

TEACHER AND STUDENT RESOURCE

Piecewise Functions and Contexts



NC Math 4 • NC.M4.AF.4

Advanced Mathematics

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.M4.AF.4 | NC Math 4 mathematics

This sample contains 19 complete selected pages from the 102-page resource, plus this sample contents page. Original printed page numbers are retained. Gaps are intentional.

Included original pages: 1-15, 30-31, 60, 76

Representative activities

M01: sample PDF page(s) 16; original page(s) 15

M02: sample PDF page(s) 16; original page(s) 15

O01: sample PDF page(s) 17; original page(s) 30

O02: sample PDF page(s) 18; original page(s) 31

Selected teacher prompts and keys: original page(s) 60, 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.

ALIGNMENT

Standard and learning targets

Understand the properties and key features of piecewise functions.

T1 NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

T2 NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

NC.M4.AF.4.1 Translate between algebraic and graphical representations of piecewise functions (linear, exponential, quadratic, polynomial, square root).

NC.M4.AF.4.2 Construct piecewise functions to model a contextual situation.

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, M03, M05, M07, M09, M11, M13, M15, M17, M19, M21, M23, M25, M27, M29, O01, O03, O05, O07, O09, O11, O13, O15, O17, O19, O21, O23, O25, O27, O29

T2: M02, M04, M06, M08, M10, M12, M14, M16, M18, M20, M22, M24, M26, M28, M30, O02, O04, O06, O08, O10, O12, O14, O16, O18, O20, O22, O24, O26, O28, O30

DAILY LEARNING TARGETS

A multi-session teaching path

Session 1 Diagnose and model

Learning target: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

Learning target: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

Use warm-up evidence to choose explicit I Do models. Collect predictions before revealing the worked solution.

Session 2 Compare and explain

Learning target: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

Use selected We Do and collaborative tasks. Ask each learner for an initial representation, then compare methods and checks.

Session 3 Transfer independently

Learning target: Apply the objectives with explicit restrictions, checks and contextual interpretations.

Choose independent items across every objective. Use small-group tasks for a documented gap and a fresh exit task to test transfer.

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

Function notation, inequalities, evaluating standard function families, interval endpoints and coordinates.

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 branch applies only on its stated input interval. A filled endpoint is included; an open endpoint is excluded. Every allowed input must have one output. Contexts and prices are invented. Do not join across a jump unless the rule actually includes the connecting values.

TEACHER MODEL

A threshold changes the rule, not the input

Build and interpret the parking model: \$5 for $0 < t \leq 2$ hours, then \$2.50 per additional hour without rounding.

Use $C(t)=5$ for $0 < t \leq 2$ and $C(t)=5+2.5(t-2)$ for $t > 2$. The second branch retains the \$5 already charged and bills only $t-2$ extra hours. $C(2)=5$ and $C(4)=10$. At the threshold the branch values agree. For a student graph, label hours horizontally and dollars vertically; zero-stay policy is not given.

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: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

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 $f(x)=2x-1$ when $x<2$ and $f(x)=x^2$ when $x\geq 2$, evaluate $f(-1)$, $f(2)$, $f(3)$. For each value identify the selected interval first.

Teacher solution and discussion

$-1<2$ gives $f(-1)=-3$. The boundary 2 belongs to $x\geq 2$, so $f(2)=4$. Since $3\geq 2$, $f(3)=9$. The first expression’s boundary value 3 is not $f(2)$.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

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

Graph $f(x)=2^x$ for $-2 \leq x < 0$ and $f(x)=x+1$ for $0 \leq x \leq 3$. Explain whether the graph has a jump at 0 and how the overlapping endpoint drawing should be handled.

Teacher solution and discussion

The exponential runs from $(-2, 1/4)$ to an open $(0, 1)$; the line starts at filled $(0, 1)$ and ends at $(3, 4)$. The same-location filled point establishes inclusion. Both boundary values are 1, so there is no jump.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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 • T1: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

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 $f(x)=\sqrt{x+1}$ on $[-1, 3)$ and $f(x)=x-1$ on $[3, 5]$, sketch the graph and find the range. Explain the junction at 3.

Teacher solution and discussion

Root piece outputs $[0, 2)$; line outputs $[2, 4]$. The range is $[0, 4]$. The root approaches $(3, 2)$ open and the line supplies $(3, 2)$ filled, so the pieces meet with no jump.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

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

A club charges \$10 monthly plus \$3 per attended session. Write a piecewise rule distinguishing zero sessions from positive sessions, state the domain, and explain why the graph is discrete.

Teacher solution and discussion

$C(0)=10$; $C(n)=10+3n$ for positive integers n . Domain is $\{0, 1, 2, \dots\}$. Outputs include 10, 13, 16, ... at isolated integer inputs. Connecting every point would imply fractional session counts not included in this model.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

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 $f(x)=2x$ on $[-1, 1)$ and $f(x)=5-x$ on $[1, 4]$, find domain and range. State whether every output between the global minimum and maximum is attained.

Teacher solution and discussion

Domain $[-1, 4]$. First range $[-2, 2)$; second range $[1, 4]$. Their union is $[-2, 4]$, so every value between the minimum -2 and maximum 4 is attained despite the jump at $x=1$.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

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

A population model doubles each hour from 30 for the first 4 hours, then grows linearly by 20 per hour. Write a continuous piecewise model and find its value at 6 hours.

Teacher solution and discussion

For $0 \leq t \leq 4$, $P = 30 \cdot 2^t$. At 4, $P = 480$. For $t > 4$, $P = 480 + 20(t - 4)$. At 6, $P = 520$. The linear branch starts at the final exponential value rather than resetting to 30.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

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

A data plan gives the first 5 GB free, charges \$4/GB for usage from 5 through 12 GB, and caps the monthly data charge at \$28 beyond 12 GB. Build the full three-piece function and check both thresholds.

Teacher solution and discussion

$C(u)=0$ for $0 \leq u \leq 5$; $C(u)=4(u-5)$ for $5 < u \leq 12$; $C(u)=28$ for $u > 12$. At 5 the middle expression is 0; at 12 it is 28. The pieces match at both thresholds, and charges never exceed 28.

Evidence and response

Ask learners to select the interval before evaluating its formula. At a boundary check both the inequality and the endpoint symbol. For modeling, distinguish a charge on all units from a charge only on additional units. Require a defined context domain and verify at least one value in each branch.

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**

Let $f(x)=x+2$ for $x<1$ and $f(x)=x^2$ for $x\geq 1$. What is $f(1)$?

- A. 1
- B. 3
- C. Both 1 and 3
- D. Undefined

Reasoning: _____

M02 | Warm-up | T2

A parking model charges \$4 for $0< t \leq 2$ hours, then \$3 per additional hour without rounding. Which rule applies for $t>2$?

- A. $4+3t$
- B. $4+3(t-2)$
- C. $3(t-2)$
- D. $7t$

Reasoning: _____

WARM-UP

001 • Show your reasoning

T1: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

For $f(x)=2x-1$ when $x<2$ and $f(x)=x^2$ when $x\geq 2$, evaluate $f(-1)$, $f(2)$, $f(3)$. For each value identify the selected interval first.

Representation / calculation

Explanation / check

WARM-UP

002 • Show your reasoning

T2: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

A parking lot charges \$5 for any stay $0 < t \leq 2$ hours, then \$2.50 for each additional hour with no rounding. Build the total-cost function and find $C(1)$, $C(2)$, $C(4.5)$.

Representation / calculation

Explanation / check

WORKED TEACHER KEYS

M01 / M02

M01 • T1: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

Answer: A. 1

At $x=1$ use x^2 , so $f(1)=1$.

Check each alternative

- A. Correct. At $x=1$ use x^2 , so $f(1)=1$.
- B. The $x<1$ branch excludes the boundary 1.
- C. Only the $x\geq 1$ branch owns the boundary.
- D. The second branch includes 1.

M02 • T2: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

Answer: B. $4+3(t-2)$

Keep the initial \$4 and add \$3 for only the elapsed time beyond 2 hours.

Check each alternative

- A. This charges for the first two hours again.
- B. Correct. Keep the initial \$4 and add \$3 for only the elapsed time beyond 2 hours.
- C. This drops the initial \$4 charge.
- D. The fixed and variable charges cannot be combined as a single hourly rate.

WORKED TEACHER KEYS

001 / 002

001 • T1: NC.M4.AF.4.1 Translate between formulas and graphs with linear, exponential, quadratic, polynomial and square-root pieces.

$-1 < 2$ gives $f(-1) = -3$. The boundary 2 belongs to $x \geq 2$, so $f(2) = 4$. Since $3 \geq 2$, $f(3) = 9$. The first expression's boundary value 3 is not $f(2)$.

Full evidence: Three interval choices and values, including the boundary decision. Partial credit: preserve and score a valid intermediate representation or justified step separately from the final accuracy.

002 • T2: NC.M4.AF.4.2 Build piecewise models with meaningful intervals, thresholds and units.

$C(t) = 5$ for $0 < t \leq 2$ and $C(t) = 5 + 2.5(t - 2)$ for $t > 2$. Values are 5, 5, 11.25 dollars. The domain excludes 0 because the statement covers positive stays; define any zero-stay convention separately rather than assuming it.

Full evidence: Both branches, boundary ownership, three costs and a stated domain. Partial credit: preserve and score a valid intermediate representation or justified step separately from the final accuracy.