

TEACHER AND STUDENT RESOURCE

Factors, Solutions and Function Zeros



NC Math 1 • NC.M1.A-APR.3

Expressions and algebraic structure

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.M1.A-APR.3 | NC Math 1 mathematics

This sample contains 18 complete selected pages from the 94-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-14, 29-30, 59, 74

Representative activities

M01: sample PDF page(s) 15; original page(s) 14

M02: sample PDF page(s) 15; original page(s) 14

O01: sample PDF page(s) 16; original page(s) 29

O02: sample PDF page(s) 17; original page(s) 30

Selected teacher prompts and keys: original page(s) 59, 74

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

Understand the relationships among the factors of a quadratic expression, the solutions of a quadratic equation, and the zeros of a quadratic function.

T1 Connect factors to equation solutions and function zeros.

T2 Connect algebraic zeros to graphs and other representations.

T3 Construct and compare quadratic functions using their zeros.

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, M02, M03, M06, M08, M11, M12, M13, M16, M18, M21, M22, M26, M28, O01, O06, O11, O16, O21, O26

T2: M04, M07, M09, M14, M17, M19, M23, M24, M27, M29, O03, O04, O07, O09, O13, O14, O17, O19, O23, O24, O27, O29

T3: M05, M10, M15, M20, M25, M30, O02, O05, O08, O10, O12, O15, O18, O20, O22, O25, O28, O30

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

Check distribution, signed-number products/sums, the zero-product property, substitution, ordered pairs and coordinate scales.

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.

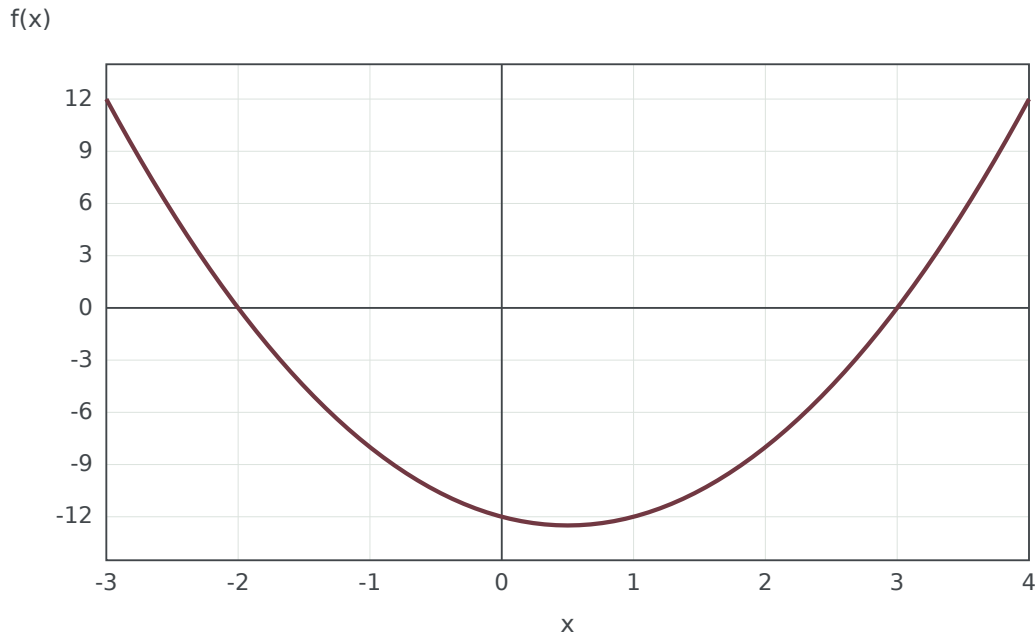
Review convention

A quadratic has nonzero leading coefficient. Zeros are input values; intercepts are ordered pairs. Count distinct zeros separately from factor multiplicity. Graphs use labeled coordinate scales.

TEACHER MODEL

From an expression to its zeros

Factor $2x^2 - 2x - 12$, solve $2x^2 - 2x - 12 = 0$, and interpret the zeros of $f(x) = 2x^2 - 2x - 12$.



Factor $2(x^2 - x - 6) = 2(x - 3)(x + 2)$. Expansion gives $2x^2 - 2x - 12$. Since 2 is nonzero, a zero product requires $x - 3 = 0$ or $x + 2 = 0$: $x = 3$ or -2 . These are equation solutions and function zeros; graph intercepts are $(3, 0)$ and $(-2, 0)$. At $x = 0$, $f(0) = -12$, which is the y-intercept value, not a zero.

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: Connect factors to equation solutions and function zeros.

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 graph when present. Invite a first independent response before discussion. Ask, “What do the symbols represent? What evidence supports your claim?”

Core task

For $f(x) = (x + 4)(x - 3)$, list the factors, solve $f(x) = 0$, and state the zeros and x-intercepts. Explain which objects are expressions, numbers and ordered pairs.

Teacher solution and discussion

Linear factors $x - (-4)$ and $x - (3)$; multiplier 1. Equation solutions and function zeros are numbers $-4, 3$; intercepts are ordered pairs $(-4, 0), (3, 0)$. Factors are expressions, not the same kind of object as a zero.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 • T3: Construct and compare quadratic functions using their zeros.

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 graph when present. Think aloud through the core task. Say, “I will identify the quantities first, then build a representation and check it against the stated domain.” Hide the worked key until after predictions.

Core task

Compare $f(x) = (x - 2)(x - (-3))$ with $g(x) = 3(x - 2)(x + 3)$. State what stays the same about zeros and intercepts, and what changes about other outputs. Check an input that is not a zero.

Teacher solution and discussion

Both have zeros 2, -3 and the same x-intercepts. $g=3f$, so nonzero outputs are multiplied by 3. At $x=-4$, $f=6$ and $g=18$. Since $3 \neq 1$, their vertical sizes differ.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: Connect algebraic zeros to graphs and other representations.

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 graph when present. Have learners propose the next step, then ask a partner to verify it using the original representation. Record more than one valid explanation.

Core task

For $f(x) = -2(x - 1)(x + 4)$, determine both x-intercepts and the y-intercept. Explain why these are found by different substitutions.

Teacher solution and discussion

Solve $f(x)=0$ using factors: $x=1, -4$, so intercepts $(1,0), (-4,0)$. Set $x=0$ for the y-intercept: $f(0)=8$, giving $(0,8)$. A zero is an input, not this y-intercept value.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: Connect algebraic zeros to graphs and other representations.

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 graph when present. Assign reader, representer, checker and explainer roles. Each learner first makes a private prediction; compare reasoning and resolve differences with the data.

Core task

Given $f(x) = -(x - 1)(x - 2)$, make a table using both zeros and the integer immediately below the smaller zero and above the larger zero. Graph these points and the vertex, and connect factors to the intercepts.

Teacher solution and discussion

Zeros 1,2. Table includes (0,-2), (1,0), (2,0), (3,-2). Vertex (1.5,0.25). Each zero makes a factor zero and locates an x-intercept.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: 019 • T2: Connect algebraic zeros to graphs and other representations.

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 graph when present. Provide the printed task and neutral access supports. Preserve the first independent response; do not point to the requested answer or select a method for the learner.

Core task

For $f(x) = -2(x - 2)(x + 6)$, determine both x -intercepts and the y -intercept. Explain why these are found by different substitutions.

Teacher solution and discussion

Solve $f(x)=0$ using factors: $x=2, -6$, so intercepts $(2,0), (-6,0)$. Set $x=0$ for the y -intercept: $f(0)=24$, giving $(0,24)$. A zero is an input, not this y -intercept value.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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: Connect algebraic zeros to graphs and other representations.

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 graph when present. Start with the learner’s prior evidence. Rebuild one representation with explicit terms and operations, then use a fresh item to check transfer without the prior cue.

Core task

Given $f(x) = -(x - 2)(x)$, make a table using both zeros and the integer immediately below the smaller zero and above the larger zero. Graph these points and the vertex, and connect factors to the intercepts.

Teacher solution and discussion

Zeros 2,0. Table includes $(-1,-3)$, $(2,0)$, $(0,0)$, $(3,-3)$. Vertex $(1,1)$. Each zero makes a factor zero and locates an x-intercept.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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 • T3: Construct and compare quadratic functions using their zeros.

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 graph when present. Ask for a concise claim supported by the representation. Collect the response before sharing a solution; use it to choose the next instructional step.

Core task

Construct two different quadratic functions that both have zeros 0 and -3. Show both expanded forms and find one input at which their outputs differ.

Teacher solution and discussion

One pair is $f(x)(x + 3) = x^2 + 3x$ and $g = -2(x)(x + 3) = -2x^2 - 6x$. Both zeros are preserved by nonzero scaling. At $x = -4$, $f = 4$, $g = -8$. Accept any pair satisfying the conditions.

Evidence and response

Look for a claim tied to specific terms, factors, operations or graph features. If a learner only names an answer, ask which values or parts of the graph support it. If a sign or operation is mishandled, reconstruct that step with a numerical analogy, then collect a fresh response. A selected option alone does not identify a unique misconception.

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**

The quadratic $f(x) = (x + 3)(x - 2)$ has a factor $x - (-3)$. Which input makes that factor zero?

- A. 1
- B. -1
- C. -6
- D. -3

Reasoning: _____

M02 | Warm-up | T1

For $f(x) = (2x - 3)(x + 2)$, which input is the positive zero?

- A. $3/2$
- B. 3
- C. $5/2$
- D. 2

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: Connect factors to equation solutions and function zeros.

For $f(x) = (x + 4)(x - 3)$, list the factors, solve $f(x) = 0$, and state the zeros and x-intercepts. Explain which objects are expressions, numbers and ordered pairs.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T3: Construct and compare quadratic functions using their zeros.

A quadratic has zeros $\frac{3}{2}$ and -2 , and leading coefficient 2. Build its factored and expanded forms, then verify both zeros. Explain why the zeros alone would not fix the leading coefficient.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02**M01 • T1: Connect factors to equation solutions and function zeros.****Answer: D. -3**

Solve $x - (-3) = 0$: $x = -3$. This makes the product zero, so it is both a solution of $f(x) = 0$ and a zero of f .

Check each alternative

A. $-1 \cdot (-3 + 2) = 1$. This reports the expanded x coefficient rather than the requested quantity.

B. $-3 + 2 = -1$. This reports the sum of zeros rather than the requested quantity.

C. $-3 \cdot 2 = -6$. This reports the product of zeros rather than the requested quantity.

D. Correct: Solve $x - (-3) = 0$: $x = -3$. This makes the product zero, so it is both a solution of $f(x) = 0$ and a zero of f .

M02 • T1: Connect factors to equation solutions and function zeros.**Answer: A. $3/2$**

$2x^2 + x - 6 = (2x - 3)(x + 2)$. Expand: $2x^2 + (4-3)x + (-6) = 2x^2 + x - 6$. The factors vanish at $x = 3/2$ and $x = -2$; the positive zero is $3/2$.

Check each alternative

A. $2x^2 + x - 6 = (2x - 3)(x + 2)$. Expand: $2x^2 + (4-3)x + (-6) = 2x^2 + x - 6$. The factors vanish at $x = 3/2$ and $x = -2$; the positive zero is $3/2$.

B. This makes $2x-3$ equal 3, not zero; the other factor is also nonzero.

C. This makes the first factor equal 2, not zero.

D. At this input both factors are nonzero; the other zero is -2 , not 2.

WORKED TEACHER KEYS

001 / 002**001 • T1: Connect factors to equation solutions and function zeros.**

Linear factors $x - (-4)$ and $x - (3)$; multiplier 1. Equation solutions and function zeros are numbers $-4, 3$; intercepts are ordered pairs $(-4, 0), (3, 0)$. Factors are expressions, not the same kind of object as a zero.

002 • T3: Construct and compare quadratic functions using their zeros.

Use $2(x - 3/2)(x + 2) = (2x - 3)(x + 2) = 2x^2 + x - 6$. At $x = 3/2$, $2x - 3 = 0$; at $x = -2$, $x + 2 = 0$. Any nonzero scalar multiple preserves the zeros, so the given leading coefficient selects this function.