

# Graphing Cube Root Functions

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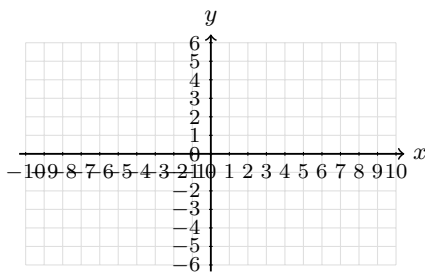
## Quick Review

A **cube root function** is built from  $f(x) = \sqrt[3]{x}$ . Unlike a square root, a cube root can use negative inputs, so the domain and range of the parent function are both all real numbers. For  $g(x) = a\sqrt[3]{x-h} + k$ , the key center point is  $(h, k)$ . Use perfect cubes such as  $-8, -1, 0, 1, 8$  to make a table. Cube-root graphs flatten near the center and keep moving left and right.

## PRACTICE

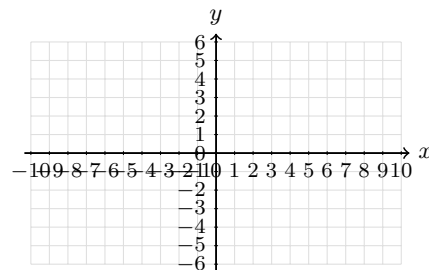
Graph each cube-root function or use the graph/table to answer.

1. Graph  $y = \sqrt[3]{x}$ . Plot the center point and the perfect-cube points.



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

2. Graph  $y = \sqrt[3]{x-1}$ . Mark the center point clearly.



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

3. Graph  $y = \sqrt[3]{x+2}$ . Use a table of perfect-cube steps.



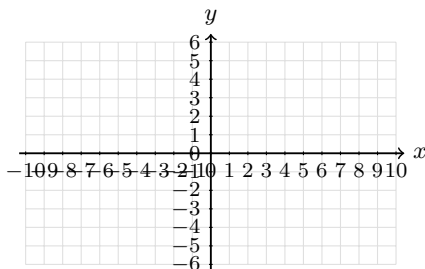
Answer: \_\_\_\_\_

4. Graph  $y = \sqrt[3]{x} + 2$ . Show the vertical shift.



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

5. Graph  $y = -\sqrt[3]{x}$ . Make the reflected shape clear.



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

6. Graph  $y = 2\sqrt[3]{x}$ . Use the parent graph points and stretch the outputs.



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



7. Graph  $y = \sqrt[3]{x-2} - 1$ . Label the center point.



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

8. Graph  $y = -\sqrt[3]{x+1} + 3$ . Show the shift and reflection.



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

9. Complete the table for  $y = \sqrt[3]{x-2} + 1$ , then graph the points.

$x$	-6	1	2	3	10
$y$					



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

10. Complete the table for  $y = 3 - \sqrt[3]{x+2}$ , then graph the curve.

$x$	-10	-3	-2	-1	6
$y$					



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

11. Complete the table for  $y = 2\sqrt[3]{x} - 1$ , then graph it.

$x$	-8	-1	0	1	8
$y$					



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

12. Complete the table for  $y = -2\sqrt[3]{x-1} + 2$ , then graph it.

$x$	-7	0	1	2	9
$y$					



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



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13. Use the graph. What is the center point, and how was the parent graph shifted?



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

14. Use the graph. Is the function increasing or decreasing? What is its center point?



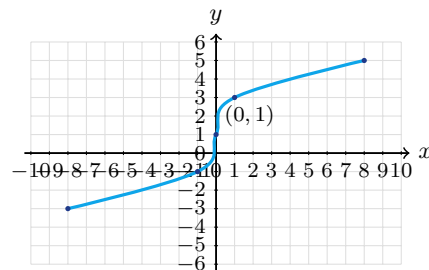
Answer: \_\_\_\_\_

15. Which equation matches the graph:  $y = \sqrt[3]{x+2} - 1$  or  $y = \sqrt[3]{x-2} - 1$ ?



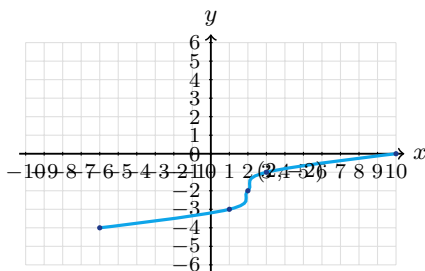
Answer: \_\_\_\_\_

16. Use the graph to find  $a$  in  $y = a\sqrt[3]{x} + 1$ .



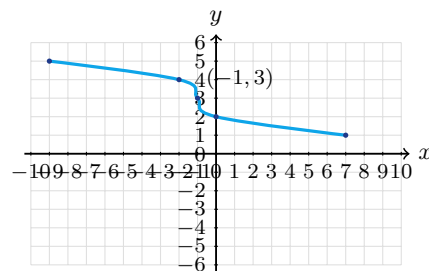
Answer: \_\_\_\_\_

17. Use the graph to write a possible equation.



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

18. Use the graph to write a possible equation.



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



19. A cube-root graph has center  $(-2, 1)$  and is vertically stretched by 2. Write an equation, then sketch it.



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

20. A cube-root graph has center  $(3, -2)$  and passes through  $(4, 0)$ . Write a possible equation, then sketch it.



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

◆ Word Problems

21. A cube has volume 216 cubic inches. Use a cube root to find the edge length.

\_\_\_\_\_

22. A storage cube has volume  $V$  cubic feet. Write a function for its side length and find the side length when  $V = 64$ .

\_\_\_\_\_

23. A model cube's volume changes from  $27 \text{ cm}^3$  to  $125 \text{ cm}^3$ . How much did the edge length change?

\_\_\_\_\_

24. The function  $r(V) = \sqrt[3]{\frac{3V}{4\pi}}$  gives the radius of a sphere from its volume. What happens to the radius when the volume becomes 8 times as large?

\_\_\_\_\_



## Answer Keys

1.  $(-8, -2), (0, 0)$   
 $(8, 2)$

2.  $(-7, -2), (1, 0)$   
 $(9, 2)$

3.  $(-10, -2), (-2, 0)$   
 $(6, 2)$

4.  $(-8, 0), (0, 2)$   
 $(8, 4)$

5.  $(-8, 2), (0, 0)$   
 $(8, -2)$

6.  $(-8, -4), (0, 0)$   
 $(8, 4)$

7.  $(-6, -3), (2, -1)$   
 $(10, 1)$

8.  $(-9, 5), (-1, 3)$   
 $(7, 1)$

9.  $(-6, -1), (2, 1)$   
 $(10, 3)$

10.  $(-10, 5), (-2, 3)$   
 $(6, 1)$

11.  $(-8, -5), (0, -1)$   
 $(8, 3)$

12.  $(-7, 6), (1, 2)$   
 $(9, -2)$

13.  $(1, 2)$ ; right 1, up 2

14. decreasing;  $(0, 1)$

15.  $y = \sqrt[3]{x+2} - 1$

16.  $a = 2$

17.  $y = \sqrt[3]{x-2} - 2$

18.  $y = -\sqrt[3]{x+1} + 3$

19.  $y = 2\sqrt[3]{x+2} + 1$

20.  $y = 2\sqrt[3]{x-3} - 2$

21. 6 in

22.  $s(V) = \sqrt[3]{V}$ ; 4 ft

23. 2 cm

24. the radius doubles

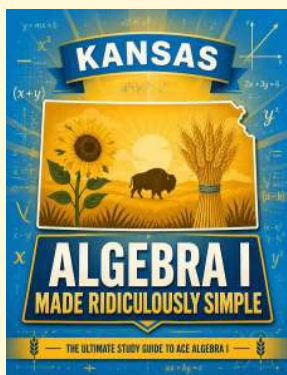
### Step-by-Step Tutor Notes

1. Use inputs  $-8, -1, 0, 1, 8$  because their cube roots are  $-2, -1, 0, 1, 2$ .
2. The expression  $x - 1$  shifts the parent graph right 1, so the center point is  $(1, 0)$ .
3. Writing  $x + 2$  as  $x - (-2)$  shows a shift left 2, so the center is  $(-2, 0)$ .
4. Work one inverse operation at a time and keep both sides balanced. Adding 2 outside the cube root moves each parent-graph point up 2 units. After simplifying, the answer is  $(-8, 0), (0, 2)$   
 $(8, 4)$ .
5. The negative sign changes every output to its opposite, creating a reflection over the  $x$ -axis.
6. Use the clue in the question first, then let the arithmetic finish the job. The coefficient 2 doubles every  $y$ -value from the parent cube-root graph. So the answer is  $(-8, -4), (0, 0)$   
 $(8, 4)$ .
7. The center point is  $(2, -1)$ . From there, use horizontal changes  $-8, -1, 0, 1, 8$ .
8. The center point is  $(-1, 3)$ . The negative sign makes the graph decrease from left to right.
9. These inputs make the radicand  $-8, -1, 0, 1, 8$ , so the cube roots are easy to plot.
10. Move carefully through the arithmetic; one clean operation usually unlocks the next one. The radicands are  $-8, -1, 0, 1, 8$ . Subtract each cube root from 3. After simplifying, the answer is  $(-10, 5), (-2, 3)$   
 $(6, 1)$ .
11. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Find the cube root first, multiply by 2, then subtract 1. After simplifying, the answer is  $(-8, -5), (0, -1)$   
 $(8, 3)$ .
12. The center is  $(1, 2)$ . The coefficient  $-2$  reflects the graph and doubles the vertical changes.
13. The middle point of the cube-root shape is  $(1, 2)$ , so the parent graph moved right 1 and up 2.
14. The graph falls as  $x$  increases, and its center point is the labeled middle point  $(0, 1)$ .
15. Focus on the main idea of the problem, then simplify carefully. The center point is  $(-2, -1)$ , so the inside must be  $x + 2$ . So the answer is  $y = \sqrt[3]{x+2} - 1$ .
16. From the center  $(0, 1)$  to  $(1, 3)$ , a 1-unit cube-root output became a 2-unit rise.
17. The center point is  $(2, -2)$  and the graph uses the parent scale, so shift right 2 and down 2.
18. The center point is  $(-1, 3)$ , and the graph decreases, so the cube root has a negative coefficient.
19. The center gives  $x + 2$  and  $+1$ . A vertical stretch by 2 puts the coefficient 2 outside.
20. From the center to  $(4, 0)$ , the cube-root input changes by 1 and the output rises 2, so the coefficient is 2.
21. Set up the model from the story, then calculate carefully. Volume is  $s^3 = 216$ . Taking the cube root gives  $s = 6$  inches.
22. The edge length is the cube root of the volume. Since  $4^3 = 64$ , the side length is 4 ft.
23. The original edge is  $\sqrt[3]{27} = 3$  cm and the new edge is  $\sqrt[3]{125} = 5$  cm, so it increased by 2 cm.
24. Cube root functions turn an 8-times volume change into a 2-times radius change because  $\sqrt[3]{8} = 2$ .



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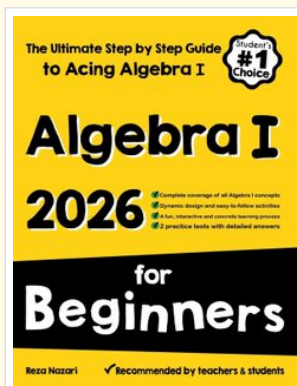
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