

Linear Relations

KEY IDEAS

Linear relation: y changes by the **same amount** each time x goes up by 1. Its graph is a **straight line**.

Rule: $y = (\text{change in } y) \times x + (\text{value of } y \text{ when } x = 0)$. Example: x: 0, 1, 2, 3 → y: 4, 7, 10, 13 gives $y = 3x + 4$.

Graphing: make a table of values, plot each (x, y) point, then join them with a ruler.

A Complete each table of values

4 marks

1. $y = 3x + 1$

x	0	1	2	3	4
y	1				

2. $y = -2x + 5$

x	0	1	2	3	4
y	5				

B Find the rule for each table

4 marks

3.

x	0	1	2	3
y	2	5	8	11

4.

x	0	1	2	3
y	10	8	6	4

5.

x	1	2	3	4
y	4	8	12	16

6.

x	0	1	2	3
y	-3	-1	1	3

C Linear or not?

2 marks (½ each)

Find the change in y each time. Write Yes if the relation is linear.

7.

x	0	1	2	3
y	1	3	5	7

Linear? _____

8.

x	0	1	2	3
y	1	2	4	8

Linear? _____

9.

x	0	1	2	3
y	20	15	10	5

Linear? _____

10.

x	0	1	2	3
y	0	1	4	9

Linear? _____

D Real-world problems

6 marks

11. A plumber charges a \$60 call-out fee plus \$45 per hour. Write a rule for the cost, C, of a job lasting h hours. Then find the cost of a 3-hour job.

12. A candle is 30 cm tall and burns down 2 cm every hour. Write a rule for its height, H, after t hours. After how many hours does it burn out?

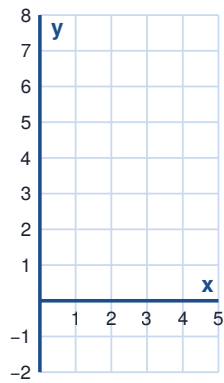
13. A pool has 200 L of water. A hose adds 50 L every minute. Write a rule for the volume, V, after m minutes, and find the volume after 12 minutes.

E Graph each relation

4 marks

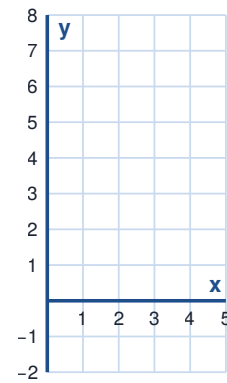
14. Graph $y = 2x - 1$. Complete the table first.

x	y
0	
1	
2	
3	
4	



15. Graph $y = -x + 4$. Complete the table first.

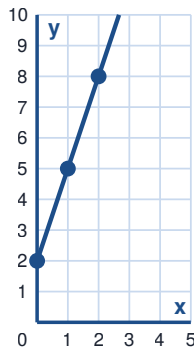
x	y
0	
1	
2	
3	
4	



F Find the rule from a graph

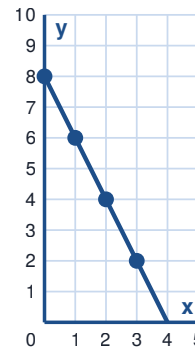
4 marks

16. Write the rule for this line.



Rule: _____

17. Write the rule for this line.



Rule: _____

G Growing pattern

4 marks

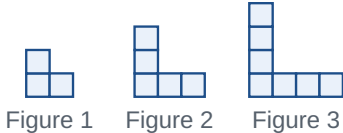


Figure 1

Figure 2

Figure 3

18. How many tiles will Figure 4 have?

19. Write a rule for the number of tiles, t , in Figure n .

20. Which figure has 31 tiles?

H Spot the mistake

2 marks

21. For the table x : 0, 1, 2, 3 and y : 5, 8, 11, 14, a student writes the rule $y = 5x + 3$. Explain the error and correct it.

22. A student says the point (3, 6) is on the line $y = 2x + 1$. Explain the error and correct it.

Linear Relations

ANSWER KEY

KEY IDEAS

Linear relation: y changes by the **same amount** each time x goes up by 1. Its graph is a **straight line**.

Rule: $y = (\text{change in } y) \times x + (\text{value of } y \text{ when } x = 0)$. Example: x: 0, 1, 2, 3 → y: 4, 7, 10, 13 gives $y = 3x + 4$.

Graphing: make a table of values, plot each (x, y) point, then join them with a ruler.

A Complete each table of values

4 marks

1. $y = 3x + 1$

x	0	1	2	3	4
y	1	4	7	10	13

2. $y = -2x + 5$

x	0	1	2	3	4
y	5	3	1	-1	-3

B Find the rule for each table

4 marks

3.

x	0	1	2	3
y	2	5	8	11

$y = 3x + 2$

4.

x	0	1	2	3
y	10	8	6	4

$y = -2x + 10$

5.

x	1	2	3	4
y	4	8	12	16

$y = 4x$

6.

x	0	1	2	3
y	-3	-1	1	3

$y = 2x - 3$

C Linear or not?

2 marks (½ each)

Find the change in y each time. Write Yes if the relation is linear.

7.

x	0	1	2	3
y	1	3	5	7

Linear? **Yes (+2, +2, +2)**

8.

x	0	1	2	3
y	1	2	4	8

Linear? **No (+1, +2, +4)**

9.

x	0	1	2	3
y	20	15	10	5

Linear? **Yes (-5, -5, -5)**

10.

x	0	1	2	3
y	0	1	4	9

Linear? **No (+1, +3, +5)**

D Real-world problems

6 marks

11. A plumber charges a \$60 call-out fee plus \$45 per hour. Write a rule for the cost, C, of a job lasting h hours. Then find the cost of a 3-hour job.

$C = 45h + 60$. $C = 45(3) + 60 = \$195$

12. A candle is 30 cm tall and burns down 2 cm every hour. Write a rule for its height, H, after t hours. After how many hours does it burn out?

$H = 30 - 2t$ (or $H = -2t + 30$). $30 - 2t = 0 \rightarrow 15$ hours

13. A pool has 200 L of water. A hose adds 50 L every minute. Write a rule for the volume, V, after m minutes, and find the volume after 12 minutes.

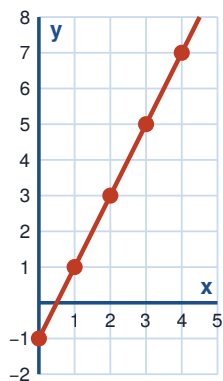
$V = 50m + 200$. $V = 50(12) + 200 = 800$ L

E Graph each relation

4 marks

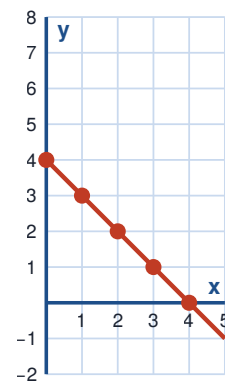
14. Graph $y = 2x - 1$. Complete the table first.

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



15. Graph $y = -x + 4$. Complete the table first.

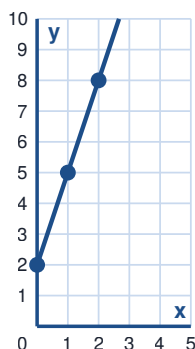
x	y
0	4
1	3
2	2
3	1
4	0



F Find the rule from a graph

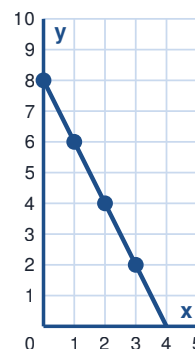
4 marks

16. Write the rule for this line.



Rule: $y = 3x + 2$

17. Write the rule for this line.



Rule: $y = -2x + 8$

G Growing pattern

4 marks

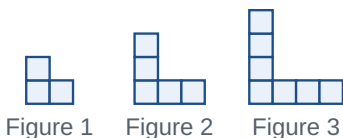


Figure 1

Figure 2

Figure 3

18. How many tiles will Figure 4 have?

9 tiles (add 2 each time: 3, 5, 7, 9)

19. Write a rule for the number of tiles, t , in Figure n .

$t = 2n + 1$ (2 more each figure, and $2(1) + 1 = 3$)

20. Which figure has 31 tiles?

$2n + 1 = 31 \rightarrow 2n = 30 \rightarrow$ **Figure 15**

H Spot the mistake

2 marks

21. For the table x : 0, 1, 2, 3 and y : 5, 8, 11, 14, a student writes the rule $y = 5x + 3$. Explain the error and correct it.

The numbers are switched. y goes up by 3 each time (that multiplies x) and starts at 5 when $x = 0$: $y = 3x + 5$.

22. A student says the point (3, 6) is on the line $y = 2x + 1$. Explain the error and correct it.

Substitute $x = 3$: $y = 2(3) + 1 = 7$, not 6. So (3, 6) is **not** on the line; (3, 7) is.