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# Algebraic Expressions

Indicators 7.A.3; 8.A.2

algebraic expression   variable   verbal expression   polynomial   term   coefficient

An **algebraic expression** represents a number. It may contain numerals, variables, and/or operations.

$$5y \quad x^2 - 4 \quad \frac{2a + 1}{b} \quad 4p^2 + \frac{1}{9}$$

A **variable** is a symbol that stands for a number. It is often a letter of the alphabet.

$a \quad b \quad n \quad x \quad y$

An algebraic expression can represent a **verbal expression**, a quantity that is described in words. You can translate words into symbols, or symbols into words, according to their meanings.

A tree was 8 feet tall. It is growing 3 feet taller each year. Write an expression for the height of the tree after  $n$  years.

1. Write a term to describe the increase in the tree's height:  $3n$ .
2. Add the tree's initial height:  $3n + 8$ . The tree will be  $3n + 8$  feet tall after  $n$  years.

Translating between words and symbols:

$$n + 7 \quad 7 \text{ more than } n$$

$$n - 7 \quad 7 \text{ less than } n$$

$$7n \quad 7 \text{ times } n$$

$$\frac{n}{7} \quad n \text{ divided by } 7$$

A **polynomial** is an algebraic expression that contains one or more terms. However, none of the terms is a fraction with variables in the denominator, and none of the exponents is negative.

Is the expression below a polynomial?

$$6x^2 + \frac{3x}{4} - 5x^{-2}$$

1. Check to see if any term is a fraction with variables in the denominator: No.
2. Check to see if any term has a negative exponent: Yes. Since the third term has a negative exponent, the expression is **not** a polynomial.

A **term** in a polynomial is a number, a variable, or a product of numbers and variables.

$$-2 \quad x \quad 5y \quad -3z^2 \quad 8xy$$

$5y$  means  $5 \cdot y$  or  $5 \times y$ .

The number in a term is called the **coefficient**.

$$6x \quad 3x^2 \quad -8xy$$



## GUIDED PRACTICE

Try this sample multiple-choice problem.

- S** When James bought a chess set, an 8% sales tax was added to the price. He paid with a \$20 bill. If  $p$  = the price in dollars, which expression gives the amount of change in dollars James received?

- A**  $20 + 0.08p$
- B**  $20 - 0.08p$
- C**  $20 + p + 0.08p$
- D**  $20 - p - 0.08p$



This problem asks you to choose the algebraic expression that represents a quantity described in words. The price of the chess set is  $p$  dollars, so the amount of sales tax is 8% of  $p$ , which can be written as  $0.08p$ . The change James received was the result of subtracting the price,  $p$ , and the sales tax,  $0.08p$ , from \$20. So the expression that describes the change is  $20 - p - 0.08p$ . The correct answer is D.



## INDEPENDENT PRACTICE

Read each problem. Circle the letter of the best answer.

- 1** Which of these is a polynomial?

- A**  $y^3 - 6$
- B**  $\frac{2}{y} - 6$
- C**  $y^{-2} + 6$
- D**  $\frac{1}{y^3 + 6}$

- 2** Which verbal expression is equivalent to the algebraic expression  $4x - 5$ ?

- A** four times  $x$  less than five
- B** five less than four times  $x$
- C** negative five times four times  $x$
- D** five more than negative four times  $x$

- 3** Which is **not** a polynomial?

- A**  $8z$
- B**  $7z - 2$
- C**  $\frac{3}{5}z^2 - 8z + 4$
- D**  $\frac{4}{z^2} + 3z - 1$

- 4** The height of a triangle is 4 inches more than twice its base. If  $b$  = the base in inches of the triangle, which expression gives its height in inches?

- A**  $\frac{b}{2} + 4$
- B**  $\frac{b + 4}{2}$
- C**  $2b + 4$
- D**  $2(b + 4)$

- 5** Three friends had dinner at a restaurant. They left a 15% tip and split the cost equally. If the cost of the dinner (before tip) was  $n$  dollars, which expression gives the amount in dollars each of the friends paid?

- A**  $\frac{0.15n}{3}$
- B**  $\frac{3}{0.15n}$
- C**  $\frac{n + 0.15n}{3}$
- D**  $\frac{3}{n + 0.15n}$



## GUIDED PRACTICE

Try this sample constructed response problem.

5 Look at this algebraic expression.

$$\frac{1}{2}x^3 - \frac{1}{3}x^2 - \frac{1}{4}x$$

Is this expression a polynomial?

**Answer:** yes

Explain how you know your answer is correct.



This problem asks you to decide whether a given algebraic expression is a polynomial. Look to see if any term is a fraction with a variable in the denominator. Each term has a fraction, but none has a variable in the denominator. Look to see if any term has a negative exponent: **No**. Since no term has a variable in the denominator or a negative exponent, this expression **is** a polynomial.



## INDEPENDENT PRACTICE

Read the problem. Write your answers.

6 Look at this algebraic expression.

$$\frac{5}{y} - 8$$

**Part A:** Is this expression a polynomial? Explain why or why not.

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**Part B:** Write a verbal expression that is equivalent to the algebraic expression  $\frac{5}{y} - 8$ .

**Answer:** \_\_\_\_\_



Read the problem. Write your answers.

- 7 Nick, Carlos, and Mychal counted their baseball cards. Carlos has 10 more baseball cards than Nick. Mychal has twice as many as Nick.

**Part A:** If Nick has  $n$  baseball cards, write expressions for the number of baseball cards that Carlos and Mychal have.

**Carlos:** \_\_\_\_\_

**Mychal:** \_\_\_\_\_

Write an expression for the total number of baseball cards the three friends have.

**Answer:** \_\_\_\_\_

**Part B:** If Nick has 30 baseball cards, how many baseball cards do the three friends have in all?



To find the total number of baseball cards, replace each  $n$  in your expression with the number 30. Then simplify.

**Answer:** \_\_\_\_\_

SAMPLE