Worksheet 3.5 – Linear and Nonlinear Relations

Complete the following questions on this worksheet and check the answer key on the final page before submitting.

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In Summary

Key Ideas
• Some relations are nonlinear.
• If a relation is nonlinear, then the following are true:
  • The graph is not a straight line.
  • The first differences are not constant.
  • The degree of its equation is not 1.

Need to Know
• In a nonlinear relation, the slope between pairs of points is not constant.

1. Identify each relation as linear or nonlinear. Explain how you know.

2. The area of a circle of radius $r$ is $A = \pi r^2$. Identify this relation as linear or nonlinear. Explain.
3. Identify each relation as linear or nonlinear.

\[ \begin{array}{c|c} x & y \\ \hline -3 & 9 \\ -2 & 4 \\ -1 & 1 \\ 0 & 0 \\ \end{array} \quad \begin{array}{c|c} x & y \\ \hline 5 & 1 \\ 6 & 2 \\ 7 & 3 \\ 8 & 4 \\ \end{array} \quad \begin{array}{c|c} x & y \\ \hline 1 & 0.25 \\ 2 & 0.50 \\ 3 & 0.75 \\ 4 & 1.00 \\ \end{array} \]

6. Identify each relation as linear or nonlinear. Explain your reasoning.

a) the relation between the number of circles in each figure and the figure number

b) the relation between the number of stars in each figure and the figure number

7. The relation between kilometres driven, \( k \), and the amount of gasoline, \( G \), (in litres) in the tank of a hybrid car is \( G = 80 - 0.2k \).

a) Identify this relation as linear or nonlinear. Explain how you know.
9. When a piece of paper is folded in half, one crease line and two sections of paper are created. The paper is then folded in half again and again, each time increasing the number of crease lines by 1. Identify the relation between the number of creases and the number of sections of paper as linear or nonlinear. Justify your answer.

(HINT: Make a table of values)

99. Experiment with equations that do not have degree 1 by entering the following into Green Globs:

\[ y = x^2 \quad y = x^3 \quad x = y^2 \quad x^2 + y^2 = 9 \quad xy = 8 \quad y = \frac{1}{x} \quad x = -\frac{1}{y} \]

**Answer Key:**
1. a) linear; graph is straight line  
   b) nonlinear; points lie on curve  
2. nonlinear; equation is degree 2, not degree 1  
3. a) nonlinear  
   b) linear  
   c) linear  
6. a) linear, one shape is added for each new figure  
   b) nonlinear; different number of shapes are added for each new figure  
7. a) linear, equation is of degree 1  
9. nonlinear; number of sections doubles for each paper fold