

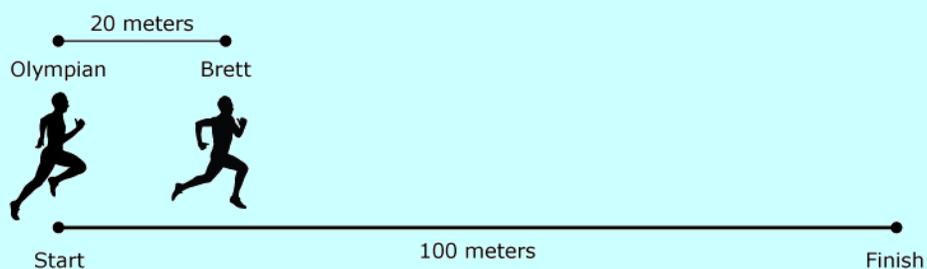


Sample Mathematics Item: Algebra I/Mathematics I

“Brett’s Race”

November 2013

Brett is on the high school track team and his coach surprises the team by having an Olympic track champion attend a practice. The Olympian challenges Brett to a 100-meter race. To make the race more interesting, the Olympian will not start the race until Brett reaches the 20 meter mark. Brett's average time in the 100-meter race is 12 seconds, while the Olympian's average time is 10 seconds. Assume that Brett and the Olympian run at a constant speed throughout the race.



Part A

Based on their average running times, write an equation for each person that describes the relationship between their distance from the starting line, in meters, and time, in seconds.

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Part B

Based on your equations in Part A, who will win the race and by how much? Justify your answer.

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| HS | Brett's race |
| Type | Type III 3 Points |
| Evidence Statement | <p>HS.D.2-5: Solve multi-step contextual word problems with degree of difficulty appropriate to the course, requiring application of course-level knowledge and skills articulated in A-CED, N-Q, A-SSE.3, A-REI.6, A-REI.12, A-REI.11-2, limited to linear equations and exponential equations with integer exponents.</p> <p>Clarification: A-CED is the primary content; other listed content elements may be involved in tasks as well.</p> |
| Most Relevant Standards for Mathematical Content | <p>A-CED Creating Equations A-CED.A Create equations that describe numbers or relationships 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.</p> <p>This standard is major content in the course based on the PARCC Model Content Frameworks.</p> |
| Most Relevant Standards for Mathematical Practice | <p>This item requires students to model the given situation using equations, then students use that model to determine who will win the race and their margin of victory (MP.4). In order to create and interpret these models, students will have to decontextualize and contextualize the information at various points in the solution process to create a mathematical model and then to interpret the meaning and structure of that model (MP.2). Students that choose to use the graph may create another model of the situation, and look for and use structure within that model (MP.7).</p> |
| Item Description and Assessment Qualities | <p>This application task requires students to use content from widely applicable algebra standards in order to solve a modeling problem with difficulty expected in high school. Students first create equations that model the situation described in the first paragraph. It is important for students to define their variables when creating equations. Then, students reason with their models, and perhaps the graphing tool, to interpret the model and determine the margin of victory. There are a variety of solution methods that students may use to successfully answer Part B.</p> |
| Scoring Information | <p>Scoring Rubric for Sample Item HS.D. 2-5</p> <p>Task is worth 3 points. Task can be scored as 0, 1, 2, or 3. Task has 2 parts.</p> <p>Scoring for Part A – Formulating the Model – 1 point</p> |

Student produces two equations to determine the distance in meters from the starting line, of each person as a function of the time x , in seconds since the Olympian starts running.

For example, Brett's distance y , as related to time, x :

$$y = 8\frac{1}{3}x + 20. \text{ Or } \frac{100}{12}x = 20$$

The Olympian's distance y , as related to time, x :

$$y = 10x.$$

NOTE: All variables should be defined. The student may choose to define x as time in seconds since Brett starts running.

Scoring for Part B

Student earns 1 calculation point for stating the correct winner and the correct margin of victory.

Students earn 1 modeling point for providing an accurate justification using the equations in Part A.

Sample Student Response 1:

- For Brett, $y = 100$ when

$$100 = 8\frac{1}{3}x + 20$$

$$80 = 8\frac{1}{3}x$$

$$x = 9.6$$

- For the Olympian $y = 100$ when

$$100 = 10x$$

$$x = 10.$$

- So, Brett wins the race by $10 - 9.6 = 0.4$ seconds.

Sample Student Response 2:

- When Brett finishes the race at 9.6 seconds, the Olympian is only $10(9.6) = 96$ meters from the start. Therefore, Brett was 4 meters ahead of the Olympian when he finished the race.

Note:

- If Part A contains incorrect equations, but Part B is correct based on one or two incorrect equations in Part A, the student is still awarded 1 or 2 points of the 3 possible points.

Task score: The task score is the sum of the points awarded in each component.