

# Piecewise Functions

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 27

## Q Quick Review

A **piecewise function** uses different rules on different parts of the domain. First decide which interval contains the input, then use only that rule. On graphs, a closed circle means the endpoint is included; an open circle means it is not. Piecewise functions are useful for real situations with changing rules, such as shipping costs, tax brackets, parking fees, and step rates.

## PRACTICE

Evaluate each piecewise function or interpret the boundary correctly.

- |   |  |
|---|--|
| <p>1. <math>f(x) = \begin{cases} 2x + 1, &amp; x &lt; 0 \\ x^2, &amp; x \geq 0 \end{cases}; f(-3)</math> _____</p>                              | <p>11. Open point <math>(-2, 1)</math>, closed point <math>(-2, 5)</math>; <math>f(-2)</math> _____</p>  |
| <p>2. <math>f(x) = \begin{cases} 2x + 1, &amp; x &lt; 0 \\ x^2, &amp; x \geq 0 \end{cases}; f(0)</math> _____</p>                               | <p>12. Graph has <math>f(x) = x + 1</math> for <math>x &lt; 3</math>, <math>f(x) = 6</math> for <math>x \geq 3</math>; <math>f(3)</math> _____</p> |
| <p>3. <math>f(x) = \begin{cases} 2x + 1, &amp; x &lt; 0 \\ x^2, &amp; x \geq 0 \end{cases}; f(4)</math> _____</p>                               | <p>13. <math>S(w) = \begin{cases} 6, &amp; 0 &lt; w \leq 2 \\ 6 + 1.5(w - 2), &amp; w &gt; 2 \end{cases}; S(2)</math> _____</p>                    |
| <p>4. <math>g(x) = \begin{cases} x + 5, &amp; x &lt; 2 \\ 3x, &amp; x \geq 2 \end{cases}; g(1)</math> _____</p>                                 | <p>14. <math>S(w) = \begin{cases} 6, &amp; 0 &lt; w \leq 2 \\ 6 + 1.5(w - 2), &amp; w &gt; 2 \end{cases}; S(5)</math> _____</p>                    |
| <p>5. <math>g(x) = \begin{cases} x + 5, &amp; x &lt; 2 \\ 3x, &amp; x \geq 2 \end{cases}; g(2)</math> _____</p>                                 | <p>15. <math>A(a) = \begin{cases} 9, &amp; a &lt; 13 \\ 15, &amp; 13 \leq a &lt; 60 \\ 11, &amp; a \geq 60 \end{cases}; A(13)</math> _____</p>     |
| <p>6. <math>g(x) = \begin{cases} x + 5, &amp; x &lt; 2 \\ 3x, &amp; x \geq 2 \end{cases}; g(5)</math> _____</p>                                 | <p>16. <math>A(a) = \begin{cases} 9, &amp; a &lt; 13 \\ 15, &amp; 13 \leq a &lt; 60 \\ 11, &amp; a \geq 60 \end{cases}; A(62)</math> _____</p>     |
| <p>7. <math>h(x) = \begin{cases} -4, &amp; x &lt; -1 \\ 2x + 1, &amp; -1 \leq x &lt; 3 \\ 9, &amp; x \geq 3 \end{cases}; h(-2)</math> _____</p> | <p>17. <math>P(n) = \begin{cases} 12n, &amp; n &lt; 10 \\ 10n, &amp; n \geq 10 \end{cases}; P(9)</math> _____</p>                                  |
| <p>8. <math>h(x) = \begin{cases} -4, &amp; x &lt; -1 \\ 2x + 1, &amp; -1 \leq x &lt; 3 \\ 9, &amp; x \geq 3 \end{cases}; h(-1)</math> _____</p> | <p>18. <math>P(n) = \begin{cases} 12n, &amp; n &lt; 10 \\ 10n, &amp; n \geq 10 \end{cases}; P(10)</math> _____</p>                                 |
| <p>9. <math>h(x) = \begin{cases} -4, &amp; x &lt; -1 \\ 2x + 1, &amp; -1 \leq x &lt; 3 \\ 9, &amp; x \geq 3 \end{cases}; h(3)</math> _____</p>  | <p>19. <math>C(t) = \begin{cases} 25, &amp; 0 \leq t \leq 500 \\ 25 + 0.05(t - 500), &amp; t &gt; 500 \end{cases}; C(500)</math> _____</p>         |
| <p>10. Open point <math>(4, 7)</math>, closed point <math>(4, 2)</math>; <math>f(4)</math> _____</p>  | <p>20. <math>C(t) = \begin{cases} 25, &amp; 0 \leq t \leq 500 \\ 25 + 0.05(t - 500), &amp; t &gt; 500 \end{cases}; C(620)</math> _____</p>         |



◆ VISUAL PRACTICE

Use the graph, table, chart, or diagram to answer the question.

21. Use the piecewise graph. What is  $f(1)$ ?



Answer: \_\_\_\_\_

22. Use the rule  $f(x) = \begin{cases} x + 2, & x < 3 \\ 10, & x \geq 3 \end{cases}$ . Find  $f(3)$ .

$x$ value	$x < 3$	$x \geq 3$
rule	$x + 2$	10

Answer: \_\_\_\_\_

23. Use the parking fee rule. What is  $C(6)$ ?

$h$ hours	$0 < h \leq 2$	$h > 2$
$C(h)$	8	$8 + 3(h - 2)$

Answer: \_\_\_\_\_

◆ Word Problems

24. A parking garage charges \$4 for the first hour and \$2 for each additional hour. Write a piecewise cost function for  $h$  hours.

\_\_\_\_\_

25. A delivery service charges \$6 for packages up to 5 lb and \$10 for packages over 5 lb. Find the cost for 5 lb and 8 lb. \_\_\_\_\_

26. A concert ticket costs \$12 before the event day and \$18 on the event day. Write a simple piecewise model for the ticket price.

\_\_\_\_\_

27. A water bill is \$20 for up to 1000 gallons and then \$0.03 for each gallon over 1000. Write the cost for  $g$  gallons. \_\_\_\_\_



## Answer Keys

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24. 
$$C(h) = \begin{cases} 4, & 0 < h \leq 1 \\ 4 + 2(h - 1), & h > 1 \end{cases}$$

25.

26. 
$$P = \begin{cases} 12, & \text{before event day} \\ 18, & \text{event day} \end{cases}$$

27. 
$$C(g) = \begin{cases} 20, & 0 \leq g \leq 1000 \\ 20 + 0.03(g - 1000), & g > 1000 \end{cases}$$

### Step-by-Step Tutor Notes

1. Start with the definition the problem is testing, then apply it directly. Since  $-3 < 0$ , use  $2x + 1$ . Then  $2(-3) + 1 = -5$ . So the answer is  $-5$ .
2. Use the clue in the question first, then let the arithmetic finish the job. The boundary  $0$  is included in  $x \geq 0$ , so use  $x^2$  and get  $0$ . So the answer is  $0$ .
3. This is a good place to slow down, check the notation, and simplify cleanly. Because  $4 \geq 0$ , use  $x^2$ . Then  $4^2 = 16$ . So the answer is  $16$ .
4. Use the clue in the question first, then let the arithmetic finish the job. Since  $1 < 2$ , use  $x + 5$ . That gives  $1 + 5 = 6$ . So the answer is  $6$ .
5. Start with the definition the problem is testing, then apply it directly. The value  $2$  belongs to  $x \geq 2$ , so use  $3x$ :  $3(2) = 6$ . So the answer is  $6$ .
6. Take it one clear step at a time and keep the original question in mind. Since  $5 \geq 2$ , use the second rule. Then  $3(5) = 15$ . So the answer is  $15$ .
7. Start with the definition the problem is testing, then apply it directly. The input  $-2$  is less than  $-1$ , so use the first rule. So the answer is  $-4$ .
8. Use the clue in the question first, then let the arithmetic finish the job. The input  $-1$  is included in the middle interval, so  $2(-1) + 1 = -1$ . So the answer is  $-1$ .
9. Start with the definition the problem is testing, then apply it directly. The middle interval stops before  $3$ , so  $x = 3$  uses the last rule. So the answer is  $9$ .
10. At one  $x$ -value, the closed point gives the function value. The open point is not included.
11. Focus on the main idea of the problem, then simplify carefully. The closed point at  $x = -2$  is the one the graph actually includes. So the answer is  $5$ .
12. Focus on the main idea of the problem, then simplify carefully. Because the second rule includes  $x = 3$ , use the constant value  $6$ . So the answer is  $6$ .
13. Use the clue in the question first, then let the arithmetic finish the job. The first shipping bracket includes  $2$  lb, so the cost is  $6$ . So the answer is  $6$ .
14. Use the clue in the question first, then let the arithmetic finish the job. Five pounds is over  $2$ , so use  $6 + 1.5(5 - 2) = 10.5$ . So the answer is  $10.5$ .
15. Take it one clear step at a time and keep the original question in mind. Age  $13$  is included in the middle bracket, so the price is  $15$ . So the answer is  $15$ .
16. This is a good place to slow down, check the notation, and simplify cleanly. Since  $62 \geq 60$ , use the senior-price bracket. So the answer is  $11$ .
17. Take it one clear step at a time and keep the original question in mind. Nine shirts is below the discount threshold, so  $12(9) = 108$ . So the answer is  $108$ .
18. Start with the definition the problem is testing, then apply it directly. Ten shirts qualifies for the lower unit price, so  $10(10) = 100$ . So the answer is  $100$ .
19. Focus on the main idea of the problem, then simplify carefully. The base plan includes  $500$  texts, so the cost is still  $25$ . So the answer is  $25$ .
20. There are  $120$  extra texts, and  $0.05(120) = 6$ . Add that to  $25$  to get  $31$ .
21. At  $x = 1$ , the closed point is at  $y = 1$ . The open point is not included.
22. This is a good place to slow down, check the notation, and simplify cleanly. Because  $3$  is included in  $x \geq 3$ , use the second rule. So the answer is  $10$ .
23. Take it one clear step at a time and keep the original question in mind. Since  $6 > 2$ , use  $8 + 3(h - 2)$ . Then  $8 + 3(6 - 2) = 20$ . So the answer is  $20$ .
24. The first rule handles the first hour. After  $1$  hour, add  $\$2$  for each extra hour.
25. The  $5$ -lb package is included in the first rule, while  $8$  lb is over  $5$  lb and uses the second rule.
26. The price depends on which time category applies, so a two-rule piecewise model fits the situation.
27. The flat fee covers the first  $1000$  gallons. After that, only the extra gallons are charged at  $\$0.03$  each.



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