

Modeling with a Linear Function

Which of the following could be modeled by $y = 2x + 5$?

Answer YES or NO for each one.

- a. There are initially 5 rabbits on the farm. Each month thereafter the number of rabbits is 2 times the number in the month before. How many rabbits are there after x months?

YES NO

- b. Joaquin earns \$2.00 for each magazine sale. Each time he sells a magazine he also gets a five-dollar tip. How much money will he earn after selling x magazines?

YES NO

- c. Sandy charges \$2.00 an hour for babysitting. Parents are charged \$5.00 if they arrive home later than scheduled. Assuming the parents arrived late, how much money does she earn for x hours?

YES NO

- d. I have a sequence of integers. The first term of the sequence is 7 and the difference between any consecutive terms is always equal to 2.

YES NO

- e. Sneak Preview is a members-only video rental store. There is a \$2.00 initiation fee and a \$5.00 per video rental fee. How much would John owe on his first visit if he becomes a member and rents x videos?

YES NO

- f. Andy is saving money for a new CD player. He began saving with a \$5.00 gift and will continue to save \$2.00 each week. How much money will he have saved at the end of x weeks?

YES NO



Commentary

PURPOSE: The primary purpose of this task is to elicit common misconceptions that arise when students try to model situations with linear functions. This task, being multiple choice, could also serve as a quick assessment to gauge a class' understanding of modeling with linear functions.

- Situation (a): Students may mistakenly think the situation in (a) as matching the equation since the phrase “2 times the number...” will be interpreted as $2x$. This is mistake opens up an opportunity to discuss the importance of labeling a variable and of reading phrases in their entirety. It highlights the limited usefulness of encouraging students to search for key words instead of reading for meaning.
- Situations (b) and (c): These two examples highlight the differences between the roles of the coefficient and the constant in a linear equation in slope-intercept form. It might be useful to ask students how they could modify the situation in (b) so that it would fit the given linear equation.
- Situation (d): Since the number 7 appears in the description and not 5, students may not notice that the description is about the outputs, not directly about the structure of the equation. Asking student to create a table for the equation and then comparing it to this situation may help them see the connection.
- Situation (e): Since the numbers 5 and 2 appear, a student may think it fits the equation. Once again, here is an opportunity to highlight the difference in the role that the coefficient and the constant play in a linear equation in slope-intercept form.
- Situation (f): Notice how the structure of this situation is similar to Situation (c). Having students discuss the similarities might help them focus on structure as opposed to the specifics of a given situation.



Solution

- a. NO: If y is the number of rabbits at time x months, then in this scenario the number of rabbits starts with 5 and doubles every months. This situation is modeled by the function $y = 5 \times 2^x$.
- b. NO: If y is the amount of money in dollars Joaquin earns for selling x magazines, then for each magazine sold, Joaquin actually gets $2 + 5 = 7$ dollars. So this situation is modeled by the function $y = 2x + 5x = 7x$.
- c. YES: If y is the amount of money Sandy earns for x hours of babysitting then $y = 2x + 5x$ models this situation. She earns 2 dollars per hour and the extra term of 5 represents the 5 dollar penalty Sandy charges parents for coming home late.
- d. YES: In this case we can think of y as the x^{th} term of the sequence. So

$$7 = 2(1) + 5$$

$$9 = 2(2) + 5$$

$$11 = 2(3) + 5$$

In general we have: $y = 2x + 5$

- e. NO: If y is the amount of money in dollars John owes for renting x videos, then this situation is modeled by the function $y = 5x + 2$. John pays 5 dollars per video and a one time initiation fee of 2 dollars.
- f. Yes: If y is the amount of money (in dollars) Andy has saved after x weeks then this situation is modeled by the function $y = 5 + 2x$. Andy already has 5 dollars to begin with and he saves an additional 2 dollars per week.