

TEACHER AND STUDENT RESOURCE

Equivalent Radicals and Rational Powers



NC Math 2 • NC.M2.N-RN.2

The Real Number System

Seven instructional sections with 30 multiple-choice and 30 open or performance tasks, teaching scripts, original mathematical visuals, generous workspaces, and worked keys.

Free sample | Contents

NC.M2.N-RN.2 | NC Math 2 mathematics

This sample contains 22 complete selected pages from the 123-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-16, 31-32, 61-62, 91-92

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) 61-62, 91-92

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.

ALIGNMENT

Standard and learning targets

Rewrite expressions with radicals and rational exponents into equivalent expressions using the properties of exponents.

T1 Simplify radical products, sums, and quotients without changing their values.

T2 Apply exponent laws to rational exponents.

T3 State domain restrictions and identify invalid radical rules.

Each item names its own target. The bank supports multiple sessions; do not assign all 60 tasks in one sitting.

NAVIGATION

Choose evidence deliberately

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

T1: M01, O01, M02, O02, M05, O05, M07, O07, M11, O11, M12, O12, M17, O17, M19, O19, M22, O22, M24, O24, M27, O27, M30, O30

T2: M03, O03, M04, O04, M09, O09, M10, O10, M13, O13, M14, O14, M18, O18, M20, O20, M23, O23, M25, O25, M28, O28

T3: M06, O06, M08, O08, M15, O15, M16, O16, M21, O21, M26, O26, M29, O29

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Identify and represent

Learning target: Simplify radical products, sums, and quotients without changing their values.

Learning target: Apply exponent laws to rational exponents.

Use Warm-up, I Do, and early We Do tasks. Ask for a first response before showing the model.

Session 2 Explain and connect

Learning target: Apply exponent laws to rational exponents.

Learning target: State domain restrictions and identify invalid radical rules.

Use We Do and collaborative tasks. Compare approaches and justify each step with the original conditions.

Session 3 Transfer independently

Learning target: Simplify radical products, sums, and quotients without changing their values.

Learning target: Apply exponent laws to rational exponents.

Learning target: State domain restrictions and identify invalid radical rules.

Select independent items spanning the targets, reteach an evidenced gap, and use an unrehearsed exit item.

PLANNING

Materials, access and pacing

Materials

Pencils, erasers, straightedge, student pages, and optional graph paper. A calculator may support arithmetic after a learner states the intended relationship. No device or paid software is required.

Prerequisites

Prime and square factors, integer exponent laws, reciprocals, absolute value, and like terms.

Pacing

Use a short diagnostic warm-up, a model and shared task in one session; collaborative and independent reasoning in later sessions; then targeted reteaching and an exit task. Select two to four tasks at a time based on evidence. Each section's full bank is reusable, not mandatory in one lesson.

Neutral access

Read directions aloud without interpreting the graph, enlarge a page, supply a writing or pointing response method, and allow a learner to dictate an explanation. Keep axes, units, data and mathematical demand unchanged.

Separate instruction from evidence

Keep the learner's first response. Record answer-supplying cues separately from access supports. A completed teacher graph or worked key is for discussion after independent work, never a student construction template.

Review convention

All rational-exponent simplifications explicitly state a positive base when that condition is needed. $\sqrt{(x^2)}=|x|$ for real x . Radical-product rules here use nonnegative radicands.

TEACHER MODEL

A square factor can leave the radical

Simplify $\sqrt{72}$ and explain why $\sqrt{(36+36)}$ is not $\sqrt{36}+\sqrt{36}$.

For a product of nonnegative factors, $\sqrt{72}=\sqrt{(36 \times 2)}=6\sqrt{2}$. The sum rule is invalid: $\sqrt{(36+36)}=\sqrt{72}$, while $\sqrt{36}+\sqrt{36}=12$ and $12^2=144$, not 72. Distribution works over products here, not addition.

VISUAL ANCHOR

Structure determines the rule

The operation between expressions determines what can be combined.

Structure	Valid rule	Example
Product	$\sqrt{a}\sqrt{b} = \sqrt{ab}, a,b\geq 0$	$\sqrt{3}\sqrt{12} = 6$
Like radical terms	$c\sqrt{a} + d\sqrt{a} = (c+d)\sqrt{a}$	$2\sqrt{5} + 3\sqrt{5} = 5\sqrt{5}$
Like-base quotient	$x^p/x^q = x^{(p-q)}, x>0$	$x^{(5/3)}/x^{(2/3)} = x$
Principal square root	$\sqrt{(x^2)} = x $	$\sqrt{((-4)^2)} = 4$

A rule is justified by the mathematical structure and its restrictions. A similar-looking sum is not automatically covered by a product rule.

REUSABLE REASONING GUIDE

Represent, justify, interpret

Name: _____ Date: _____

Givens, quantities and restrictions**Representation and calculation****Justification or check****Conclusion, domain and units**

WARM-UP

Teaching script

Core: O01 • T1: Simplify radical products, sums, and quotients without changing their values.

Optional bank: M01–M04; O01–O04. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O01, including its visual when present. Ask which operation joins the radicals or powers before selecting a rule. Have learners state a perfect-square factor or common denominator aloud, then preserve their first written calculation.

Core task

Simplify $\sqrt{75}$, then square your result to check it.

Teacher solution and discussion

$\sqrt{75} = \sqrt{(25 \times 3)} = 5\sqrt{3}$. Squaring gives $(5\sqrt{3})^2 = 25 \times 3 = 75$, and the result is nonnegative.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M01 to compare all alternatives after evidence is collected.

I DO

Teaching script

Core: 005 • T1: Simplify radical products, sums, and quotients without changing their values.

Optional bank: M05–M08; O05–O08. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–12 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O05, including its visual when present. Model an equivalence chain and name the domain at the step where it matters. Show that $\sqrt{(x^2)}=|x|$ by testing a negative value, then explain when the absolute-value bars may be removed.

Core task

Simplify $\sqrt{300} + 5\sqrt{3}$. Explain why the radicands are not added.

Teacher solution and discussion

$\sqrt{300}=\sqrt{(100 \times 3)}=10\sqrt{3}$. Then $10\sqrt{3}+5\sqrt{3}=15\sqrt{3}$. These are like terms with common factor $\sqrt{3}$; addition combines coefficients, not radicands.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M05 to compare all alternatives after evidence is collected.

WE DO

Teaching script

Core: 009 • T2: Apply exponent laws to rational exponents.

Optional bank: M09–M13; O09–O13. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O09, including its visual when present. Compare two valid simplification routes. Ask the group to justify the nonzero denominator or the common radical factor rather than accepting matching final answers as a proof.

Core task

For $x > 0$, simplify $x^{(2/5)} \times x^{(3/5)}$. Explain the same result using fifth-root factors.

Teacher solution and discussion

The exponent sum is $(2+3)/5=1$, giving x . If r =the fifth root of x , the factors are r^2 and r^3 ; their product is $r^5=x$.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M09 to compare all alternatives after evidence is collected.

COLLABORATIVE PRACTICE

Teaching script

Core: O14 • T2: Apply exponent laws to rational exponents.

Optional bank: M14–M18; O14–O18. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O14, including its visual when present. Give each partner a role: propose a simplification, challenge a restriction, and verify with a test value. For constructions, require both partners to check that every stated condition is met.

Core task

Find rational p and q satisfying $x^p \cdot x^{1/3} = x^{5/4}$ and $x^q / x^{1/3} = x^{5/4}$ for all $x > 0$. Explain why the two missing exponents differ.

Teacher solution and discussion

For the product, $p + 1/3 = 5/4$, so $p = 15/12 - 4/12 = 11/12$. For the quotient, $q - 1/3 = 5/4$, so $q = 15/12 + 4/12 = 19/12$. The first removes $1/3$ from the target exponent; the second must add it before division subtracts it.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M14 to compare all alternatives after evidence is collected.

INDEPENDENT PRACTICE

Teaching script

Core: O19 • T1: Simplify radical products, sums, and quotients without changing their values.

Optional bank: M19–M23; O19–O23. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 15–20 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O19, including its visual when present. Keep original responses. Do not cue which exponent law to use. Evaluate whether a learner preserves the expression's value, domain, sign, and units at every requested step.

Core task

Rationalize $2/(\sqrt{3}+1)$. Explain why multiplying by the conjugate changes neither the value nor the sign of the denominator, then verify by multiplying your result by $\sqrt{3}+1$.

Teacher solution and discussion

Multiply by $(\sqrt{3}-1)/(\sqrt{3}-1)$, which is 1 because $\sqrt{3}-1 \neq 0$. The denominator becomes $3-1=2$, so the result is $\sqrt{3}-1$. The original denominator and the new denominator are positive. Check $(\sqrt{3}-1)(\sqrt{3}+1)=2$, matching the original numerator.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M19 to compare all alternatives after evidence is collected.

SMALL-GROUP RETEACH

Teaching script

Core: O24 • T1: Simplify radical products, sums, and quotients without changing their values.

Optional bank: M24–M27; O24–O27. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 10–15 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O24, including its visual when present. Use the first incorrect equality to identify the gap. Rebuild a single rule using small positive numbers, then contrast it with a nearby nonexample and collect a fresh calculation.

Core task

Simplify $\sqrt{180}$ by two different square-factor decompositions, one beginning with 36×5 and one with 9×20 . Explain why both must lead to the same simplified form.

Teacher solution and discussion

From 36×5 , $\sqrt{180} = 6\sqrt{5}$. From 9×20 , $\sqrt{180} = 3\sqrt{20} = 3\sqrt{(4 \times 5)} = 3 \times 2\sqrt{5} = 6\sqrt{5}$. Both start with the same nonnegative number and use equivalence-preserving factorizations; 5 has no square factor greater than 1.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M24 to compare all alternatives after evidence is collected.

EXIT TICKET

Teaching script

Core: O28 • T2: Apply exponent laws to rational exponents.

Optional bank: M28–M30; O28–O30. Select tasks across more than one meeting if needed.

Suggested discussion/work time: 5–8 minutes. Adjust for access and evidence; this is not a speed criterion.

Display student page O28, including its visual when present. Use an unrehearsed mixed expression, a general proof, or a constrained construction. Require explanations of equivalence rather than only a simplified final form.

Core task

For $x > 0$, simplify $(x^{3/4} \cdot x^{-1/2}) / x^{1/8}$. Express the answer in radical form and verify at $x=256$.

Teacher solution and discussion

The exponent is $3/4 - 1/2 - 1/8 = 6/8 - 4/8 - 1/8 = 1/8$. Thus the result is $x^{1/8}$, the positive eighth root of x . At $x=256$, the original is $(64 \times 1/16) / 2 = 2$, matching $256^{1/8} = 2$.

Evidence and response

Look for a named law that matches the operation, not a memorized visual pattern. If a learner adds radicands or drops an absolute value, test the claimed identity numerically, then gather a new response.

Closure: Ask learners to state one feature they verified and one check they used. Use the worked key for M28 to compare all alternatives after evidence is collected.

MULTIPLE-CHOICE BANK

M01 / M02 • Select and justify**M01 | Warm-up | T1****Simplify $\sqrt{8}$.**

- A. 4
- B. $2\sqrt{3}$
- C. 8
- D. $2\sqrt{2}$

Reasoning: _____

M02 | Warm-up | T1**Simplify $\sqrt{6} \times \sqrt{24}$.**

- A. 144
- B. 30
- C. 12
- D. 6

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Simplify radical products, sums, and quotients without changing their values.

Simplify $\sqrt{75}$, then square your result to check it.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T1: Simplify radical products, sums, and quotients without changing their values.

Find $\sqrt{10} \times \sqrt{40}$ in two ways: combine radicands, then simplify each factor first when possible.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01**M01 • T1: Simplify radical products, sums, and quotients without changing their values.****Answer: D. $2\sqrt{2}$**

$8=4\times 2$. Therefore $\sqrt{8}=\sqrt{4\times 2}=2\sqrt{2}$. The remaining radicand 2 has no perfect-square factor greater than 1.

Check each alternative

- A. This treats the remaining $\sqrt{2}$ as 2.
- B. The leftover radicand must be 2 after removing the square factor.
- C. This leaves the radicand unchanged rather than taking its square root.
- D. $8=4\times 2$. Therefore $\sqrt{8}=\sqrt{4\times 2}=2\sqrt{2}$. The remaining radicand 2 has no perfect-square factor greater than 1.

Evidence to assess

Assess accurate representation, a valid justification, and a conclusion consistent with the domain and units. Accept equivalent reasoning or another construction meeting every condition. An answer alone does not establish a unique misconception.

WORKED TEACHER KEYS

M02**M02 • T1: Simplify radical products, sums, and quotients without changing their values.****Answer: C. 12**

Both radicands are nonnegative, so the product is $\sqrt{(6 \times 24)} = \sqrt{144} = 12$.

Check each alternative

- A. This is the product inside the radical before taking its square root.
- B. This adds the radicands instead of multiplying their roots.
- C. Both radicands are nonnegative, so the product is $\sqrt{(6 \times 24)} = \sqrt{144} = 12$.
- D. The product is twice this value.

Evidence to assess

Assess accurate representation, a valid justification, and a conclusion consistent with the domain and units. Accept equivalent reasoning or another construction meeting every condition. An answer alone does not establish a unique misconception.

WORKED TEACHER KEYS

001

001 • T1: Simplify radical products, sums, and quotients without changing their values.

$\sqrt{75} = \sqrt{(25 \times 3)} = 5\sqrt{3}$. Squaring gives $(5\sqrt{3})^2 = 25 \times 3 = 75$, and the result is nonnegative.

Evidence to assess

Check the equivalence at each step, correct use of the exponent or radical law, and the stated domain. For an error analysis, require the incorrect step and a valid counterexample or repair.

WORKED TEACHER KEYS

002**002 • T1: Simplify radical products, sums, and quotients without changing their values.**

Combining gives $\sqrt{400}=20$. Alternatively $\sqrt{(10)}\times\sqrt{(4\times 10)}=\sqrt{10}\times 2\sqrt{10}=2\times 10=20$. Both use nonnegative radicands.

Evidence to assess

Check the equivalence at each step, correct use of the exponent or radical law, and the stated domain. For an error analysis, require the incorrect step and a valid counterexample or repair.