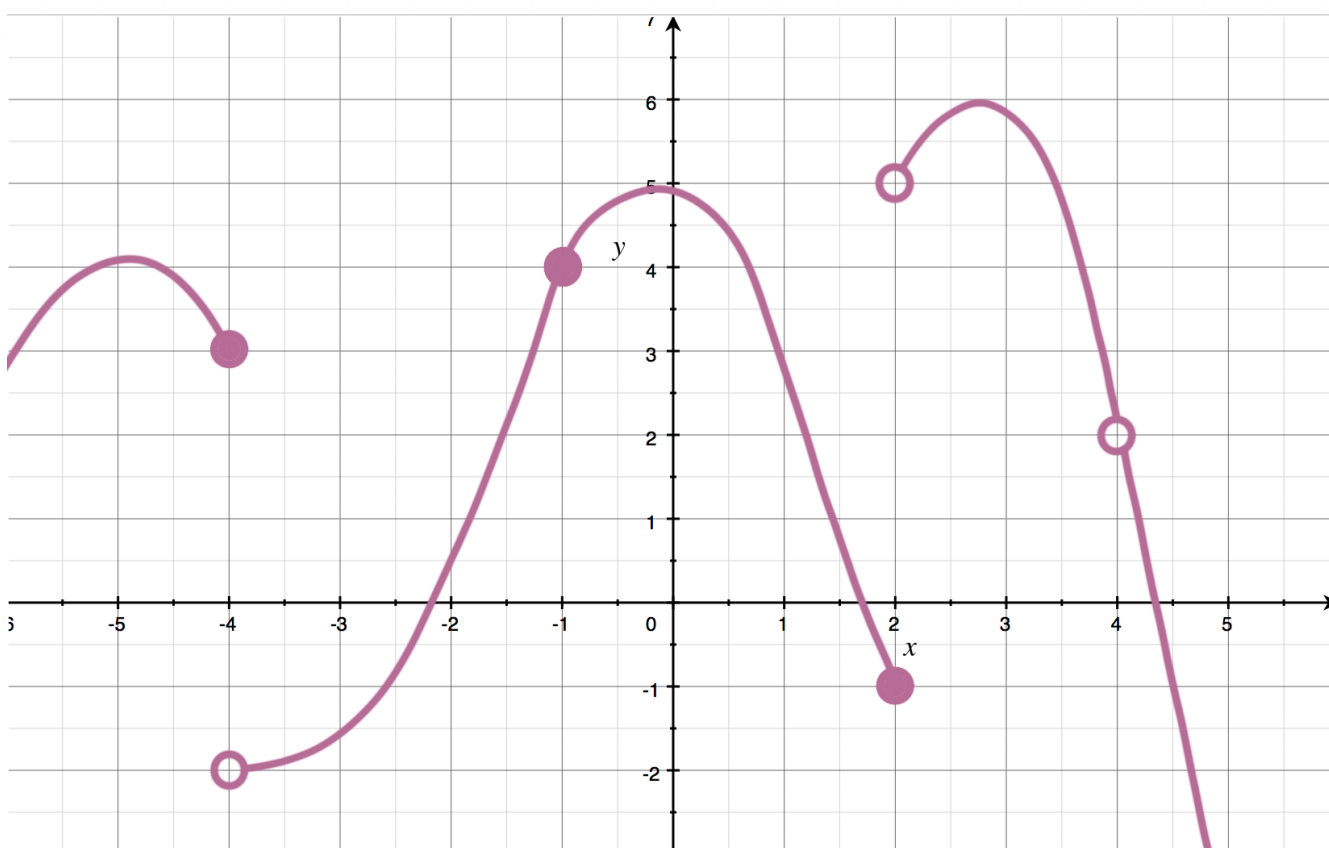


- 2. Use the graph to find the value of  $\lim_{x \rightarrow 5.5} g(x)$ .

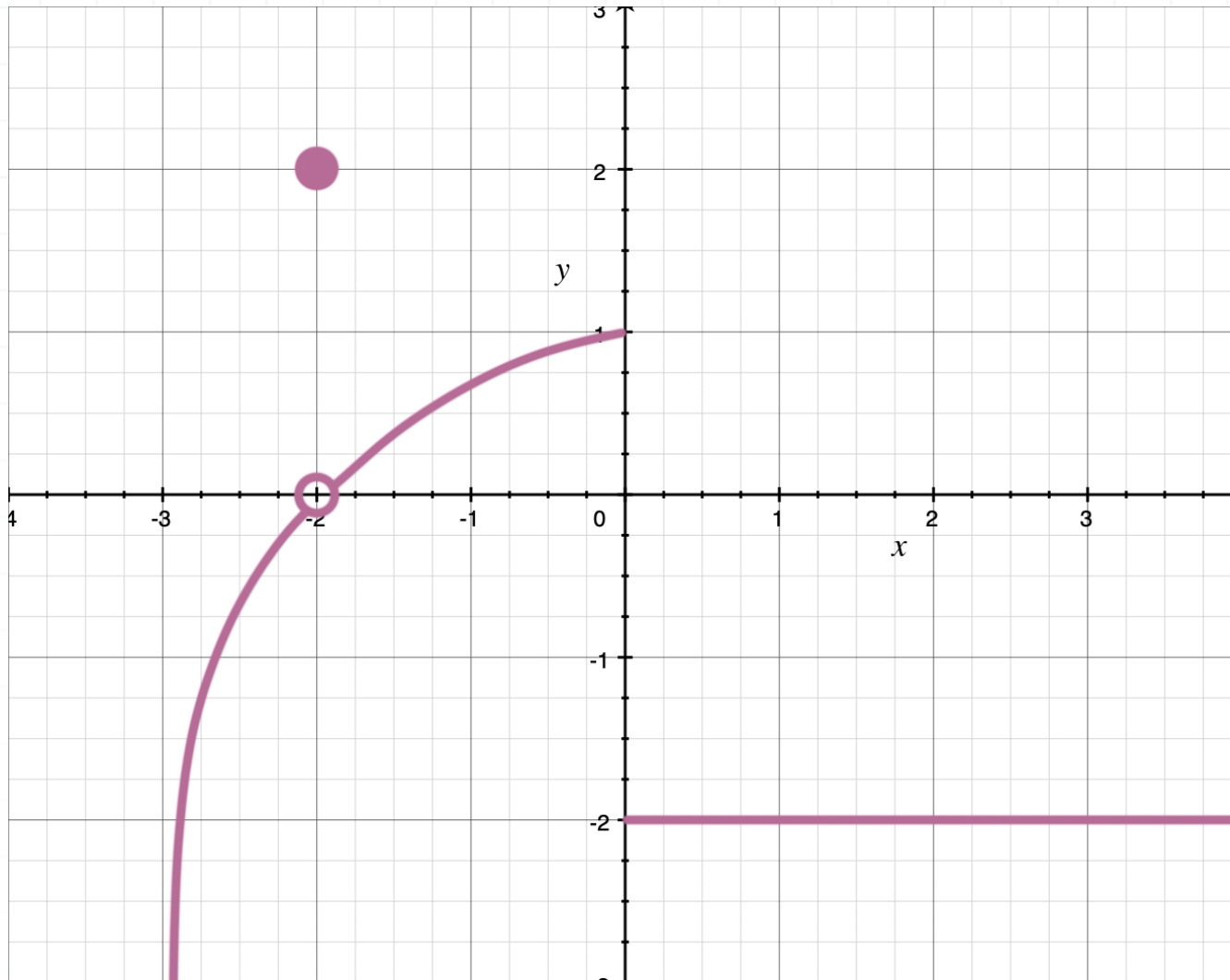




■ 3. Use the graph to find the value of  $\lim_{x \rightarrow 4} h(x)$ .



- 4. Use the graph to determine whether or not the limit exists at  $x = 0$ .



- 5. Sketch the graph of a function that satisfies each of the following conditions.

$$\lim_{x \rightarrow -1^-} f(x) = 2 \qquad \lim_{x \rightarrow -1^+} f(x) = -1 \qquad f(-1) = 0$$

- 6. Sketch the graph of a function that satisfies each of the following conditions.

$$\lim_{x \rightarrow 0} f(x) = -5 \qquad f(0) \text{ does not exist}$$



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

$$\lim_{x \rightarrow 3^+} f(x) = -4$$

$$f(3) = 0$$



## TRIGONOMETRIC LIMITS

- 1. Find  $\lim_{x \rightarrow \pi} f(x)$  if  $f(x) = 3 \cos x - 2$ .

- 2. Evaluate the limit.

$$\lim_{x \rightarrow 0} \frac{\sin(8x)}{x}$$

- 3. Evaluate the limit.

$$\lim_{x \rightarrow \frac{\pi}{4}} \frac{1 - \cot x}{\cos x - \sin x}$$

- 4. Evaluate the limit.

$$\lim_{x \rightarrow 0} \frac{\tan(4x)}{\sin(2x)}$$

- 5. Evaluate the limit.

$$\lim_{x \rightarrow 0} \frac{x}{\sin \frac{x}{3}}$$





■ 6. Evaluate the limit.

$$\lim_{x \rightarrow 0} \frac{\sin^2 x}{1 - \cos x}$$



## MAKING THE FUNCTION CONTINUOUS

- 1. What value of  $c$  makes the function  $h(x)$  continuous if  $c$  is a constant?

$$h(x) = \begin{cases} x^2 & x \leq 4 \\ 3x + c & x > 4 \end{cases}$$

- 2. What value of  $k$  makes the function  $f(x)$  continuous if  $k$  is a constant?

$$f(x) = \begin{cases} kx^2 - 2x + 1 & x \leq 3 \\ kx + 1 & x > 3 \end{cases}$$

- 3. What values of  $a$  and  $b$  make the function  $g(x)$  continuous if  $a$  and  $b$  are constant?

$$g(x) = \begin{cases} 3 & x \leq -2 \\ ax - b & -2 < x < 2 \\ -2 & x \geq 2 \end{cases}$$

- 4. What value of  $c$  makes the function  $f(x)$  continuous if  $c$  is a constant?

$$f(x) = \begin{cases} 2x^3 - 6x^2 + 8x + 3 & x \leq 1 \\ cx + 9 & x > 1 \end{cases}$$



■ 5. What value of  $c$  makes the function  $g(x)$  continuous if  $c$  is a constant?

$$g(x) = \begin{cases} \sqrt{x} + 18 & x \leq 16 \\ x - 2c & x > 16 \end{cases}$$

■ 6. What values of  $a$  and  $b$  make the function  $h(x)$  continuous if  $a$  and  $b$  are constant?

$$h(x) = \begin{cases} ax^2 & x \leq -1 \\ ax + b & -1 < x < 3 \\ bx + 2 & x \geq 3 \end{cases}$$



