

Roots and Equation Solutions



Grade 8 | NC.8.EE.2

Teacher scripts, original models and student organizers
30 multiple-choice + 30 open/performance tasks
Worked keys and individual evidence records

Current NC standards for 2026-27 and 2027-28. Select tasks across several sessions. This resource bank is not one test.

Free sample | Contents

NC.8.EE.2 | Eighth Grade mathematics

This sample contains 20 complete selected pages from the 93-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-16, 31-32, 61, 76

Representative activities

M01: sample PDF page(s) 17; original page(s) 16

M02: sample PDF page(s) 17; original page(s) 16

O01: sample PDF page(s) 18; original page(s) 31

O02: sample PDF page(s) 19; original page(s) 32

Selected teacher prompts and keys: original page(s) 61, 76

Using this sample

Read the preparation and access guidance before using a selected activity.
Keep teacher keys and private preparation pages separate from student copies.
Use the original resource contents to see the scope of the complete packet.

Complete paid download

The complete resource includes the full PDF task bank and teaching materials.

TEACHER GUIDE

Exact standard and scope

Use square root and cube root symbols to:

- Represent solutions to equations of the form $x^2 = p$ and $x^3 = p$, where p is a positive rational number.
- Evaluate square roots of perfect squares and cube roots of perfect cubes for positive numbers less than or equal to 400.

Domain: EXPRESSIONS AND EQUATIONS

Cluster: Work with radicals and integer exponents.

Current NC wording and numerical limits are retained. Adopted 2026 revisions beginning in 2028-29 are not substituted.

TEACHER GUIDE

Targets and evidence

Square: Evaluate a principal square root of a perfect square.

Evidence: M12, M17, M22, M23, M26, O08, O15, O23, O25, O28

Cube: Evaluate the cube root of a positive perfect cube.

Evidence: M11, M13, M16, M18, M24, O01, O13, O16, O18, O27

Squareeq: Represent all real solutions of a square equation.

Evidence: M01, M07, M10, M21, M25, O03, O07, O19, O21, O30

Cubeeq: Represent the real solution of a cube equation.

Evidence: M02, M14, M15, M19, M20, O02, O04, O06, O09, O14

Fraction: Represent and evaluate equation solutions for positive rational p.

Evidence: M03, M04, M05, M06, M08, O12, O20, O22, O26, O29

Context: Solve a square equation and interpret a positive length.

Evidence: M09, M27, M28, M29, M30, O05, O10, O11, O17, O24

MP2: connect quantities and symbols. MP3: justify claims. MP6: attend to signs, notation and precision. Open tasks collect actual reasoning, calculations and representations.

TEACHER GUIDE

Plan and navigation

Use four sessions of about 25-35 minutes: warm-up/model; shared/partner work; independent work; reteach/exit. Select one M and one O item per section first, using targets to match prior learning. The remaining bank supports later practice and conferences, not a single 60-item test.

Warm-up: M01-M04 and O01-O04

I Do: M05-M08 and O05-O08

We Do: M09-M13 and O09-O13

Collaborative practice: M14-M18 and O14-O18

Independent practice: M19-M23 and O19-O23

Small-group reteach: M24-M27 and O24-O27

Exit ticket: M28-M30 and O28-O30

Contents: standard/targets; planning/access; worked model; anchor/organizer; seven scripts; 15 choice pages; 30 open pages; worked keys; rubric; evidence record; sources. Print only selected student pages. Keep teacher examples and keys separate.

TEACHER GUIDE

Preparation and access

Prerequisites: multiplication, square/cube values, fractions and equations. Check these separately before teaching the selected target.

Materials: pencil, ruler and supplied blank organizers. For approximation, a calculator may check a bound after the learner records the reasoning; it is not a substitute for explaining the bound. No special manipulatives are needed.

Access: neutral read-aloud, enlargement, high contrast, AAC/signing and dictated explanations. A scribe records student-directed steps exactly. Do not score handwriting, decoding or accent. Record calculator use and other access supports separately.

Answer-supplying cues include classifying the decimal for a learner, supplying a property, giving the rounding direction, or naming the missing equation solution. Preserve the first response and record later supported responses separately.

Differentiate by first using small perfect powers, simple fractions and explicit factors. Then change the representation or ask for a counterexample. Do not replace a required construction, calculation or justification with recognition.

N/O means unobserved, inaccessible or insufficient evidence. Zero is for observed interpretable incorrect work. These instructional ratings are not official mastery cutoffs. All instructional contexts and numerical data are invented.

WORKED TEACHER MODEL

Think aloud and connect

Say: " $\sqrt{49} = 7$ names the nonnegative principal root. But solving $x^2 = 49$ gives $x = \pm\sqrt{49} = \pm 7$, because both 7^2 and $(-7)^2$ equal 49. For $x^3 = 27$, the only real solution is $x = \sqrt[3]{27} = 3$; $(-3)^3$ is -27. For $x^2 = 9/16$, $x = \pm\sqrt{9/16} = \pm 3/4$. For $x^3 = 8/125$, $x = \sqrt[3]{8/125} = 2/5$. In a square-area situation, a side length must be positive even though the associated square equation has two real solutions. This standard uses positive rational p and evaluates positive perfect squares/cubes no greater than 400."

Teacher prompt: Which definition or inverse operation verifies each step?

TEACHER GUIDE

Anchor: definitions and checks

$\sqrt{p}$ is the nonnegative principal square root. For $p > 0$, $x^2 = p$ has two real solutions $x = \pm\sqrt{p}$.

$\sqrt[3]{p}$ is the real cube root. For positive p , $x^3 = p$ has one real solution $x = \sqrt[3]{p}$.

Evaluation bank: positive perfect squares and perfect cubes with radicands ≤ 400 .
Equation bank: p is positive rational, including fractions.

A contextual length is positive. Distinguish the complete solution set of an equation from the value allowed by a context. Negative cube roots are discussed in NS.2, not required by the positive- p limit of this standard.

Ask the learner to supply the mathematical decision. Read symbols neutrally and distinguish exact values from estimates.

REPRODUCIBLE STUDENT TOOL

Reasoning organizer

Name: _____ Date: _____ Item: _____

Given information / requested decision or value**Representation / definitions / equivalent steps****Answer / precision / all solutions when requested****Check / why the conclusion follows**

TEACHER GUIDE

Warm-up teaching script

Start with M01 and O01; save the rest through 04 for later. Target: Evaluate the cube root of a positive perfect cube.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O01. Teacher solution: $3^3 = 27$, so $\sqrt[3]{27} = 3$. Cubing is one-to-one on real numbers, so this cube root has one real value.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

I Do teaching script

Start with M05 and O05; save the rest through 08 for later. Target: Solve a square equation and interpret a positive length.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Read the worked teacher model aloud, pausing after each equality or bound. Ask the learner to name what makes the next step valid. Keep this example separate from the student response.

Probe the selected task | 3-5 minutes

Use O05. Teacher solution: Let s be the side length. $s^2 = 9$, so the equation has solutions ± 3 , but a length is positive. Therefore $s = \sqrt{9} = 3$ centimeters. Check $3 \times 3 = 9$ square centimeters.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

We Do teaching script

Start with M09 and O09; save the rest through 13 for later. Target: Represent the real solution of a cube equation.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O09. Teacher solution: Cubing $\sqrt[3]{15}$ gives 15. Its negative cubes to -15, not 15. Thus the unique real solution is $x = \sqrt[3]{15}$.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Collaborative practice teaching script

Start with M14 and O14; save the rest through 18 for later. Target: Represent the real solution of a cube equation.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O14. Teacher solution: Cubing $\sqrt[3]{10}$ gives 10. Its negative cubes to -10, not 10. Thus the unique real solution is $x = \sqrt[3]{10}$.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Independent practice teaching script

Start with M19 and O19; save the rest through 23 for later. Target: Represent all real solutions of a square equation.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O19. Teacher solution: Both $\sqrt{10}$ and $-\sqrt{10}$ square to 10. Thus $x = \pm\sqrt{10}$; $\sqrt{10}$ alone denotes only the principal root.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Small-group reteach teaching script

Start with M24 and O24; save the rest through 27 for later. Target: Solve a square equation and interpret a positive length.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O24. Teacher solution: Let s be the side length. $s^2 = 81$, so the equation has solutions ± 9 , but a length is positive. Therefore $s = \sqrt{81} = 9$ centimeters. Check $9 \times 9 = 81$ square centimeters.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

TEACHER GUIDE

Exit ticket teaching script

Start with M28 and O28; save the rest through 30 for later. Target: Evaluate a principal square root of a perfect square.

Launch | 2 minutes

Say: "What is known exactly, and what are you asked to determine? Restate the question before calculating." Read symbols neutrally. Do not identify the correct classification, property or sign.

Teach or elicit | 5-7 minutes

Say: "Show a definition, equivalent expression or power check that supports your answer." During shared practice invite individual steps; during independent and exit work collect first responses without supplying a method.

Probe the selected task | 3-5 minutes

Use O28. Teacher solution: $9^2 = 81$, so $\sqrt{81} = 9$. The square-root symbol denotes the nonnegative principal root; it does not mean both signs.

Respond | 3-5 minutes

If a learner relies only on a display or remembered rule, return to the relevant anchor. Use a different small example, then retry a fresh bank item. Record any supplied classification, property, sign or bound as a cue, not neutral access.

Close | 2 minutes

Each partner first records a solution independently, then compares the reasoning. Early finishers change one value or condition and test whether the method still works. Record the first response, access supports, cues, and a next step. Exit evidence guides later teaching; no speed threshold applies.

STUDENT CHOICE

Choice practice 1-2

M01 | Give all real solutions of $x^2 = 2$ using root symbols.

- A. $x = \pm 2$
- B. $x = -\sqrt{2}$ only
- C. $x = \pm\sqrt{2}$
- D. $x = \sqrt{2}$ only

Reasoning notes: _____

M02 | Give all real solutions of $x^3 = 5$ using root symbols.

- A. $x = \sqrt[3]{5}$
- B. $x = \pm\sqrt[3]{5}$
- C. $x = -\sqrt[3]{5}$
- D. $x = 5/3$

Reasoning notes: _____

STUDENT PERFORMANCE

001 | Warm-up

Target: Evaluate the cube root of a positive perfect cube.

Evaluate $\sqrt[3]{27}$. Write an exact value and a power equation that verifies it. Explain how the root index determines the checking operation.

Definitions / equations / calculations / requested diagram

Answer / justification / check

STUDENT PERFORMANCE

002 | Warm-up

Target: Represent the real solution of a cube equation.

Give all real solutions of $x^3 = 3$ using root symbols. Give all real solutions and verify them by the corresponding power. Explain why the square and cube cases differ in number of real solutions.

Definitions / equations / calculations / requested diagram

Answer / justification / check

TEACHER ONLY

M worked keys 1-2

M01: C. $x = \pm\sqrt{2}$

Target: Represent all real solutions of a square equation.

Both $\sqrt{2}$ and $-\sqrt{2}$ square to 2. Thus $x = \pm\sqrt{2}$; $\sqrt{2}$ alone denotes only the principal root.

Option checks: $x = \pm 2$: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. $x = -\sqrt{2}$ only: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. $x = \sqrt{2}$ only: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value.

M02: A. $x = \sqrt[3]{5}$

Target: Represent the real solution of a cube equation.

Cubing $\sqrt[3]{5}$ gives 5. Its negative cubes to -5, not 5. Thus the unique real solution is $x = \sqrt[3]{5}$.

Option checks: $x = \pm\sqrt[3]{5}$: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. $x = -\sqrt[3]{5}$: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value. $x = 5/3$: This does not match the classification, sign set or contextual restriction justified above. Test its stated claim against the exact definition or substitute its proposed value.

TEACHER ONLY

O worked keys 1-2

001: 3

Target: Evaluate the cube root of a positive perfect cube.

$3^3 = 27$, so $\sqrt[3]{27} = 3$. Cubing is one-to-one on real numbers, so this cube root has one real value.

Accept equivalent exact forms and valid explanations. Assess the requested process as well as the final result. A final number or label alone is incomplete when justification is requested.

002: $x = \sqrt[3]{3}$

Target: Represent the real solution of a cube equation.

Cubing $\sqrt[3]{3}$ gives 3. Its negative cubes to -3, not 3. Thus the unique real solution is $x = \sqrt[3]{3}$.

Accept equivalent exact forms and valid explanations. Assess the requested process as well as the final result. A final number or label alone is incomplete when justification is requested.