Comparing Linear, Quadratic, and Exponential Functions

Algebra I & II · 20 practice problems with a full answer key · Free to print

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Name: _____ Date: _____

LINEAR

$y = mx + b$

x on its own. Add the same amount each step. Example: $y = 2x + 3$

QUADRATIC

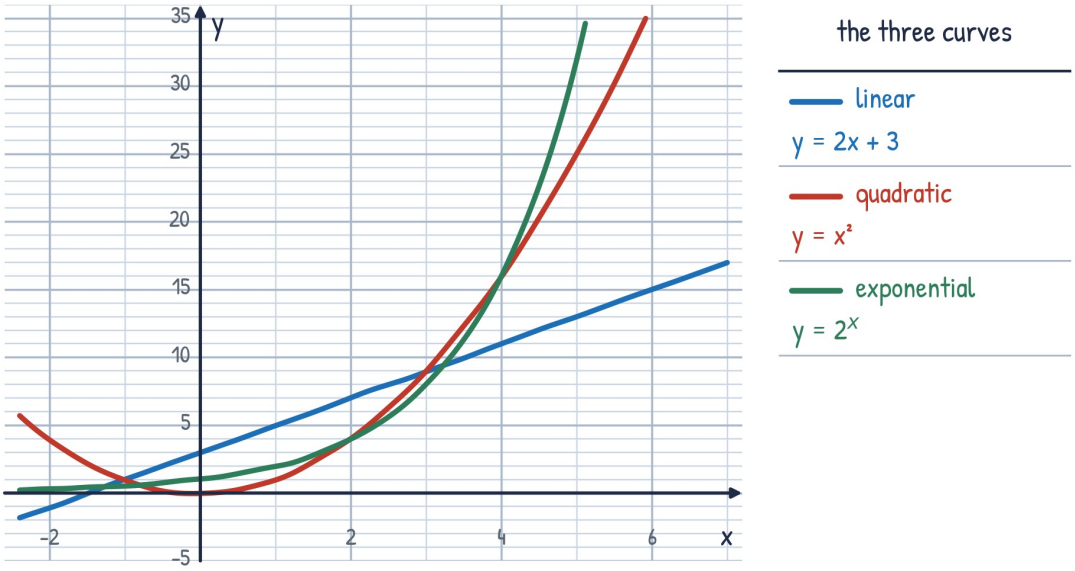
$y = ax^2 + bx + c$

x is squared. What you add grows evenly. Example: $y = x^2 - 4x + 1$

EXPONENTIAL

$y = a \cdot b^x$

x is the exponent. Multiply by the same amount each step. Example: $y = 3(2)^x$



Same axes, three families. The exponential starts lowest and finishes highest.

linear

x	y	
0	7	
		−3
1	4	
		−3
2	1	
		−3
3	−2	
		−3
4	−5	

first differences match

add the same amount each step

quadratic

x	y	
0	2	
		+1
1	3	
		+3
2	6	
		+5
3	11	
		+7
4	18	

first differences grow evenly

second differences: 2, 2, 2

exponential

x	y	
0	5	
		×2
1	10	
		×2
2	20	
		×2
3	40	
		×2
4	80	

same multiplier each step

differences never settle down

Subtract twice before you give up on quadratic. Then try dividing.

CHECK THE X COLUMN FIRST

Differences only mean something if x steps up by the same amount every row.

Part A — name the family (linear, quadratic, or exponential) and give your reason

1. $y = 5x - 4$

2. $y = 3(2)^x$

3. $y = x^2 + 4x - 5$

4.

x	0	1	2	3
y	5	10	20	40

5.

x	0	1	2	3	4
y	1	4	9	16	25

6.

x	0	1	2	3	4
y	7	4	1	−2	−5

7. $y = 100(0.8)^x$

8. $y = -2x^2 + 7$

9.

x	0	1	2	3	4
y	2	3	6	11	18

10.

x	0	1	2	3	4
y	1	1.5	2.25	3.375	5.0625

Part B — find the equation, then answer the question

11. Write the equation, then find y when x = 5.

x	0	1	2	3
y	6	18	54	162

12. Write the equation, then find y when x = 6.

x	0	1	2	3	4
y	3	5	11	21	35

13. Write the equation, then find x when y = −9.

x	0	1	2	3	4
y	12	9	6	3	0

14. A culture starts with 200 bacteria and doubles every hour. Write the equation and find the count after 6 hours.

15. A phone plan costs $30 a month plus $0.10 per GB of data. Write the equation and find the bill for a month with 45 GB.

16. A car worth $24,000 loses 15% of its value each year. Write the equation and find its value after 3 years.

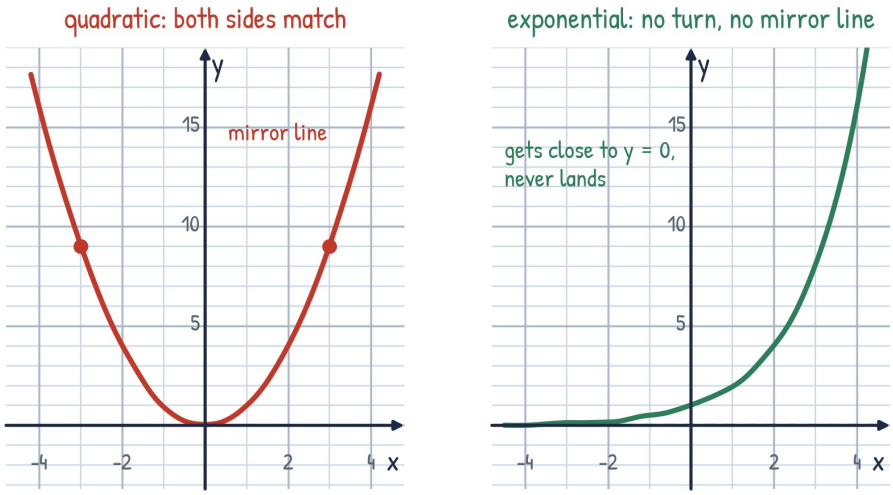
17. A ball is thrown from a 4 ft ledge and its height is $h = -16t^2 + 48t + 4$. How high does it get, and when?

18. Account A starts at $500 and gains $25 a month. Account B starts at $500 and grows 4% a month. Which is worth more after 12 months? After 24 months?

19. Compare $y = x^2$ and $y = 2^x$ at x = 2, 3, 4, and 5. From which whole number is the exponential ahead for good?

20. Three functions: $y = 50x$, $y = x^2$, $y = 1.2^x$. Which is largest at x = 10? Which is largest at x = 100?

Answer Key



Left: turns around, both sides match. Right: no turn, and the curve never reaches y = 0.

Part A

1. **Linear.** x is to the first power.
2. **Exponential.** x is the exponent, base fixed at 2.
3. **Quadratic.** Highest power of x is 2.
4. **Exponential, $y = 5(2)^x$.** Ratios 2, 2, 2.
5. **Quadratic.** First differences 3, 5, 7, 9; second differences 2.
6. **Linear, $y = -3x + 7$.** First differences all −3.
7. **Exponential (decay).** Base 0.8 is under 1.
8. **Quadratic.** The negative only flips the parabola.
9. **Quadratic, $y = x^2 + 2$.** Second differences 2, 2, 2.
10. **Exponential, $y = (1.5)^x$.** Every ratio is 1.5.

Part B

11. **$y = 6(3)^x$; $y = 1{,}458$.** Ratio 3, start 6; 6×3^5.
12. **$y = 2x^2 + 3$; $y = 75$.** Second differences 4 so a = 2; c = 3, b = 0.
13. **$y = -3x + 12$; $x = 7$.** $-3x + 12 = -9$.
14. **$y = 200(2)^t$; 12,800 bacteria.** 200×64.
15. **$C = 0.10g + 30$; \$34.50.** Same amount added per GB, so linear.
16. **$V = 24{,}000(0.85)^n$; \$14,739.** Keeping 85% each year.
17. **40 ft at t = 1.5 s.** Vertex at $t = -48 / (2 \times -16)$.
18. **Nearly tied at 12 months (B by 52¢); B by about \$182 at 24 months.** 800 vs 800.52; 1,100 vs 1,281.65.
19. **Exponential ahead from x = 5.** 4 & 4, 9 & 8, 16 & 16, 25 & 32.
20. **Linear at x = 10; exponential at x = 100.** 500, 100, 6.2 → 5,000, 10,000, ~83 million. It passes both near x = 41.