

Problem-Based Task 1.2.1: Man Versus Cat

Coaching Sample Responses

- a. What units are given?

We are given a distance, 20 meters, and a time, 1.61 seconds. The given units are “meters” and “seconds.”

- b. What is Usain Bolt’s speed in terms of the given units?

To find the speed, divide the distance by the time:

$$\frac{20 \text{ meters}}{1.61 \text{ seconds}} \approx \frac{12.42 \text{ meters}}{1 \text{ second}}$$

Usain Bolt’s speed in terms of the given units is 12.42 meters per second.

- c. What are the target units?

We want to convert the speed to miles per hour, or $\frac{\text{miles}}{\text{hour}}$.

- d. What conversion factors are needed?

We need to convert meters to miles, and seconds to hours. We are given that 1 mile is approximately 1.6 kilometers, or $\frac{1 \text{ mile}}{1.6 \text{ kilometers}}$. We need additional factors to convert kilometers to meters and seconds to hours.

There are 1,000 meters in one kilometer, 60 minutes in an hour, and 60 seconds in a minute.

This gives us conversion factors of $\frac{1,000 \text{ meters}}{1 \text{ kilometers}}$, $\frac{60 \text{ minutes}}{1 \text{ hour}}$, and $\frac{60 \text{ seconds}}{1 \text{ minute}}$.

The relevant conversion factors are $\frac{1 \text{ mile}}{1.6 \text{ kilometers}}$, $\frac{1,000 \text{ meters}}{1 \text{ kilometers}}$, $\frac{60 \text{ minutes}}{1 \text{ hour}}$, and $\frac{60 \text{ seconds}}{1 \text{ minute}}$.

UNIT 1 • RELATIONSHIPS BETWEEN QUANTITIES AND EXPRESSIONS

Lesson 2: Units of Measure

Instruction

- e. How do you set up the conversion?

To convert the speed of 12.42 meters per second to miles per hour, multiply the speed by the appropriate conversion factors. Set up the conversion so that unwanted units will cancel. In other words, unwanted units should appear in the numerator and denominator the same number of times. Some conversion factors will need to be flipped.

$$\frac{12.42 \text{ meters}}{1 \text{ second}} \cdot \frac{1 \text{ mile}}{1.6 \text{ kilometers}} \cdot \frac{1 \text{ kilometer}}{1000 \text{ meters}} \cdot \frac{60 \text{ seconds}}{1 \text{ minute}} \cdot \frac{60 \text{ minutes}}{1 \text{ hour}}$$

- f. What is Usain Bolt's speed in miles per hour?

Cancel out the units that appear in the numerator and denominator, then multiply the numbers and simplify.

$$\frac{12.42 \text{ meters}}{1 \text{ second}} \cdot \frac{1 \text{ mile}}{1.6 \text{ kilometers}} \cdot \frac{1 \text{ kilometer}}{1000 \text{ meters}} \cdot \frac{60 \text{ seconds}}{1 \text{ minute}} \cdot \frac{60 \text{ minutes}}{1 \text{ hour}}$$

$$\frac{12.42 \cancel{\text{ meters}}}{1 \cancel{\text{ second}}} \cdot \frac{1 \text{ mile}}{1.6 \cancel{\text{ kilometers}}} \cdot \frac{1 \cancel{\text{ kilometer}}}{1000 \cancel{\text{ meters}}} \cdot \frac{60 \cancel{\text{ seconds}}}{1 \cancel{\text{ minute}}} \cdot \frac{60 \cancel{\text{ minutes}}}{1 \text{ hour}}$$

$$\frac{12.42 \cdot 1 \cdot 1 \cdot 60 \cdot 60 \text{ miles}}{1 \cdot 1.6 \cdot 1,000 \cdot 1 \cdot 1 \text{ hours}}$$

$$\frac{44,712 \text{ miles}}{1600 \text{ hours}}$$

$$\frac{27.945 \text{ miles}}{1 \text{ hours}} \approx \frac{28 \text{ miles}}{1 \text{ hour}}$$

Usain Bolt's speed is approximately 28 miles per hour.

- g. If Usain Bolt raced a house cat, who would win?

If both Usain Bolt and the cat ran all-out in a straight line for the entirety of the race, the cat would probably win. However, in reality, the cat would probably neither start nor finish the race.

Recommended Closure Activity

Select one or more of the essential questions for a class discussion or as a journal entry prompt.