

F.LE.B.5: Interpret Parts of an Expression or Equation

EQUATIONS AND INEQUALITIES

F.LE.B.5: Interpret Parts of an Expression or Equation

B. Interpret expressions for functions in terms of the situation they model.

5. Interpret the parameters in a linear or exponential function in terms of a context (linear and exponential of form $f(x) = b^x + k$).

Overview of Lesson

- activate prior knowledge and review learning objectives (see above)
- explain vocabulary and/or big ideas associated with the lesson
- connect assessment practices with curriculum
- model an assessment problem and solution strategy
- facilitate guided discussion of student activity
- facilitate guided practice of student activity

Selected problem set(s)

- facilitate a summary and share out of student work

Homework – Write the Math Assignment

Big Idea

Each number, variable, or product of a number and variable in an expression can be represented in narrative form.

Example:

Exponential growth can be modeled by the function $A = P(1 + r)^t$, where:

A represents the current amount,

P represents the starting amount,

$(1 + r)$ represents the rate of growth per cycle, and

t represents the number of growth cycles

If the current amount of money in one student's savings account is represented by the function $A(t) = 1000(1.03)^t$, then the rate of growth is 3 percent, because $(1 + r) = (1 + .03)$ and .03 is equal to 3 percent.

Vocabulary

parameter (A)(G)($A2T$) A quantity or constant whose value varies with the circumstances of its application.

Example: In $y = ax^2$ a is a parameter

REGENTS PROBLEMS TYPICAL OF THIS STANDARD

1. A company that manufactures radios first pays a start-up cost, and then spends a certain amount of money to manufacture each radio. If the cost of manufacturing r radios is given by the function $c(r) = 5.25r + 125$, then the value 5.25 best represents
 - a. the start-up cost
 - b. the profit earned from the sale of one radio
 - c. the amount spent to manufacture each radio
 - d. the average number of radios manufactured

Lesson Plan

2. A satellite television company charges a one-time installation fee and a monthly service charge. The total cost is modeled by the function $y = 40 + 90x$. Which statement represents the meaning of each part of the function?
- y is the total cost, x is the number of months of service, \$90 is the installation fee, and \$40 is the service charge per month.
 - y is the total cost, x is the number of months of service, \$40 is the installation fee, and \$90 is the service charge per month.
 - x is the total cost, y is the number of months of service, \$40 is the installation fee, and \$90 is the service charge per month.
 - x is the total cost, y is the number of months of service, \$90 is the installation fee, and \$40 is the service charge per month.
3. The cost of belonging to a gym can be modeled by $C(m) = 50m + 79.50$, where $C(m)$ is the total cost for m months of membership. State the meaning of the slope and y -intercept of this function with respect to the costs associated with the gym membership.
4. The number of carbon atoms in a fossil is given by the function $y = 5100(0.95)^x$, where x represents the number of years since being discovered. What is the percent of change each year? Explain how you arrived at your answer.
5. The breakdown of a sample of a chemical compound is represented by the function $p(t) = 300(0.5)^t$, where $p(t)$ represents the number of milligrams of the substance and t represents the time, in years. In the function $p(t)$, explain what 0.5 and 300 represent.

Lesson Plan

6. The owner of a small computer repair business has one employee, who is paid an hourly rate of \$22. The owner estimates his weekly profit using the function $P(x) = 8600 - 22x$. In this function, x represents the number of
- a. computers repaired per week
 - b. hours worked per week
 - c. customers served per week
 - d. days worked per week
7. Some banks charge a fee on savings accounts that are left inactive for an extended period of time. The equation $y = 5000(0.98)^x$ represents the value, y , of one account that was left inactive for a period of x years. What is the y -intercept of this equation and what does it represent?
- a. 0.98, the percent of money in the account initially
 - b. 0.98, the percent of money in the account after x years
 - c. 5000, the amount of money in the account initially
 - d. 5000, the amount of money in the account after x years
8. The function $V(t) = 1350(1.017)^t$ represents the value $V(t)$, in dollars, of a comic book t years after its purchase. The yearly rate of appreciation of the comic book is
- a. 17%
 - b. 1.7%
 - c. 1.017%
 - d. 0.017%

F.LE.B.5: Interpret Parts of an Expression or Equation Answer Section

1. ANS: C

Strategy: Interpret the the function $c(r) = 5.25r + 125$ in narrative (word) form.

$$\frac{c(r)}{\text{the cost of manufacturing } r \text{ radios}} = \frac{5.25}{\text{for each radio}} + \frac{125}{\text{plus a start-up cost of } \$125}$$

\$5.25 for each radio represents the amount spent to manufacture each radio, which is answer choice c.

PTS: 2 REF: 061407ai NAT: F.LE.B.5 TOP: Modeling Linear Equations

2. ANS: B

Strategy: Interpret the the function $y = 40 + 90x$ in narrative (word) form.

$$\frac{y}{\text{total cost}} = \frac{40}{\text{a one time installation fee of } \$40} + \frac{90}{\text{plus a } \$90 \text{ service charge}} \times \frac{x}{\text{times the number of months}}$$

PTS: 2 REF: 081402ai NAT: F.LE.B.5 TOP: Modeling Linear Equations

3. ANS:

$$y = mx + b$$

$$y = (\text{slope})x + (\text{y-intercept})$$

$$C(x) = 50(m) + (79.50)$$

The slope is 50 and represents the amount paid each month for membership in the gym.

The y-intercept is 79.50 and represents the initial cost of membership.

PTS: 2 REF: 011629ai NAT: F.LE.B.5 TOP: Modeling Linear Functions

4. ANS:

The percent of change each year is 5%.

Strategy: Use information from the problem together with the standard formula for exponential decay, which is $A = P(1 - r)^t$, where A represents the amount remaining, P represents the initial amount, r represents the rate of decay, and t represents the number of cycles of decay.

$$A = P(1 - r)^t$$

$$y = 5100(0.95)^x$$

The structures of the equations show that $(1 - r) = 0.95$.

Solving for r shows that $r = 0.05$, or 5%.

$$(1 - r) = 0.95$$

$$-r = 0.95 - 1$$

$$-r = -0.05$$

$$r = 0.05$$

Lesson Plan

PTS: 2 REF: 081530ai NAT: F.LE.B.5 TOP: Modeling Exponential Functions

5. ANS:

0.5 represents the rate of decay and 300 represents the initial amount of the compound.

Strategy: Use information from the problem together with the standard formula for exponential decay, which is $A = P(1 - r)^t$, where A represents the amount remaining, P represents the initial amount, r represents the rate of decay, and t represents the number of cycles of decay.

$$A = P(1 - r)^t$$

$$p(t) = 300(0.5)^t$$

The structures of the equations show that $P = 300$ and $(1 - r) = 0.5$.

Accordingly, 300 represents the initial amount of chemical substance in milligrams and 0.5 represents the rate of decay each year.

PTS: 2 REF: 061426ai NAT: F.LE.B.5 TOP: Modeling Exponential Equations

6. ANS: B

The problem states that the employee is paid an hourly rate of \$22.

In the equation $P(x) = 8600 - 22x$, the hourly rate of \$22 appears next to the letter x , which is a *variable* representing the number of hours that the employee works.

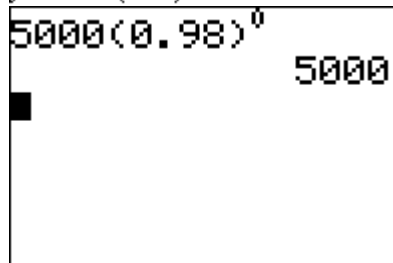
DIMS (Does it Make Sense?)

Yes. The equation $P(x) = 8600 - 22x$ says that the owner's profit (P) is a function of how much the employee gets paid. As the value of x increases, the employee gets paid more and the owner's profits get smaller.

PTS: 2 REF: 011501ai NAT: A.SSE.A.1 TOP: Modeling Linear Equations

7. ANS: C

Strategy 1: The y-intercept of a function occurs when the value of x is 0. The strategy is to evaluate the function $y = 5000(0.98)^x$ for $x = 0$



This represents the amount of money in the account before exponential decay begins.

Strategy 2. Input the equation in a graphing calculator and view the table of values.

Plot1 Plot2 Plot3	X	Y1
$\sqrt{Y1} = 5000(0.98)^{X0}$	0	5000
	1	4900
	2	4802
	3	4706
	4	4611.8
	5	4519.6
	6	4429.2

Press + for Δ |b|

The table of values clearly shows the initial value of the account and its exponential decay.

PTS: 2 REF: 011515ai NAT: F.IF.C.8b TOP: Modeling Exponential Equations

Lesson Plan

8. ANS: B

Strategy: Identify each of the parts of the function $V(t) = 1350(1.017)^t$, then answer the question.

$V(t)$ represents the current value of the comic book in dollars.

1350 represents the original value of the comic book when it was purchased.

(1.017) represents the growth factor, which consists of $(1+r)$, where r is the rate of growth per year. The value of r is 0.017, which is found by subtracting 1 from (1.017).

t represents the number of years since its purchase.

The problem wants to know the value of r , which is 0.017. However, all of the answer choices are expressed as percents rather than decimals. A decimal may be converted to a percent as follows:

$$\frac{.017}{1} = \frac{x\%}{100\%}$$

$$.017 \times 100 = x\%$$

$$1.7\% = x\%$$

$$\frac{.017}{1} = \frac{1.7\%}{100\%}$$

The yearly appreciation rate of the comic book is 1.7% and the correct answer is b.

DIMS? Does It Make Sense? The appreciation rate seems to make sense, but it is difficult to understand why someone would originally pay \$1,350 for a comic book.

PTS: 2

REF: 061517ai

NAT: A.SSE.A.1

TOP: Modeling Exponential Equations

Homework - Write the Math Assignment

START Write your name, date, topic of lesson, and class on your paper.
 NAME: Mohammed Chen
 DATE: December 18, 2015
 LESSON: Missing Number in the Average
 CLASS: Z

PART 1a. Copy **the problem** from the lesson and underline/highlight key words.
 PART 1b. State your understanding of **what the problem is asking**.
 PART 1c. **Answer** the problem.
 PART 1d. Explanation of **strategy** with all work shown.

PART 2a. Create **a new problem** that addresses the same math idea.
 PART 2b. State your understanding of **what the new problem is asking**.
 PART 2c. **Answer** the new problem.
 PART 2d. Explanation of **strategy** used in solving the new problem with all work shown.

Clearly label each of the eight parts.

Grading Rubric

Each homework writing assignment is graded using a four point rubric, as follows:

Part 1. The Original Problem	Up to 2 points will be awarded for: a) correctly restating the original problem; b) explicitly stating what the original problem is asking; c) answering the original problem correctly; and d) explaining the math.
Part 2. My New Problem	Up to 2 points will be awarded for: a) creating a new problem similar to the original problem; b) explicitly stating what the new problem is asking; c) answering the new problem correctly; and d) explaining the math.

This assignment/activity is designed to incorporate elements of [Polya's four step universal algorithm](#) for problem solving with the idea that writing is thinking. Polya's four steps for solving any problem are:

1. Read and understand the problem.
2. Develop a strategy for solving the problem.
3. Execute the strategy.
4. Check the answer for reasonableness.

EXEMPLAR OF A WRITING THE MATH ASSIGNMENT

Part 1a. The Problem

TOP Electronics is a small business with five employees. The mean (average) weekly salary for the five employees is \$360. If the weekly salaries of four of the employees are \$340, \$340, \$345, and \$425, what is the salary of the fifth employee?

Part 1b. What is the problem asking?

Find the salary of the fifth employee.

Part 1c. Answer

The salary of the fifth employee is \$350 per week.

Part 1d. Explanation of Strategy

The arithmetic mean or average can be represented algebraically as:

$$\bar{X} = \frac{x_1 + x_2 + \dots + x_n}{n}$$

I put information from the problem into the formula. The problem says there are 5 employees, so $n = 5$. The problem also gives the mean (average) salary and the salaries of 4 of the employees. These numbers can be substituted into the formula as follows:

$$360 = \frac{340 + 340 + 345 + 425 + x_5}{5}$$

$$1800 = 340 + 340 + 345 + 425 + x_5$$

$$1800 = 1450 + x_5$$

$$1800 - 1450 = x_5$$

$$350 = x_5$$

$$\text{Check: } 360 = \frac{340 + 340 + 345 + 425 + 350}{5} = \frac{1800}{5} = 360$$

Part 2a. A New Problem

Joseph took five math exams this grading period and his average score on all of the exams is 88. He remembers that he received test scores of 78, 87, 94, and 96 on four of the examinations, but he has lost one examination and cannot remember what he scored on it. What was Joseph's score on the missing exam?

Part 2b. What is the new problem asking?

Find Joseph's score on the missing exam.

Part 2c. Answer to New Problem

Joseph received a score of 85 on the missing examination.

Part 2d. Explanation of Strategy

I substitute information from the problem into the formula for the arithmetic mean, as follows:

$$88 = \frac{78 + 87 + 94 + 96 + x_5}{5}$$

$$440 = 355 + x_5$$

$$85 = x_5$$

$$88 = \frac{78 + 87 + 94 + 96 + 85}{5} = \frac{440}{5} = 88$$

The answer makes sense.