Inverse Functions

Name: _____	Date: _____	Score: _____ / 26

Quick Review

The **inverse function** f^{-1} "undoes" f: if $f(a) = b$, then $f^{-1}(b) = a$. Algebraically, to find f^{-1}: **(1)** replace $f(x)$ with y, **(2)** swap x and y, **(3)** solve for y. The result is $f^{-1}(x)$. To **verify** that two functions are inverses, check that $f(f^{-1}(x)) = x$ *and* $f^{-1}(f(x)) = x$. **Graphically**, f^{-1} is the reflection of f across the line $y = x$. (Points swap: (a, b) on f becomes (b, a) on f^{-1}.) A function has an inverse *function* only if it's one-to-one — linear functions with nonzero slope always do.

PRACTICE

Find the inverse, verify, or solve.

1. $f(x) = 3x + 2;\ f^{-1}$ _____
2. $f(x) = \frac{x}{5} - 1;\ f^{-1}$ _____
3. $f(x) = 7x;\ f^{-1}$ _____
4. $f(x) = -2x + 9;\ f^{-1}$ _____
5. $f(x) = x + 10;\ f(x) = 25,\ x = ?$ _____
6. $f(x) = 5x - 3;\ f(x) = 22,\ x = ?$ _____
7. $f(x) = \frac{x-4}{3};\ f^{-1}$ _____
8. $f(x) = 8 - x;\ f^{-1}$ _____
9. $f(x) = 6x + 1;$ verify $f(f^{-1}(x)) = x$ _____
10. $f(x) = \frac{x}{2} + 7;\ f(x) = 10,\ x = ?$ _____
11. $f(x) = 2x;\ f^{-1}$ _____
12. $f(x) = x - 5;\ f^{-1}$ _____
13. $f(x) = 3x + 12;\ f^{-1}(15)$ _____
14. $f(x) = -x;\ f^{-1}$ _____
15. $f(x) = x^3;\ f^{-1}$ _____
16. $f(x) = \sqrt{x};\ f^{-1}\ (x \geq 0)$ _____
17. $f(x) = 2x + 8;\ f^{-1}(0)$ _____
18. f^{-1} of $(2, 7)$ on f _____
19. $f(x) = \frac{x+1}{2};\ f^{-1}$ _____
20. $f(x) = 10x - 3;\ f^{-1}(7)$ _____

VISUAL PRACTICE

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

21. The table shows f. Find $f^{-1}(5)$.

x	1	2	3
$f(x)$	3	5	9

Answer: _____

22. The table shows f. Find $f^{-1}(9)$.

x	-1	0	4
$f(x)$	2	6	9

Answer: _____

Word Problems

23. The formula $F = \frac{9}{5}C + 32$ converts Celsius to Fahrenheit. Find the inverse function, then use it to convert $212°$F back to Celsius. _____

24. A taxi fare is modeled by $f(d) = 2.50d + 3.00$, where d is the number of miles traveled. If a rider paid $\$15.50$, use the inverse idea to find the distance traveled. _____

25. A coffee shop's revenue function is $R(p) = 20p - 100$ dollars when selling at price p per cup. What price yields $500 revenue?

_____

26. The function $w(h) = 2.2h$ converts kilograms to pounds. Find the inverse and convert 176 lbs. _____

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Answer Keys

1. $\boxed{\frac{x-2}{3}}$
2. $\boxed{5(x+1)}$
3. $\boxed{\frac{x}{7}}$
4. $\boxed{\frac{9-x}{2}}$
5. $\boxed{x=15}$
6. $\boxed{x=5}$
7. $\boxed{3x+4}$
8. $\boxed{8-x}$
9. $\boxed{\text{yes}}$
10. $\boxed{x=6}$
11. $\boxed{\frac{x}{2}}$
12. $\boxed{x+5}$
13. $\boxed{1}$
14. $\boxed{-x}$
15. $\boxed{\sqrt[3]{x}}$
16. $\boxed{x^2}$
17. $\boxed{-4}$
18. $\boxed{(7,2)}$
19. $\boxed{2x-1}$
20. $\boxed{1}$
21. $\boxed{2}$
22. $\boxed{4}$
23. $\boxed{C=\frac{5}{9}(F-32);\ 100°\text{C}}$
24. $\boxed{d=5}$
25. $\boxed{p=\$30}$
26. $\boxed{h=80\text{ kg}}$

Step-by-Step Tutor Notes

1. Read the table by matching the correct row and column first, then use the count or total that fits the question. $y=3x+2 \Rightarrow x=3y+2 \Rightarrow y=\frac{x-2}{3}$. This gives $\frac{x-2}{3}$.
2. $y=\frac{x}{5}-1 \Rightarrow x=\frac{y}{5}-1 \Rightarrow x+1=\frac{y}{5} \Rightarrow y=5(x+1)$.
3. This is a good place to slow down, check the notation, and simplify cleanly. Multiplication by 7 is undone by division by 7. So the answer is $\frac{x}{7}$.
4. For a table question, slow down and locate the exact row, column, or cell before calculating. $y=-2x+9 \Rightarrow x=-2y+9 \Rightarrow 2y=9-x \Rightarrow y=\frac{9-x}{2}$. This gives $\frac{9-x}{2}$.
5. Use the labels on the display first; they tell you which count or total belongs in the answer. $x+10=25 \Rightarrow x=15$. (Same as $f^{-1}(25)=15$.). This gives $x=15$.
6. Read the table by matching the correct row and column first, then use the count or total that fits the question. $5x-3=22 \Rightarrow 5x=25 \Rightarrow x=5$. This gives $x=5$.
7. Read the table by matching the correct row and column first, then use the count or total that fits the question. $y=\frac{x-4}{3} \Rightarrow x=\frac{y-4}{3} \Rightarrow 3x=y-4 \Rightarrow y=3x+4$. This gives $3x+4$.
8. Read the table by matching the correct row and column first, then use the count or total that fits the question. $y=8-x \Rightarrow x=8-y \Rightarrow y=8-x$. (Self-inverse!). This gives $8-x$.
9. $f^{-1}(x)=\frac{x-1}{6}$. Then $f(f^{-1}(x))=6\cdot\frac{x-1}{6}+1=x-1+1=x$. ✓.
10. Use the labels on the display first; they tell you which count or total belongs in the answer. $\frac{x}{2}+7=10 \Rightarrow \frac{x}{2}=3 \Rightarrow x=6$. This gives $x=6$.
11. This is a good place to slow down, check the notation, and simplify cleanly. Doubling is undone by halving. So the answer is $\frac{x}{2}$.
12. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Subtracting 5 is undone by adding 5. After simplifying, the answer is $x+5$.
13. Read the table by matching the correct row and column first, then use the count or total that fits the question. Solve $f(x)=15$: $3x+12=15 \Rightarrow x=1$. So $f^{-1}(15)=1$. This gives 1.
14. Use the clue in the question first, then let the arithmetic finish the job. Negating is self-inverse: $-(-x)=x$. So the answer is $-x$.
15. Start with the definition the problem is testing, then apply it directly. Cubing is undone by taking cube root. So the answer is $\sqrt[3]{x}$.
16. Focus on the main idea of the problem, then simplify carefully. Square root is undone by squaring (with the domain restriction $x \geq 0$ for both functions). So the answer is x^2.
17. Focus on the main idea of the problem, then simplify carefully. Solve $2x+8=0$: $x=-4$. So the answer is -4.
18. Start with the definition the problem is testing, then apply it directly. Inverse swaps coordinates: $(2,7) \to (7,2)$. So the answer is $(7,2)$.
19. Use the labels on the display first; they tell you which count or total belongs in the answer. $y=\frac{x+1}{2} \Rightarrow x=\frac{y+1}{2} \Rightarrow 2x=y+1 \Rightarrow y=2x-1$. This gives $2x-1$.
20. Use the labels on the display first; they tell you which count or total belongs in the answer. Solve $10x-3=7$: $10x=10 \Rightarrow x=1$. This gives 1.
21. $f^{-1}(5)$ asks which input gives output 5. The table shows that input is 2.
22. Use the clue in the question first, then let the arithmetic finish the job. $f^{-1}(9)$ asks which input gives output 9. That input is 4. So the answer is 4.
23. Solve for C: subtract 32, then multiply by $\frac{5}{9}$: $C=\frac{5}{9}(F-32)$. At $F=212$: $\frac{5}{9}(180)=100°\text{C}$. (Water's boiling point in both scales.).
24. Solve $2.50d+3.00=15.50$: $2.50d=12.50$, so $d=5$ miles. (Or compute $f^{-1}(15.50)$.).
25. For a table question, slow down and locate the exact row, column, or cell before calculating. $20p-100=500 \Rightarrow 20p=600 \Rightarrow p=30$ dollars per cup. This gives $p=\$30$.
26. Name the quantities first so the model is easy to read. Inverse: $h=\frac{w}{2.2}$. At $w=176$: $h=\frac{176}{2.2}=80$ kg.

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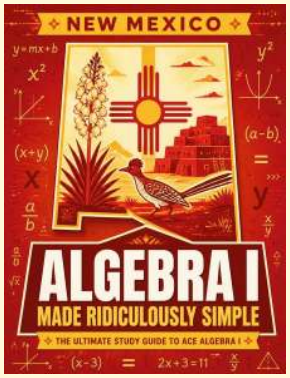

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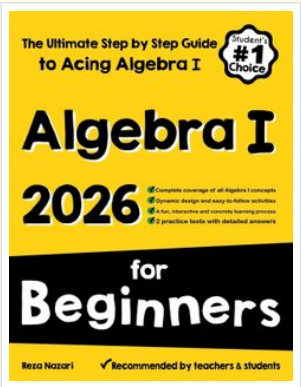

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