

Focus
Standards
and Claim

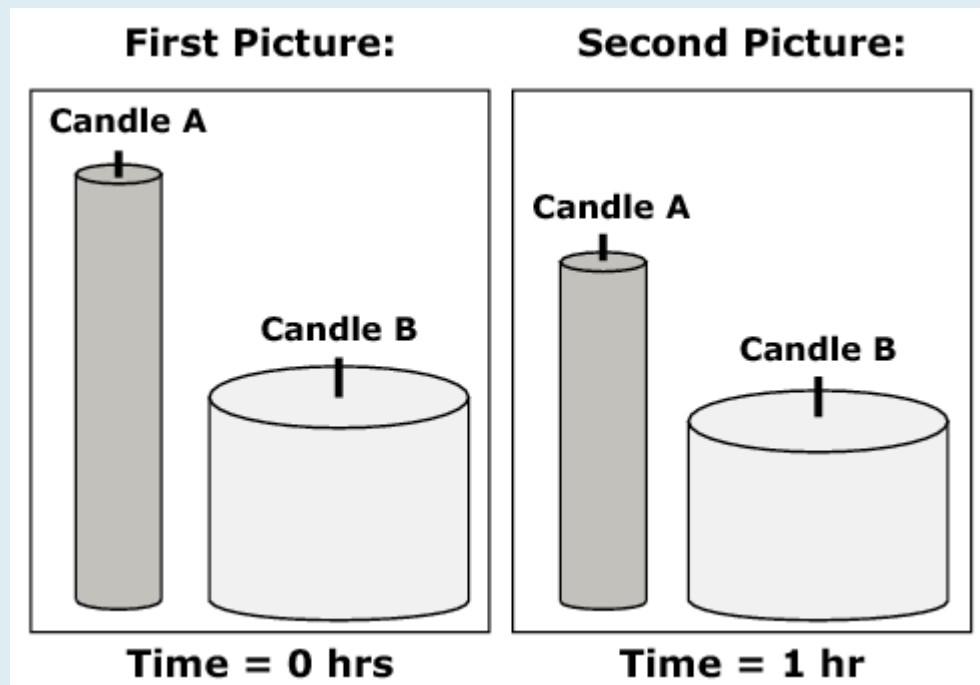
Claim 3
7.EE.B.4

Stimulus

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.

<h3 style="margin: 0;">Item Prompt</h3>	<p>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.</p> <p>Julie thinks that since Candle Type B starts out much shorter than Candle Type A, it will be the candle to burn out first.</p> <p>Which candle will burn out first? Give a mathematical explanation to convince Abbie and Julie of your solution. Clearly identify the quantities involved.</p>
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Scoring Guide

SCORE	2 POINTS	1 POINT	0 POINTS
	<p>The student correctly determines that Candle Type A will burn out first AND provides a valid mathematical explanation which includes the initial heights and the burn rates.</p> <p>Note: The students are not required to calculate the burn out times.</p>	<p>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.</p> <p>OR</p> <p>Student correctly reasons from an incorrect calculation.</p>	<p>All other responses.</p>

Sample Responses

Student Sample A



A initial: 20 cm -4cm/hr

B initial: 10cm -1cm/hr

$$20 - 4 = 16 - 4 = 12 - 4 = 8 - 4 = 4 - 4 = 0$$

$$10 - 1 = 9 - 1 = 8 - 1 = 7 - 1 = 6 - 1 = 5$$

$$\text{---1hr-----2hr-----3hr-----4hr-----5hr-----}$$

Candle A will burn out first. Every hour, candle A decreases in height by 4cm while candle B decreases in height by 1 cm. After 5 hours, candle A will be 0cm and candle B will still be 5 cm tall.

SCORE RATIONALE

The student correctly determined that Candle Type A will burn out first, and developed a model to represent the first 5 hours of burning for each candle. The model includes the burn rate and initial height of each candle. The response includes a valid and clear mathematical explanation as to why Candle Type A reaches 0 cm first. This response receives full credit.

Student Sample B



I think Candle A will burn out first because it burns out more quickly than Candle B. That's because candle A has a much smaller circumference than Candle B.

Ex.

Every hour, candle A burns 4 cm and candle B burns only 1cm

You could make a chart to represent this.

	Candle A	Candle B
0hr	20cm	10cm
1hr	16cm	9cm
2hr	12cm	8cm
3hr	8cm	7cm
4hr	4cm	6cm
5hr	0cm	5cm

SCORE RATIONALE

The student determined correctly that Candle Type A will burn out first, and provided a chart to represent the height of each burning candle for 5 hours. The response includes valid reasoning to support the explanation, as well as both the burn rate and initial height of each candle. This response receives full credit.

Student Sample C



Candle Type A will burn out first because mathematically, every hour candle A's height decreases by 4 centimeters while candle B only decreases by 1 cm.

Candle A:

Number of Hours Burned:

1 2 3 4 5 6

Height after each hour:

16 12 8 4 0 X

Candle B:

Number of Hours Burned:

1 2 3 4 5 6 7 8 9 10

Height after each hour:

8 8 7 6 5 4 3 2 1 0

Using the table, we could clearly see that candle A burns out way quicker than candle B because candle A burns out within 5 hours of being lit while candle B burns out within 10 hours of being lit.

SCORE RATIONALE

The student correctly stated that Candle Type A will burn out first, clearly indicated the burn rate for each candle, and developed two tables of values to compare the heights of each candle after every hour of burning. The response includes a clear and valid explanation of the values and the reasoning, and earns full credit.

Student Sample D



Candle A will burn out first because the rate of the decrease in height per hour is greater. Candle A burns at 4cm/hour. Candle B burns at 1cm/hour.

Candle A $y = 4x + 20$

Candle B $y = x + 10$

SCORE RATIONALE

The student correctly determined that Candle Type A will burn out first by comparing the burn rates of Candle Type A and Candle Type B. However, the student did not include a consideration of the initial height of each candle in his/her explanation. Then, in the student's attempt to support the claim, the equation he/she wrote for each candle does not fit the explanation: the coefficient of x (representing the burn rate) is positive instead of negative. This response earns 1 point since the student reasoned correctly from incorrect equations.

Student Sample E



Type A.

Type A

0 hrs – 20

1 hr – 16

2 hr – 12

3 hr – 8

4 hr – 4

5 hr – 0

Type B

0 hrs – 10

1 hr – 9

2 hr – 8

3 hr – 7

4 hr – 6

5 hr – 5

6 hr – 4

7 hr – 3

8 hr – 2

9 hr – 1

10 hr – 0

SCORE RATIONALE

The student indicated correctly that the answer is Candle Type A, and provided evidence of valid mathematical reasoning to support this choice. However, the response does not include clear identification of the quantities involved. Specifically, the height values of the candles each hour are unlabeled and the burn rates are not mentioned. The response does not include a clear explanation to connect the values in the model to a comparison between two different burning candles. The response receives partial credit of 1 point.

Student Sample F



Candle Type A will be the first one to reach the height of 0 cm first since it burns out at a faster rate. Type B will be at 4 cm by the time type A has completely burnt out.

SCORE RATIONALE

The student correctly identified that Candle Type A will burn out first, but did not indicate the initial height and burn rate of each candle. The explanation to support the claim contains a minor calculation error, and does not provide sufficient explicit evidence of considering all of the relevant quantities. The response earns 1 point.

Student Sample G



Candle A will burn out first because even though the candle is long in height, it burns out 3 times the length of candle B. Example, candle A is 20cm but it burns out 4cm/hr which results to 16 and now it will burn out after 4 hours. Candle B will burn out after 9 hrs since it only burns 1 cm/hr and the height of candle B is 10.

SCORE RATIONALE

The student identified that Candle Type A will burn out first, and clearly stated the burn rate of each candle. However, the explanation includes evidence of inconsistent reasoning and does not sufficiently support the claim. The response earns partial credit of 1 point.

Student Sample H



Candle A and B are burning at different time. Candle A is thinner and B is thicker but smaller so it burns first.

SCORE RATIONALE

The student concluded that Candle Type B will burn out first because it is smaller in height than Candle Type A. The first part of the response suggests an attempt to compare the burn rates. The student did not provide sufficient evidence of valid mathematical reasoning to support the claim or earn any points.

Student Sample H



$$20 - 4h = 0 \quad 4h = 5$$

$$10 - h = 0 \quad h = 10$$

SCORE RATIONALE

The student did not state which candle will burn out first, and did not provide any explanation. Although there is clear evidence of strong algebraic reasoning in this response, the reasoning is not developed into a valid response. Without a clear statement of which candle burns out first, without any mention of initial heights or burn rates of the candles, and without an explanation, the response earns 0 points.