Name: $\qquad$
Linear and Nonlinear Expressions in $\mathbf{x}$ Date: $\qquad$ Period: $\qquad$

Focus Standard: 8.EE.C. 7 Solve linear equations in one variable.
a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x=a$, $a=a$, or $a=b$ result (where $a$ and $b$ are different numbers).
b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

## Student Outcomes

- Students know the properties of linear and nonlinear expressions in $x$.
- Students transcribe and identify expressions as linear or nonlinear.

Linear expressions in $x$ are special types of expressions. Linear expressions are expressions that are sums of constants and products of a constant and $x$ raised to a power of 0 , which simplifies to a value of 1 , or a power of 1 . Nonlinear expressions are also sums of constants and products of a constant and a power of $x$. However, nonlinear expressions will have a power of $x$ that is not equal to 1 or 0 .

The following chart contains noth linear and nonlinear expression in $x$. Based on the definitions above, identify the expressions that are linear by placing a " L " in the box, and use " $N L$ " to identify those that are nonlinear.

| $5 x+3$ | $-8 x+\frac{7}{9}-3$ | $9-x^{2}$ |
| :---: | :---: | :---: |
| $4 x^{2}-9$ | $0.31 x+7-4.2 x$ | $\left(\frac{x}{2}\right)^{3}+1$ |
| $11(x+2)$ | $-(6-x)+15-9 x$ | $7+x^{-4}+3 x$ |

## Lesson Summary

Linear expressions are sums of constants and products of constants and $x$ raised to a power of 0 or 1 . For example, $4+3 x, 7 x+x-15$, and $\frac{1}{2} x+7-2$ are all linear expressions in $x$.
Nonlinear expressions are also sums of constants and products of constants and $x$ raised to a power that is not 0 or 1 . For example, $2 x^{2}-9,-6 x^{-3}+8+x$, and $\frac{1}{x}+8$ are all nonlinear expressions in $x$.

Let's examine the following expressions:

1. $4+3 x^{5}$ Linear or nonlinear: $\qquad$
Number of terms: $\qquad$
Constant(s): $\qquad$ Coeffiencient(s): $\qquad$
2. $7 x+9+6+3 x$

Linear or nonlinear: $\qquad$
Number of terms: $\qquad$ Constant(s): $\qquad$ Coeffiencient(s): $\qquad$
3. $5+9 x * 7+2 x^{9} \quad$ Linear or nonlinear: $\qquad$
Number of terms: $\qquad$
Constant(s): $\qquad$ Coeffiencient(s): $\qquad$
4. $94+x+4 x^{-6}-2 \quad$ Linear or nonlinear: $\qquad$
Number of terms: $\qquad$
Constant(s): $\qquad$ Coeffiencient(s): $\qquad$
5. $x^{1}+9 x-4 \quad$ Linear or nonlinear: $\qquad$
Number of terms: $\qquad$
Constant(s): $\qquad$
$\qquad$

## Exercises

Write each of the following statements in Exercises 1-12 as a mathematical expression. State whether or not the expression is linear or nonlinear. If it is nonlinear, then explain why.

1. The sum of a number and four times the number.
2. The product of five and a number.
3. Multiply six and the reciprocal of the quotient of a number and seven.
4. Twice a number subtracted from four times a number, added to 15 .
5. The square of the sum of six and a number.
6. The cube of a positive number divided by the square of the same positive number.
7. The sum of four consecutive numbers.
8. Four subtracted from the reciprocal of a number.
9. Half of the product of a number multiplied by itself three times.
10. The sum that shows how many pages Maria read if she read 45 pages of a book yesterday and $\frac{2}{3}$ of the remaining pages today.
11. An admission fee of $\$ 10$ plus an additional $\$ 2$ per game.
12. Five more than four times a number and then twice that sum.

Problem Set: Write each of the following statements as a mathematic expression. State whether the expression is linear or nonlinear. If it is nonlinear, then explain why.

1. A number decreased by three squared.
2. The quotient of two and a number, subtracted from seventeen.
3. The sum of thirteen and twice a number.
4. 5.2 more than the product of seven and a number.
5. The sum that represents the number of tickets sold if 35 tickets were sold Monday, half of the remaining tickets were sold on Tuesday, and 14 tickets were sold on Wednesday.
6. The product of 19 and a number, subtracted from the reciprocal of the number cubed.
7. The product of 15 and a number, and then the product multiplied by itself four times.
8. A number increased by five and then divided by two.
9. Eight times the result of subtracting three from a number.
10. The sum of twice a number and four times a number subtracted from the number squared.
11. One-third of the result of three times a number that is increased by 12.
12. Five times the sum of one-half and a number.
13. Three-fourths of a number multiplied by seven.
14. The sum of a number and negative three, multiplied by the number.
15. The square of the difference between a number and 10 .
