Lesson 16

Algebraic Expressions

Name: _____

Prerequisite: Write Numerical Expressions

Study the example showing how to write numerical expressions. Then solve problems 1–6.

Example

Write a numerical expression for this phrase: 12 minus the product of 3 and 2.

Think about what the words mean.

12 minus   the product of 3 and 2

Minus means   A product is the result
to subtract.   of multiplication.

Before you can subtract the product from 12, you need to multiply 3 by 2 to find the product. Use parentheses to show that first you need to multiply.

The numerical expression is $12 - (3 \times 2)$.

B   **1** Jennifer says that you can also write $(12 - 3) \times 2$ for the phrase in the example. Is Jennifer correct? Explain why or why not.

No; Possible explanation: The value of $(12 - 3) \times 2$ is 18 and the value of $12 - (3 \times 2)$ is

6, so the expressions are not the same. You could write the expression $(12 - 3) \times 2$ for

a phrase like "Multiply the difference of 12 and 3 by 2."

M   **2** Write a numerical expression for the phrase "16 times the difference of 9 and 3." What operation should you perform first? Explain.

$16 \times (9 - 3)$; Subtraction; Possible explanation:

You multiply the difference by 16, so you must

subtract to find the difference before you

multiply.

Vocabulary

parentheses the symbols ( ) that can be used to group numbers and operations in an expression.

$24 - (3 \times 5)$

$(5 + 7) \times 3$

Solve.

B   **3** To evaluate the expression "10 minus the sum of 2 and 3," should you subtract or add first? Explain how you know.

Add; Possible explanation: The numerical expression is $10 - (2 + 3)$, so you need to

find the sum before you can subtract it from 10.

M   **4** Write a numerical expression for each word phrase. Then evaluate the expression.

a. 5 times the sum of 3 and 4

    $5 \times (3 + 4)$; 35

b. 24 divided by the sum of 6 and 2

    $24 \div (6 + 2)$; 3

c. Divide the difference of 18 and 3 by the sum of 1 and 2.

    $(18 - 3) \div (1 + 2)$; 5

d. the sum of 4 and 3 multiplied by the quotient of 4 and 2

    $(4 + 3) \times (4 \div 2)$; 14

M   **5** Write a word phrase for the expression $12 \div (7 - 3)$.

12 divided by the difference of 7 and 3

C   **6** Marisa made a fruit salad. She used 1 cup of green grapes and 3 cups of red grapes. She used twice as many cups of blueberries as cups of grapes.

Write an expression for the number of cups of blueberries that Marisa used. Then evaluate the expression. Explain your reasoning.

$2 \times (1 + 3)$; 8; Marisa used 8 cups of blueberries. Possible explanation: First I

needed to find the total number of cups of grapes. So I put the sum in parentheses.

Then I multiplied by 2 because Marisa used twice as many cups of blueberries:

$2 \times (1 + 3) = 2 \times 4 = 8$.

Key

B Basic	**M** Medium	**C** Challenge

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Write Expressions with Variables

Study the example showing how to write an expression from words. Then solve problems 1–10.

Example
Write an expression with the same meaning as "add a number times 2 to 5."

Find operation words to help you write the expression. *Add* a number times 2 to 5. This expression will be an addition of two terms.

| First term | + | Second term |

The first term is 5. The second term is 2x. So the expression is 5 + 2x.

B **1** What does the variable x in the example represent?
the unknown number that is multiplied by 2

M **2** The number 2 in the expression 5 + 2x is called the coefficient of x. How does changing the coefficient to 6 change the meaning of the expression?
The new expression 5 + 6x means "add a number times 6 to 5."

B **3** In the expression, 5 + 2x, how is the first term different from the second term?
Possible answer: The first term is a known number called a constant. The second term represents two times an unknown number called a variable.

M **4** Write an expression for each word phrase.
a. Multiply 4 by a number and then subtract 5.
$4x - 5$
b. 15 more than half a number
$\frac{1}{2}x + 15$

Vocabulary
variable a letter that stands for an unknown number.

constant a term that is a known number without variables.

coefficient a factor of a variable term that is a known number. The coefficient of the term 4x is 4.

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Solve.

M **5** Connie says an expression for the phrase "10 more than the square of a number" is $x^2 + 10$. Sharon says it is $10x^2$. Who is correct? Explain.
Connie is correct; Possible explanation: The word "more" indicates addition, so Connie was right because she added 10 to the square of a number.

M **6** Write an expression for each word phrase.
a. 5 less than the quotient of a number and 2
Possible answer: $\frac{x}{2} - 5$
b. 5 minus the quotient of a number and 2
Possible answer: $5 - \frac{x}{2}$

M **7** How are the expressions that you wrote in problem 6 similar? How are they different?
The expressions are similar because they each involve a difference and a quotient. In the first expression, the constant is subtracted from the quotient. In the second expression, the quotient is subtracted from the constant.

M **8** Write a word phrase for the expression $16 \div (x + 4)$.
16 divided by the sum of a number and 4

M **9** Write an expression with two terms. One term should have a coefficient with a variable and the other term should be a constant. Name the coefficient, the variable, and the constant in the expression. Then write a word phrase for your expression.
Possible answer: $2x + 5$; the coefficient is 2, the variable is x, and the constant is 5. The word phrase is "add 5 to the product of 2 and a number."

C **10** Mario says that the expression $4 + 3n^2$ has four terms: 4, 3, n, and 2. Is he correct? Explain.
Mario is not correct. A term is a number, a variable, or the product of a number and a variable or variables. 4 is a known number, so it is a term. $3n^2$ is the product $3 \times n \times n$, so it is a term. $4 + 3n^2$ has two terms.

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Write and Evaluate Expressions

Study the example showing how to write and evaluate expressions. Then solve problems 1–7.

Example

Lina is making jewelry. She has 7 beads and buys 4 additional packets of beads that each have the same number of beads. Write an expression to show the total number of beads that Lina uses.

Draw the beads she starts with and the packets she buys, and label the number of beads in each. You don't know how many beads are in each packet, so use a variable like b to label the number of beads in each packet.

Amount Lina Starts With	Additional Amount Lina Buys
7 beads	b beads b beads b beads b beads
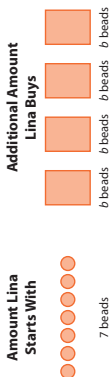
B **1** Write an expression for each word or phrase.

a. the number of beads Lina starts with

   7

b. the total number of beads in the four packets

   $4b$

c. the total number of beads Lina has

   $7 + 4b$

M **2** Laura wrote and solved the following expression to find the total number of beads Lina has if there are 6 beads in each packet. Find and correct Laura's mistake.

$7 + 4b = 11b$
$= 11(6)$
$= 66$

Laura added 7 and 4 before she multiplied the 4 by b. The order of operations is to multiply before adding. The correct answer is $7 + 4b = 7 + 4(6) = 7 + 24 = 31$.

Solve.

M **3** Blake and three friends meet for lunch. His friends all get the same thing, but Blake gets a different lunch that costs $6. Write an expression to show the total amount that Blake and his friends spend. Then find the total amount that Blake and his friends spend if each friend spends $8.

$6 + 3c$; $30

M **4** Ana's age is 8 years less than 4 times her sister's age. Write an expression for Ana's age. How old is Ana if her sister is 5 years old?

$4y − 8$; 12 years old

C **5** Belle put the muffins she baked on six plates, four of which are red and two of which are yellow. The four red plates each have 5 muffins. The two yellow plates each have the same number of muffins. Write an expression for the total number of muffins Belle baked. If each yellow plate has 8 muffins, find how many muffins Belle baked in all. Explain.

$20 + 2m$ or $4(5) + 2m$; Belle baked 36 muffins. Possible explanation: I can evaluate the expression $20 + 2m$ or $2m$ for $m = 8$, $20 + 2(8) = 20 + 16 = 36$.

M **6** Adam says that the expression $52 − 3y$ is equal to 20 when $y = 2$. Explain why Adam's answer is incorrect.

Adam evaluated 3(2) as 32 and then subtracted 32 from 52. The answer should be $52 − 3y = 52 − 3(2) = 52 − 6 = 46$.

C **7** A blue suitcase weighs 10 pounds less than three-fourths the weight of a green suitcase. Write an expression that you can use to find the weight of the blue suitcase. Then explain how you can find the total weight of both suitcases if the green suitcase weighs 36 pounds.

$\frac{3}{4}g − 10$; I evaluate the expression $\frac{3}{4}g − 10$ when $g = 36$ to find the weight of the blue suitcase. Then I find the sum of the weights of both suitcases.

$\frac{3}{4}(36) − 10 = 27 − 10 = 17$. The blue suitcase weighs 17 pounds. The total weight of the two suitcases is $36 + 17 = 53$ pounds.

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### Write and Evaluate More Expressions

Study the example showing how to write and evaluate more expressions. Then solve problems 1–5.

Example

Last week Juan mowed lawns and walked his neighbor's dog to earn money. For mowing lawns, he earned $6 less than twice as much as he did for walking dogs. Juan saves one-third of the money he earns and spends the rest.

Write an expression to show how much money Juan earned last week.

Draw a picture to help you understand the problem.

| walking dogs | $ | $ | $ | |
| mowing lawns | $ | $ | $ | $6 |

money saved / money spent / money spent
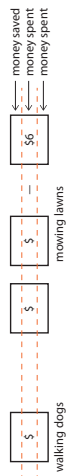
Let w be the amount Juan earned walking dogs. Then $(2w - 6)$ is the amount Juan earned mowing lawns. The total amount Juan earned is $w + (2w - 6)$, or $3w - 6$.

M **1** Emma wrote the expression $2(3w - 6)$ to represent the amount of money that Juan spent. Is she correct? Explain.

No; Possible explanation: Juan spent two-thirds of the money he earned. She should

have written $\frac{2}{3}(3w - 6)$.

M **2** Explain how you can find the amount of money Juan saved if he earned $12 walking dogs.

Possible explanation: Juan saved $\frac{1}{3}$ of what he earned. Use the expression $3w - 6$ to

find what he earned in all if he earned $12 walking dogs: $3(12) - 6 = 36 - 6 = 30$. So,

he earned $30 in all. He saved $\frac{1}{3}$ of $30, so he saved $\frac{1}{3}(\$30) = \$10$.

Solve.

B **3** The price p of a gallon of gas goes up $0.05 cents on Friday. On Saturday the price goes down $0.03. Write an expression with three terms to show the price of a gallon of gas on Saturday.

$p + 0.05 - 0.03$

M **4** Look at problem 3. If the price of a gallon of gas was $2.59 on Friday morning before the change in price, what was the price of a gallon of gas on Saturday? Explain how you know.

$2.61; I evaluated the expression $p + 0.05 - 0.03$ for $p = 2.59$. $2.59 + 0.05 - 0.03 = 2.61$

C **5** Katie gives Maggie half of her pencils. Maggie keeps 5 pencils and gives the rest to Jamil.

a. Write an expression for the number of pencils Maggie gives to Jamil.

$\frac{1}{2}k - 5$

b. If Katie had 16 pencils, how many pencils does Maggie give to Jamil?

Show your work.

Possible work: $\frac{1}{2}k - 5 = \frac{1}{2}(16) - 5$

$$= 8 - 5$$
$$= 3; \text{ 3 pencils}$$

Solution: **Maggie gives Jamil 3 pencils.**

c. How many pencils did Katie have if Maggie gave Jamil 1 pencil? Explain how you can use the expression to help you answer the question.

Show your work.

Possible work: I can try different numbers for k in the expression $\frac{1}{2}k - 5$ until I get

the solution 1.

$\frac{1}{2}(12) - 5 = 6 - 5 = 1$

Solution: **If Katie had 12 pencils, she would give Maggie 6 pencils. Maggie would**

keep 5 pencils and give Jamil 1 pencil.

Solve.

M **4** Martin used some apples to make muffins. Omar used some apples to make applesauce. Omar used 5 fewer than half as many apples as Martin used.

After you find the solution, read the problem again and check to be sure that your solution makes sense.

a. Write an expression to show the number of apples that Martin and Omar used in all. What does your variable represent?

Possible answer: $a + \frac{1}{2}a - 5 = \frac{3}{2}a - 5$;

a is the number of apples that Martin used.

b. Could Martin have used 10 apples? Why or why not? Use the expression to help you decide.

Show your work.

10 apples: $\frac{3}{2}a - 5 = \frac{3}{2}(10) - 5 = 10$

Solution: **Martin must have used more than 10 apples. If Martin had used**

10 apples, the total number of apples used by both Martin and Omar

would be 10 also. So Omar would have used 0 apples, which doesn't

make sense for this problem.

C **5** Lilla read $\frac{1}{5}$ of her book last week. This week she read 3 times as much as she read last week.

What should the variable in your expression represent?

a. Write an expression to show how much of her book Lilla has left to read. Then simplify the expression.

Possible answer: $b - \frac{1}{5}b - 3(\frac{1}{5}b) =$

$b - \frac{1}{5}b - \frac{3}{5}b = \frac{1}{5}b$

b. There are 75 pages in Lilla's book. How many pages does she have left to read?

Show your work.

$\frac{1}{5}(75) = 15$

Solution: **Lilla has 15 pages left to read.**

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Algebraic Expressions

Solve the problems.

M **1** Lewa's hiking backpack weighs 5 pounds less than $\frac{1}{2}$ the weight of Alani's hiking backpack. Write an expression to describe the weight of Lewa's backpack. How many pounds does Lewa's backpack weigh if Alani's backpack weighs 36 pounds?

Finding $\frac{1}{2}$ of an amount is the same as dividing that amount by 2.

Show your work.

Possible solution: $\frac{a}{2} - 5$

$\frac{36}{2} - 5 = 18 - 5 = 13$

Solution: $\frac{a}{2} - 5$; **Lewa's backpack weighs 13 pounds.**

B **2** A bookcase has two shelves. The top shelf has 10 more than $\frac{1}{3}$ the number of books on the bottom shelf. There are 12 books on the bottom shelf. How many books are on the top shelf?

Which operations will you use to solve this problem?

A 4   **C** 40

B 14   **D** 46

Cohen chose **D** as the correct answer. How did he get that answer?

Possible answer: Cohen multiplied the number of books on the bottom shelf

by 3 and then added 10. He should have divided by 3.

C **3** Which expression equals 6 when $a = 5$ and $b = \frac{1}{3}$? Circle all that apply.

Remember to use the order of operations when evaluating expressions.

A $9b^2 + 3a - 10$

B $a^2 - 20 - 3b$

C $3(a - 2) - a + 6b$

D $9b + ab$