

TEACHER AND STUDENT RESOURCE

Adding Subtracting and Multiplying Polynomials



NC Math 2 • NC.M2.A-APR.1

Arithmetic with Polynomial and Rational Expressions

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.A-APR.1 | 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

Extend the understanding that operations with polynomials are comparable to operations with integers by adding, subtracting, and multiplying polynomials.

T1 Add and subtract polynomials by matching powers and distributing subtraction correctly.

T2 Multiply every term of one polynomial by every term of another and combine like terms.

T3 Explain polynomial arithmetic through integer properties, structure, models, and checks.

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, M20, O20, M23, O23, M27, O27

T2: M03, O03, M04, O04, M06, O06, M08, O08, M09, O09, M13, O13, M16, O16, M18, O18, M21, O21, M24, O24, M26, O26, M28, O28

T3: M10, O10, M14, O14, M15, O15, M19, O19, M22, O22, M25, O25, M29, O29, M30, O30

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Identify and represent

Learning target: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Learning target: Multiply every term of one polynomial by every term of another and combine like terms.

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: Multiply every term of one polynomial by every term of another and combine like terms.

Learning target: Explain polynomial arithmetic through integer properties, structure, models, and checks.

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

Session 3 Transfer independently

Learning target: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Learning target: Multiply every term of one polynomial by every term of another and combine like terms.

Learning target: Explain polynomial arithmetic through integer properties, structure, models, and checks.

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

Integer sign rules, distributive property, nonnegative integer exponents, and identifying coefficients and variable powers.

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

Use algebraic identities for all real inputs unless a context states a smaller domain. A positive-length area model may illustrate an identity that algebra proves more generally. Addition combines like coefficients; multiplication adds exponents of the same base. Degree refers to the highest nonzero power; the zero polynomial has no ordinary degree.

TEACHER MODEL

Every term meets every term

Expand $(2x+3)(x+4)$, explaining the four products and the resulting degree.

Multiply $2x$ by x and 4 to obtain $2x^2$ and $8x$. Multiply 3 by x and 4 to obtain $3x$ and 12 . Add all products: $2x^2+8x+3x+12=2x^2+11x+12$. The degree is 2 because the highest nonzero term is $2x^2$. The distributive property is the same property used for multiplying ordinary integers.

VISUAL ANCHOR

Compare operations before using rules

Addition, subtraction, and multiplication preserve different pieces of structure.

Operation	What happens	Example
Add like terms	Add coefficients; keep powers	$3x^2+5x^2=8x^2$
Subtract a polynomial	Negate every term, then add	$x-(x-2)=2$
Multiply monomials	Multiply coefficients; add powers	$3x^2\cdot2x^3=6x^5$
Multiply polynomials	Distribute every pair of terms	$(x+2)(x+3)=x^2+5x+6$

The distributive property links polynomial arithmetic to integer arithmetic. Keep unlike powers separate until an actual multiplication or cancellation justifies another step.

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: 001 • T1: Add and subtract polynomials by matching powers and distributing subtraction correctly.

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 learners to name the operation first. Align like powers for sums and differences, and list every product before simplifying multiplication.

Core task

Add $(4x^2 - 3x + 6) + (x^2 + 7x - 2)$. Show which terms combine and explain why the x^2 and x terms remain separate.

Teacher solution and discussion

$(4+1)x^2 + (-3+7)x + (6-2) = 5x^2 + 4x + 4$. Like terms have identical variable powers; x^2 and x describe different powers and cannot be combined by adding their coefficients.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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: Add and subtract polynomials by matching powers and distributing subtraction correctly.

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. Use a two-row or area model to make every distributive product visible. Model subtraction by replacing the entire second polynomial with its additive opposite.

Core task

Simplify $3x^2 - 5x + 7 + 2x - 4x^2 - 9$. Explain which terms cancel or combine, and why a negative coefficient does not prevent two terms from being like terms.

Teacher solution and discussion

The quadratic terms give $(3-4)x^2 = -x^2$; linear terms give $(-5+2)x = -3x$; constants give $7-9 = -2$. The result is $-x^2 - 3x - 2$. Like terms depend on variable powers, not coefficient signs.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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: Multiply every term of one polynomial by every term of another and combine like terms.

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. Have students predict the constant or leading term before expanding. Then compare predictions with the full calculation and locate any missing product or sign change.

Core task

Use multiplication to prove $(a+b)(a-b)=a^2-b^2$. Then apply the identity to calculate 103×97 mentally, showing the polynomial-arithmetic connection to integers.

Teacher solution and discussion

Expansion gives $a^2-ab+ab-b^2=a^2-b^2$. With $a=100$, $b=3$,
 $103 \times 97 = (100+3)(100-3) = 10000 - 9 = 9991$. The same distributive property and cancellation apply to symbols and numbers.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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 • T3: Explain polynomial arithmetic through integer properties, structure, models, and checks.

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. Assign one learner to compute, one to organize by degree, and one to verify with a different method or substitution. For constructions, test every requested degree and coefficient condition.

Core task

Explain why adding, subtracting, and multiplying polynomials with integer coefficients keeps integer coefficients and nonnegative integer exponents. Use one small example for each operation.

Teacher solution and discussion

Sums and differences add or subtract integer coefficients on existing nonnegative powers. Products multiply integer coefficients and add nonnegative integer exponents, then combine like terms. Examples: $(x+1)+(x-2)=2x-1$; $(x+1)-(x-2)=3$; $(x+1)(x-2)=x^2-x-2$. All remain polynomials with integer coefficients.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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 • T3: Explain polynomial arithmetic through integer properties, structure, models, and checks.

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. Collect first-response calculations without pointing to the needed sign change. Ask for reasoning about operations and structure, not only a final polynomial.

Core task

Use $(x+2)(x+5)$ at $x=10$ to explain the distributive calculation 12×15 . Then explain why evaluating at $x=10$ verifies that numerical case but does not by itself prove an identity for all x .

Teacher solution and discussion

Expansion gives $x^2+7x+10$. At $x=10$ this is $100+70+10=180=12 \times 15$. The four products correspond to 100, 50, 20, and 10. The numerical check confirms one input; the distributive expansion supplies the all-input algebraic proof.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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 • T2: Multiply every term of one polynomial by every term of another and combine like terms.

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. Distinguish a like-term error, a missing distributive product, and a mistaken sign from subtraction. Use one counterexample to isolate the error, then collect an unrehearsed calculation.

Core task

Simplify $3(x^2 - 2x + 1) - 2(x^2 + x - 4)$. Explain why the second polynomial's constant contributes +8 rather than -8.

Teacher solution and discussion

Distribute to get $3x^2 - 6x + 3 - 2x^2 - 2x + 8 = x^2 - 8x + 11$. The constant -4 is multiplied by the outside -2, producing positive 8.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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: Multiply every term of one polynomial by every term of another and combine like terms.

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 mixed operations or a learner-created pair of polynomials. Require all requested operations, an explanation of the relevant arithmetic property, and a check that does not substitute for a general proof.

Core task

Simplify $(x+3)^2 - (x-1)(x+1)$. Interpret the result as a difference of areas when $x > 1$, and explain why the quadratic terms disappear.

Teacher solution and discussion

The square area is $x^2 + 6x + 9$. The rectangle area is $x^2 - 1$. Their difference is $6x + 10$ square units. For $x > 1$ all stated side lengths are positive. Both contain the same x^2 leading area, which cancels in subtraction.

Evidence and response

Check whether every required product or sign change is present before judging the final result. Ask which terms have the same variable part and which operation permits a coefficient or exponent rule. A correct single-value test supports checking but does not replace an identity proof.

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 $(3x^2+2x+1)+(2x^2-5x+4)$.**

- A. $5x^4-3x^2+5$
- B. $5x^2-3x+5$
- C. $5x^2+7x+5$
- D. x^2+7x-3

Reasoning: _____

M02 | Warm-up | T1**Simplify $(5x^2+3x-2)-(2x^2-x+4)$.**

- A. $7x^2+2x+2$
- B. $3x^2+2x-6$
- C. $3x^2+4x-6$
- D. $3x^2+2x+2$

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Add $(4x^2-3x+6)+(x^2+7x-2)$. Show which terms combine and explain why the x^2 and x terms remain separate.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T1: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Subtract $(3x^2-2x+5)$ from $(7x^2+x-4)$. Write an equivalent addition of the opposite polynomial before simplifying.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01

M01 • T1: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Answer: B. $5x^2-3x+5$

Add coefficients of like powers: $(3+2)x^2+(2-5)x+(1+4)=5x^2-3x+5$. Addition does not change the exponent on a term.

Check each alternative

- A. Adding like terms combines coefficients, not exponents.
- B. Add coefficients of like powers: $(3+2)x^2+(2-5)x+(1+4)=5x^2-3x+5$. Addition does not change the exponent on a term.
- C. The linear coefficients are 2 and -5, so their sum is -3.
- D. This uses subtraction for some terms instead of addition.

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: Add and subtract polynomials by matching powers and distributing subtraction correctly.

Answer: C. $3x^2+4x-6$

Distribute the subtraction: $5x^2+3x-2-2x^2+x-4$. Combine to get $3x^2+4x-6$.

Check each alternative

- A. This adds the leading terms instead of subtracting.
- B. The subtracted term $-x$ becomes $+x$, giving linear coefficient 4.
- C. Distribute the subtraction: $5x^2+3x-2-2x^2+x-4$. Combine to get $3x^2+4x-6$.
- D. This fails to negate all terms of the subtracted polynomial.

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: Add and subtract polynomials by matching powers and distributing subtraction correctly.

$(4+1)x^2+(-3+7)x+(6-2)=5x^2+4x+4$. Like terms have identical variable powers; x^2 and x describe different powers and cannot be combined by adding their coefficients.

Evidence to assess

Require all three coefficient sums and a correct explanation of like terms.

WORKED TEACHER KEYS

002

002 • T1: Add and subtract polynomials by matching powers and distributing subtraction correctly.

$(7x^2+x-4)+(-3x^2+2x-5)=4x^2+3x-9$. The opposite polynomial reverses the sign of every term, not only the first.

Evidence to assess

Assess order of subtraction, all sign changes, and the final three coefficients.