Piecewise Functions

Name: _____	Date: _____	Score: _____ / 27

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.

1. $f(x)=\begin{cases}2x+1, & x<0\\ x^2, & x\geq 0\end{cases}$; $f(-3)$ _____

2. $f(x)=\begin{cases}2x+1, & x<0\\ x^2, & x\geq 0\end{cases}$; $f(0)$ _____

3. $f(x)=\begin{cases}2x+1, & x<0\\ x^2, & x\geq 0\end{cases}$; $f(4)$ _____

4. $g(x)=\begin{cases}x+5, & x<2\\ 3x, & x\geq 2\end{cases}$; $g(1)$ _____

5. $g(x)=\begin{cases}x+5, & x<2\\ 3x, & x\geq 2\end{cases}$; $g(2)$ _____

6. $g(x)=\begin{cases}x+5, & x<2\\ 3x, & x\geq 2\end{cases}$; $g(5)$ _____

7. $h(x)=\begin{cases}-4, & x<-1\\ 2x+1, & -1\leq x<3\\ 9, & x\geq 3\end{cases}$; $h(-2)$ _____

8. $h(x)=\begin{cases}-4, & x<-1\\ 2x+1, & -1\leq x<3\\ 9, & x\geq 3\end{cases}$; $h(-1)$ _____

9. $h(x)=\begin{cases}-4, & x<-1\\ 2x+1, & -1\leq x<3\\ 9, & x\geq 3\end{cases}$; $h(3)$ _____

10. Open point $(4,7)$, closed point $(4,2)$; $f(4)$ _____

11. Open point $(-2,1)$, closed point $(-2,5)$; $f(-2)$ _____

12. Graph has $f(x)=x+1$ for $x<3$, $f(x)=6$ for $x\geq 3$; $f(3)$ _____

13. $S(w)=\begin{cases}6, & 0<w\leq 2\\ 6+1.5(w-2), & w>2\end{cases}$; $S(2)$ _____

14. $S(w)=\begin{cases}6, & 0<w\leq 2\\ 6+1.5(w-2), & w>2\end{cases}$; $S(5)$ _____

15. $A(a)=\begin{cases}9, & a<13\\ 15, & 13\leq a<60\\ 11, & a\geq 60\end{cases}$; $A(13)$ _____

16. $A(a)=\begin{cases}9, & a<13\\ 15, & 13\leq a<60\\ 11, & a\geq 60\end{cases}$; $A(62)$ _____

17. $P(n)=\begin{cases}12n, & n<10\\ 10n, & n\geq 10\end{cases}$; $P(9)$ _____

18. $P(n)=\begin{cases}12n, & n<10\\ 10n, & n\geq 10\end{cases}$; $P(10)$ _____

19. $C(t)=\begin{cases}25, & 0\leq t\leq 500\\ 25+0.05(t-500), & t>500\end{cases}$; $C(500)$ _____

20. $C(t)=\begin{cases}25, & 0\leq t\leq 500\\ 25+0.05(t-500), & t>500\end{cases}$; $C(620)$ _____

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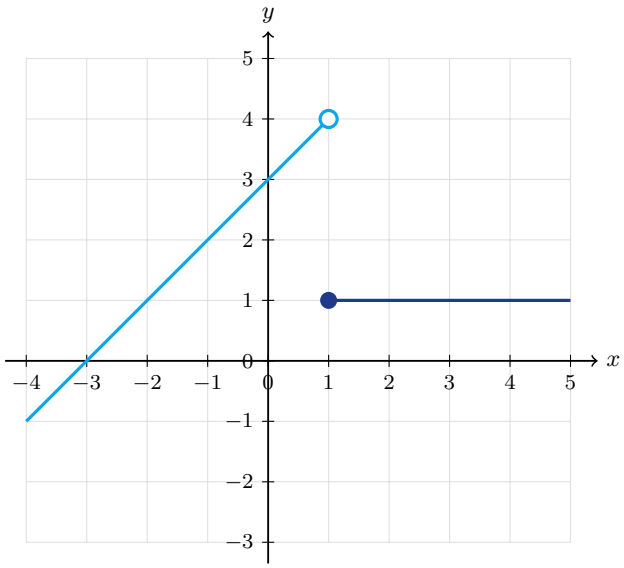
VISUAL PRACTICE

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

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



Answer: _____

22. Use the piecewise 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. _____

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Answer Keys

1. $\boxed{-5}$
2. $\boxed{0}$
3. $\boxed{16}$
4. $\boxed{6}$
5. $\boxed{6}$
6. $\boxed{15}$
7. $\boxed{-4}$
8. $\boxed{-1}$
9. $\boxed{9}$
10. $\boxed{2}$
11. $\boxed{5}$
12. $\boxed{6}$
13. $\boxed{6}$
14. $\boxed{10.5}$
15. $\boxed{15}$
16. $\boxed{11}$
17. $\boxed{108}$
18. $\boxed{100}$
19. $\boxed{25}$
20. $\boxed{31}$
21. $\boxed{1}$
22. $\boxed{10}$
23. $\boxed{20}$
24. $\boxed{C(h) = \begin{cases} 4, & 0 < h \le 1 \\ 4 + 2(h-1), & h > 1 \end{cases}}$
25. $\boxed{\$6;\ \$10}$
26. $\boxed{P = \begin{cases} 12, & \text{before event day} \\ 18, & \text{event day} \end{cases}}$
27. $\boxed{C(g) = \begin{cases} 20, & 0 \le g \le 1000 \\ 20 + 0.03(g - 1000), & g > 1000 \end{cases}}$

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 $x \ge 0$, 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 $4 \ge 0$, 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 $x \ge 2$, 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 $5 \ge 2$, 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 $62 \ge 60$, 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 $x \ge 3$, 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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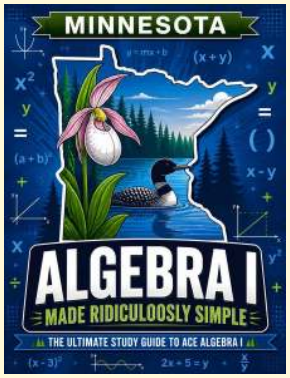

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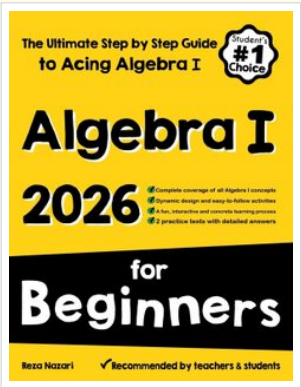

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