



Smarter Balanced Assessment Consortium:

Mathematics Practice Test Scoring Guide
Grade 11

08/14/2019



About the Practice Test Scoring Guides

The Smarter Balanced Mathematics Practice Test Scoring Guides provide details about the items, student response types, correct responses, and related scoring considerations for the Smarter Balanced Practice Test items. The items selected for the Practice Test are designed to reflect

- a broad coverage of claims and targets that closely mirror the summative blueprint.
- a range of student response types.
- a breadth of difficulty levels across the items, ranging from easier to more difficult items.

It is important to note that all student response types are not fully represented on every practice test, but a distribution can be observed across all the practice tests. The items presented are reflective of refinements and adjustments to language based on pilot test results and expert recommendations from both content and accessibility perspectives.

Within this guide, each item is presented with the following information¹:

- Claim: statement derived from evidence about college and career readiness
- Domain: a broad content area that contains related targets and standards (i.e., Geometry)
- Target: statement that bridges the content standards and the assessment evidence that supports the claim
- Depth of Knowledge (DOK): measure of complexity considering the student's cognitive process in response to an item. There are four DOK levels, a 4 being the highest level.
- Common Core State Standards for Mathematical Content (CCSS-MC)
- Common Core State Standards for Mathematical Practice (CCSS-MP)
- Static presentation of the item: static presentation of item from test administration system
- Static presentation of student response field(s): static presentation of response field from test administration system
- Answer key or exemplar: expected student response or example response from score point value
- Rubric and applicable score points for each item: score point representations for student responses

The following items are representative of the kinds of items that students can expect to experience when taking the Computer Adaptive Test (CAT) portion of the summative assessment for high school. A separate document is available that provides a high school sample performance task and scoring guide.

¹ Most of these terms (Claim, Domain, Target, DOK, etc.) are further defined in various other Smarter Balanced documents, as well as the Common Core State Standards for Mathematics. Refer to the *Content Specifications for the Summative Assessment of the Common Core State Standards for Mathematics* for more information.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#1	1	A-SSE	D	1	A-SSE.A.2	7

Select the expression that is equivalent to $(m^2 - 25)$.

- Ⓐ $(m^2 - 10m + 25)$
- Ⓑ $(m^2 + 10m + 25)$
- Ⓒ $(m - 5)(m + 5)$
- Ⓓ $(m - 5)^2$

Key: C

Rubric: (1 point) The student selects the correct equivalent expression.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#2	1	N-RN	A	1	N-RN.A.2	7

Select an expression that is equivalent to $\sqrt{3^8}$.

- (A) $3^{\frac{1}{4}}$
- (B) 3^3
- (C) 3^4
- (D) 3^6

Key: C

Rubric: (1 point) Student selects the correct expression in exponential form.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#3	1	A-APR	F	2	A-APR.A.1	7

Enter an expression equivalent to
 $(3x^2 + 2y^2 - 3x) + (2x^2 + y^2 - 2x) - (x^2 + 3y^2 + x)$
 using the fewest number of possible terms.

← → ↶ ↷ ✕

1	2	3	x	y
4	5	6	+	- * ÷
7	8	9	< ≤ = ≥ >	
0	.	-	$\frac{\square}{\square}$ $\square^\square$ $\square_\square$	$() [] \sqrt{\square} \sqrt[n]{\square} \pi i$
sin cos tan arcsin arccos arctan				

Key: $4x^2 - 6x$ or $-6x + 4x^2$

Rubric: (1 point) The student enters a correct equivalent expression.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#4	3	G-CO	F	3	G-CO.C.9	7

When a transversal intersects a pair of parallel lines it will create two pairs of alternate exterior angles.

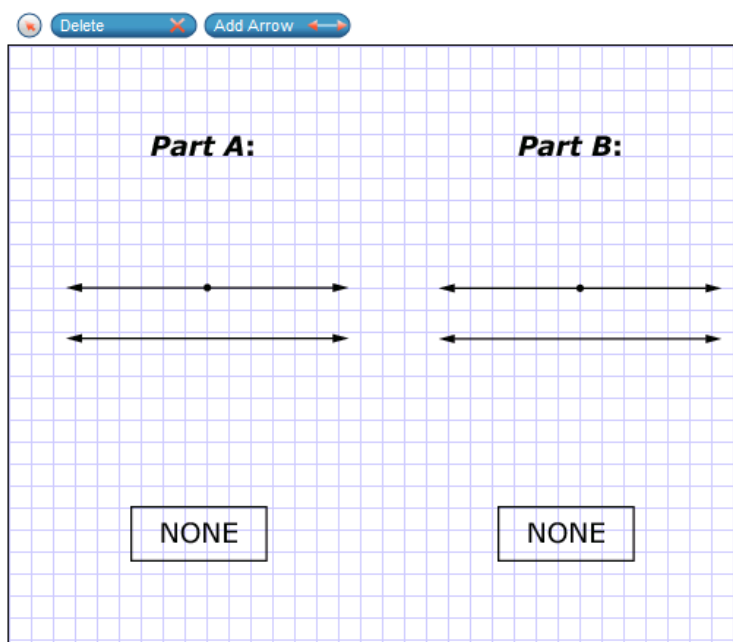
Ricky claims the angles within each pair are congruent to each other, but not congruent to either angle in the other pair.

Part A

Draw a transversal through the point that supports Ricky's claim or select **NONE** if there is not a situation to support the claim.

Part B

Draw a transversal through the point that **refutes** Ricky's claim, or select **NONE** if there is not a situation to refute the claim.



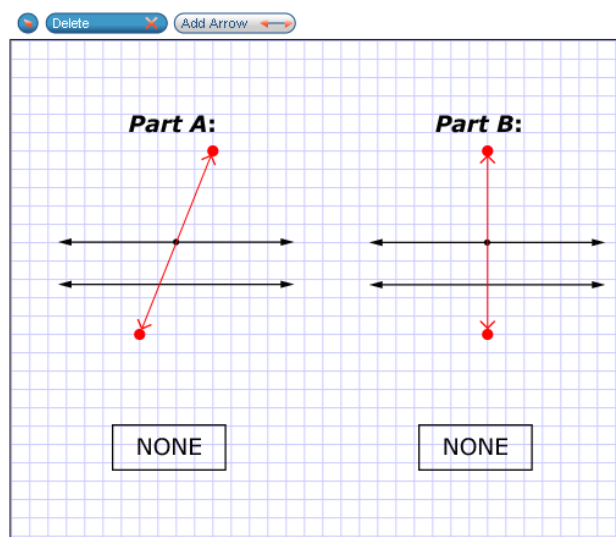
Exemplar: (shown at right)

Part A: a pair of parallel lines cut by transversal that is not perpendicular to the parallel lines

Part B: a pair of parallel lines cut by perpendicular transversal

Rubric: (2 points) Student draws correct transversals for Part A and Part B.

(1 point) Student draws correct transversal for Part A or Part B.



Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#5	1	A-REI	I	1	A-REI.B.3	7

Which inequality represents all possible solutions of $-6n < -12$?

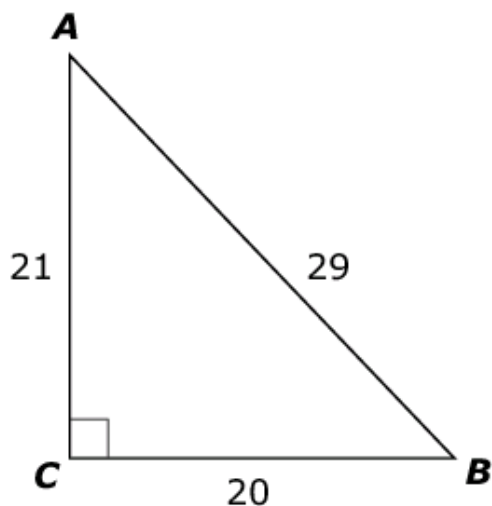
- Ⓐ $n < 72$
- Ⓑ $n > 2$
- Ⓒ $n < 2$
- Ⓓ $n > 72$

Key: B

Rubric: (1 point) Student selects the correct inequality.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#6	1	G-SRT	0	1	G-SRT.C.6	6

Consider this right triangle.



Enter the ratio equivalent to $\sin(B)$.

←
→
↶
↷
✕

1	2	3	+	-	*	÷		
4	5	6	<	≤	=	≥	>	
7	8	9	$\frac{\square}{\square}$	$\square^\square$	$\square_\square$	()		$\sqrt{\square}$
0	.	-	sin	cos	tan	arcsin	arccos	arctan

Key: 21/29

Rubric: (1 point) The student enters the correct ratio.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#7	3	N-RN	A	2	N-RN.B.3	7

Cheryl claims that any irrational number squared will result in a rational number.

Part A

Drag an irrational number into the first response box that when squared will result in a rational number.

Part B

Drag an irrational number into the second response box that when squared will result in an irrational number.

$\sqrt[3]{2}$
 $\sqrt{3}$
 $\frac{\sqrt{3}}{\sqrt{2}}$
 $\sqrt[3]{2}$
 $\sqrt{2}$
 π
 $\sqrt{\pi}$

Delete
✕

Part A

² = rational number

Part B

² = irrational number

Key: (Part A) any of the following: $\frac{\sqrt{3}}{\sqrt{2}}$, $\sqrt{2}$

(Part B) any of the following: $\frac{\sqrt[3]{2}}{\sqrt{3}}$, $\sqrt[3]{2}$, π , $\sqrt{\pi}$

Rubric: (1 point) The student correctly selects two numbers that when squared result in a rational number (Part A) and an irrational number (Part B).

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#8	1	A-CED	G	2	A-CED.A.1	N/A

A train travels 250 miles at a constant speed (x), in miles per hour.

Enter an equation that can be used to find the speed of the train, if the time to travel 250 miles is 5 hours.

← → ↶ ↷ ✖

1	2	3	x								
4	5	6	+	-	*	÷					
7	8	9	<	≤	=	≥	>				
0	.	-	$\frac{\Box}{\Box}$	$\Box^\Box$	$\Box_\Box$	()		$\sqrt{\Box}$	$\sqrt[\Box]{\Box}$	π	i
			sin	cos	tan	arcsin	arccos	arctan			

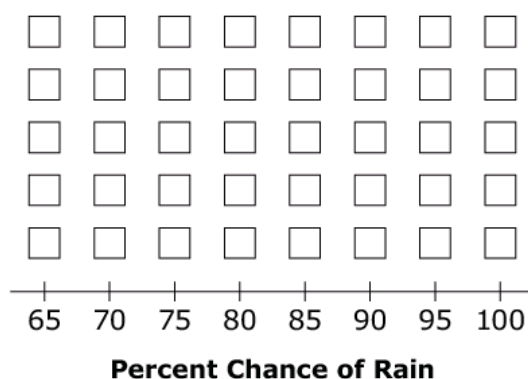
Key: $x = \frac{250}{5}$ or equivalent. However, do not accept $x = 50$ only.

Rubric: (1 point) The student enters a correct equation.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#9	1	S-ID	P	2	S-ID.A.1	4

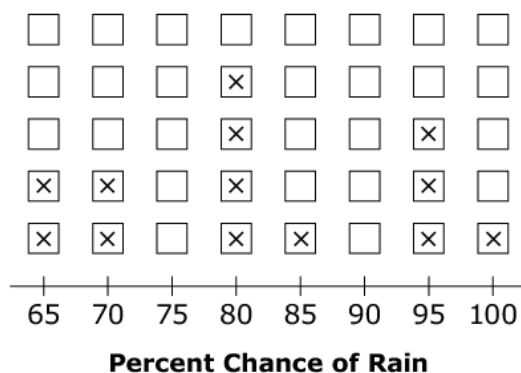
Click above the numbers to create a line plot for the given percent chances of rain in different cities.

65, 65, 70, 70, 80, 80, 80, 80, 85, 95, 95, 95, 100



Exemplar: (shown at right)

Rubric: (1 point) The student clicks the bottom two boxes of 65, two boxes of 70, four boxes of 80, one box of 85, three boxes of 95, and one box of 100.



Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#10	1	A-Q	C	2	A-Q.A.1	N/A

The formula for the rate at which water is flowing is $R = \frac{V}{t}$, where

- R is the rate,
- V is the volume of water measured in gallons (g), and
- t is the amount of time, in seconds (s), for which the water was measured.

Select an appropriate measurement unit for the rate.

(A) gs

(B) $\frac{g}{s}$

(C) $\frac{s}{g}$

(D) $\frac{1}{sg}$

Key: B

Rubric: (1 point) The student selects the correct measurement unit.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#11	3	A-REI	E	3	A-REI.B	3

Emily is solving the equation $2(x + 9) = 4(x + 7) + 2$. Her steps are shown.

Part A

Click on the first step in which Emily made an error.

Part B

Click on the solution to Emily's original equation.

Part A

Step 1: $2(x + 9) = 4(x + 7) + 2$

Step 2: $2x + 18 = 4x + 28 + 2$

Step 3: $2x + 18 = 4x + 26$

Step 4: $-8 = 2x$

Step 5: $-4 = x$

Part B

-10.5 -6 -2 0 2 4.5 8

Exemplar: (shown at right)

Rubric: (2 points) The student selects Step 3 in Part A and indicates -6 as the correct response in Part B.

(1 point) The student gets Part A or Part B correct, but not both.

Part A

Step 1: $2(x + 9) = 4(x + 7) + 2$

Step 2: $2x + 18 = 4x + 28 + 2$

Step 3: $2x + 18 = 4x + 26$

Step 4: $-8 = 2x$

Step 5: $-4 = x$

Part B

-10.5 -2 0 2 4.5 8

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#12	4	A-REI	D	3	A-REI.C	1

A store sells used and new video games. New video games cost more than used video games. All used video games cost the same. All new video games also cost the same.

Omar spent a total of \$84 on 4 used video games and 2 new video games. Sally spent a total of \$78 on 6 used video games and 1 new video game. Janet has \$120 to spend.

Enter the number of used video games Janet can purchase after she purchases 3 new video games.

←
→
↶
↷
✖

1	2	3
4	5	6
7	8	9
0	.	-

Key: 5

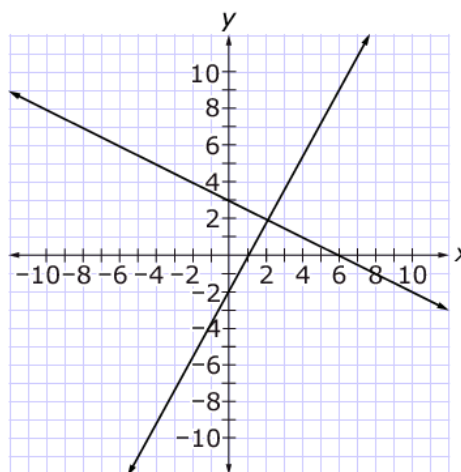
Rubric: (1 point) The student enters the number of used video games that Janet can purchase.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#13	1	A-REI	J	1	A-REI.D.12	N/A

Click on the region of the graph that contains the solution set of the system of linear inequalities.

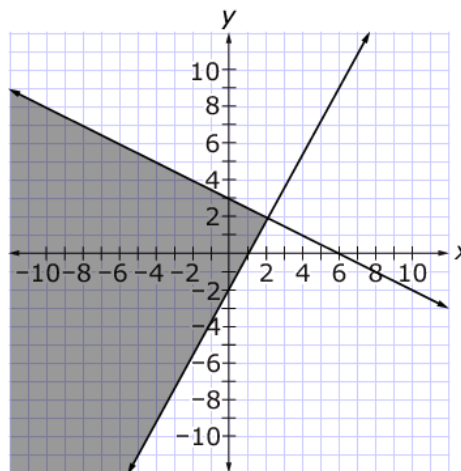
$$y \leq -\frac{1}{2}x + 3$$

$$y \geq 2x - 2$$



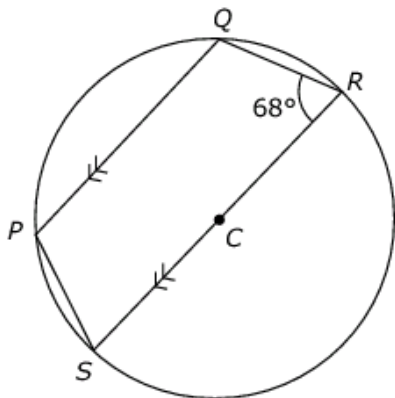
Exemplar: (shown at right)

Rubric: (1 point) The student correctly selects the region containing the solution set.



Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#14	3	G-C	G	2	G-C.A.3	6, 7

Use the circle below to answer the question.



The circle is centered at point C . Line segment PQ is parallel to SR . What is the measure of angle QPS ?

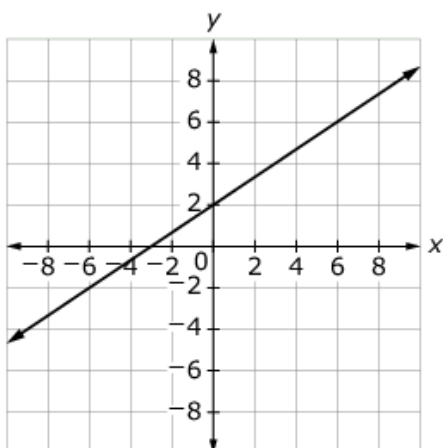
- (A) 68°
- (B) 112°
- (C) 136°
- (D) 158°

Key: B

Rubric: (1 point) The student selects the correct angle measure.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#15	1	A-REI	J	2	A-REI.D.10	N/A

Choose the ordered pair that is a solution to the equation represented by the graph.



- Ⓐ $(0, -3)$
- Ⓑ $(2, 0)$
- Ⓒ $(2, 2)$
- Ⓓ $(-3, 0)$

Key: D

Rubric: (1 point) The student selects the correct ordered pair.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#16	3	A-REI	E	3	A-REI.B.3	3

Consider this solution to a problem.

Problem: $-4(6 - y) + 4 = -4$

Step 1: $-24 - 4y + 4 = -4$

Step 2: $-20 - 4y = -4$

Step 3: $-4y = 16$

Step 4: $y = -4$

In the first response box, enter the number of the step where the mistake is made.

In the second response box, enter the correct solution to the problem.

← → ↶ ↷ ✕

1	2	3	y								
4	5	6	+	-	*	÷					
7	8	9	<	≤	=	≥	>				
0	.	-	$\frac{\Box}{\Box}$	$\Box^\Box$	$\Box_\Box$	()		$\sqrt{\Box}$	$\sqrt[\Box]{\Box}$	π	i
			sin	cos	tan	arcsin	arccos	arctan			

Key: Part 1: Step 1

Part 2: $y = 4$ (or 4)

Rubric: (1 point) The student enters the step where the mistake occurs and enters the correct solution.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#17	1	F-IF	K	2	F-IF.A.3	N/A

Consider a sequence whose first five terms are: -1.75 , -0.5 , 0.75 , 2 , 3.25

Which function (with domain all integers $n \geq 1$) could be used to define and continue this sequence?

Ⓐ $f(n) = \frac{7}{4}(n - 1) - \frac{5}{4}$

Ⓑ $f(n) = \frac{5}{4}(n - 1) - \frac{7}{4}$

Ⓒ $f(n) = \frac{7}{4}n - \frac{5}{4}$

Ⓓ $f(n) = \frac{5}{4}n - \frac{7}{4}$

Key: B

Rubric: (1 point) The student selects the correct function.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#18	1	A-SSE	E	2	A-SSE.B.3	7

Write an expression equivalent to $\frac{b^{11}}{b^4}$ in the form b^m .

←
→
↶
↷
✕

1	2	3	b								
4	5	6	+	-	*	÷					
7	8	9	<	≤	=	≥	>				
0	.	-	$\frac{\Box}{\Box}$	$\Box^\Box$	$\Box_\Box$	()		$\sqrt{\Box}$	$\sqrt[\Box]{\Box}$	π	i
			sin	cos	tan	arcsin	arccos	arctan			

Key: b^7

Rubric: (1 point) The student enters the correct expression.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#19	4	A-REI	E	3	A-REI.B.3	6

Nina has some money saved for a vacation she has planned.

- The vacation will cost a total of \$1600.
- She will put \$150 every week into her account to help pay for the vacation.
- She will have enough money for the vacation in 8 weeks.

If Nina was able to save \$200 a week instead of \$150 a week, how many fewer weeks would it take her to save enough money for the vacation? Enter the result in the response box.

← → ↶ ↷ ✖

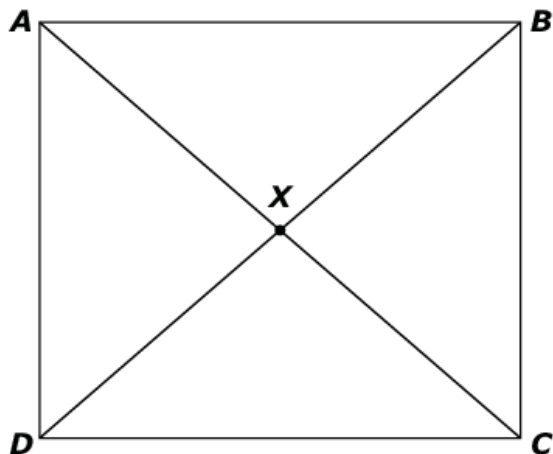
1	2	3
4	5	6
7	8	9
0	.	-

Key: 2

Rubric: (1 point) Student enters the correct number of weeks.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#20	3	G-CO	A	2	G-CO.C.11	3

Consider parallelogram $ABCD$ with point X at the intersection of diagonal segments AC and BD .



Evelyn claims that $ABCD$ is a square. Select **all** statements that must be true for Evelyn's claim to be true.

- ☐ $AB = BD$
- ☐ $AD = AB$
- ☐ $AC = BX$
- ☐ $m\angle ABC \neq 90^\circ$
- ☐ $m\angle AXB = 90^\circ$

Exemplar: (shown at right)

Rubric: (1 point) The student selects the statements that must be true.

- ☐ $AB = BD$
- ☒ $AD = AB$
- ☐ $AC = BX$
- ☐ $m\angle ABC \neq 90^\circ$
- ☒ $m\angle AXB = 90^\circ$

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#21	2	A-CED	A	2	A-CED.A.1	2

A student earns \$7.50 per hour at her part-time job. She wants to earn at least \$200.

Enter an inequality that represents all of the possible numbers of hours (h) the student could work to meet her goal. Enter your response in the first response box.

Enter the least whole number of hours the student needs to work in order to earn at least \$200. Enter your response in the second response box.

← → ↶ ↷ ✖

1	2	3	h			
4	5	6	+	-	*	÷
7	8	9	<	≤	=	≥
0	.	-	$\frac{\Box}{\Box}$	$\Box^\Box$	$\Box_\Box$	() $\sqrt{\Box}$ $\sqrt[\Box]{\Box}$ π i
			sin	cos	tan	arcsin arccos arctan

Key: Part A: $7.5h \geq 200$ or equivalent

Part B: 27 or $h = 27$

Rubric: (2 points) The student enters the correct inequality and value.

(1 point) The student enters the correct inequality or correct value. OR The student enters the correct answers in the wrong box.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#22	1	S-ID	P	2	S-ID.A	7

Michael took 12 tests in his math class. His lowest test score was 78. His highest test score was 98. On the 13th test, he earned a 64. Select whether the value of each statistic for his test scores increased, decreased, or could not be determined when the last test score was added.

	Standard Deviation	Median	Mean
Increased	☐	☐	☐
Decreased	☐	☐	☐
Could Not Be Determined	☐	☐	☐

Exemplar: (shown below)

	Standard Deviation	Median	Mean
Increased	☒	☐	☐
Decreased	☐	☐	☒
Could Not Be Determined	☐	☒	☐

Rubric: (1 point) The student correctly selects the changes in statistics.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#23	2	G-SRT	D	2	G-SRT.C.8	3

Emma is standing 10 feet away from the base of a tree and tries to measure the angle of elevation to the top. She is unable to get an accurate measurement, but determines that the angle of elevation is between 55 degrees and 75 degrees.

Decide whether each value given in the table is a reasonable estimate for the tree height. Select Reasonable or Not Reasonable for each height.

	Reasonable	Not Reasonable
4.2 feet	☐	☐
14.7 feet	☐	☐
24.4 feet	☐	☐
33.9 feet	☐	☐
39.1 feet	☐	☐
58.7 feet	☐	☐

Exemplar: (shown at right)

Rubric: (1 point) The student correctly identifies the reasonable estimates.

	Reasonable	Not Reasonable
4.2 feet	☐	☒
14.7 feet	☒	☐
24.4 feet	☒	☐
33.9 feet	☒	☐
39.1 feet	☐	☒
58.7 feet	☐	☒

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#24	4	A-CED	F	3	A-CED	1; 4

Emily has a gift certificate for \$10 to use at an online store. She can purchase songs for \$1 each or episodes of TV shows for \$3 each. She wants to spend exactly \$10.

Part A

Create an equation to show the relationship between the number of songs, x , Emily can purchase and the number of episodes of TV shows, y , she can purchase.

Part B

Use the Add Point tool to plot **all** possible combinations of songs and TV shows Emily can purchase.

Part A

$x +$ $y =$

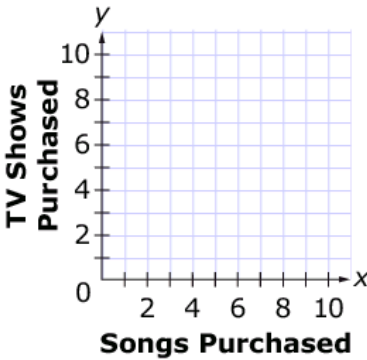
0
1
2
3
4
5
6
7
8
9
10

0
1
2
3
4
5
6
7
8
9
10

0
1
2
3
4
5
6
7
8
9
10

Part B

Emily's Online Spending



Exemplar: (shown at right)

Rubric: (2 points) The student creates the equation $1x + 3y = 10$ (or equivalent) and plots only the points (10, 0), (7, 1), (4, 2), and (1, 3).

(1 point) The student creates the equation $1x + 3y = 10$ (or equivalent) OR plots only the points (10, 0), (7, 1), (4, 2), and (1, 3).

Note: The student may leave the response box in front of the x blank as an assumed 1.

Part A

1

 $x +$

3

 $y =$

10

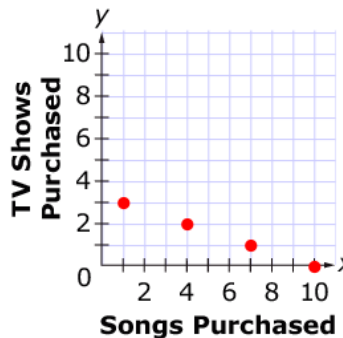
0
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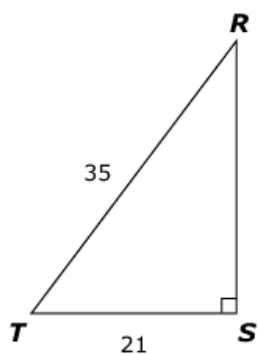
Part B

Emily's Online Spending



Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#25	1	G-SRT	0	1	G-SRT.C.8	2

Consider this right triangle.



Determine whether each expression can be used to find the length of side RS . Select Yes or No for each expression.

	Yes	No
$35 \cdot \sin(R)$	☐	☐
$21 \cdot \tan(T)$	☐	☐
$35 \cdot \cos(R)$	☐	☐
$21 \cdot \tan(R)$	☐	☐

Exemplar: (shown at right)

Rubric: (1 point) The student correctly selects the expressions that can be used to find the length of the side.

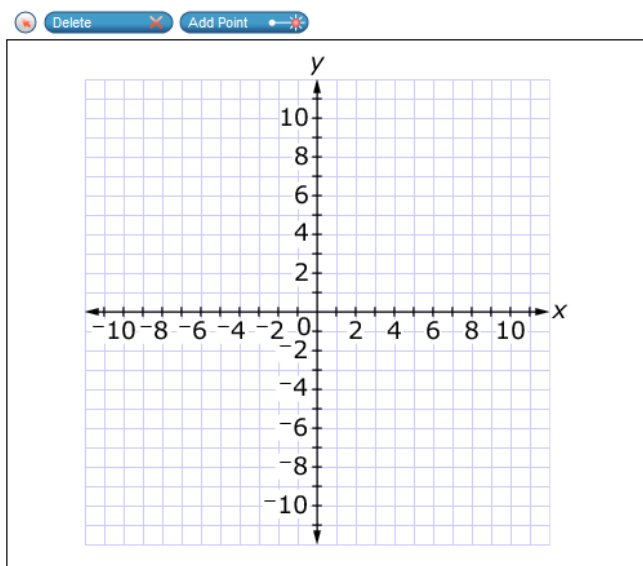
	Yes	No
$35 \cdot \sin(R)$	☐	☒
$21 \cdot \tan(T)$	☒	☐
$35 \cdot \cos(R)$	☒	☐
$21 \cdot \tan(R)$	☐	☒

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#26	1	F-IF	M	2	F-IF.C.7	N/A

Given the function

$$y = 3x^2 - 12x + 9,$$

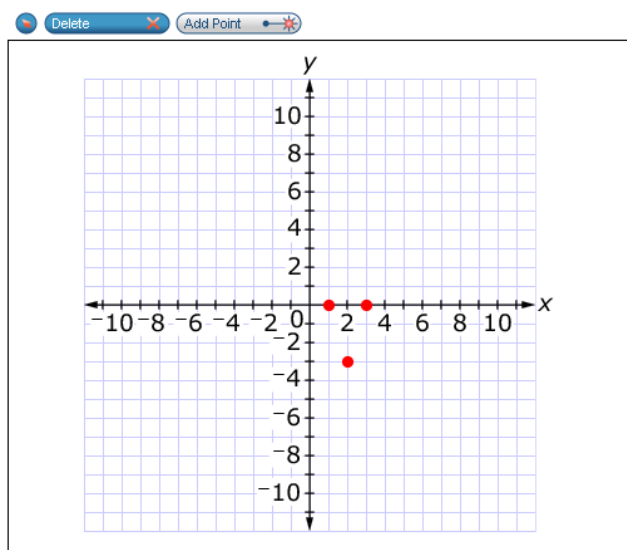
- Place a point on the coordinate grid to show each x-intercept of the function.
- Place a point on the coordinate grid to show the minimum value of the function.



Exemplar: (shown at right)

Rubric: (2 points) Part A: The student correctly plots the x-intercepts (with no other x-intercepts plotted). Part B: The student correctly plots the minimum (with no other points not on the x-axis plotted).

(1 point) The student gets Part A or Part B correct, but not both.



Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#27	1	A-CED	G	2	A-CED.A.1	N/A

Mike earns \$6.50 per hour plus 4% of his sales.

Enter an equation for Mike's total earnings, E , when he works x hours and has a total of y sales, in dollars.

← → ↶ ↷ ✕

1	2	3	x	y	E						
4	5	6	+	-	*	÷					
7	8	9	<	≤	=	≥	>				
0	.	-	$\frac{\Box}{\Box}$	$\Box^\Box$	$\Box_\Box$	()		$\sqrt{\Box}$	$\sqrt[n]{\Box}$	π	i
			sin	cos	tan	arcsin	arccos	arctan			

Key: $E = 6.5x + 0.04y$ OR equivalent

Rubric: (1 point) The student enters the correct equation.

Item	Claim	Domain	Target	DOK	CCSS-MC	CCSS-MP
#28	2	A-REI	A	2	A-REI.C	6

The basketball team sold t-shirts and hats as a fund-raiser. They sold a total of 23 items and made a profit of \$246. They made a profit of \$10 for every t-shirt they sold and \$12 for every hat they sold.

Determine the number of t-shirts and the number of hats the basketball team sold.

Enter the number of t-shirts in the first response box.

Enter the number of hats in the second response box.

←

→

↶

↷

✖

1	2	3
4	5	6
7	8	9
0	.	-

Key: Part A: 15

Part B: 8

Rubric: (1 point) The student enters the correct number of t-shirts in the first response box and the correct number of hats in the second box.

Smarter Balanced Assessment Consortium:

Lights, Candles, Action! Performance Task
Grade 11 Mathematics Practice Test
Scoring Guide
08/14/2019



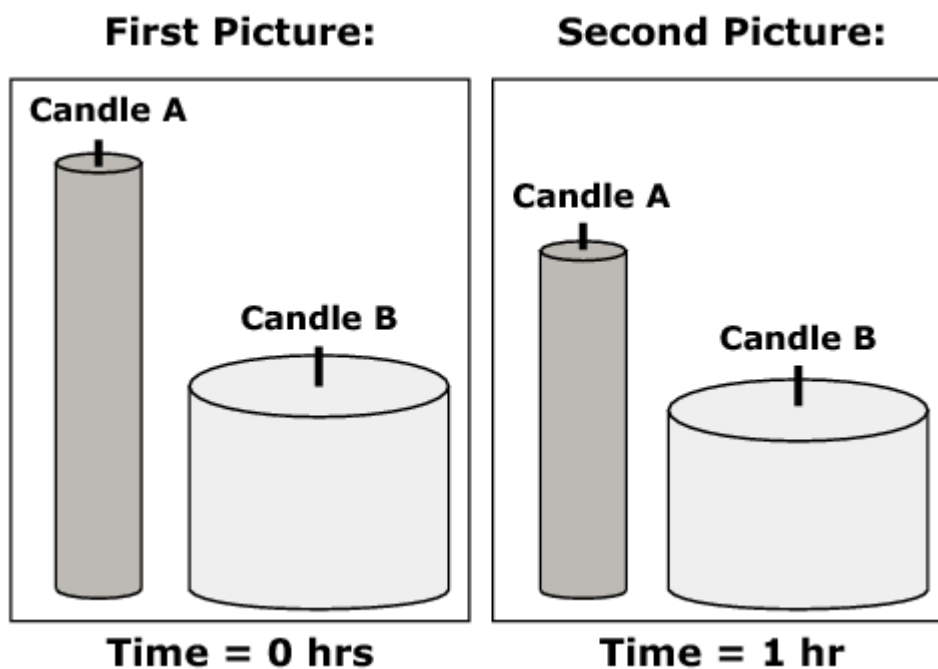
Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Lights, Candles, Action!

Your friend Abbie is making a movie. She is filming a fancy dinner scene and she has two types of candles on the table. She wants to determine how long the candles will last.

She takes a picture, lights the candles, and then lets them burn for 1 hour. She then takes a second picture. You can assume that each candle burns at its own constant rate.



Candle Type A initial height = 20 cm

Candle Type B initial height = 10 cm

Candle Type A height after burning for 1 hour = 16 cm

Candle Type B height after burning for 1 hour = 9 cm

You will use this information to help Abbie think about the candles she might use for her film.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

1

Candles A and B are lit at the same time. What will be the height, in cm, of each candle after 3 hours of burning?

Candle Type A:

Candle Type B:

2

Candles of each type were lit at the same time. Abbie thinks that since Candle Type A burns more quickly than Candle Type B, that it will burn out (have a height of 0 cm) first.

Julie thinks that since Candle Type B starts out much shorter than Candle Type A, it will be the candle to burn out first.

Which candle will burn out first? Give a mathematical explanation to convince Abbie and Julie of your solution. Clearly identify the quantities involved.

3

Abbie has 3 hours left to film. She lights a **new** Candle Type A and Candle Type B and then starts filming.

In the 3 hours she has left, will Abbie capture the moment when the candles are exactly the same height?

Explain to Abbie how you can determine the answer.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

4

You have decided to use functions to help Abbie think about the candles.

You show her how to represent the height of a candle, ***h***, as a function of time, ***t***, using this equation:

$$h = k + nt$$

First, explain to Abbie what ***k*** and ***n*** represent in order to model the different candles. Be specific in your explanation.

5

Now, choose either Candle A or Candle B to create an equation that will tell Abbie the height of the candle at ***t*** hours after it is lit.

Determine what the numerical values for ***k*** and ***n*** should be for the candle you chose.

Using these ***k*** and ***n*** values, write an equation that tells Abbie the height ***h*** of the candle, in cm, at ***t*** hours after it is lit.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

6

For her next film, Abbie wants candles that will burn for exactly 8 hours. You want to give her a choice by designing two different candles (Type C and Type D).

Using the equation $h = k + nt$, determine two different pairs of values for k and n that will meet the requirement to burn down to a height of 0 cm in exactly 8 hours.

Complete the table to show two possible sets of values for k and n for your new candle designs.

	k	n
Candle Type C		
Candle Type D		

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

1

Candles A and B are lit at the same time. What will be the height, in cm, of each candle after 3 hours of burning?

Candle Type A:

Candle Type B:

#1 Equation/numeric – 2 response boxes – 1 point for both correct answers

Item	Claim	Domain	Target	DOK	Content	MP	Key
#1	2	RP	D	2	6.RP.A.3	1	Candle A: 8 Candle B: 7

Rubric:

1 point: The student provides *both* correct answers: Candle Type A will be 8 cm and Candle Type B will be 7 cm.

0 points: All other responses

Commentary:

The purpose of the question is to assess whether the student (1) understands the context and the information given and (2) can identify and infer relevant quantities and perform routine calculations.

The context is reasonably authentic. Many students have experience with watching a candle burn and understand the concept of a candle getting shorter as it burns.

Rationale for Content:

This content is securely held, being essentially Grade 6.

6.RP.A.3: Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

Since the question is intended to be accessible for most students, the numbers have been kept simple so as not to create arithmetic computational obstacles in obtaining evidence of Claims 2, 3, or 4.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rationale for Claim:

The purpose of this first question is to provide an entry-level ramp into the work of the task. This question assesses whether students understand the context, can identify relevant quantities in the given representations, and can perform routine calculations as part of problem solving.

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

Rationale for DOK:

This is a DOK 2. From the *Depth of Thinking* chart:

APPLY (DOK 2):

- Retrieve information to solve a problem
- Select a procedure and perform it

Because students have to retrieve the information and decide how to use it, this qualifies as DOK 2.

2

Candles of each type were lit at the same time. Abbie thinks that since Candle Type A burns more quickly than Candle Type B, that it will burn out (have a height of 0 cm) first.

Julie thinks that since Candle Type B starts out much shorter than Candle Type A, it will be the candle to burn out first.

Which candle will burn out first? Give a mathematical explanation to convince Abbie and Julie of your solution. Clearly identify the quantities involved.

#2 Short text – 2 points

Item	Claim	Domain	Target	DOK	Content	MP	Key
#2	3	EE	B	3	7.EE.B.4	3	See sample responses

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rubric:

2 points: The student correctly determines that Candle Type A will burn out first AND provides a valid mathematical explanation that includes the initial heights and the burn rates.

Note: The students are not required to calculate the burn out times.

1 point: The student correctly determines that Candle Type A will burn out first, but does not provide a valid mathematical explanation that includes the initial heights and the burn rates.

OR Student correctly reasons from an incorrect calculation.

0 points: All other responses

Commentary:

The purpose of this question is to confront a pair of reasonable sounding arguments. The student is required to use mathematics to justify which of the two claims is correct. The question requires attending to both parameters (initial height and burn rate) of the context and using those to construct a viable argument.

Rationale for Content:

The content is securely held, being Grade 7 Expressions and Equations.

7.EE.B.4: Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

Although students are not specifically asked to solve this problem using an equation, the underlying mathematical structure is that of analyzing linear relationships of the form $px + q = r$.

Rationale for Claim:

The fact that students are given two ideas as to which candle will burn out first and asked to defend which one they agree with based on a mathematical argument is what makes this a Target 3B.

Claim 3, Target B: Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rationale for DOK:

This question qualifies as DOK 3 (Evaluate) because students are required to:

- Cite evidence and develop a logical argument.
- Compare/contrast solution methods.

What follows are sample responses and scoring annotations for Item 2.

Sample Response 2a

B
I
U
~~I_x~~

$\frac{1}{2}$
 $\frac{3}{4}$
 $\frac{5}{6}$
 $\frac{7}{8}$

ABC
Ω

Abbie is correct, "because" candle A looks taller, but it burns at a rate of 4cm per hour, where candle B looks shorter and burns at a rate of 1 cm per second. Since candle A is 20 cm tall, it will burn out in 5 hours where candle B would take 10 hours.

SCORE POINT

2

This student correctly identified that Candle Type A would burn out first and used both initial heights and burn rates to compute and compare the burn out times.

Sample Response 2b

B
I
U
~~I_x~~

$\frac{1}{2}$
 $\frac{3}{4}$
 $\frac{5}{6}$
 $\frac{7}{8}$

ABC
Ω

Candle A will burn out first becaus candle A burns 4 cms each hour while Candle B burns 1 cm each hour. Candle A will burn out while candle B still has 5cm left.

SCORE POINT

1

Although this student correctly provided the information that 5 cm are left for Candle Type B, he/she did not give any indication as to how that information was derived.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Sample Response 2c

B I U I_x **:= ::=** **≡ ≡** **✂** **📄** **📁** **↶** **↷** **ABC** **Ω**

Candle A will burn out faster b/c it get 4 inches shorter every hour when B only get 1 inch shorter.

SCORE POINT

1

This student correctly stated that Candle Type A would burn out first, but only attended to the burn rates and did not mention the initial heights.

Sample Response 2d

B I U I_x **:= ::=** **≡ ≡** **✂** **📄** **📁** **↶** **↷** **ABC** **Ω**

I think candle b will burn out faster because its shorter and fatter candle a is tall in skinny therefore it will take longer to burn out

SCORE POINT

0

This student only attended to one quantity (height of candle) and concluded that Candle Type B would burn out first, which is incorrect.

3

Abbie has 3 hours left to film. She lights a **new** Candle Type A and Candle Type B and then starts filming.

In the 3 hours she has left, will Abbie capture the moment when the candles are exactly the same height?

Explain to Abbie how you can determine the answer.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

#3 Short text – 2 points

Item	Claim	Domain	Target	DOK	Content	MP	Key
#3	2	EE	A	3	8.EE.C.8	2	See sample responses

Rubric:

2 points: The student correctly answers *No*, Abbie will not capture the moment when Candle Type A and Candle Type B are the same height during the 3 hours of filming, AND supports the claim with a mathematically valid argument.

Note: The underlying content is about Systems of Linear Equations; however, students are not required to set up, symbolically, a system of linear equations in order to solve this problem.

1 point: Student correctly answers *No*, Abbie will not capture the moment when Candle Type A and Candle Type B are the same height during the 3 hours of filming, but does not support the claim with a mathematically valid argument.

OR Student correctly reasons from an incorrect calculation.

0 points: All other responses

Commentary:

The purpose of the question is to have students engage with a meaningful context, where the underlying mathematical content is systems of linear equations. By design, the question does not specify or require the student to use any particular solution method. This is to allow more access and opportunities for students to engage in problem solving. By requiring the solution method to be explained, rather than just give an answer, this increases the depth of knowledge.

Rationale for Content:

This content is securely held, being Grade 8 Expressions and Equations.

8.EE.C.8: Analyze and solve pairs of simultaneous linear equations.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rationale for Claim:

The fact that students are given a context (candles burning) and asked a question (Will the candles reach the same height during a specified time?), the problem is well-posed, but students are not told what technique or procedure they must use to solve.

Claim 2, Target A: Apply mathematics to solve well-posed problems in pure mathematics and arising in everyday life, society, and the workplace.

Rationale for DOK:

This question qualifies as DOK 3 (Evaluate) because students are asked to:

- Cite evidence and develop a logical argument.
- Compare/contrast solution methods.

Note: If the rubric gave credit for the student merely getting the correct answer, this would qualify as DOK 2, but because the rubric demands a logical argument, this qualifies it as DOK 3.

What follows are sample responses and scoring annotations for Item 3.

Sample Response 3a

B I U I_x
☰ ☷ ☰ ☷
✂ 📄 📁 ↶ ↷
ABC Ω

$1(-4) = -4$ $2(-4) = -8$ $3(-4) = -12$	$1(-1) = -1$ $2(-1) = -2$ $3(-1) = -3$	No, Abbie will not see the 2 candles at the same height during the 3 hours that she is filming
$20-4 = 16$ $20-8 = 12$ $20-12 = 8$	$10-1 = 9$ $10-2 = 8$ $10-3 = 7$	

SCORE POINT

1

This response is “almost a 2.” In order to move from a score of 1 to a score of 2, this student would need to be more explicit about the meaning of the numbers and calculations, and ultimately connect those to the context.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Sample Response 3b

B I U I_x **:= :: ≡ ≡** **✂ ☰ ☲ ↶ ↷** **ABC Ω**

She will not have enough time to capture both candle having the same height. After 3 hours candle A will be at 8 cm & candle B will be a 6 cm.

SCORE POINT

1

The student correctly states *No*, but does not provide a mathematically valid argument and makes a mistake in the calculation of the height of Candle Type B.

Sample Response 3c

B I U I_x **:= :: ≡ ≡** **✂ ☰ ☲ ↶ ↷** **ABC Ω**

No b/c at 3 hours candle A is 8 cm and B is 7 hours. She would only be able to if she was filming for 4 hours.

SCORE POINT

1

The student correctly states *No*, but does not provide a mathematically valid argument.

Sample Response 3d

B I U I_x **:= :: ≡ ≡** **✂ ☰ ☲ ↶ ↷** **ABC Ω**

I don't know if they will be equal because candle b is burning out faster then candle a. She might be able to capture them burning but not at the same height.

SCORE POINT

0

Student does not state a definitive answer and does not provide a mathematical justification.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

4

You have decided to use functions to help Abbie think about the candles.

You show her how to represent the height of a candle, ***h***, as a function of time, ***t***, using this equation:

$$h = k + nt$$

First, explain to Abbie what ***k*** and ***n*** represent in order to model the different candles. Be specific in your explanation.

#4 Short text – 2 points

Item	Claim	Domain	Target	DOK	Content	MP	Key
#4	2	F-LE	A, D	2	F-LE.B.5	1	See rubric

Rubric:

2 points: The student correctly identifies that “*k*” represents the initial height of the candle and “*n*” represents the burn rate of the candle.

1 point: The student is only able to correctly identify one of the parameters, not both.

0 points: All other responses

Note: It is necessary for the student to identify “*k*” as the initial or original height in order to receive full credit, because the height of the candle changes as it burns and it is represented by “*h*” in the equation.

Commentary:

This question is designed to assess a critical aspect of problem solving, namely identifying important quantities in a real-world context and interpreting their meaning in a symbolic representation. For this problem, the students have been provided a linear model and asked to determine the meaning and values of the parameters.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rationale for Content:

The content is securely held (typically Algebra/Integrated 1), primarily focusing on identifying meaning and finding values of parameters in a linear model. This is part of FLE.B.5:

Interpret the parameters in a linear or exponential function in terms of a context.

Rationale for Claim:

The purpose of this question is to assess whether students can determine the meaning of parameters in a linear function. Because the form of the linear function is explicitly given to the students, this question fits the criteria for Claim 2, Targets A and D.

Claim 2, Target A: Apply mathematics to solve well-posed problems in pure mathematics and arising in everyday life, society, and the workplace.

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

Rationale for DOK:

This question qualifies for a DOK 2, Understand, because students are asked to specify and explain relationships.

5

Now, choose either Candle A or Candle B to create an equation that will tell Abbie the height of the candle at t hours after it is lit.

Determine what the numerical values for k and n should be for the candle you chose.

Using these k and n values, write an equation that tells Abbie the height h of the candle, in cm, at t hours after it is lit.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

#5 Equation/numeric – 1 point

Item	Claim	Domain	Target	DOK	Content	MP	Key
#5	4	F	F	2	8.F.B	4	Either $h = 20 - 4t$ or $h = 10 - t$ (and equivalents)

Rubric:

1 point: The student provides either $h = 20 - 4t$ or $h = 10 - t$ or equivalent.

0 points: All other responses

Commentary:

Students need to understand that the candles are characterized by two parameters: initial height and burn rate. Students must identify a correct initial height and burn rate. This question is designed for students to arrive at a single answer. Students will need to understand how the height, as a function of time, depends on these two parameters. Students will need to interpret the burn time algebraically in order to create an equation, which labels this item as mathematical modeling as opposed to problem solving.

Rationale for Content:

The content is securely held from Grade 8, focusing on identifying meaning and finding values of the parameters in a linear model. This is part of 8.F.B: Use functions to model relationships between quantities.

Rationale for Claim:

This question aligns with Claim 4, Target F.

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

Rationale for DOK:

Since the student needs to determine an equation that models the height of the candle, this aligns to DOK 2.

DOK 2: Understand, because students are asked to specify and identify a relationship.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

6

For her next film, Abbie wants candles that will burn for exactly 8 hours. You want to give her a choice by designing two different candles (Type C and Type D).

Using the equation $h = k + nt$, determine two different pairs of values for k and n that will meet the requirement to burn down to a height of 0 cm in exactly 8 hours.

Complete the table to show two possible sets of values for k and n for your new candle designs.

	k	n
Candle Type C		
Candle Type D		

#6 Fill-in table – 2 points

Item	Claim	Domain	Target	DOK	Content	MP	Key
#6	4	F-LE	E	3	F-LE.5.B	4	Many sets of values work. =

Rubric:

2 points: The student creates values for k and n that result in Candle Type C *and* Candle Type D burning out in 8 hours.

1 point: The student creates values for k and n that result in Candle Type C *or* Candle Type D burning out in 8 hours.

0 points: All other responses

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Commentary:

As the culminating question in this task, the students need to understand that candles are characterized by two parameters: initial height and burn rate. This question is designed to have infinitely many solutions; hence it is not the type of problem where students solve an equation and arrive at a single answer. Students will need to understand how the height, as a function of time, depends on these two parameters. Students will have to interpret the constraint (burn time of 8 hours) algebraically in order to create examples that satisfy this constraint. It is this aspect of the work that pushes this question into mathematical modeling as opposed to problem solving.

Note that this problem provides some scaffolding by asking students to fill in a table with the parameters. Based on piloting, this was to help students focus on the mathematical work of finding parameters that met the requirement, rather than spend time trying to decide what the parameters were or what specifies a candle.

Also, even though this is a high school task, the numbers have been kept purposefully simple in order to have the students focus on the design under constraint element of this work, rather than the arithmetic complexity.

Rationale for Content:

The content is securely held (typically Algebra/Integrated 1), primarily focusing on identifying meaning and finding values of parameters in a linear model. This is part of FLE.B.5:

Interpret the parameters in a linear or exponential function in terms of a context.

Rationale for Claim:

This question aligns with Claim 4, Target E because this problem asks students to develop a model of a real phenomenon (at least parts of the model). This particular question is asking students to design candles by specifying values of essential parameters in a linear model.

Claim 4, Target E: Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Rationale for DOK:

Since the student needs to design new candles while meeting certain requirements, finding parameters to meet given constraints in a context is asking students to apply and create. For these reasons, this question would satisfy the requirements for DOK 3.

DOK 3:

Apply: Use reasoning, planning, and supporting evidence

Create: Develop an alternative solution

Sample full-credit responses:

	k	n
Candle Type C	16	-2
Candle Type D	8	-1

	k	n
Candle Type C	12	-1.5
Candle Type D	24	-3

The hand-scored items in this guide are 2-point short-text items. The general rubric that is used as a basis for scoring all 2-point short-text items is shown below. Although item-specific rubrics are also provided to scorers to facilitate the hand-scoring of short-text items, every response should be able to map back to this general rubric in a consistent and reliable manner.

Grade 11 Mathematics

Lights, Candles, Action! Performance Task

Smarter Balanced Mathematics General Rubric for 2-Point Items

Score	Description
2	The student has demonstrated a full and complete understanding of all mathematical content and practices essential to this task. The student has addressed the task in a mathematically sound manner. The response contains evidence of the student's competence in problem solving, reasoning, and/or modeling to the full extent that these processes apply to the specified task. The response may, however, contain minor flaws that do not detract from a demonstration of full understanding.
1	The student has demonstrated a partial understanding of the mathematical content and practices essential to this task. The student's response contains some of the attributes of an appropriate response but lacks convincing evidence that the student fully comprehends the essential mathematical ideas addressed by this task. Such deficits include evidence of insufficient mathematical knowledge; errors in fundamental mathematical procedures; and other omissions or irregularities that bring into question the student's competence in problem solving, reasoning, and/or modeling related to the specified task.
0	The student has demonstrated merely an acquaintance with the topic, or provided a completely incorrect or uninterpretable response. The student's response may be associated with the task, but contains few attributes of an appropriate response. There are significant omissions or irregularities that indicate a lack of comprehension in regard to the mathematical content and practices essential to this task. No evidence is present that demonstrates the student's competence in problem solving, reasoning, and/or modeling related to the specified task.