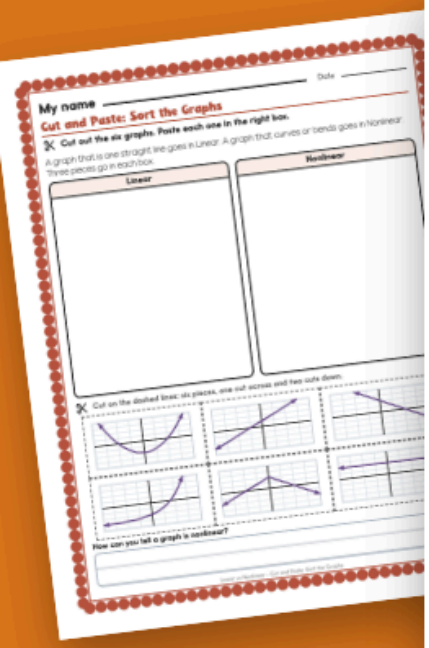
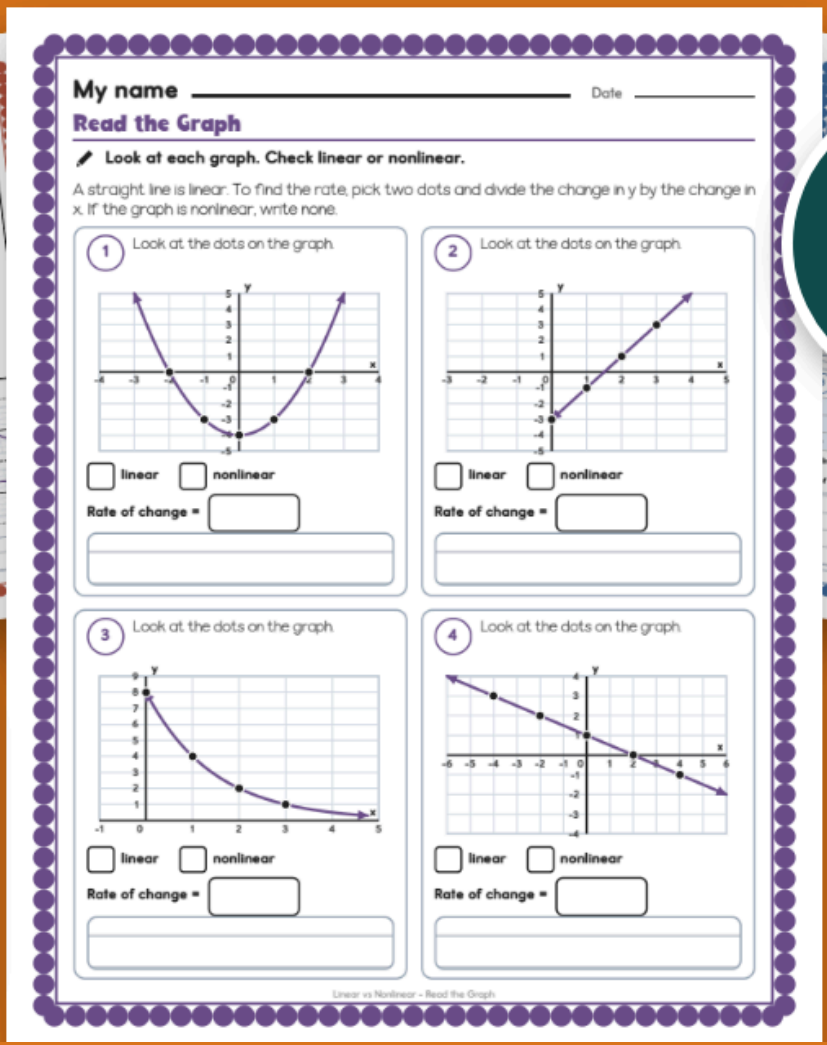
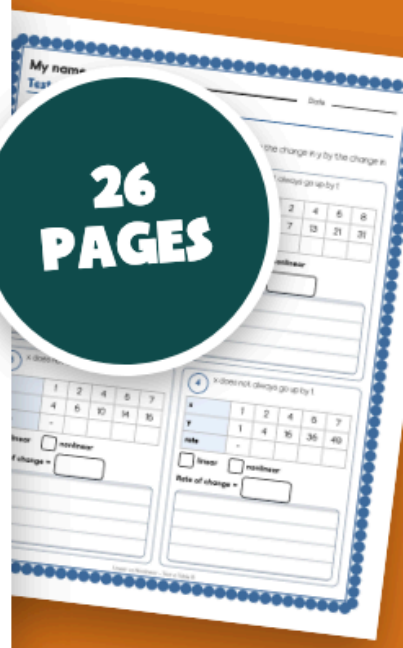
LINEAR VS NONLINEAR

FUNCTIONS WORKSHEETS · GRADES 8-9







26 PAGES



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PREVIEW

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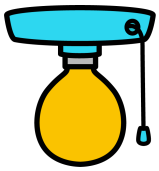


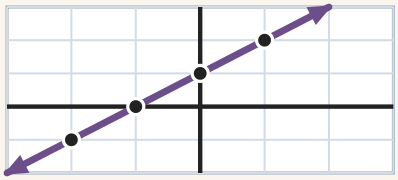
Linear vs Nonlinear: The Words

Read about each word. Fill in the blanks.

Linear and nonlinear are two kinds of functions. These six words and ideas come up on every page.

Linear

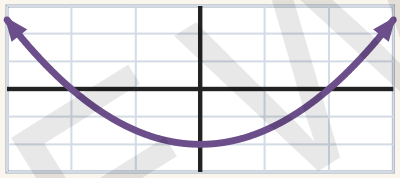
The graph is a straight line. The rate of change stays the same.



A linear graph is a straight ____

Nonlinear

The graph is not a straight line. It curves or bends. The rate of change changes.



A curve is linear or ___ ____

Rate of change

How much y changes when x goes up by 1. Subtract.

x	0	1	2	3
y	4	7	10	13

From 7 to 10, y changes by ____

Constant rate

The same change every step. Here y goes up 4, 4, 4.

x	0	1	2	3
y	9	13	17	21

Every change is 4. The rate is ____

y = mx + b

m is the rate of change. b is y when x is 0. The x has no power.

$$y = 6x + 2$$

In y = 6x + 2, m = ____

Nonlinear equation

A power on x, or x in an exponent, makes it nonlinear.

$$y = x^2 + 1$$

y = x squared + 1 is ____

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Worked Example: Tables

Read the examples. Then fill in the blanks.

Subtract each y from the next y. The numbers are made up for practice.

Example 1: a linear table

x	1	2	3	4	5
y	4	7	10	13	16
change in y	-	+3	+3	+3	+3

The changes are 3, 3, 3, 3. Every change is the same, so the rate of change is constant. The table is linear. The rate of change is 3.

Example 2: a nonlinear table

x	1	2	3	4	5
y	3	4	6	9	13
change in y	-	+1	+2	+3	+4

The changes are 1, 2, 3, 4. The changes are not the same, so the rate of change is not constant. The table is nonlinear. There is no one rate of change.

Your turn: do the same steps

x	0	1	2	3	4
y	9	7	5	3	1
change in y	-				

The changes are all ☐ **linear** ☐ **nonlinear**

Rate of change = ☐

PREVIEW

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My name _____ Date _____

Test a Table A

Fill in the changes. Check linear or nonlinear.

Subtract to find how much y changes each time. If every change is the same, the table is linear. The rate of change is that number.

1 x goes up by 1 each time.

x	0	1	2	3	4
y	2	5	8	11	14
change in y	-				

☐ linear ☐ nonlinear

Rate of change = ☐

2 x goes up by 1 each time.

x	0	1	2	3	4
y	1	2	4	7	11
change in y	-				

☐ linear ☐ nonlinear

Rate of change = ☐

3 x goes up by 1 each time.

x	0	1	2	3	4
y	6	10	14	19	24
change in y	-				

☐ linear ☐ nonlinear

Rate of change = ☐

4 x goes up by 1 each time.

x	0	1	2	3	4
y	20	17	14	11	8
change in y	-				

☐ linear ☐ nonlinear

Rate of change = ☐

PREVIEW

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My name _____ Date _____

Test an Equation A

Find y. Fill in the changes. Check one.

Put each x in the equation to find y. Then find the changes. If a power is on the x, or x is in an exponent, expect a nonlinear table.

1

$$y = 4x - 5$$

x	0	1	2	3
y				
change in y	-			

☐ linear ☐ nonlinear

Rate of change = ☐

2

$$y = x^2 - 3$$

x	0	1	2	3
y				
change in y	-			

☐ linear ☐ nonlinear

Rate of change = ☐

3

$$y = 9 - 2x$$

x	0	1	2	3
y				
change in y	-			

☐ linear ☐ nonlinear

Rate of change = ☐

4

$$y = 2^x + 1$$

x	0	1	2	3
y				
change in y	-			

☐ linear ☐ nonlinear

Rate of change = ☐

PREVIEW

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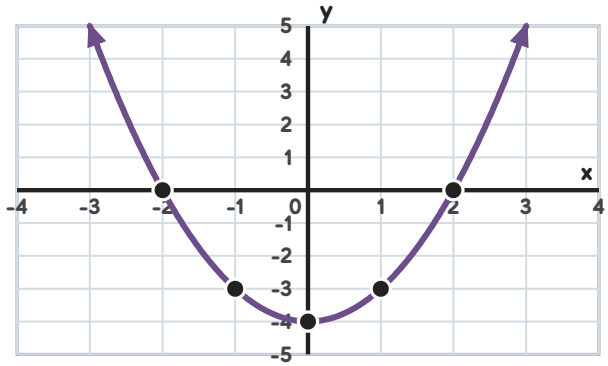
My name _____ Date _____

Read the Graph

Look at each graph. Check linear or nonlinear.

A straight line is linear. To find the rate, pick two dots and divide the change in y by the change in x. If the graph is nonlinear, write none.

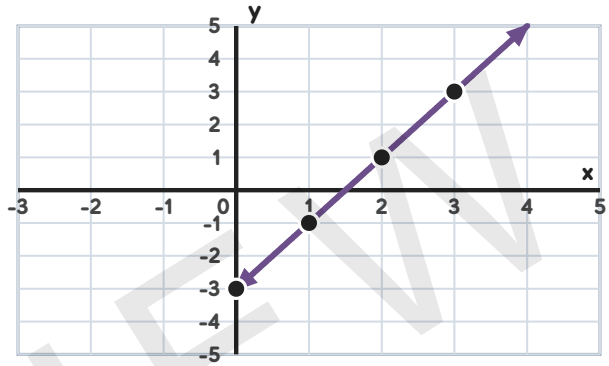
1 Look at the dots on the graph.



☐ linear ☐ nonlinear

Rate of change = ☐

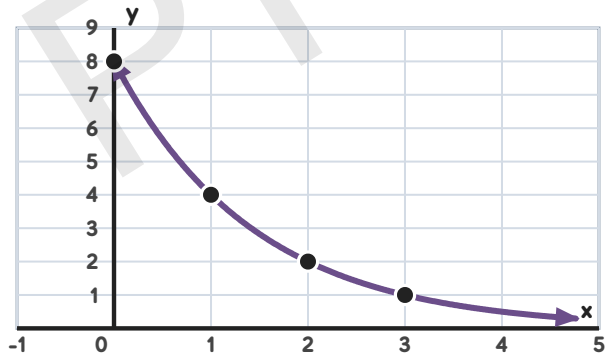
2 Look at the dots on the graph.



☐ linear ☐ nonlinear

Rate of change = ☐

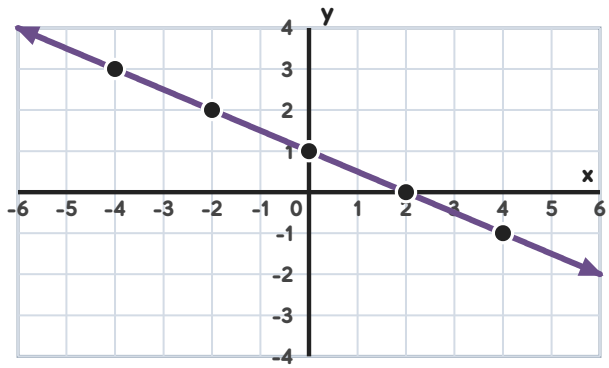
3 Look at the dots on the graph.



☐ linear ☐ nonlinear

Rate of change = ☐

4 Look at the dots on the graph.



☐ linear ☐ nonlinear

Rate of change = ☐

PREVIEW

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Real-World Situations A

Read each story. Fill in the table.

The numbers are made up for practice. Use the story to fill in y. Then look at how y changes.

1 A taxi ride costs 5 dollars to start plus 3 dollars for each mile.

miles	0	1	2	3
cost (dollars)				

☐ linear ☐ nonlinear

Rate of change = ☐

2 A sample starts with 3 cells. The number of cells doubles every hour.

hours	0	1	2	3
cells				

☐ linear ☐ nonlinear

Rate of change = ☐

3 Figure x is a rectangle of tiles, x tiles wide and x + 1 tiles long. How many tiles are in Figure x?

figure	1	2	3	4
tiles				

☐ linear ☐ nonlinear

Rate of change = ☐

4 A small pool has 40 gallons of water. A hose adds 6 gallons every minute.

minutes	0	1	2	3
gallons				

☐ linear ☐ nonlinear

Rate of change = ☐

PREVIEW

My name _____ Date _____

Quiz

Solve each one. Show your work.

Take your time. Show your work in the box. Write none for the rate if it is nonlinear.

1 Is this table linear or nonlinear?

x	1	2	3	4
y	12	9	6	3

☐ **linear** ☐ **nonlinear**

Rate of change = ☐

2 Find y for x = 0, 1, 2. Then decide.

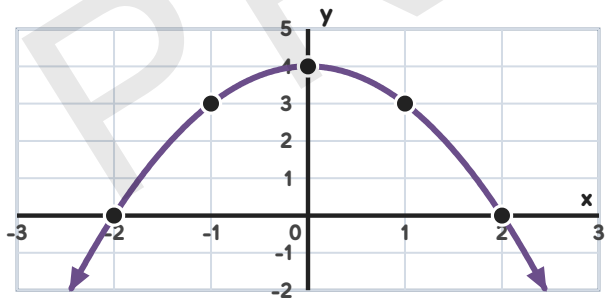
$$2y = 6x + 8$$

x	0	1	2
y			

☐ **linear** ☐ **nonlinear**

Rate of change = ☐

3 Look at the dots on the graph.



☐ **linear** ☐ **nonlinear**

Rate of change = ☐

4 A gym charges 15 dollars to join plus 9 dollars for each month.

months	0	1	2	3
cost (dollars)				

☐ **linear** ☐ **nonlinear**

Rate of change = ☐

PREVIEW

Answer Key: Words, Examples, Tables

Accept the rate written as a fraction or a decimal. A nonlinear table has no one rate of change.

The Words page 4

Card	Blank	Answer
Linear	A linear graph is a straight ___	line
Nonlinear	A curve is linear or ___	nonlinear
Rate of change	From 7 to 10, y changes by	3
Constant rate	Every change is 4. The rate is	4
y = mx + b	In y = 6x + 2, m =	6
Nonlinear equation	y = x squared + 1 is	nonlinear

Worked Example: Tables, your turn page 5

Blank	Answer
Change in y	-2, -2, -2, -2
All the changes are	-2
Linear or nonlinear	linear
Rate of change	-2

Worked Example: Equations, your turn page 6

Step	Answer
Step 1	y = -5x + 11
Step 2	m = -5, b = 11
Step 3	y = 11, 6, 1
Step 4	linear (changes -5 and -5)

Test a Table A page 7

Item	Table	Answer
7.1	x: 0, 1, 2, 3, 4; y: 2, 5, 8, 11, 14	changes 3, 3, 3, 3; linear, rate 3
7.2	x: 0, 1, 2, 3, 4; y: 1, 2, 4, 7, 11	changes 1, 2, 3, 4; nonlinear
7.3	x: 0, 1, 2, 3, 4; y: 6, 10, 14, 19, 24	changes 4, 4, 5, 5; nonlinear
7.4	x: 0, 1, 2, 3, 4; y: 20, 17, 14, 11, 8	changes -3, -3, -3, -3; linear, rate -3

Test a Table B page 8

Item	Table	Answer
8.1	x: 0, 5, 10, 15, 20; y: 50, 45, 40, 35, 30	rates -1, -1, -1, -1; linear, rate -1
8.2	x: 0, 2, 4, 6, 8; y: 3, 7, 13, 21, 31	rates 2, 3, 4, 5; nonlinear
8.3	x: 1, 2, 4, 6, 7; y: 4, 6, 10, 14, 16	rates 2, 2, 2, 2; linear, rate 2
8.4	x: 1, 2, 4, 6, 7; y: 1, 4, 16, 36, 49	rates 3, 6, 10, 13; nonlinear

How the answers were made

Every answer is computed from the table or the rule that draws the page: the change row, the rate, and the verdict. Linear means every change (or every change in y over change in x) is the same. Where y changes by different amounts but the rates match, the table is still linear.

PREVIEW

Answer Key: Stories, Mistakes, Quiz, Sort

Sam, in the Find the Mistake problems, is invented. Pieces are named by row and column in the cutting grid, left to right and top to bottom.

Item	Mistake	What went wrong	Right answer
15.1	Line 2	Sam checked only one change. All the changes must match: 6 - 3 = 3, 11 - 6 = 5, 18 - 11 = 7. They are not the same, so the table is nonlinear.	nonlinear
15.2	Line 2	x is squared, so this is not y = mx + b. A table shows it: y is 5, 4, 1 for x = 0, 1, 2. The changes are -1 and -3, so it is nonlinear.	nonlinear
15.3	Line 3	Going down does not make a graph linear. A linear graph is a straight line. This one is a curve, and the rates -4, -2, -1 are not the same.	nonlinear
15.4	Line 2	x does not go up by 1 each time, so compare change in y over change in x: 2 over 1, 4 over 2, 4 over 2. Every rate is 2, so the table is linear.	linear, rate 2

Real-World Situations A page 13

Item	Story	Answer
13.1	A taxi ride costs 5 dollars to start plus 3 dollars for each mile	5, 8, 11, 14; linear, rate 3 dollars per mile
13.2	A sample starts with 3 cells	3, 6, 12, 24; nonlinear, it doubles each hour (changes 3, 6, 12)
13.3	Figure x is a rectangle of tiles, x tiles wide and x + 1 tiles long	2, 6, 12, 20; nonlinear, changes 4, 6, 8
13.4	A small pool has 40 gallons of water	40, 46, 52, 58; linear, rate 6 gallons per minute

Real-World Situations B page 14

Item	Story	Answer
14.1	A car is worth 800 dollars	800, 400, 200, 100; nonlinear, it halves each year (changes -400, -200, -100)
14.2	A bike shop charges 2 dollars for a helmet plus 7 dollars for each hour	2, 9, 16, 23; linear, rate 7 dollars per hour
14.3	A candle is 30 cm tall	30, 28, 26, 24; linear, rate -2 cm per hour
14.4	A garden has a perimeter of 20 ft	9, 16, 21, 24; nonlinear, changes 7, 5, 3

Quiz page 16

Item	Type	Answer
16.1	Table	changes -3, -3, -3; linear, rate -3
16.2	Equation	y: 4, 7, 10; changes 3, 3; linear, rate 3
16.3	Graph	points (-2, 0), (-1, 3), (0, 4), (1, 3), (2, 0); nonlinear, rates 3, 1, -1, -3
16.4	Story	15, 24, 33, 42; linear, rate 9 dollars per month

Cut and Paste page 17

Piece	Graph	Box
r1 c1	a U-shaped curve	Nonlinear
r1 c2	a straight line going up	Linear
r1 c3	a straight line going down	Linear
r2 c1	a curve that bends up	Nonlinear
r2 c2	a peak, a V upside down	Nonlinear
r2 c3	a flat straight line	Linear

PREVIEW

Class Progress Grid

Every student on one grid: items right by kind of problem.

Class or group _____ Month _____

Student	Tables (of 8)	Equations (of 8)	Graphs (of 8)	Stories (of 8)	Mistakes (of 4)	Quiz (of 4)	Sort (of 6)

PREVIEW

How to fill this in

For each column, add up how many items that student has right with no prompt (the tracker rows). One glance across a row shows which kind of problem is easiest and which is next.

Grouping for small-group time

Students low in Tables need the words and the table example (pages 4 and 5). Students low in Equations need the equation example (page 6) and the table pages first. Students near full marks can move to the mistakes and the quiz (pages 15 and 16).

Maya's Tracker (Invented Student)

Maya R. is invented; nothing on this page describes a real student. The blank tracker is on page 21.

Student: Maya R. (an invented student)

Teacher: Mr. Okafor (invented)

Month: October

Page	Page type and set	Items	Right	Date	Notes
7	Test a Table A	4	4	10/6	-
8	Test a Table B	4	3	10/8	Forgot to divide by the change in x once
9	Test an Equation A	4	4	10/13	-
10	Test an Equation B	4	3	10/15	Called y = 6 not linear
11	Read the Graph	4	3	10/20	Read the rate off two dots that were not neighbors
12	Plot It, Then Decide	4	-	-	-
13	Real-World Situations A	4	2	10/22	Filled the table but stopped after one change
14	Real-World Situations B	4	-	-	-
15	Find the Mistake	4	3	10/27	Found the line, one fix not finished
16	Quiz	4	-	-	-
17	Cut and Paste: Sort the Graphs	6	-	-	-

PREVIEW

How to read it

Maya R. has done **7 of 11** scored pages and got **22 of 28** items right with no prompt. **2** pages were all right and **5** carry a note. Every number comes from the table.

What the table points to

The lowest page is Real-World Situations A (2 of 4). That is where the next practice goes. The 4 pages left blank are not tried yet, never wrong.