

DOK PROGRESSION GUIDE • SBAC MATHEMATICS

Math 1

Every SBAC claim and target for Math 1, with a Test Bank question at each Depth of Knowledge (DOK) level the blueprint assesses, and the clicks to find more.

DOK 1 Recall

DOK 2 Skills & concepts

DOK 3 Strategic thinking

DOK 4 Extended thinking

For Math 1 teachers. Claims, targets and DOK levels follow the official Smarter Balanced blueprint.

achievetricstestbank.com • October 2026 edition

How to use this booklet

Depth of Knowledge (DOK) describes the kind of thinking a question asks for, not how hard it is. A long calculation can still be DOK 1, and a short question can be DOK 3. For each target, this booklet shows one question at every DOK level SBAC assesses it at, so you can see the climb and then pick questions at the level your students need next.

The four DOK levels

DOK 1 • Recall

Recall a fact, term or property, or carry out a routine one-step procedure. Read a value straight from a table or graph.

DOK 2 • Skills & concepts

Decide how to approach it and use two or more steps: compare, classify, interpret data, or move between representations.

DOK 3 • Strategic thinking

Reason and plan: justify an answer, critique an argument, use evidence, or solve a problem with no routine path.

DOK 4 • Extended thinking

Carry out an extended investigation that connects several ideas, conditions or sources. On SBAC, DOK 4 is assessed only in the performance task, and only for Claim 3 and Claim 4 targets.

Reading a target page

1. The heading names the claim, the target code and the official target wording, with the standards it draws on.
2. The DOK ladder shows which levels the SBAC blueprint assesses for this target in this grade. Levels in grey with a line through them are not assessed for this target.
3. One example question at each assessed level, lowest first, with the answer shown. Read them top to bottom to see how the thinking climbs.
4. "Why DOK n" explains in one sentence what makes the question that level, so you can spot the same thing in your own questions.
5. "Find more like this" lists the exact Test Bank clicks that generate more questions for the same target at the same level.

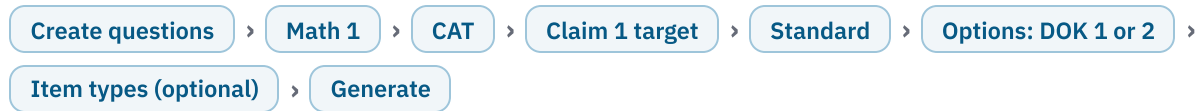
Which DOK levels each target is assessed at comes from the official Smarter Balanced test blueprint for this grade (2015–16 Summative Technical Report, Appendix 2.A). Every example was checked by hand against the DOK definitions above, not just its Test Bank tag. A few targets had no Test Bank question that truly fit a level, so we wrote one; those are marked "Written for this guide."

Finding these questions in the Test Bank

Every example page ends with the exact clicks. These are the two routes, starting from Create questions with Math 1 chosen as the course.

Claim 1 targets (CAT)

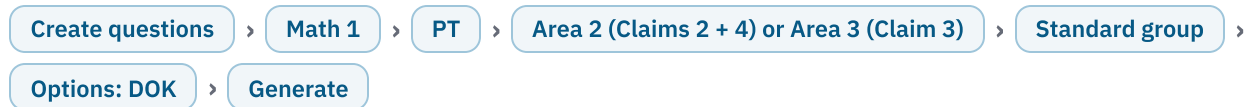
Claim 1 questions are filed by target and standard.



The DOK buttons only allow the levels the blueprint assesses for that target, so a level that is greyed out in this booklet is greyed out in the Test Bank too.

Claims 2, 3 and 4 (PT)

These claims are built from performance-task standard groups.



Each question card shows its claim and target, such as "Claim 3 · Tgt B". Generate at the DOK you want, then keep the cards for your target.

Questions you have saved

Saved questions are filed the same way in your Item Bank.



Tip: to move a class up the ladder, generate the same target at the next DOK level. To check that a skill is secure before going further, generate a set at the lowest assessed level.

All targets at a glance

A dot means the SBAC blueprint assesses the target at that DOK level in this grade. Each dot has an example question in this booklet.

Claim 1 • Concepts & Procedures

Target	DOK 1	DOK 2	DOK 3	DOK 4
1A Extend the properties of exponents to rational exponents	●	●	—	—
1B Use properties of rational and irrational numbers	●	●	—	—
1C Reason quantitatively and use units to solve problems	●	●	—	—
1D Interpret the structure of expressions	●	●	—	—
1F Perform arithmetic operations on polynomials	—	●	—	—
1G Create equations that describe numbers or relationships	●	●	—	—
1H Understand solving equations as a process of reasoning and explain the reasoning	●	●	—	—
1I Solve equations and inequalities in one variable	●	●	—	—
1J Represent and solve equations and inequalities graphically	●	●	—	—
1K Understand the concept of a function and use function notation	●	●	—	—
1L Interpret functions that arise in applications in terms of a context	●	●	—	—
1M Analyze functions using different representations	●	●	●	—
1N Build a function that models a relationship between two quantities	—	●	—	—
1P Summarize, represent, and interpret data on a single measurement variable	—	●	—	—

Claim 2 • Problem Solving

Target	DOK 1	DOK 2	DOK 3	DOK 4
2A Apply mathematics to solve well-posed problems from everyday life	—	●	●	—
2B Select and use appropriate tools strategically	●	●	●	—
2C Interpret results in the context of a situation	●	●	●	—
2D Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas)	●	●	●	—

Claim 3 • Communicating Reasoning

Target		DOK 1	DOK 2	DOK 3	DOK 4
3A	Test propositions or conjectures with specific examples	—	●	●	—
3B	Construct chains of reasoning that will justify or refute propositions	—	●	●	●
3C	State logical assumptions being used	—	●	●	—
3D	Use the technique of breaking an argument into cases	—	●	●	—
3E	Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is	—	●	●	●
3F	Base arguments on concrete referents such as objects, drawings, diagrams, and actions	—	●	●	—
3G	Determine conditions under which an argument does and does not apply	—	●	●	—

Claim 4 • Modeling & Data Analysis

Target		DOK 1	DOK 2	DOK 3	DOK 4
4A	Apply mathematics to solve problems from everyday life (Modeling)	—	●	●	—
4B	Construct chains of reasoning to justify mathematical models	—	●	●	●
4C	State logical assumptions being used	●	●	●	—
4D	Interpret results in the context of a situation	—	●	●	—
4E	Analyze adequacy and make improvements to existing models	—	●	●	●
4F	Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas)	●	●	●	—
4G	Identify, analyze, and synthesize relevant external resources to pose or solve problems	—	—	●	●

CLAIM 1

Claim 1 • Concepts & Procedures

Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency. Claim 1 is tested with individual items on the computer adaptive test (CAT). In the Test Bank, choose CAT, then the target.

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1A Extend the properties of exponents to rational exponents

Standards: N-RN.1; N-RN.2

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4**DOK 1 · Recall****Why DOK 1:** Students recall one definition, that a cube root equals an exponent of one third, and apply it directly with no planning or extra steps.

A basketball player's vertical jump height can be modeled using the expression $\sqrt[3]{512}$. Which of the following expressions is equivalent to $\sqrt[3]{512}$ using rational exponents?

☒ $512^{1/3}$



☐ $512^{1/2}$

☐ 512^3

☐ 3^{512}

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Test Bank question

DOK 2 · Skills & concepts**Why DOK 2:** Each entry takes two linked steps: find the root named by the denominator then apply the power in the numerator, so students interpret the exponent rather than recall a fact.

A basketball player's vertical jump height (in inches) can be modeled using rational exponents. Complete the table by rewriting each expression involving radicals or rational exponents in simplified form.

Original Expression	Simplified Form
$16^{1/2}$	4
$27^{2/3}$	9
$32^{3/5}$	8
$\sqrt[4]{81}$ or $81^{1/4}$	3

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Test Bank question

CLAIM 1 · CONCEPTS & PROCEDURES

1B Use properties of rational and irrational numbers

Standards: N-RN.3

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4

DOK 1 · Recall

Why DOK 1: Students apply one known property, rational plus irrational is irrational, to a single sum; the explanation simply names that property.

A basketball player's vertical jump height can be expressed as $3 + \sqrt{5}$ feet. Explain whether this height is a rational or irrational number. Use properties of rational and irrational numbers to justify your answer.

Model response: The height $3 + \sqrt{5}$ feet is irrational. Since 3 is a rational number and $\sqrt{5}$ is an irrational number, their sum must be irrational. According to the properties of rational and irrational numbers, the sum of a rational number and an irrational number is always irrational.

Rubric: 1 point: Correctly identifies the number as irrational and provides clear reasoning that the sum of a rational number (3) and an irrational number ($\sqrt{5}$) is irrational.

0 points: Anything less, including a response that is only partly correct.

FIND MORE LIKE THIS

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must first simplify the expression and then classify the result by reasoning about a rational times an irrational number, which takes two connected steps.

Use the drop-down menus to complete the statement about a runner's training data.

A coach records that a runner's average speed is $\frac{12}{\sqrt{3}}$ miles per hour. When rationalized, this

speed equals $4\sqrt{3}$ miles per hour. Since $4\sqrt{3}$ is irrational, the runner's

speed is a(n) irrational number.

Drop-down 1 choices: $\frac{4}{\sqrt{3}}$ $12\sqrt{3}$ **$4\sqrt{3}$ ✓**

Drop-down 2 choices: **irrational ✓** rational

Drop-down 3 choices: **irrational ✓** rational

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Test Bank question

1C Reason quantitatively and use units to solve problems

Standards: N-Q.1; N-Q.2; N-Q.3

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4**DOK 1 · Recall****Why DOK 1:** This is a single routine unit conversion with the conversion factor given; Part B only asks students to recognize why the units cancel.

A basketball player's vertical jump is measured at 28 inches. The coach wants to track the player's progress and record all measurements in centimeters for the team database. (Use the conversion: 1 inch = 2.54 centimeters)

Part A: What is the player's vertical jump in centimeters?

Choose one answer.

☐ 11.02 centimeters☒ 71.12 centimeters ✓☐ 30.54 centimeters☐ 25.46 centimeters**Part B:** Which statement best explains why the conversion $28 \text{ inches} \times 2.54 \frac{\text{centimeters}}{\text{inch}}$ is the correct method?

Choose one answer.

☐ The conversion factor 2.54 is larger than 1, so it always gives a bigger number in centimeters.☐ Centimeters are always used in sports, so we must multiply by 2.54 regardless of the starting unit.☐ The number 28 must be multiplied by any conversion factor to ensure the answer is correct.☒ Multiplying by the conversion factor changes inches to centimeters because the units of 'inches' cancel and leave 'centimeters' in the answer. ✓**FIND MORE LIKE THIS**[Create questions](#) > [Math 1](#) > [CAT](#) > [Target C](#) > [N-Q.1](#) > [DOK 1](#) > [Generate](#)

Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must find the hourly rate from the table, use it to fill a missing distance, and convert kilometers to miles, coordinating several steps and units.

A runner is training for a marathon. The table below shows the relationship between time in hours and distance covered in kilometers. Use unit conversion and dimensional analysis to complete the table.
(Use the conversion: 1 kilometer $\approx$ 0.621 miles)

Time (hours)	Distance (km)	Distance (miles)
0.5	6	3.73
1	12	7.45
1.5	18	11.18
2	24	14.90

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Test Bank question

1D Interpret the structure of expressions

Standards: A-SSE.1

Assessed at: **DOK 1** DOK 2 DOK 3 DOK 4**DOK 1 · Recall**

Why DOK 1: Students only need to recall vocabulary (coefficient, constant, variable) and point to each part of a simple expression.

A basketball player's total points scored this season can be represented by the expression $12g + 8$, where g is the number of games played. Select all the statements that correctly identify parts of this expression.

☒ The coefficient is 12 ✓

☒ The constant term is 8 ✓

☒ The variable is g ✓

☐ The coefficient is 8

☐ The variable is 12

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students interpret what each part of a linear and an exponential expression means in context, including treating a factor as a single quantity, rather than just naming parts.

A basketball player's total season points are modeled by $P(g) = 18g + 250$, where g is the number of games played. A booster club's fundraising account grows according to $F(t) = 1200(1.08)^t$, where t is the number of years. Decide whether each statement about the structure of these expressions is True or False.

	True	False
In $P(g) = 18g + 250$, the 18 represents the number of points the player scores per game played.	☒	☐
In $P(g) = 18g + 250$, the 250 represents the number of points scored per game.	☐	☒
The expression $18g + 250$ is linear because the variable g appears raised only to the first power.	☒	☐
In $F(t) = 1200(1.08)^t$, the 1200 represents the yearly growth rate of the fund.	☐	☒
In $F(t) = 1200(1.08)^t$, the factor $(1.08)^t$ can be treated as a single entity representing the total growth multiplier after t years.	☒	☐

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Test Bank question

1F Perform arithmetic operations on polynomials

Standards: A-APR.1

Assessed at:

DOK 1

DOK 2

DOK 3

DOK 4

DOK 2 · Skills & concepts

Why DOK 2: Students multiply two binomials, which requires distributing each term and then combining like terms, a multi-step procedure that ends in a single polynomial.

A soccer field's dimensions can be expressed using polynomials. The length of the field is represented by $(3x + 8)$ meters, and the width is represented by $(2x - 3)$ meters. Find the area of the field by multiplying these two expressions. Write your answer as a polynomial in standard form.

Correct answer: $6x^2 + 7x - 24$

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Test Bank question

1G Create equations that describe numbers or relationships

Standards: A-CED.1; A-CED.2; A-CED.3; A-CED.4

Assessed at: **DOK 1** DOK 2 DOK 3 DOK 4**DOK 1 · Recall****Why DOK 1:** The situation translates directly into one multiplication equation; students recognize that equation and its simple rearrangements.

A soccer player scores 3 goals in each game. After playing several games, the player has scored a total of 24 goals. Which equations correctly represent this situation? Select all that apply.

☐ $g + 3 = 24$, where g is the number of games played☐ $3 + g = 24$, where g is the number of games played☒ $24 \div 3 = g$, where g is the number of games played ✓☒ $3g = 24$, where g is the number of games played ✓☒ $g = \frac{24}{3}$, where g is the number of games played ✓☐ $24 - 3 = g$, where g is the number of games played

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must decide which inequality matches "at least," recognize the hidden nonnegative and whole-number constraints, and reject equations that do not fit the context.

A high school basketball team is planning a fundraiser selling custom team apparel. The team sells hoodies for \$35 each and t-shirts for \$12 each. They need to raise at least \$840 to fund their spring tournament. Let h represent the number of hoodies sold and t represent the number of t-shirts sold. Which of the following correctly represent constraints or relationships for this fundraiser scenario? Select all that apply.

☐ $t = 35h - 12$

☒ $h \geq 0$ and $t \geq 0$ ✓

☒ $35h + 12t \geq 840$ ✓

☒ h and t must be non-negative integers because you cannot sell a partial item ✓

☐ $h + t = 840$

☐ $35h + 12t = 840$

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Test Bank question

1H Understand solving equations as a process of reasoning and explain the reasoning

Standards: A-REI.1

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4

DOK 1 · Recall **Why DOK 1:** Students carry out a routine two-step solve and match each step to the familiar reason for it, such as adding to both sides.

A basketball player is solving the equation $2x - 5 = 11$ to find how many points she needs to score. Complete the table showing each step of solving and the reasoning that justifies moving from one step to the next.

Step	Equation or Value	Reasoning
Start	$2x - 5 = 11$	Original equation
Step 1	$2x = 16$	Add 5 to both sides of the equation
Step 2	$x = 8$	Divide both sides by 2 ▾
Solution	$x = 8$	The player needs to score 8 points

FIND MORE LIKE THIS

Create questions > Math 1 > CAT > Target H > A-REI.1 > **DOK 1** > Generate

Test Bank question

Why DOK 2: Students must explain why a step is valid and also judge whether a different first step would work, which requires reasoning about equivalent equations, not just following a procedure.

Maya solved the equation $3(x - 4) = 2x + 5$ as shown.

Step 1: $3x - 12 = 2x + 5$

Step 2: $x - 12 = 5$

Step 3: $x = 17$

Part A: Which reason justifies going from Step 1 to Step 2?

Choose one answer.

- ☒ Subtract $2x$ from both sides; subtracting the same quantity from both sides keeps the two sides equal. ✓
- ☐ Use the distributive property on the left side.
- ☐ Add 12 to both sides to undo the subtraction.
- ☐ Divide both sides by x so that only one x term remains.

Part B: Devon says Maya could have started by dividing both sides of the original equation by 3 instead. Which statement is correct?

Choose one answer.

- ☒ Devon is right. Dividing both sides by 3 gives $x - 4 = \frac{2x+5}{3}$, an equation with the same solution, so it also leads to $x = 17$. ✓
- ☐ Devon is wrong, because the distributive property must always be used first.
- ☐ Devon is right, and dividing both sides by 3 gives $x - 4 = 2x + 5$.
- ☐ Devon is wrong, because dividing both sides by a number changes the solution of an equation.

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Written for this guide

1I Solve equations and inequalities in one variable

Standards: A-REI.3; A-REI.3.1

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4**DOK 1 · Recall**

Why DOK 1: Solving requires one routine step, multiplying both sides by 12, with the value of the other variable given.

A basketball player's scoring average over the season is found using the equation $\frac{s}{g} = 18.5$, where s is total points scored and g is games played. If the player played $g = 12$ games, solve for s , the total points scored.

Write your answer as a whole number.

Correct answer: **222**

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students translate a verbal description into an absolute value inequality, solve it as a compound inequality, and match it to equivalent forms and a context statement.

A basketball player is analyzing her shooting performance. Her actual number of successful free throws differs from her target of 12 makes by at most 3. Which of the following correctly represent this situation? Select all that apply.

☐ $|x - 3| \leq 12$

☐ The player made fewer than 9 or more than 15 successful free throws

☒ $|x - 12| \leq 3$

☐ $x - 12 \leq 3$ only

☒ $9 \leq x \leq 15$

☒ The player made between 9 and 15 successful free throws, inclusive

FIND MORE LIKE THIS

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Test Bank question

1J Represent and solve equations and inequalities graphically

Standards: A-REI.5; A-REI.6; A-REI.10; A-REI.11; A-REI.12

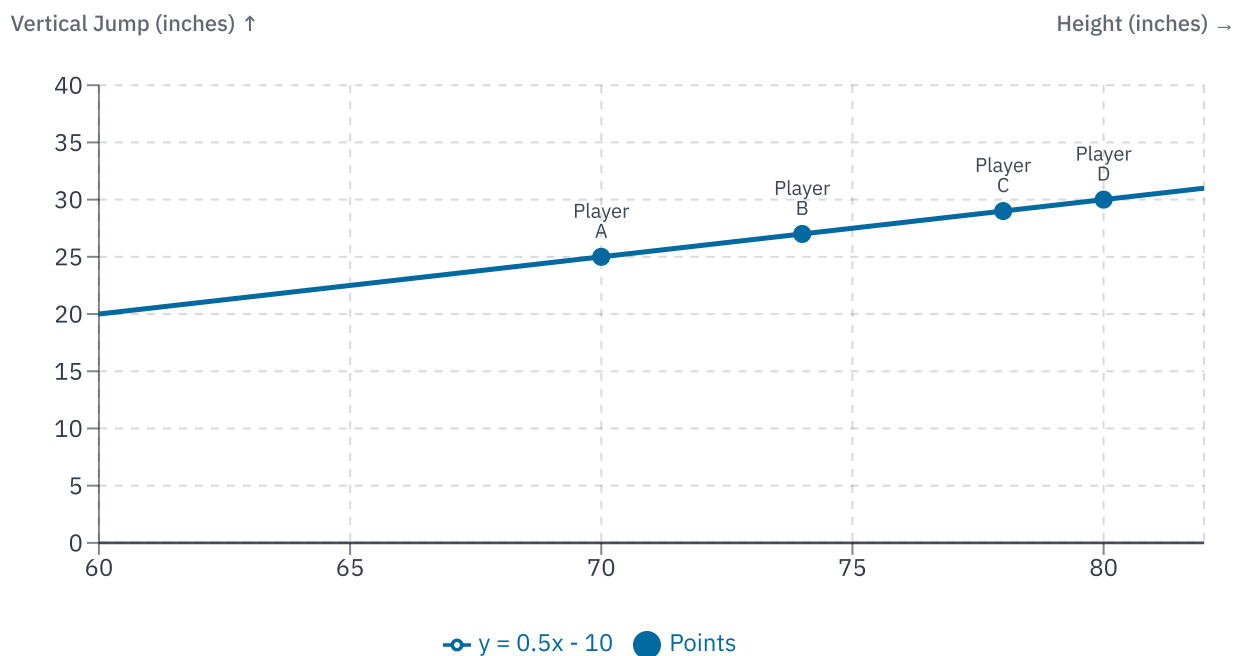
Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4

DOK 1 • Recall

Why DOK 1: Students find the input that gives an output of 20 by reading the graph or doing one substitution, which is a direct read-off.

The line shown models the relationship between a player's height and vertical jump. According to the graph, at what height would a player have a vertical jump of exactly 20 inches?

Basketball Player Height vs. Vertical Jump



☐ $x = 70$ inches

☐ $x = 50$ inches

☐ $x = 75$ inches

☒ $x = 60$ inches ✓

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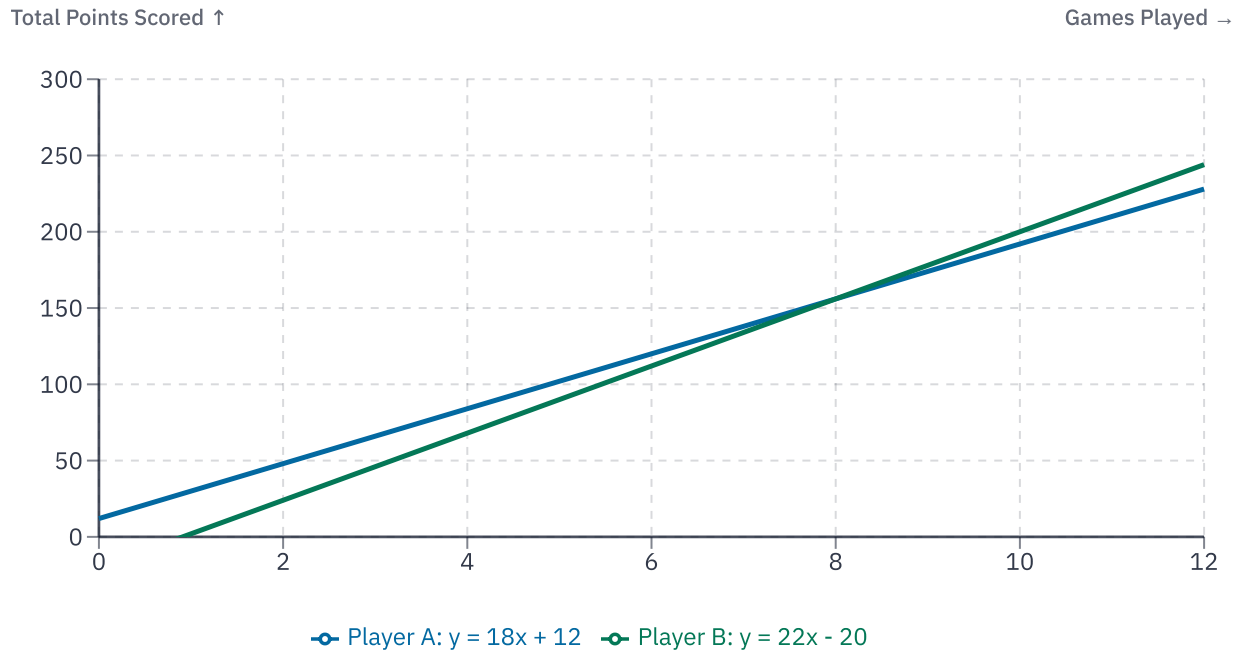
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Test Bank question

Why DOK 2: Students must recognize that equal totals mean the intersection of two lines and then find it by setting the equations equal and solving.

Two basketball players have scoring patterns modeled by linear equations. Player A scores according to $y = 18x + 12$, and Player B scores according to $y = 22x - 20$, where x represents games played and y represents total points scored. Based on the graphs shown, after how many games will both players have scored the same total number of points?

Basketball Player Scoring Models



☐ After 10 games

☐ After 16 games

☐ After 4 games

☒ After 8 games ✓

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Target J

A-REI.11

DOK 2

Generate

Test Bank question

1K Understand the concept of a function and use function notation

Standards: F-IF.1; F-IF.2; F-IF.3

Assessed at: **DOK 1** **DOK 2** DOK 3 DOK 4**DOK 1 · Recall**

Why DOK 1: Students identify which number is the input and which is the output in a given function statement, a direct use of function notation.

Use the drop-down menus to complete the statement.

A basketball player's total points scored in a season is given by the function $P(g) = 18g + 5$, where g is the number of games played. In this context, $P(10) = 185$ means the player scored points after playing games.

Drop-down 1 choices:

Drop-down 2 choices:

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must apply a recursive rule repeatedly to reach the fourth term and then interpret that value in context, which takes several connected steps.

A volleyball player's point totals form a sequence, where $f(n)$ is the number of points she scores in game n . The sequence is defined by $f(1) = 9$ and $f(n) = f(n - 1) + 5$ for $n \geq 2$. Select the statement that correctly interprets $f(4)$ for this situation.

$f(4) = 24$, meaning the player scores 24 points in her 4th game. ✓

$f(4) = 4$, meaning the player scores 4 points in her 9th game.

$f(4) = 9$, meaning the player scores 9 points in her 4th game.

$f(4) = 14$, meaning the player scores 14 points in her 2nd game.

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Test Bank question

1L Interpret functions that arise in applications in terms of a context

Standards: F-IF.4; F-IF.5; F-IF.6

Assessed at:

DOK 1

DOK 2

DOK 3

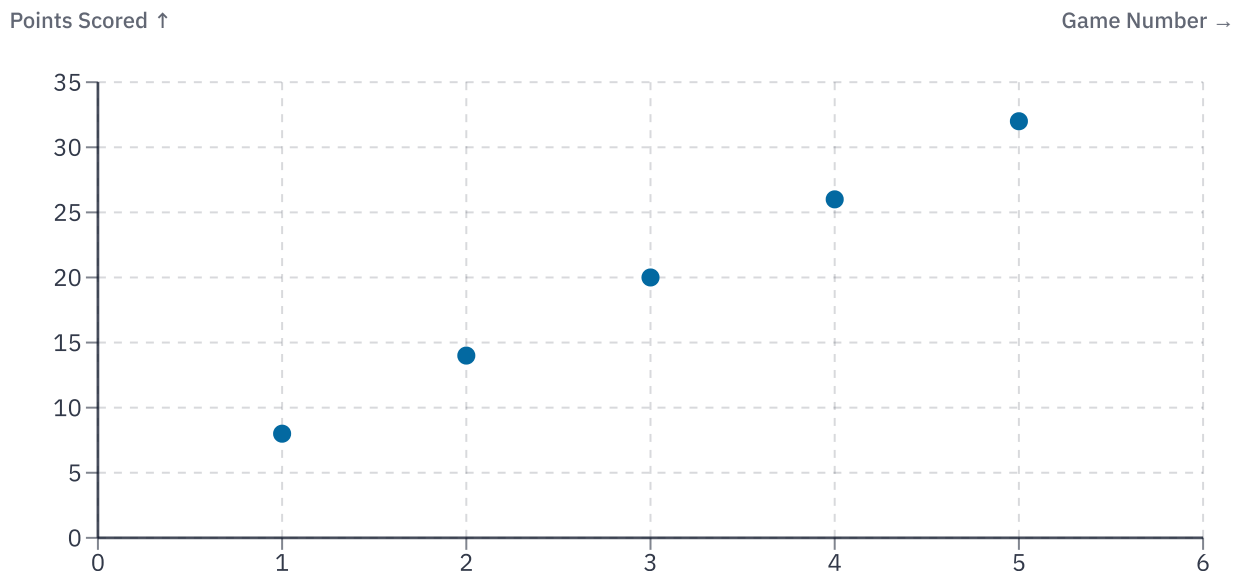
DOK 4

DOK 1 · Recall

Why DOK 1: Students read one labeled point from a graph and state what its coordinates mean, which is a direct read-off.

The graph shows how many points a basketball player scored in each of the first 5 games of the season. What does the point (3, 20) represent in this context?

Basketball Player's Points Scored Over Games



☐ The player's average score per game is 20 points in 3 games.

☒ In game 3, the player scored 20 points. ✓

☐ After 20 games, the player had scored 3 points total.

☐ The player scored 3 points in game 20.

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Test Bank question

A basketball player's vertical jump height over time during a training session is modeled by the function $h(t) = 24 + 0.5t$, where $h(t)$ is the height in inches and t is the number of weeks of training. Select all statements that correctly interpret key features of this function in terms of the context.

- ☐ After 10 weeks of training, the vertical jump height will be 29 inches. ✓
- ☐ The vertical jump height increases by 0.5 inches each week. ✓
- ☐ The function is decreasing, meaning the player's vertical jump gets worse over time.
- ☐ The initial vertical jump height before training begins is 24 inches. ✓
- ☐ The y -intercept of 24 represents the number of weeks needed to improve the jump.
- ☐ The vertical jump height reaches its maximum value at $t = 24$ weeks.

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Test Bank question

CLAIM 1 • CONCEPTS & PROCEDURES

1M Analyze functions using different representations

Standards: F-IF.7a; F-IF.7e; F-IF.9; F-BF.3

Assessed at: **DOK 1** **DOK 2** **DOK 3** ~~DOK 4~~**DOK 1 • Recall****Why DOK 1:** Students find each intercept with one routine step (set the input to zero, or set the output to zero) for a given linear function.

The balance on a gift card is modeled by $B(w) = 60 - 5w$, where $B(w)$ is the balance in dollars after w weeks. What are the intercepts of the graph of B ?

- ☒ Vertical intercept $(0, 60)$ and horizontal intercept $(12, 0)$ ✓
- ☐ Vertical intercept $(0, -5)$ and horizontal intercept $(60, 0)$
- ☐ Vertical intercept $(0, 60)$ and horizontal intercept $(-12, 0)$
- ☐ Vertical intercept $(0, 12)$ and horizontal intercept $(60, 0)$

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DOK 2 • Skills & concepts**Why DOK 2:** Students compare a function given as an equation with one given as a table, evaluating both at the same input before drawing a conclusion.

A high school basketball team is analyzing two players' scoring performance over the season. Player A's total points scored after each game is represented by the linear function $p(g) = 18g + 5$, where g is the number of games played. Player B's total points scored is shown in the table below:

Games Played	1	2	3	4	5
Total Points	12	24	36	48	60

Use these two different representations to answer the following questions.

Part A: Which statement correctly compares the initial scoring advantage of these two players?

Choose one answer.

- ☐ Player A starts with more total points after game 1, scoring 18 points compared to Player B's 12 points.

- ☒ Player A starts with more total points after game 1, scoring 23 points compared to Player B's 12 points. ✓
- ☐ Player B starts with more total points after game 1, scoring 24 points compared to Player A's 18 points.
- ☐ Both players have the same total points after game 1.

Part B: Which mathematical evidence from the two representations supports your answer to Part A?

Choose one answer.

- ☐ From the table, Player B's points increase by 12 each game. From the function, Player A's points increase by 18 each game.
- ☒ From the table, Player B scores 12 points total after game 1. From the linear function, $p(1) = 18(1) + 5 = 23$ points for Player A. ✓
- ☐ The y-intercept of Player A's function is 5, which is less than Player B's starting value of 12.
- ☐ Player B's function has a steeper slope of 12 points per game compared to Player A's slope of 18.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students compare a linear table with an exponential equation across several properties, including average rate of change and long-run behavior, and must reason about what happens beyond the data.

Two youth sports leagues are tracking participant growth. League A's number of participants is given by the table below, where x is years since 2015. League B's number of participants is modeled by the exponential function $B(x) = 200(1.15)^x$.

x : 0, 1, 2, 3

League A participants: 200, 240, 280, 320

Decide whether each statement is True or False.

	True	False
Both League A and League B start with 200 participants when $x = 0$.	☒	☐
League A grows by a constant number of participants each year, while League B grows by a constant percentage each year.	☒	☐
At $x = 3$, League B has fewer participants than League A.	☒	☐
As x increases without bound, League A will always have more participants than League B.	☐	☒
The rate of change of League A from $x = 1$ to $x = 2$ (40 participants/year) is greater than the average rate of change of League B over the same interval.	☒	☐

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Test Bank question

CLAIM 1 · CONCEPTS & PROCEDURES

1N Build a function that models a relationship between two quantities

Standards: F-BF.1; F-BF.2; F-LE.1; F-LE.2; F-LE.3; F-LE.5

Assessed at:

~~DOK 1~~

DOK 2

~~DOK 3~~

~~DOK 4~~

DOK 2 · Skills & concepts

Why DOK 2: Students build an explicit function from a verbal description, using the given first term and constant change to work out the starting value, not just copying numbers.

A lacrosse team's equipment budget increases by 150 dollars each season. If the team spent 800 dollars on equipment in season 1, write an explicit function $f(n)$ that models the total equipment budget in dollars for season n , where n is a positive integer. Write your answer in the form $f(n) =$ your expression.

Correct answer: **$f(n) = 150n + 650$**

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Test Bank question

CLAIM 1 · CONCEPTS & PROCEDURES

1P Summarize, represent, and interpret data on a single measurement variable

Standards: S-ID.1; S-ID.2; S-ID.3; S-ID.5; S-ID.6; S-ID.7; S-ID.8; S-ID.9

Assessed at: DOK-1 **DOK 2** DOK-3 DOK-4

DOK 2 · Skills & concepts

Why DOK 2: Students must check each step of a comparison of two data sets (medians, quartiles, IQR, outlier fence) and find where the work goes wrong.

A coach compared the points scored by two basketball teams over 7 games.

Team A: 12, 14, 15, 16, 18, 20, 45

Team B: 30, 32, 34, 35, 36, 38, 40

A student analyzed the two data sets. Select the step where the student made the first error.

Step 1: List the data in order — Team A: 12, 14, 15, 16, 18, 20, 45; Team B: 30, 32, 34, 35, 36, 38, 40.

Step 2: The median of Team A is 16 and the median of Team B is 35.

Step 3: For Team A, $Q1 = 14$ and $Q3 = 20$, so $IQR = 20 - 14 = 6$.

Step 4: The upper outlier boundary for Team A is $Q3 + 1.5(IQR) = 20 + 1.5(6) = 29$. Since $45 > 29$, the value 45 is an outlier for Team A.

Step 5: For Team B, $Q1 = 32$ and $Q3 = 38$, so $IQR = 38 - 32 = 16$. ✓

Step 6: Team B has a smaller spread and no outliers, so Team B's scores are more consistent than Team A's.

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Test Bank question

CLAIM 2

Claim 2 • Problem Solving

Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies. In the Test Bank, Claims 2, 3 and 4 are built in the performance task (PT) step: choose PT, then Area 2 • Claims 2 + 4. Each question card is marked with its claim and target (for example "Claim 2 • Tgt A"), so generate a set at the DOK you want and keep the cards for the target you need.

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2A Apply mathematics to solve well-posed problems from everyday life

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts**

Why DOK 2: Students write a cost expression for each gym and set them equal, choosing the approach themselves in a familiar two-step problem.

Gym A charges a one-time joining fee of 50 dollars plus 30 dollars per month. Gym B has no joining fee and charges 40 dollars per month. After how many months will the total amount paid be the same at both gyms?

Write your answer as a whole number.

Correct answer: **5**

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DOK 3 · Strategic thinking

Why DOK 3: Students must plan a multi-step solution, model profit for two companies, compare them, and explain how the best choice changes with the number of shirts.

The art club will sell T-shirts for 15 dollars each and wants a profit of at least 600 dollars. It can order the shirts from one of two companies.

Company A: 120 dollar setup fee plus 7 dollars per shirt

Company B: no setup fee, 9 dollars per shirt

- (a) For each company, find the least number of shirts the club must sell to make a profit of at least 600 dollars. Assume the club sells every shirt it orders.
- (b) The club expects to sell about 120 shirts. Which company should it use? Justify your choice with calculations.
- (c) Explain how your recommendation would change if the club expected to sell only 50 shirts.

Model response: (a) Company A: profit = $15x - (120 + 7x) = 8x - 120$. $8x - 120 \geq 600$ gives $x \geq 90$ shirts. Company B: profit = $15x - 9x = 6x$. $6x \geq 600$ gives $x \geq 100$ shirts.

(b) At 120 shirts, Company A gives $8(120) - 120 = 840$ dollars and Company B gives $6(120) = 720$ dollars. Company A is better. The costs are equal when $120 + 7x = 9x$, or $x = 60$, so Company A is cheaper for any order above 60 shirts.

(c) At 50 shirts, Company A gives $8(50) - 120 = 280$ dollars and Company B gives $6(50) = 300$ dollars, so Company B is better, but neither company lets the club reach its 600 dollar goal.

Rubric: 1 point: Correct minimum numbers of shirts for both companies (90 and 100), a correct comparison at 120 shirts with a recommendation of Company A, and a correct explanation that Company B is better at 50 shirts (noting the goal is not reached).

0 points: Anything less, including a response that is only partly correct.

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2B Select and use appropriate tools strategically

Assessed at: **DOK 1** **DOK 2** **DOK 3** ~~DOK 4~~

DOK 1 · Recall

Why DOK 1: The equation is given and students only carry out a routine two-step solve, using a calculator as a tool for the arithmetic.

A school band is renting a sound system for a concert. The rental company charges a flat fee of 45 dollars plus 15 dollars for each hour of use. The band pays a total of 165 dollars. Write and solve the equation $45 + 15h = 165$ using a calculator to find the number of hours, h , the band rented the sound system.

Correct answer: 8

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must recognize that the equation cannot be solved with algebra steps and choose graphing technology, then interpret the intersection correctly.

Account A starts with 500 dollars and grows by 35 dollars each year. Account B starts with 200 dollars and grows by 8% each year. Jordan wants to know after about how many years the two accounts will have the same balance. Which strategy and result are correct?

- ☒ Graph $y = 500 + 35t$ and $y = 200(1.08)^t$ with graphing technology and find where the graphs intersect; the balances are equal after about 25 years. ✓
- ☐ Set $500 + 35t = 200(1.08)^t$ and subtract 500 from both sides to solve exactly; the balances are equal after about 9 years.
- ☐ Make a table of both balances for $t = 0$ to $t = 10$; since Account A is larger in every row, the balances are never equal.
- ☐ Graph both functions with graphing technology and find where the graphs intersect; the balances are equal after about 15 years.

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A town planner recorded the town's population:

Year 0: 12,000

Year 1: 12,600

Year 2: 13,230

Year 3: 13,892

Year 4: 14,586

The town must open a new school in the first year the population is greater than 20,000.

- Decide whether a linear model or an exponential model fits the data better. Use the data as evidence, and write your model.
- Choose a tool (for example, a spreadsheet, the table feature of a graphing calculator, or a graph) to find the first whole year in which the population is greater than 20,000. Explain why the tool you chose is a good choice for this problem, and give the year.
- Describe how you could check your answer using a different tool or method.

Model response: (a) The differences (600, 630, 662, 694) are not constant, but the ratios are all about 1.05 (for example, $12,600 \div 12,000 = 1.05$ and $13,230 \div 12,600 = 1.05$). The population grows by 5% each year, so an exponential model fits: $P(t) = 12,000(1.05)^t$.

(b) A table in a spreadsheet or graphing calculator is a good tool, because the equation $12,000(1.05)^t = 20,000$ cannot be solved with algebra steps from this course, and a table quickly lists the population year by year. The table shows $P(10) \approx 19,547$ and $P(11) \approx 20,524$, so the first year is year 11.

(c) Graph $y = 12,000(1.05)^x$ and $y = 20,000$ and find the intersection, which is at about $x = 10.5$, so the first whole year above 20,000 is year 11. Or substitute $t = 10$ and $t = 11$ into the model with a calculator.

Rubric: 1 point: Justifies an exponential model using constant ratios and writes $P(t) = 12,000(1.05)^t$; uses an appropriate tool with a reason for choosing it and finds year 11; describes a valid second method to check.

0 points: Anything less, including a response that is only partly correct.

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2C Interpret results in the context of a situation

Assessed at: **DOK 1** **DOK 2** **DOK 3** ~~DOK 4~~

DOK 1 • Recall

Why DOK 1: The solution is already given; students only restate what it means in context with the correct units.

Use the drop-down menus to complete the statement.

A runner's distance from the starting line is modeled by the equation $d = 8t + 15$, where d is distance in meters and t is time in seconds. After solving for when the runner reaches 79 meters, you find $t = 8$ seconds. This result means the runner is 79 meters from ▼ the starting line after 8 seconds ▼.

Drop-down 1 choices: has passed is 79 meters from ✓ started at

Drop-down 2 choices: 8 seconds ✓ 15 seconds 64 seconds

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Test Bank question

A high school track coach is analyzing her sprinters' performance. During practice, one sprinter runs 100 meters in 12.5 seconds. The coach wants to express this sprinter's average speed in meters per second to compare it with a teammate who ran 200 meters in 24 seconds. What is the first sprinter's average speed, and what does this value tell you about how her performance compares to her teammate?

- ☒ The first sprinter's average speed is 8 m/s, which is slower than her teammate's speed of $\frac{200}{24} \approx 8.3$ m/s, so the teammate is the faster sprinter. ✓
- ☐ The first sprinter's average speed is 12.5 m/s, which is faster than her teammate's speed of 8 m/s, so the first sprinter is the faster sprinter.
- ☐ The first sprinter's average speed is 1,250 m/s, which makes her much faster than her teammate.
- ☐ The first sprinter's average speed is 8 m/s, which is the same as her teammate's speed of $\frac{200}{24} \approx 8.3$ m/s, so they have similar performance levels.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students compute two results and then judge each against the data range used to build the model, explaining which prediction can be trusted.

A track coach studies how standing vertical jump height relates to body mass using the rational-exponent model $H(m) = 120 m^{-1/3}$, where $H(m)$ is predicted jump height in centimeters and m is body mass in kilograms. The coach built this model using data from adult sprinters with masses between 50 kg and 100 kg. Use the properties of rational exponents to find the exact values of $H(64)$ and $H(8)$. Then explain whether each result is a meaningful prediction in the context of the coach's athletes, discussing the model's range of validity and your confidence in each prediction. Explain your reasoning.

Model response: Since $64^{1/3} = 4$, $H(64) = 120/4 = 30$ cm. Since $8^{1/3} = 2$, $H(8) = 120/2 = 60$ cm. The value $H(64) = 30$ cm is a reasonable, trustworthy prediction because 64 kg falls within the 50–100 kg range of the sprinters whose data built the model. However, $H(8) = 60$ cm is not a meaningful prediction: no adult sprinter has a mass of 8 kg, so this input lies far outside the data used to create the model. Using the formula there is an extrapolation beyond the model's valid domain, so the result, while mathematically correct, has no real-world confidence and should not be interpreted as an actual jump height.

Rubric: 1 point: Correctly computes $H(64) = 30$ cm and $H(8) = 60$ cm using rational exponent properties, and clearly explains that the first is a valid prediction within the model's data range while the second is an invalid extrapolation outside the realistic mass domain, discussing prediction confidence and model limitations.

0 points: Anything less, including a response that is only partly correct.

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Test Bank question

2D Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas)

Assessed at: **DOK 1** **DOK 2** **DOK 3** ~~DOK 4~~

DOK 1 • Recall

Why DOK 1: Students recognize which quantities matter for the stated goal, a direct identification with no calculation or relationship building.

A coach is planning a training program for a basketball team. The team needs to track player performance over 12 weeks. The coach wants to measure improvement and set goals. Which of the following represent important quantities and their relationships that should be mapped out for this problem? Select all that apply.

- ☐ The color of each player's jersey and its effect on shooting accuracy
- ☐ The total cost of basketballs divided by the number of players on the team
- ☒ The number of free throws made per player per week and how this changes over the 12-week period ✓
- ☒ The number of minutes played per player per game as it relates to total points scored over 12 weeks ✓
- ☒ Each player's average points scored per game and the relationship between practice hours and points scored ✓
- ☐ The alphabetical order of players' last names

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Test Bank question

DOK 2 · Skills & concepts

Why DOK 2: Students must pick out the relevant quantities and the correct relationship (time equals distance divided by speed, plus the stop) and convert minutes to hours.

A high school soccer team is planning a trip to a tournament 180 miles away. The team's bus travels at an average speed of 45 miles per hour. The trip will include one 30-minute stop for gas and food. Which of the following correctly identifies the important quantities and their relationship for finding the total time needed for the trip?

- ☐ The important quantities are distance (180 miles) and speed (45 mph), and the total time equals distance times speed: $180 \times 45 = 8100$ hours
- ☐ The important quantities are speed (45 mph) and the stop time (30 minutes), and the total time equals $45 + 0.5 = 45.5$ hours
- ☐ The important quantities are distance (180 miles) and the stop time (30 minutes), and the total time equals $180 - 30 = 150$ hours
- ☒ The important quantities are distance (180 miles) and speed (45 mph), and the total time equals distance divided by speed, then add the 30-minute stop: $\frac{180}{45} + 0.5 = 4.5$ hours ✓

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students organize many quantities, build the time and cost relationships themselves, and weigh a time cushion against cost to make and justify a decision.

A soccer team of 20 players must travel 240 miles to a tournament. They will leave at 8:30 AM and must arrive by 1:00 PM to warm up. The trip includes one 30-minute rest stop, and the coach wants at least a 15-minute cushion before 1:00 PM in case of traffic.

Bus A: costs 850 dollars total and averages 60 miles per hour

Bus B: costs 1,200 dollars total and averages 75 miles per hour

- (a) Identify the important quantities and show how they are related, using a table, diagram, or formulas.
- (b) Determine whether each bus meets all of the coach's requirements. Show your work.
- (c) Recommend a bus and find the cost per player for that bus.

Model response: (a) Important quantities: distance (240 miles), speed of each bus, driving time, rest stop (0.5 hour), cushion (0.25 hour), time window (8:30 AM to 1:00 PM is 4.5 hours), cost of each bus, and number of players (20). Relationships: driving time = distance $\div$ speed; total trip time = driving time + 0.5; the trip must satisfy total trip time + 0.25 $\leq$ 4.5, so total trip time $\leq$ 4.25 hours; cost per player = bus cost $\div$ 20.

(b) Bus A: $240 \div 60 = 4$ hours driving, total 4.5 hours. It arrives at exactly 1:00 PM with no cushion, so it does not meet the requirements. Bus B: $240 \div 75 = 3.2$ hours driving, total 3.7 hours (3 hours 42 minutes). It arrives at 12:12 PM with a 48-minute cushion, so it meets the requirements.

(c) Bus B is the only bus that meets the time requirements, even though it costs more. Cost per player: $1,200 \div 20 = 60$ dollars.

Rubric: 1 point: Clearly maps the quantities and relationships, correctly finds that Bus A arrives at 1:00 PM with no cushion and Bus B arrives at 12:12 PM, and recommends Bus B at 60 dollars per player.

0 points: Anything less, including a response that is only partly correct.

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CLAIM 3

Claim 3 • Communicating Reasoning

Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others. In the Test Bank, Claims 2, 3 and 4 are built in the performance task (PT) step: choose PT, then Area 3 • Claim 3. Each question card is marked with its claim and target (for example "Claim 3 • Tgt A"), so generate a set at the DOK you want and keep the cards for the target you need.

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3A Test propositions or conjectures with specific examples

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts**

Why DOK 2: Students test each value against the conjecture and decide which values make it false, applying the idea of a counterexample to several cases.

Lena makes this conjecture: "For every real number x , $x^2 > x$." Select all values of x that are counterexamples to Lena's conjecture.

☐ $x = 3$ ☐ $x = -2$ ☒ $x = 1$ ✓☒ $x = \frac{1}{2}$ ✓☒ $x = 0$ ✓☐ $x = 10$ **FIND MORE LIKE THIS**[Create questions](#)

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Marcus makes this conjecture: "For any linear function f , $f(a + b) = f(a) + f(b)$ for all numbers a and b ."

- (a) Test the conjecture using $f(x) = 2x + 3$ with $a = 1$ and $b = 2$.
- (b) Test the conjecture using $g(x) = 4x$ with two values of a and b of your choice.
- (c) Is Marcus's conjecture always true, sometimes true, or never true for linear functions? Use the general linear function $f(x) = mx + k$ to describe exactly which linear functions make the conjecture true, and explain why.

Model response: (a) $f(1 + 2) = f(3) = 2(3) + 3 = 9$, but $f(1) + f(2) = 5 + 7 = 12$. Since $9 \neq 12$, this is a counterexample.

(b) Example: $a = 1, b = 2$. $g(3) = 12$ and $g(1) + g(2) = 4 + 8 = 12$. The conjecture holds for this function.

(c) Sometimes true. For $f(x) = mx + k$: $f(a + b) = m(a + b) + k = ma + mb + k$, while $f(a) + f(b) = (ma + k) + (mb + k) = ma + mb + 2k$. These are equal only when $k = 2k$, which means $k = 0$. So the conjecture is true exactly for linear functions whose graphs pass through the origin, $f(x) = mx$, and false for every other linear function.

Rubric: 1 point: Correct tests in (a) and (b), concludes sometimes true, and uses algebra to show the conjecture holds exactly when the constant term is 0.

0 points: Anything less, including a response that is only partly correct.

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3B Construct chains of reasoning that will justify or refute propositions

Assessed at: DOK 1 DOK 2 DOK 3 DOK 4 DOK 4 is assessed only in the performance task.

DOK 2 • Skills & concepts

Why DOK 2: Students evaluate several step-by-step arguments and choose the one where each step correctly follows from the property that justifies it.

Which argument correctly justifies that every solution of $3x - 7 > 11$ is greater than 6?

- ☒ Add 7 to both sides to get $3x > 18$, because adding the same number to both sides keeps an inequality true. Then divide both sides by 3 to get $x > 6$, because dividing by a positive number keeps the direction of the inequality. ✓
- ☐ Divide both sides by 3 to get $x - 7 > 6$. Then add 7 to both sides to get $x > 13$, and every number greater than 13 is greater than 6.
- ☐ Subtract 7 from both sides to get $3x > 4$. Then divide both sides by 3 to get $x > \frac{4}{3}$.
- ☐ Add 7 to both sides to get $3x > 18$. Then divide both sides by 3 and reverse the inequality sign, because dividing always reverses the sign, giving $x < 6$.

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DOK 3 · Strategic thinking

Why DOK 3: Students must build a general argument by contradiction, linking definitions of rational numbers into a chain that works for every case, not just examples.

Kai claims: "If you add a rational number and an irrational number, the sum is always irrational."

Construct a logical argument that justifies Kai's claim. Your argument must work for every rational number and every irrational number, not just for examples. (You may want to think about what would happen if the sum were rational.)

Model response: Let r be a rational number and x be an irrational number. Suppose, for the sake of argument, that their sum $s = r + x$ is rational. Then $x = s - r$. Because s and r are both rational, we can write $s = \frac{a}{b}$ and $r = \frac{c}{d}$ with integers a, b, c, d and $b, d \neq 0$. Then $s - r = \frac{ad-bc}{bd}$, which is a ratio of two integers with a nonzero denominator, so $s - r$ is rational. That would make x rational, but x is irrational. This is a contradiction, so the assumption was false. Therefore $r + x$ must be irrational.

Rubric: 1 point: Assumes the sum is rational, shows that the irrational number would then equal a difference of two rationals, explains why that difference is rational, and concludes with the contradiction.

0 points: Anything less, including a response that is only partly correct.

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DOK 4 · Extended thinking

Why DOK 4: Students model two growth patterns, build a table, refute a claim with evidence, explain long-run behavior, and examine an assumption, an extended reasoning task like a performance task.

Two student-run social media accounts are tracked each week.

Account A has 500 followers and gains 40 followers each week.

Account B has 200 followers, and its number of followers grows by 6% each week.

Priya claims: "Account A will always have more followers than Account B, because it starts with more followers and gains more followers each week right now."

- (a) Write a function for the number of followers of each account after w weeks.
- (b) Make a table showing both accounts at $w = 0, 10, 20, 30, 40, 41$, and 42 . Round to the nearest whole follower.
- (c) Use your models and table to construct an argument that supports or refutes Priya's claim. Identify the first week in which Account B has more followers than Account A.
- (d) Explain why, once Account B passes Account A, Account B will stay ahead. Use what you know about how linear and exponential functions grow.
- (e) State one assumption your argument depends on, and explain how the conclusion could change if that assumption is false.

Model response: (a) $A(w) = 500 + 40w$ and $B(w) = 200(1.06)^w$.

(b) $w = 0$: 500 and 200; $w = 10$: 900 and 358; $w = 20$: 1,300 and 641; $w = 30$: 1,700 and 1,149; $w = 40$: 2,100 and 2,057; $w = 41$: 2,140 and 2,181; $w = 42$: 2,180 and 2,311.

(c) Priya's claim is false. Account A leads for the first 40 weeks, but at week 41 Account B has about 2,181 followers and Account A has 2,140. Week 41 is the first week Account B is ahead.

(d) Account A always gains exactly 40 followers per week. Account B gains 6% of its current total each week. At week 41, 6% of about 2,181 is about 131 followers, which is already more than 40. Because Account B's total keeps increasing, its weekly gain keeps increasing too, while Account A's gain stays at 40, so the gap keeps getting wider.

(e) Example: the argument assumes both growth patterns continue for 42 weeks. If Account B's growth rate slows (for example, to 2% per week), Account B might never pass Account A, or might pass it much later.

Rubric: 1 point: All parts addressed with one error or one weak explanation.

0 points: Anything less, including a response that is only partly correct.

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3C State logical assumptions being used

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts****Why DOK 2:** Students connect features of a linear model (constant slope, time variable) to the assumptions they imply, choosing among plausible statements.

Use the drop-down menus to complete the statement about the logical assumptions being made.

A coach models a runner's distance from the starting line using the equation $d = 12t + 45$, where d is distance in meters and t is time in seconds. The coach assumes that

the runner maintains a constant speed of 12 meters per second throughout the entire run ▼ ,

and also assumes that

time is non-negative since it represents time elapsed from the start ▼ .

Drop-down 1 choices:

the runner maintains a constant speed of 12 meters per second throughout the entire run ✓

the runner started 12 meters ahead of the starting line

the runner accelerates at a constant rate of 12 meters per second

Drop-down 2 choices: distance will always increase without limit

time can be any real number, including negative values

time is non-negative since it represents time elapsed from the start ✓

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Test Bank question

DOK 3 • Strategic thinking**Why DOK 3:** Students identify the assumption behind extrapolating a model far beyond its data and explain the consequences if it fails for real decisions.

A high school soccer team is designing a training program to track player fitness. The coach collects data on sprinting speed (in meters per second) and uses the linear model $v = 0.5t + 6$ to predict a player's maximum sprint speed v after t weeks of training. The model is based on observations of 15 players over an 8-week period, with sprint speeds ranging from 6.2 to 10 meters per second. The coach plans to use this model to project players' speeds for an entire season (20 weeks) and make decisions about which players qualify for the competitive team (those predicted to reach at least 9 m/s).

Part A: Which assumption must be made for this linear model to be valid when projecting to week 20?

Choose one answer.

- ☐ All players on the team will have identical sprint speeds by week 20.
- ☐ Sprint speed is measured in different units at week 20 than during the training period.
- ☐ The 15 players observed represent the exact population of all possible soccer players.
- ☒ The linear relationship between training weeks and sprint speed will continue at the same rate beyond the 8-week observation period. ✓

Part B: Which statement best explains why this assumption is necessary and what could happen if it fails?

Choose one answer.

- ☒ The assumption is necessary because extrapolating beyond observed data (8 weeks to 20 weeks) relies on the pattern continuing unchanged. If this assumption fails—for example, if improvement plateaus or accelerates—then predictions could be significantly inaccurate, leading the coach to incorrectly identify or exclude players from the competitive team. ✓
- ☐ The assumption is necessary because meters per second must be converted to kilometers per hour; if it fails, the unit conversion becomes impossible.
- ☐ The assumption is necessary to ensure that all measured speeds are positive numbers; if it fails, the model produces negative speeds.
- ☐ The assumption is necessary only to make calculations easier; if it fails, the coach can simply use different numbers.

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Test Bank question

3D Use the technique of breaking an argument into cases

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts****Why DOK 2:** Students check how an absolute value equation splits into two cases and judge statements about each case and the full solution set.

A basketball team is analyzing player performance based on points scored per game. The team uses the absolute value function $|x - 20|$ to measure how far each player's scoring deviates from the team's target of 20 points per game, where x represents points scored. To fully understand when this function equals specific values, the team breaks the analysis into cases based on whether a player scores above, below, or exactly at the target.

For each statement about the absolute value equation $|x - 20| = 8$, determine whether it is true or false by considering the two cases: Case 1 ($x \geq 20$) and Case 2 ($x < 20$).

	True	False
In Case 1 where $x \geq 20$, the equation $ x - 20 = 8$ simplifies to $x - 20 = 8$, which gives $x = 28$ points.	☒	☐
In Case 2 where $x < 20$, the equation $ x - 20 = 8$ simplifies to $-(x - 20) = 8$, which gives $x = 12$ points.	☒	☐
Both solutions $x = 28$ and $x = 12$ are valid because they satisfy the original equation $ x - 20 = 8$ when checked in their respective cases.	☒	☐
The complete solution set to $ x - 20 = 8$ is $x = 28$ only, since only Case 1 applies to absolute value problems.	☐	☒

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students set up both cases themselves, check each result against its case condition, and use that reasoning to explain why one claimed solution fails.

Jordan solved the equation $|x - 4| = 2x + 1$ and wrote: "The solutions are $x = -5$ and $x = 1$."

Use cases to solve the equation. For each case, state what the case assumes about x , solve the equation for that case, and decide whether the result fits the case. Then explain whether Jordan is correct.

Model response: Case 1: $x \geq 4$, so $x - 4 \geq 0$ and $|x - 4| = x - 4$. Then $x - 4 = 2x + 1$, so $x = -5$. But -5 is not greater than or equal to 4, so it does not fit this case and is rejected. (Check: $|-5 - 4| = 9$, but $2(-5) + 1 = -9$.)

Case 2: $x < 4$, so $x - 4 < 0$ and $|x - 4| = -(x - 4) = 4 - x$. Then $4 - x = 2x + 1$, so $3 = 3x$ and $x = 1$. Since $1 < 4$, it fits this case. (Check: $|1 - 4| = 3$ and $2(1) + 1 = 3$.)

The two cases cover every real number, so the only solution is $x = 1$. Jordan is not correct, because $x = -5$ came from a case whose condition it does not meet.

Rubric: 1 point: Sets up both cases with their conditions, solves each, rejects $x = -5$ because it does not satisfy $x \geq 4$, keeps $x = 1$, and explains that Jordan is incorrect.

0 points: Anything less, including a response that is only partly correct.

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CLAIM 3 • COMMUNICATING REASONING

3E Distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in the argument—explain what it is

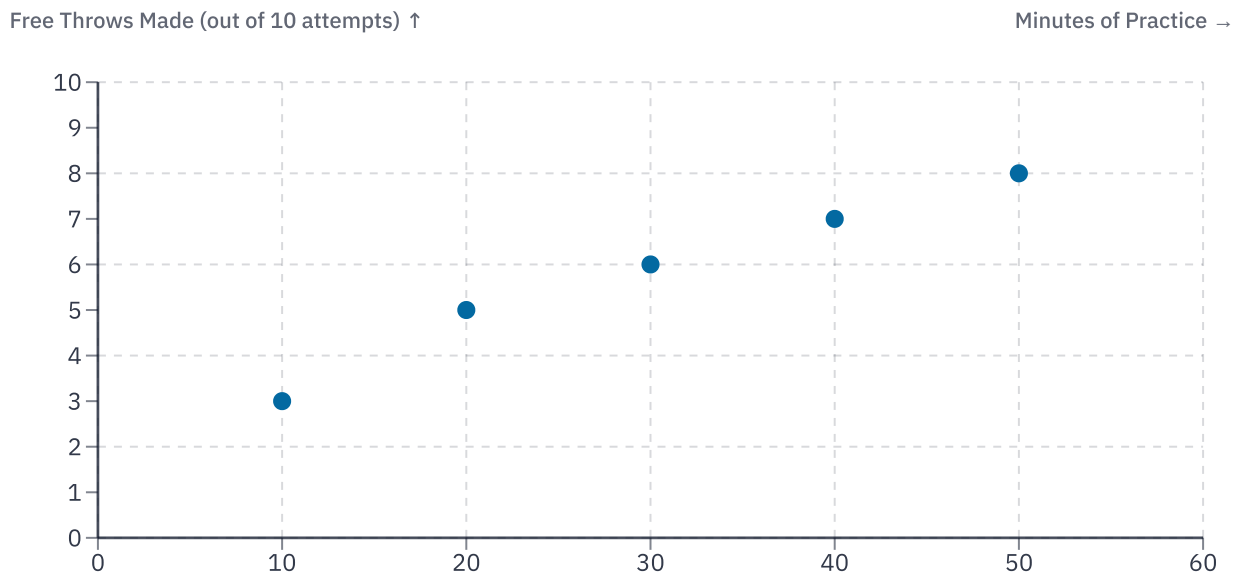
Assessed at: DOK 1 DOK 2 DOK 3 DOK 4 DOK 4 is assessed only in the performance task.

DOK 2 • Skills & concepts

Why DOK 2: Students check the coach's arithmetic and recognize that the flaw is extending a pattern past a real limit of 10 attempts.

A coach analyzes a player's free-throw practice data shown in the graph. The coach makes the following claim: 'Since the player made 3 free throws after 10 minutes of practice and 8 free throws after 50 minutes of practice, the player will definitely make 13 free throws after 90 minutes of practice because the pattern adds 5 free throws every 40 minutes.' Which statement best identifies the flaw in the coach's reasoning?

Basketball Player Training: Minutes Practiced vs. Free Throws Made



- ☐ The coach's reasoning is completely correct because the pattern shows a clear linear relationship between practice time and free throws made.
- ☐ The coach failed to identify the correct rate of improvement; the player actually makes 1 free throw per 10 minutes, not 5 per 40 minutes.
- ☐ The coach should have used a bar chart instead of a line graph to display this data, so the reasoning is unreliable.

- ☐ The coach correctly identified the rate of improvement but failed to consider that the player cannot make more than 10 free throws since there are only 10 attempts.



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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students judge five arguments about exponents, including a subtle flaw that only appears for values between 0 and 1, which requires careful reasoning, not recall.

A coach is analyzing athletic performance using exponential models. For each statement about rewriting expressions with rational exponents, determine whether the reasoning is correct or contains a logical flaw.

	Correct Reasoning	Flawed Reasoning
To rewrite $\sqrt[4]{x^3}$ using rational exponents, we apply the rule $\sqrt[n]{a^m} = a^{m/n}$, so $\sqrt[4]{x^3} = x^{3/4}$. This works because the denominator of the rational exponent matches the index of the radical.	☒	☐
Since $5^{1/2} = \sqrt{5}$ and $5^{1/3} = \sqrt[3]{5}$, it follows that $5^{1/6}$ must equal $\sqrt{5} \cdot \sqrt[3]{5}$ because we can multiply the expressions together.	☐	☒
When simplifying $(16^{1/2})^{1/2}$, we can use the power rule $(a^m)^n = a^{mn}$ to get $16^{(1/2)(1/2)} = 16^{1/4}$, which equals 2 because $16^{1/4} = \sqrt[4]{16}$. This method works regardless of the order in which we apply the operations.	☒	☐
To compare $\sqrt[3]{x^2}$ and $\sqrt{x}$ for $x > 0$, we convert both to rational exponents: $x^{2/3}$ and $x^{1/2}$. Since $2/3 > 1/2$, we can conclude that $x^{2/3} > x^{1/2}$ for all positive values of x .	☐	☒
The expression $32^{2/5}$ can be rewritten as $(32^{1/5})^2$, which equals $2^2 = 4$, because $32 = 2^5$ means $32^{1/5} = 2$. We could also compute this as $(32^2)^{1/5} = 1024^{1/5} = 4$, and both methods are valid because the power rule preserves equality.	☒	☐

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Test Bank question

DOK 4 · Extended thinking

Why DOK 4: Students compute statistics, judge three separate arguments, explain how an outlier misleads two of them, and write a supported recommendation, an extended multi-source critique.

Two school clubs recorded the money (in dollars) they raised each week for 8 weeks.

Club A: 40, 42, 45, 41, 44, 43, 46, 120

Club B: 50, 52, 49, 55, 51, 53, 50, 52

(In week 8, Club A received one large donation from a local business.)

Three students made claims:

Ana: "Club A has the higher mean, so Club A usually raises more money each week."

Ben: "The median is a better measure here. Club B's median is higher, so Club B usually raises more each week."

Cal: "Club A went from 40 dollars in week 1 to 120 dollars in week 8. That is about 11.43 dollars more each week, so Club A will raise about 166 dollars in week 12."

- (a) Find the mean and median for each club.
- (b) Decide whether each student's reasoning is correct or flawed. For each flawed argument, explain the flaw.
- (c) Write a short recommendation for the student council that describes which club usually raises more each week and gives a more reasonable estimate for Club A in week 12. Justify your estimate.

Model response: (a) Club A: mean = $421 \div 8 \approx 52.6$ dollars; median = $(43 + 44) \div 2 = 43.5$ dollars. Club B: mean = $412 \div 8 = 51.5$ dollars; median = $(51 + 52) \div 2 = 51.5$ dollars.

(b) Ana is flawed: Club A's mean is higher only because of the one-time 120 dollar donation, an outlier (it is far above the other values, which are all 40 to 46). Without it, Club A's mean is about 43 dollars. Ben is correct: the median resists the outlier, and Club B's median (51.5) is higher than Club A's (43.5). Cal is flawed: he built a rate from only two points, one of which is the outlier. Club A's other weeks show only small changes (about 1 dollar per week), so the 11.43 dollar rate does not describe the pattern.

(c) Club B usually raises more each week (about 51 to 52 dollars versus about 43 to 44 dollars for Club A). A more reasonable week-12 estimate for Club A is about 44 to 51 dollars, based on its typical weeks (median 43.5, with a slight upward trend of about 1 dollar per week from weeks 1 to 7), unless another large donation is expected.

Rubric: 1 point: All parts addressed with one error or one weak explanation.

0 points: Anything less, including a response that is only partly correct.

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3F Base arguments on concrete referents such as objects, drawings, diagrams, and actions

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4

DOK 2 • Skills & concepts

Why DOK 2: Students use the concrete data table to check each claim about speed, including what the table can and cannot show between recorded times.

A track coach recorded a runner's distance during a workout in a table:

$$t = 0 \text{ min}, d = 0 \text{ m}$$

$$t = 5 \text{ min}, d = 1000 \text{ m}$$

$$t = 10 \text{ min}, d = 2000 \text{ m}$$

$$t = 15 \text{ min}, d = 3000 \text{ m}$$

Maria uses this table as evidence to make claims about the runner's speed. Decide whether each statement, based on the concrete data in the table, is true or false.

	True	False
Since the table shows the distance increasing by 1000 meters every 5 minutes, the runner's average speed was 200 meters per minute over the whole workout.	☒	☐
The entry $t = 0, d = 0$ shows that the runner started 200 meters ahead of the starting line.	☐	☒
Using the values at $t = 10$ minutes and $t = 15$ minutes, the average speed during that interval was 200 meters per minute.	☒	☐
Using the values at $t = 5$ minutes and $t = 10$ minutes, the runner's speed during that interval was 100 meters per minute.	☐	☒
The table only gives distances at specific recorded times, so it does not prove the runner's speed was exactly 200 meters per minute at every instant between those times.	☒	☐

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Test Bank question

A coach has a storage crate shaped like a cube used to hold sports balls. The crate has a volume of 64 cubic feet, and it is built from small unit cubes (1 ft x 1 ft x 1 ft) stacked evenly in a 4-by-4-by-4 arrangement. (a) Use this concrete cube arrangement to explain why $64^{1/3} = 4$. (b) The coach then looks at just one face of the crate, a 4-by-4 square of unit squares, and uses it to represent $64^{2/3}$. Explain, using this square and the properties of exponents, why $64^{2/3} = 16$, and explain how the cube and square models together show that $64^{2/3} = (64^{1/3})^2$.

Model response: Since the crate is built from 4 layers of 4-by-4 unit cubes, it contains $4 \times 4 \times 4 = 64$ unit cubes, so a cube with edge length 4 has volume 64; this means the number whose cube is 64 (i.e., $64^{1/3}$) is 4, matching the definition of a cube root. The face of the crate is a 4-by-4 square made of 16 unit squares, so its area is $4^2 = 16$. Since $64^{1/3} = 4$ from the cube model, squaring that result gives $(64^{1/3})^2 = 4^2 = 16$, which matches the face's area. By the properties of integer exponents, $(64^{1/3})^2 = 64^{2/3}$, so the cube model (finding the edge length) and the square model (finding the face area) together physically demonstrate that $64^{2/3} = 16$: the cube gives the base value 4, and the square shows what happens when that value is raised to the second power, confirming the rational exponent rule $a^{m/n} = (a^{1/n})^m$.

Rubric: 1 point: Correctly identifies edge length 4 from the cube model, correctly computes the square's area as 16, and clearly explains how both concrete models together justify $64^{2/3} = (64^{1/3})^2 = 16$, connecting the physical arrangement to the exponent rule.

0 points: Anything less, including a response that is only partly correct.

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Test Bank question

3G Determine conditions under which an argument does and does not apply

Assessed at:

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DOK 2

DOK 3

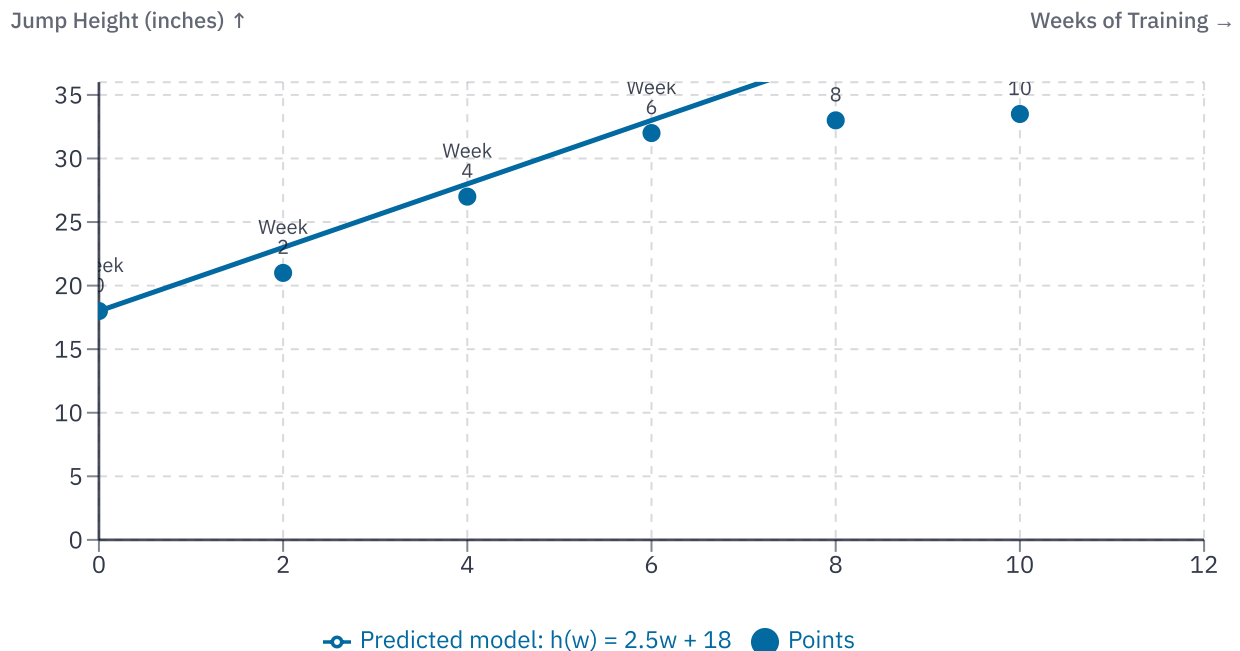
DOK 4

DOK 2 • Skills & concepts

Why DOK 2: Students compare data to a model line and identify the range of weeks where the model applies and where it stops working.

A coach uses the linear model $h(w) = 2.5w + 18$ to predict jump height from weeks of leg strength training. The scatter plot shows the actual data collected. For which weeks is the linear model a good predictor, and why does it stop working outside that range?

Vertical Jump Height vs. Leg Strength Training Weeks



- ☐ The model never fits well, since every data point differs at least slightly from the predicted line at every week shown.
- ☐ The model works only from week 0 to week 2, since after that the actual heights start rising faster than the line predicts.
- ☐ The model fits the data for all weeks from 0 to 10, since each point stays fairly close to the predicted line the whole time.

- ☐ The model is valid for about weeks 0 through 6, where the data follows the line. After week 6, gains level off, so the model's prediction of steady growth no longer applies. ✓

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students test an argument with chosen cases, describe exactly the conditions under which it holds, and correct it so it applies everywhere.

Ari says: "If $a > b$, then $ka > kb$ for any number k . So I can multiply both sides of an inequality by any number and the inequality stays true."

- (a) Test Ari's argument using $a = 5$ and $b = 2$ with $k = 3$, $k = -3$, and $k = 0$.
- (b) Describe exactly which values of k Ari's argument applies to and which values it does not apply to.
- (c) Explain how to correct Ari's statement so it works for every nonzero value of k . Then use the corrected statement to solve $-2x > 8$.

Model response: (a) $k = 3$: $15 > 6$ is true. $k = -3$: $-15 > -6$ is false (actually $-15 < -6$). $k = 0$: $0 > 0$ is false (the two sides are equal).

(b) The argument applies when $k > 0$. It does not apply when $k < 0$ (the inequality reverses) or when $k = 0$ (both sides become 0).

(c) Corrected statement: if $a > b$ and $k > 0$, then $ka > kb$; if $a > b$ and $k < 0$, then $ka < kb$.

Multiplying or dividing by a negative number reverses the inequality sign. To solve $-2x > 8$, divide both sides by -2 and reverse the sign: $x < -4$. Check: $x = -5$ gives $10 > 8$, which is true.

Rubric: 1 point: Correct tests for all three values of k , identifies $k > 0$ as the only case where the argument applies, gives a corrected statement for negative k , and solves to get $x < -4$.

0 points: Anything less, including a response that is only partly correct.

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CLAIM 4

Claim 4 • Modeling & Data Analysis

Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems. In the Test Bank, Claims 2, 3 and 4 are built in the performance task (PT) step: choose PT, then Area 2 • Claims 2 + 4. Each question card is marked with its claim and target (for example "Claim 4 • Tgt A"), so generate a set at the DOK you want and keep the cards for the target you need.

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4A Apply mathematics to solve problems from everyday life (Modeling)

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts**

Why DOK 2: Students set up a break-even equation and interpret the decimal solution in context, rounding up because partial jerseys cannot be sold.

A high school soccer team is selling spirit wear to raise money for uniforms. They paid 480 dollars for a bulk order of jerseys and plan to sell each jersey for 18 dollars. After selling some jerseys, they want to know how many they need to sell to cover their cost and break even. Which equation correctly models this situation, and what does the solution represent?

- ☐ The equation $18n - 480 = 0$ represents profit equals zero. Solving gives $n = 26.67$, so they need to sell 26 jerseys to break even.
- ☒ The equation $18n = 480$ represents total revenue equals total cost. Solving gives $n = 26.67$, so they need to sell 27 jerseys to break even. ✓
- ☐ The equation $480n = 18$ represents the relationship between cost and selling price. Solving gives $n = 26.67$, so they need to sell 27 jerseys to break even.
- ☐ The equation $18 + n = 480$ represents total money after selling jerseys. Solving gives $n = 462$, so they need to sell 462 jerseys to break even.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students define variables, write constraints and a profit function from a real situation, and find and justify the best combination, a non-routine planned solution.

A high school rowing team is planning a fundraiser where they will sell custom water bottles and team merchandise. Water bottles cost 3 dollars to produce and sell for 12 dollars each. Merchandise costs 8 dollars to produce and sell for 20 dollars each. The team has a budget of 500 dollars for production costs and can only store 80 items total before the event. The team wants to maximize profit. (a) Define variables and write an objective function and all constraints for this optimization problem. (b) Explain why your constraints fully capture the real-world limitations. (c) Find the combination of water bottles and merchandise that maximizes profit, and justify why this solution is optimal given your constraints.

Model response: Let w = number of water bottles and m = number of merchandise items. Objective function: Maximize $P = 9w + 12m$ (where $9 = 12 - 3$ and $12 = 20 - 8$). Constraints: $3w + 8m \leq 500$ (production budget), $w + m \leq 80$ (storage limit), $w \geq 0, m \geq 0$ (non-negativity). The constraints capture that production costs cannot exceed 500 dollars, total items cannot exceed storage capacity of 80, and we cannot produce negative quantities. To find the optimal solution, test corner points of the feasible region: (0, 0) gives $P = 0$; (0, 62) gives $P = 744$; (80, 0) gives $P = 720$; intersection of $3w + 8m = 500$ and $w + m = 80$ yields $w = \frac{140}{5} = 28, m = 52$, giving $P = 9(28) + 12(52) = 252 + 624 = 876$. The optimal solution is $w = 28$ water bottles and $m = 52$ merchandise items, generating a maximum profit of 876 dollars. This is optimal because it is the corner point with the highest profit value and lies within all constraints.

Rubric: 1 point: Defines variables and constraints correctly, writes objective function, finds the optimal corner point, and explains why it maximizes profit.

0 points: Anything less, including a response that is only partly correct.

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Test Bank question

4B Construct chains of reasoning to justify mathematical modelsAssessed at: ~~DOK 1~~ **DOK 2** **DOK 3** **DOK 4** DOK 4 is assessed only in the performance task.**DOK 2 • Skills & concepts****Why DOK 2:** Students test the model against the meaning of a percentage and recognize why a linear model fails for large inputs.

A basketball coach is modeling the relationship between players' practice hours per week and their free throw percentage. The coach collects data and creates a linear model: $y = 2.5x + 35$, where x is practice hours and y is free throw percentage. The coach then uses this model to make predictions about player performance. Select the statement that best justifies why this linear model may NOT be appropriate for this situation.

A linear model is appropriate because free throw percentage always increases as practice hours increase.

A linear model may not be appropriate because free throw percentage cannot exceed 100%, but the model predicts values greater than 100% for large values of x . ✓

A linear model is appropriate because the slope of 2.5 is positive, indicating improvement.

A linear model may not be appropriate because the y -intercept of 35 seems too low for player performance.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students compare two models against all the data using differences and ratios, then use context to defend one prediction over the other.

A used car's value was recorded each year after it was bought.

Year 0: 24,000 dollars

Year 1: 20,400 dollars

Year 2: 17,340 dollars

Year 3: 14,739 dollars

Sam notices the car lost 3,600 dollars in the first year and models its value with $V(t) = 24,000 - 3,600t$. Rosa models its value with $V(t) = 24,000(0.85)^t$.

- (a) Use the data to construct an argument for which model is better justified.
- (b) Use each model to predict the car's value after 7 years.
- (c) Explain which prediction is more reasonable and why.

Model response: (a) The yearly losses are 3,600, 3,060, and 2,601 dollars, which are not constant, so a linear model does not fit. The ratios are $20,400 \div 24,000 = 0.85$, $17,340 \div 20,400 = 0.85$, and $14,739 \div 17,340 = 0.85$, which are constant. The car keeps 85% of its value each year, so Rosa's exponential model is justified by the data. Sam's model only matches years 0 and 1; for year 3 it gives 13,200 dollars instead of 14,739 dollars.

(b) Sam: $24,000 - 3,600(7) = -1,200$ dollars. Rosa: $24,000(0.85)^7 \approx 7,694$ dollars.

(c) Rosa's prediction is more reasonable. A car cannot have a negative value, and the data show the car losing a smaller dollar amount each year as its value decreases, which is how an exponential decay model behaves.

Rubric: 1 point: Uses differences and ratios from the data to justify the exponential model, makes both predictions correctly, and explains why the negative value makes the linear prediction unreasonable.
0 points: Anything less, including a response that is only partly correct.

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DOK 4 · Extended thinking

Why DOK 4: Students analyze data, choose and build a model, test a competing model, apply both to a planning decision, and state assumptions, an extended modeling argument.

A city's new bike-share program recorded the number of rides taken each month.

Month 1: 1,200

Month 2: 1,450

Month 3: 1,690
Month 4: 1,960
Month 5: 2,200
Month 6: 2,450

The city needs 1 bike for every 50 rides taken in a month. A council member proposes planning with the model $R(m) = 1,200(1.2)^{m-1}$, which assumes ridership grows by 20% each month.

- (a) Analyze the data using differences and ratios. Decide whether a linear or an exponential model is better justified.
- (b) Write the model you chose.
- (c) Test the council member's model against the data, and explain what you find.
- (d) Use both models to predict the rides in month 12 and the number of bikes the city would need. Recommend how many bikes the city should plan for, and justify your recommendation.
- (e) State one assumption in your model, and describe how the city could check it as new data come in.

Model response: (a) Differences: 250, 240, 270, 240, 250, which are close to a constant 250. Ratios: about 1.21, 1.17, 1.16, 1.12, 1.11, which keep decreasing. Nearly constant differences support a linear model.

(b) Average increase = $(2,450 - 1,200) \div 5 = 250$ rides per month, so $R(m) = 1,200 + 250(m - 1)$, or $R(m) = 250m + 950$.

(c) The council model predicts $1,200(1.2)^5 \approx 2,986$ rides in month 6, but the actual number was 2,450. Its predictions grow too fast, and the gap gets larger each month, so it does not fit the data.

(d) Linear: $R(12) = 250(12) + 950 = 3,950$ rides, so $3,950 \div 50 = 79$ bikes. Council model: $R(12) = 1,200(1.2)^{11} \approx 8,916$ rides, so about 179 bikes. Recommend planning for about 80 bikes (or slightly more for a safety margin), because the linear model matches the data and the exponential model would more than double the number of bikes.

(e) Example: the linear model assumes ridership keeps increasing by about 250 rides per month, with no seasonal changes. The city can compare each new month's rides to the prediction and refit the model if the differences start to change, for example in winter.

Rubric: 1 point: All parts addressed with one error or one weak justification.

0 points: Anything less, including a response that is only partly correct.

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4C State logical assumptions being used

Assessed at: **DOK 1** **DOK 2** **DOK 3** ~~DOK 4~~**DOK 1 • Recall****Why DOK 1:** Students recognize the one assumption that makes a simple division work, with no calculation or reasoning chain required.

The student council says, "Each bus holds 50 students, so we need 6 buses to take all 300 students on the field trip." Which assumption is the student council making?

- ☒ Every bus will be filled with exactly 50 students. ✓
- ☐ Every student will bring a packed lunch.
- ☐ The field trip will last 6 hours.
- ☐ Some buses will hold more than 50 students.

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DOK 2 • Skills & concepts**Why DOK 2:** Students identify the constant-rate assumption in a linear model and connect it to the impossible 105% prediction.

A high school basketball coach models the relationship between the number of practice hours per week and the team's free throw percentage. The coach collects data over 8 weeks and finds that the free throw percentage increases by approximately 2.5 percentage points for each additional hour of practice per week. The coach uses the linear model $F = 55 + 2.5h$, where F is the free throw percentage and h is the number of practice hours per week. The model predicts that with 20 hours of practice per week, the team's free throw percentage would be 105%.

Part A: Which of the following represents a key assumption the coach made when creating this linear model?

Choose one answer.

- ☐ All players on the team have the same natural free throw ability.
- ☐ The team will definitely improve by exactly 2.5 percentage points each week regardless of current skill level.

- ☐ Free throw percentage is the only factor that affects basketball performance.
- ☒ The relationship between practice hours and free throw percentage remains constant and linear across all possible values of practice hours. ✓

Part B: Which statement best explains why this assumption creates a limitation of the model?

Choose one answer.

- ☐ The model assumes practice time is the only variable that matters, when in reality many factors influence free throw percentage.
- ☒ The model predicts physically impossible results (like 105% free throw percentage) because the linear relationship cannot continue indefinitely, showing the assumption breaks down at extreme values. ✓
- ☐ The model assumes that all basketball coaches use the same training methods.
- ☐ The model requires collecting data from more teams to be valid.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students must uncover several hidden assumptions on their own, show with calculations how changing each one affects the result, and produce a better estimate.

The student council models the profit from a school dance with $P = 12n - 900$, where n is the number of tickets sold at 12 dollars each and 900 dollars pays for the DJ and decorations. A council member says, "All 400 students in our school will come, so we will make 3,900 dollars."

- (a) Identify at least three assumptions built into this model and the council member's conclusion.
- (b) Choose two of your assumptions. For each one, describe a realistic way it might not hold, and use the model (or an adjusted model) to show how the predicted profit changes.
- (c) Give a more reasonable profit estimate. State the assumptions you used.

Model response: (a) Sample assumptions: every one of the 400 students buys a ticket; every ticket is sold at the full 12 dollar price; the only costs are the fixed 900 dollars (no cost per student); no one outside the school attends.

(b) Sample: If only 60% of students attend, $n = 240$ and $P = 12(240) - 900 = 1,980$ dollars. If the council also provides snacks costing 2 dollars per student, the model becomes $P = 10n - 900$, and with 400 students $P = 3,100$ dollars.

(c) Sample: Assuming about 60% of students attend and snacks cost 2 dollars per student, $P = 10(240) - 900 = 1,500$ dollars. Any reasonable estimate with clearly stated assumptions and correct calculations is acceptable.

Rubric: 1 point: States at least three reasonable assumptions, correctly shows the effect of two assumptions failing with calculations, and gives a reasonable estimate with stated assumptions.

0 points: Anything less, including a response that is only partly correct.

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4D Interpret results in the context of a situation

Assessed at: DOK 1 **DOK 2** DOK 3 DOK 4**DOK 2 • Skills & concepts**

Why DOK 2: Students compute a prediction and then judge whether it is reasonable by noticing it lies far outside the data used to build the model.

A track coach collected data on a runner's race times for distances between 2 miles and 5 miles and used it to build the linear model $T(d) = 6.5d + 2$, where d is the distance in miles and $T(d)$ is the predicted time in minutes. The coach wants to use this same model to predict the runner's time for a 10-mile race.

Part A: What time does the model predict for a 10-mile race, and is this prediction reasonable?

Choose one answer.

- ☒ 67 minutes, but the prediction is not reasonable because 10 miles is far outside the 2–5 mile range used to build the model ✓
- ☐ 65 minutes, but the prediction is not reasonable because the units of d are unclear
- ☐ 65 minutes, and the prediction is reasonable because a runner's pace never changes
- ☐ 67 minutes, and the prediction is reasonable because the model is linear

Part B: Which statement best supports your answer to Part A?

Choose one answer.

- ☐ Linear models can always be extended to any input value without loss of accuracy
- ☐ Since 10 is a multiple of 5, the model automatically applies to it
- ☐ The model's slope of 6.5 minutes per mile is too large to be realistic for any distance
- ☒ A runner's pace over a short race distance often differs from the pace they can sustain over a much longer distance, so extrapolating far beyond the original data range is unreliable ✓

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students interpret a break-even result, compare it with the team size, and discuss what the model assumes, building an open-ended, evidence-based judgment.

A high school soccer team is planning to sell team merchandise to raise funds. The coach models the relationship between the number of shirts sold, x , and the profit in dollars as $P(x) = 8x - 120$, where the 120 represents fixed costs for design and equipment. Based on this model, the team would need to sell $x = 15$ shirts to break even (earn zero profit). Interpret what this result means for the team's fundraising plan. Does this seem reasonable given that the team has about 45 members who could each buy a shirt? Explain your reasoning, including any concerns or advantages this model reveals.

Model response: Breaking even at $x = 15$ shirts means the team must sell at least 15 shirts just to cover their fixed costs of 120 dollars before making any profit. We can verify: $P(15) = 8(15) - 120 = 120 - 120 = 0$ ✓. This is reasonable and actually favorable because the team has 45 members, so selling 15 shirts represents only one-third of potential buyers from the team alone, making the break-even point very achievable. After selling 15 shirts, each additional shirt generates 8 dollars in profit. This suggests the plan is viable—the team can likely exceed break-even quickly and earn substantial funds by reaching all members and potentially other customers. However, the model assumes they can actually sell the shirts at the price used in the calculation and that fixed costs don't change.

Rubric: 1 point: Student interprets break-even correctly, verifies math, and compares to context, but does not fully explore implications or assumptions.

0 points: Anything less, including a response that is only partly correct.

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Test Bank question

4E Analyze adequacy and make improvements to existing models

Assessed at: DOK 4 DOK 2 DOK 3 DOK 4 DOK 4 is assessed only in the performance task.

DOK 2 • Skills & concepts

Why DOK 2: Students compare model and actual values to find where the model fits, where it fails, and which adjustment would improve it.

A track coach models a sprinter's 100-meter dash time (in seconds) as a function of weeks of training using $T(w) = 13.5 - 0.15w$, where w is the number of weeks since training began. The table shows the sprinter's actual recorded times.

$w = 0$: actual = 13.5 s, model = 13.5 s
 $w = 2$: actual = 13.2 s, model = 13.2 s
 $w = 4$: actual = 12.9 s, model = 12.9 s
 $w = 6$: actual = 12.8 s, model = 12.6 s
 $w = 8$: actual = 12.75 s, model = 12.3 s
 $w = 10$: actual = 12.7 s, model = 12.0 s

Based on this data, which statements about the model's accuracy and possible improvements are correct? Select all that apply.

- ☐ Since the sprinter's time cannot keep decreasing forever, a linear model should never be used for any part of this data.
- ☐ The model underestimates the sprinter's improvement at every point in the data set.
- ☒ The model closely matches the sprinter's actual times for $w = 0$ through $w = 4$. ✓
- ☐ To fix the model, the slope after $w = 6$ should be changed to -0.30 seconds per week to better match the data.
- ☒ A better model could use a smaller rate of decrease (a less negative slope) for weeks after $w = 6$ to reflect the sprinter's slowing rate of improvement. ✓
- ☒ After $w = 6$, the model overestimates the sprinter's improvement, predicting times that decrease faster than the sprinter's actual times. ✓

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students compute residuals, interpret their pattern to diagnose the model's flaw, build a better model, and show with evidence that it fits better.

An ice cream stand owner uses the model $S = 4T - 200$ to predict the number of cones sold, S , from the day's high temperature, T , in degrees Fahrenheit. The table shows actual sales on six days.

Temperature (°F): 70, 75, 80, 85, 90, 95

Cones sold: 85, 98, 118, 130, 148, 160

- (a) Find the residual (actual minus predicted) for each day.
- (b) Describe the pattern in the residuals and what it tells you about the model.
- (c) Write an improved linear model, and use residuals or another check to show that it fits the data better.
- (d) Use your improved model to predict sales on a 100°F day.

Model response: (a) Predicted values: 80, 100, 120, 140, 160, 180. Residuals: +5, -2, -2, -10, -12, -20.

(b) The residuals get more negative as the temperature rises, so the model predicts too many cones on hot days. The slope of 4 cones per degree is too large.

(c) Using the first and last data points, the slope is $(160 - 85) \div (95 - 70) = 3$ cones per degree, so $S = 85 + 3(T - 70)$, or $S = 3T - 125$. Predicted values: 85, 100, 115, 130, 145, 160. Residuals: 0, -2, +3, 0, +3, 0, which are small and show no pattern, so this model fits better.

(d) $S = 3(100) - 125 = 175$ cones.

Rubric: 1 point: Correct residuals, explains that the growing negative residuals show the slope is too large, writes an improved model with evidence that it fits better, and makes a correct prediction.

0 points: Anything less, including a response that is only partly correct.

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DOK 4 · Extended thinking

Why DOK 4: Students analyze residuals for two groups, find two different weaknesses, build new models with a capacity limit, and use them to defend a staffing decision.

A city pool manager uses the model $A = 12T - 700$ to predict daily attendance, A , from the high temperature, T , in degrees Fahrenheit. The pool can hold at most 400 swimmers. The table shows actual attendance.

Temperature (°F): 75, 80, 85, 90, 95

Weekday attendance: 150, 190, 230, 270, 310

Weekend attendance: 230, 290, 350, 400, 400

- (a) Find the model's residuals (actual minus predicted) for the weekday data and for the weekend data.
- (b) Describe what the residual patterns show about the model.
- (c) Build an improved model, or a set of models, that accounts for the differences you found and for the pool's capacity.
- (d) The manager schedules 1 lifeguard for every 40 swimmers (rounded up). Use your improved model to find the number of lifeguards needed on an 88°F weekday and on an 88°F weekend day. Compare with the number the original model would give, and explain why your model is better for planning.

Model response: (a) Predicted: 200, 260, 320, 380, 440. Weekday residuals:

–50, –70, –90, –110, –130. Weekend residuals: +30, +30, +30, +20, –40.

(b) The model overpredicts weekdays more and more as it gets hotter, so its slope is too steep for weekdays. On weekends it underpredicts by a constant 30 until attendance reaches the capacity of 400; after that the model keeps rising but attendance cannot.

(c) Weekday model: the slope is $(310 - 150) \div 20 = 8$, so $A = 8T - 450$. Weekend model: $A = 12T - 670$, but never more than 400 (use 400 whenever $12T - 670 > 400$, which is when T is above about 89°F).

(d) Weekday at 88°F: $8(88) - 450 = 254$ swimmers, $254 \div 40 = 6.35$, so 7 lifeguards. Weekend at 88°F: $12(88) - 670 = 386$ swimmers, so 10 lifeguards. The original model gives $12(88) - 700 = 356$ swimmers, or 9 lifeguards, for both days. That would schedule too many lifeguards on weekdays and too few on weekends. The improved models match the data and the capacity limit.

Rubric: 1 point: All parts addressed with one error or one weak explanation.

0 points: Anything less, including a response that is only partly correct.

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4F Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flow charts, or formulas)

Assessed at: **DOK 1** **DOK 2** **DOK 3** DOK 4**DOK 1 • Recall**

Why DOK 1: Students identify the independent variable from a table, a direct recognition task with no relationship building.

A high school basketball team tracks the relationship between the number of three-point shots attempted and the number made during their games. The coach creates a table to analyze this data:

Game	Three-Pointers Attempted	Three-Pointers Made
1	12	5
2	18	7
3	15	6
4	24	9

Which variable should be identified as the independent variable when mapping the relationship between these quantities?

- ☐ The game number, because it changes throughout the season
- ☒ Three-pointers attempted, because this is the quantity the team can directly control ✓
- ☐ Both variables equally, because they both appear in the table
- ☐ Three-pointers made, because this is what the team wants to maximize

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Test Bank question

Why DOK 2: Students define variables, write the revenue relationship and two constraints, and organize them in a table or diagram, mapping several connected quantities.

A high school basketball team is planning a fundraiser where they sell two types of items: team t-shirts for \$12 each and hoodies for \$28 each. The team wants to raise at least \$840 and estimates they can sell at most 50 items total. Create a diagram or table that maps the relationship between the number of t-shirts sold, the number of hoodies sold, and the total revenue. Clearly label your variables and identify which quantities are independent and which are dependent. Explain how your representation helps you understand the constraints of this situation.

Model response: Let t = number of t-shirts sold (independent variable) and h = number of hoodies sold (independent variable). Total revenue R (dependent variable) = $12t + 28h$. Constraints: $t + h \leq 50$ and $12t + 28h \geq 840$. A table or diagram should show: (1) the two independent variables t and h as inputs, (2) the dependent variable R as output with the formula $R = 12t + 28h$ clearly labeled, and (3) the two constraints listed separately. For example, a sample table might show: if $t = 30$ and $h = 20$, then total items = 50 and $R = 360 + 560 = 920$ dollars (meets both constraints). The representation clarifies that revenue depends on both sales quantities and helps visualize which combinations of t and h satisfy both the item limit and revenue goal.

Rubric: 1 point: Student clearly identifies both independent variables (t and h) and dependent variable (R), writes the revenue formula correctly, lists both constraints, and either creates a table/diagram with labeled quantities or provides a written explanation of how the representation supports understanding the problem.

0 points: Anything less, including a response that is only partly correct.

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Test Bank question

DOK 3 · Strategic thinking

Why DOK 3: Students must organize scattered facts into a two-way table, use conditional relative frequencies, and show that an overall total hides a difference between groups.

The student council surveyed 240 ninth and tenth graders about whether they prefer a car wash or a bake sale as a fundraiser.

130 of the students surveyed were ninth graders.

150 students in all preferred the car wash.

60 tenth graders preferred the bake sale.

- (a) Organize the information in a two-way frequency table. Include all row and column totals.
(b) The council claims, "More students overall prefer a car wash, so each grade should hold a car wash." Use conditional relative frequencies to decide whether the data support this claim for each grade.
(c) Recommend a fundraiser for each grade, and justify your recommendation.

Model response: (a)

	Car wash	Bake sale	Total
9th grade	100	30	130
10th grade	50	60	110
Total	150	90	240

(Tenth graders: $240 - 130 = 110$; tenth-grade car wash: $110 - 60 = 50$; ninth-grade car wash: $150 - 50 = 100$; ninth-grade bake sale: $130 - 100 = 30$.)

(b) Of the ninth graders, $100 \div 130 \approx 77\%$ prefer the car wash. Of the tenth graders, only $50 \div 110 \approx 45\%$ prefer the car wash and $60 \div 110 \approx 55\%$ prefer the bake sale. The claim is supported for ninth grade but not for tenth grade.

(c) Ninth grade should hold a car wash, and tenth grade should hold a bake sale, because a majority within each grade prefers that event. The overall total hides the difference between the grades.

Rubric: 1 point: Complete and correct table, correct conditional relative frequencies for both grades, and a recommendation for each grade justified by those frequencies.

0 points: Anything less, including a response that is only partly correct.

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4G Identify, analyze, and synthesize relevant external resources to pose or solve problems

Assessed at: DOK 1 DOK 2 DOK 3 DOK 4 Assessed only in the performance task, at DOK 3 and 4.

DOK 3 • Strategic thinking

Why DOK 3: Students judge the reliability and relevance of three outside sources and decide which combination best tests a model assumption.

A student is building a model to predict the relationship between a musician's weekly practice hours and their audition score. She finds three data sources: (A) official records from a regional youth orchestra over the past 5 years, (B) a music blog ranking performers by 'stage presence,' and (C) middle school band records from her district. To validate her model assumption that practice hours strongly predict audition scores, which combination of resources would provide the most reliable evidence, and why?

- ☐ Use only source C, since middle school records are easier to collect than orchestra data and require less analysis to use.
- ☐ Combine all three sources equally, since adding more sources always makes a model more accurate no matter their quality.
- ☐ Use source B, since stage presence rankings are made by experts and already reflect skilled judgment.
- ☒ Use source A as the main dataset since it is standardized, but also check source C to see if the same pattern holds for younger, less trained musicians. ✓

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Test Bank question

DOK 4 · Extended thinking

Why DOK 4: Students evaluate four outside sources, combine three of them with unit conversions into a model, and adapt their estimate to a new condition, an extended synthesis task.

A school is planting a vegetable garden that measures 20 feet by 20 feet. The garden club wants to estimate how much water it will need to add with a hose during the 12-week growing season and how much that water will cost. A student found these four sources:

Source 1 (university gardening guide): Vegetable gardens need about 1 inch of water per week. One inch of water over 1 square foot is about 0.623 gallon.

Source 2 (national weather service): Average rainfall in the area during the growing season is 0.4 inch per week.

Source 3 (city water department): Water costs 5.20 dollars for every 748 gallons.

Source 4 (a personal blog with no sources listed): "Gardens need at least 2 inches of water every day in summer."

- (a) Decide which sources to use and which to ignore. Justify your decisions.
- (b) Write a model for the number of gallons of hose water the garden needs each week.
- (c) Estimate the total hose water and the total cost for the 12-week season.
- (d) Explain how your estimate would change in a dry summer with only half the average rainfall, and give the new cost.

Model response: (a) Use Sources 1, 2, and 3: they come from reliable organizations and give the water need, the rainfall, and the price. Ignore Source 4: it lists no evidence, comes from a personal blog, and disagrees with the university guide by a large amount (14 inches per week).

(b) Area = $20 \times 20 = 400$ square feet. Water needed per week from all sources = $400 \times 0.623 = 249.2$ gallons. Rain supplies 0.4 inch, so the hose must supply $1 - 0.4 = 0.6$ inch: $G = 0.6 \times 249.2 \approx 149.5$ gallons per week. In general, $G = (1 - r)(400)(0.623)$, where r is the weekly rainfall in inches.

(c) Season: $149.52 \times 12 \approx 1,794$ gallons. Cost: $1,794.24 \div 748 \times 5.20 \approx 12.47$ dollars.

(d) With half the rainfall ($r = 0.2$), the hose must supply 0.8 inch per week: $0.8 \times 249.2 = 199.36$ gallons per week, or about 2,392 gallons for the season, costing about $2,392.32 \div 748 \times 5.20 \approx 16.63$ dollars. The cost rises by about 4 dollars.

Rubric: 1 point: All parts addressed with one computational error or one weak justification.

0 points: Anything less, including a response that is only partly correct.

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Sources

- Smarter Balanced Assessment Consortium, 2015–16 Summative Technical Report: claim statements, and the Appendix 2.A test blueprints (pp. 43–48), which list the DOK levels assessed for every claim and target. <https://www.cde.ca.gov/ta/tg/ca/documents/sb16sbtechrpt.pdf>
- Target wording and standards: Smarter Balanced Mathematics Content Specifications and the CCSS for Mathematics, as stored in the AchieveMetrics Test Bank.
- DOK level definitions: Smarter Balanced Content Specifications (Webb Depth of Knowledge), summarised on the "How to use" page.
- Example questions: the AchieveMetrics Test Bank, reviewed for this guide.

AchieveMetrics Test Bank · DOK Progression Guide · Math 1 · October 2026 edition.

