

Patterns and Relations: Linear Relations – AP Book 7.1: Unit 3

AP Book PR7-1

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1. a) 38, 46, 54
b) 284, 273, 262
c) 135, 405, 1215
d) 80, 20, 5

Bonus

-97, -196, -295

2. a) 5
875, 4375, 21 875,
109 375, 546 875
b) 108
684, 576, 468, 360,
252
c) 2
48, 24, 12, 6, 3
d) 30
995, 1025, 1055,
1085, 1115

Bonus

120
60, 180, 300, 420,
540

3. a) add 50
b) multiply by 2
c) subtract 250
d) divide by 5

Bonus

subtract 2000

4. a) +7, +7, +7
b) +16, +32, +64
c) -75, -75, -75, -75
d) -200, -100, -50,
-25

Bonus

- e) -100, -100, -100,
+100
f) +100, +100, +50,
+20

5. a) -12, -12
b) +72, +216
c) +8, +8, +8, +8
the same number,
linear
d) -216, -72, -24, -8
not the same
number, non-linear

6. a) linear
b) non-linear

7. a) no, the gap is not
always the same
number
b) yes, the gap is
always the same
number
c) no, the gap is not
always the same
number
d) yes, the gap is
always the same
number

Bonus

no, the gap is not
always the same
number

8. b) 10, -10

Bonus

25, -25

9. b) increasing
c) increasing
d) decreasing
10. a) ii) +7, circle
increasing
iii) -5, circle
decreasing
iv) +5, circle
increasing
b) positive, negative

11. a) 8, 29, 50, 71, 92
b) 21, 29, 37, 45, 53
c) 100, 93, 86, 79, 72
d) 100, 93, 86, 79, 72
12. b) 410, +24
Start at 410 and add
24 each time.
13. a) Start at 590 and
subtract 40 each
time.
Start at 590 and add
-40 each time.
b) Start at 100 and
subtract 50 each
time.
Start at 100 and add
-50 each time.

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1. b) 40×5
c) $95 \times h$

2. b) $9 \times n, 9n$
c) $9 \times (m + 1), 9(m + 1)$
3. b) $r \times z, rz$
c) $r \times (9 - Q), r(9 - Q)$
4. b) $30 - W = 30 - 97$
 $= -67$
c) $3y + 5x$
 $= 3(2) + 5(10)$
 $= 6 + 50 = 56$
d) $300 - 7y$
 $= 300 - 7(25)$
 $= 300 - 175 = 125$
e) $T - 24(5)$
 $= -9 - 24(5)$
 $= -9 - 120 = -129$
f) $45(3) - q$
 $= 45(3) - (-23)$
 $= 135 - (-23) = 158$

Bonus

$40(6) - 50(20)$
 $= -20$
 $= 240 - 1000 - (-20)$
 $= -740$

5. a) expression, equation
or
equation, expression
b) equation, expression
c) expression, equation
d) equation
e) expression
f) equation

6. a) ii) $15 + 5m$
 $= 15 + 5(16)$
 $= 15 + 80 = 95$

iii) $g - 25p$
 $= -10 - 25(3)$
 $= -10 - 75$
 $= -85$

- b) ii) $95 = 80$ is false
iii) $-85 = -85$ is
true

7. b) $LS = 5(25) - 20$
 $= 125 - 20 = 105$
 $RS = 4(25) = 100$
Since $LS \neq RS$, the
equation is false
when $x = 25$.
c) $LS = 3(40) + 80$
 $= 120 + 80 = 200$
 $RS = 5(40) = 200$
Since $LS = RS$, the
equation is true when
 $a = 40$.

- d) $LS = -50 - 100$
 $= -150$
 $RS = -100 - (-50)$
 $= -50$
Since $LS \neq RS$, the
equation is false
when $T = -50$

AP Book PR7-3

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1. b) $t = 8s$
c) $t = 11s$
2. a) i) 3
6
9
12
ii) 9
18
27
36
iii) 15
16
17
18
b) i) $v = 3n$
ii) $v = 9n$
iii) $v = 14 + n$
c) i) 5th term: 15
25th term: 75
ii) 5th term: 45
25th term: 225
iii) 5th term: 19
25th term: 39

- d) Sample answer:
I used the formula
because it was
faster.

3. a)	Output (B)
	$25 - (2) = 23$
	$25 - (3) = 22$
	$25 - (4) = 21$

b)	Output (y)
	$2(1) + 3 = 5$
	$2(2) + 3 = 7$
	$2(3) + 3 = 9$
	$2(4) + 3 = 11$

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(continued)

c)

Output (y)
$(1) \times (1) = 1$
$(2) \times (2) = 4$
$(3) \times (3) = 9$
$(4) \times (4) = 16$

4. a) -1
-1
-1
linear

- b) +2
+2
+2
linear

- c) +3
+5
+7
non-linear

5. a)

Output (B)
6
36
216
1296

+30
+180
+1080

circle non-linear

- b)

Output (y)
$(1) \times 8 = 8$
$(2) \times 8 = 16$
$(3) \times 8 = 24$
$(4) \times 8 = 32$

+8
+8
+8

circle linear

- c)

Output (y)
3
6
12
24

+3
+6
+12

circle non-linear

AP Book PR7-4

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1. b) 8, 16, 24, 32, 40
c) 10, 20, 30, 40, 50
d) 9, 18, 27, 36, 45
e) 9, 18, 27, 36, 45
f) 150, 300, 450, 600, 750

2. a)

(v)	RA	M
7	7	7×1
14	$7 + 7$	7×2
21	$7 + 7$ $+ 7$	7×3
28	$7 + 7$ $+ 7 + 7$	7×4
35	$7 + 7$ $+ 7 + 7$ $+ 7$	7×5

- b) 7
c) ii) 7×10
iii) 7×108
iv) $7n$
d) $v = 7n$

3. a) 7
b) They are equal.
c) The sequence rule says to add 7 each time to get the next term. So this gap of 7 is added repeatedly as many times as the term number, or multiplied by the term number, to get each term.

4. b) $v = 9n$
c) $v = 200n$

Bonus

$$v = Cn$$

5. a) 2, 11, 20, 29, 38
b) 2, 11, 20, 29, 38
c) 9, 11, 13, 15, 17

Bonus

99, 199, 299, 399, 499

6. a) 11, 8

Bonus

Start at 95 and add 100 each time.

7. a) 7, 10, 13, 16, 19
b) 3
c) 4

d)

(v)	RA	M
13	$(3 + 3 + 3) + 4$	$(3 \times 3) + 4$
16	$(3 + 3 + 3 + 3) + 4$	$(3 \times 4) + 4$
19	$(3 + 3 + 3 + 3 + 3) + 4$	$(3 \times 5) + 4$

- e) ii) $3(10) + 4$
iii) $3n + 4$

$$v = 3n + 4$$

8. b)

Gap \times n	(v)
$6 \times 1 = 6$	9
$6 \times 2 = 12$	15
$6 \times 3 = 18$	21

+6
+6

$$3$$

$$6, 3$$

$$v = 6n + 3$$

- c)

Gap \times n	(v)
$10 \times 1 = 10$	4
$10 \times 2 = 20$	14
$10 \times 3 = 30$	24

+10
+10

$$6$$

$$10, 6$$

$$v = 10n - 6$$

- d)

Gap \times n	(v)
$8 \times 1 = 8$	1
$8 \times 2 = 16$	9
$8 \times 3 = 24$	17

+8
+8

$$7$$

$$8, 7$$

$$v = 8n - 7$$

9. a) 34

b)

(v)	RA	M
30	$34 - 4$	$34 - (4 \times 1)$
26	$34 - (4 + 4)$	$34 - (4 \times 2)$
22	$34 - (4 + 4 + 4)$	$34 - (4 \times 3)$
18	$34 - (4 + 4 + 4 + 4)$	$34 - (4 \times 4)$
14	$34 - (4 + 4 + 4 + 4 + 4)$	$34 - (4 \times 5)$

$$v = 34 - 4n$$

10. a)

(M)
150
$150 \times 2 = 300$
$300 \times 2 = 600$
$600 \times 2 = 1200$

- b)

(A)
193
$191 + (2 \times 2) = 195$
$191 + (2 \times 3) = 197$
$191 + (2 \times 4) = 199$

- c)

(M)
400
$435 - (35 \times 2) = 365$
$435 - (35 \times 3) = 330$
$435 - (35 \times 4) = 295$

- d)

(V)
3200
$3200 \div 2 = 1600$
$1600 \div 2 = 800$
$800 \div 2 = 400$

11. a) non-linear
b) linear, $A = 191 + 2p$
c) linear, $M = 435 - 35n$
d) non-linear

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(continued)

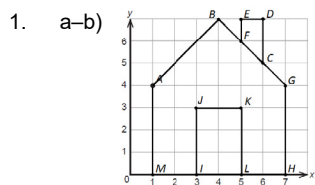
12. a)

Cost (C)
25
$25 + 11 = 36$
$25 + 11 + 11 = 47$
$25 + 11 + 11 + 11 = 58$

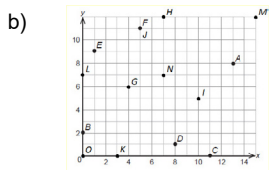
- b) yes
 c) $C = 14 + 11n$
 d) i) \$124
 ii) \$278
 iii) \$542

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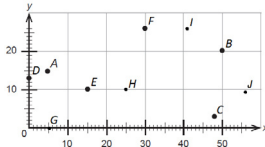


- c) a house
 2. a) $B(3, 5)$, $C(6, 4)$, $D(4, 2)$, $E(7, 3)$, $F(2, 2)$, $G(0, 2)$, $H(3, 1)$, $I(5, 0)$, $J(4, 0)$, $K(0, 0)$, $L(2, 0)$
 b) I, J, K, L
 c) G, K
 d) K
 3. a-b)
-
- c) M
 4. a) $B(0, 2)$, $C(11, 0)$, $D(8, 1)$, $E(1, 9)$, $F(5, 11)$



5. a) Teacher to check.

b)–Bonus



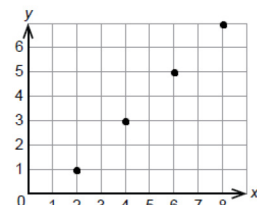
6. a) large scale
 b) small scale

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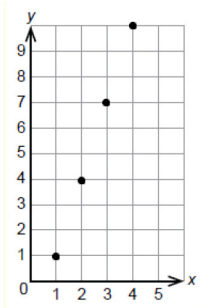
1.

Ordered Pair
(2, 1)
(4, 3)
(6, 5)
(8, 7)



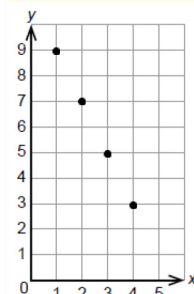
2. a)

Output (y)
1
4
7
10



b)

Output (y)
9
7
5
3



3. a)

Output (y)	Ordered Pair
$3(1) + 1 = 4$	(1, 4)
$3(2) + 1 = 7$	(2, 7)
$3(3) + 1 = 10$	(3, 10)

Teacher to check grid.

b)

Output (y)
$4 + 1 = 5$
$4 + 2 = 6$
$4 + 3 = 7$
$4 + 4 = 8$

Teacher to check grid.

Bonus

Output (y)
$100 - 2(10) = 80$
$100 - 2(20) = 60$
$100 - 2(30) = 40$
$100 - 2(40) = 20$

Teacher to check grid.

4. a)

Output (y)
12
8
4

yes

b)

Output (y)
3
6
12

no

c)

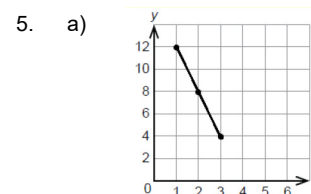
Output (y)
$5(1) - 3 = 2$
$5(2) - 3 = 7$
$5(3) - 3 = 12$

yes

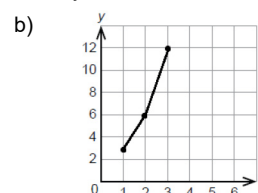
Bonus

Output (y)
$180 - 3(20) = 120$
$180 - 3(40) = 60$
$180 - 3(60) = 0$

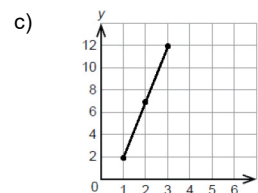
yes



yes

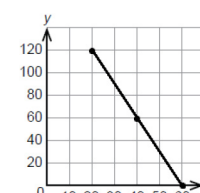


no



yes

Bonus



yes

Patterns and Relations: Linear Relations – AP Book 7.1: Unit 3

(continued)

6. If the line is straight, the relation is linear.
7. a) Yes, this graph shows a linear relation because it is a single straight line.
- b) No, this graph does not show a linear relation because the line is not straight.
- c) No, this graph does not show a linear relation because the line is not completely straight.
8. a) The relation is decreasing because it goes down from left to right.
- b) The relation is increasing because it goes up from left to right.

9. A.

Output (y)
$(5 \times 1) - 4 = 1$
$(5 \times 2) - 4 = 6$
$(5 \times 3) - 4 = 11$

Circle positive and increasing.

B.

Output (y)
$17 - (4 \times 1) = 13$
$17 - (4 \times 2) = 9$
$17 - (4 \times 3) = 5$

Circle negative and decreasing.

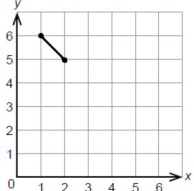
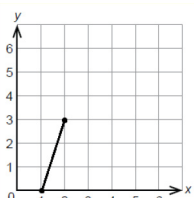
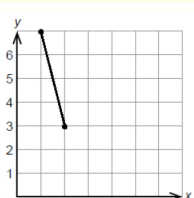
10. a) Sample answers:
A. I think the graph will have a straight line going up to the right.
B. I think the graph will have a straight line going down to the right.
- b) Teacher to check.

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1. b) +34
c) -9

Bonus

- d) -2
e) 1
f) -1
2. a) 2
b) Teacher to check grid.
(1, 3)
c) The value of y will increase by 2.
Teacher to check grid.
(2, 5)
d) Teacher to check grid.
3
3. a) 
- b) 
- c) 
4. a) -4
b) 9
c) Start at 9 and subtract 4 each time.
d) 13
e) $y = 13 - 4x$
f)

Output (y)
9
5
1

Yes

5. a) i) 2
2
Circle increasing and linear.
ii) 1
5
Circle increasing and non-linear.
iii) -3
-3
Circle decreasing and linear.
- b) A. iii)
B. ii)
C. i)
6. a) i) 2
ii) 2
iii) 4
b) i) 3
ii) 2
iii) 3
c) Teacher to check grid.
A. (1, 2)
B. (1, 4)
C. (1, 2)
d) A. 2
B. 3
C. 3
Teacher to check graphs.
e) A. ii)
B. iii)
C. i)
Sample explanation:
I matched Graph A to part ii) because the value of y increases by 2 when x increases by 1.
I matched the other graphs by looking at the starting numbers.
7. a) i) \$10
ii) \$14
iii) \$12
b) 5
c) \$18

Bonus

I would choose Aputik's store because it would only cost \$22.

AP Book PR7-8

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1. a)

Gap \times n	(v)
$5 \times 1 = 5$	4
$5 \times 2 = 10$	9
$5 \times 3 = 15$	14

$$v = 5n - 1$$

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b)

Gap \times n	(v)
$3 \times 1 = 3$	47
$3 \times 2 = 6$	44
$3 \times 3 = 9$	41

Subtract from 50

$$v = 50 - 3n$$

20

2. I assumed that they were linear sequences.
3. a) $v = 3 \times n + 4$
b) i) $v = 3 \times 23 + 4 = 69 + 4 = 73$
ii) $v = 3 \times 20 + 4 = 60 + 4 = 64$
64, 67, 70, 73
iii) yes
4. b) i) 4, 9, 14
ii) Start at 4 and add 5 each time.
iii) $5n - 1$
iv) $5(15) - 1 = 75 - 1 = 74$
The 15th figure would have 74 blocks.
- c) i) 6, 8, 10

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(continued)

- ii) Start at 6 and add 2 each time.
 iii) $2n + 4$
 iv) $2(15) + 4 = 30 + 4 = 34$
 The 15th figure would have 34 blocks.
- d) i) 4, 8, 12
 ii) $4n$
 iii) $4(15) = 60$
 iv) The 15th figure would have 60 blocks.
5. Sample answer:
 The draining water from Tank 1 follows a linear pattern, with a gap of -40 . The n th term of Tank 1's sequence is given by the expression $-40n + 540$. Since $-40(13) + 540 = 20$, Tank 1 will be empty at 13.5 minutes. The gaps in the number pattern for the water draining from Tank 2 are $-10, -20, -30$. The gap keeps increasing. If both patterns continue, the gaps in Tank 2's pattern will keep increasing by 10 every minute. Extending Tank 2's sequence, we get 500, 490, 470, 440, 400, 350, 290, 220, 140, 50, $-50 \dots$ After the 5th minute, the gap is already larger than -40 , and by the 11th minute, the tank is already empty, which means that it emptied at 10.5 minutes. So, Tank 2 will empty first.

6. a) Circle cost of renting a bicycle
 I chose the cost of renting a bicycle because the side lengths of a square are all the same, so the graph to show the area of a square would have to have the same values for x and y for each point. Because the points on this graph each have different values for x and y , it could only represent the cost of renting a bicycle.
- b) Sample answer:
 Title: Height of a Plant
 x -axis: Time (days)
 y -axis: Height of Plant (cm)
7. a) i) 1400 m
 ii) 600 m
 iii) 900 m
- b) Sima's school is 1600 m from home because that is the value of y when $x = 0$.
- c) 16 minutes
8. a) \$6
 b) \$3
 c) 3 minutes
 d) \$18
- Bonus**
 \$90

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1. a) 9, 15, 15, 9, 14, 18, 21, 27
 b) Multiples of 3:
 96, 186, 939
 Multiples of 3 and 9:
 72, 270, 792, 1422
 Neither:
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- c) The Multiples of 9 region is empty because any number that is a multiple of 9 is also a multiple of 3.
2. Circle 2, 3, 5, and 6 bags.
3. b) 0
 c) X
 d) 0
 e) X
 f) 9
 g) 0
 h) X
4. Join the following with arcs:
 b) 1 and 14
 2 and 7
 c) 1 and 9
 3 and 3
 d) 1 and 16
 2 and 8
 4 and 4
5. a) 2×5
 b) $2 \times 2 \times 2 \times 3$
 c) 2×13
- Bonus**
 2×41
6. a) $>, <$
 b) $<, >$
 c) $<, >$
7. a) -2
 b) 2
 c) -20
 d) -8
8. Teacher to check number lines.
 b) -2
 c) 4
 d) -4
9. b) $+9 - 7 = 2$
 c) $-8 + 3 = -5$
 d) $+6 - 7 = -1$
10. a) $11 - (8) \times 3 + (-5) = -18$
 b) $(42) \div (7) - (-4) = 10$
11. $-51 + 83 = 32$
12. a) 495, 460, 425, 390, 355

- b) $-495, -460, -425, -390, -355$
13. a) Sample answer:
 Start at -435 and add 90 each time.
 b) Sample answer:
 Start at -435 and subtract 90 each time.
14. a) 135, 175, 215, 255, 295
 b) 40
 c) 95
 d)
- | (v) | RA | M |
|-----|---------------------------------|----------------------|
| 215 | $(40 + 40 + 40) + 95$ | $(40 \times 3) + 95$ |
| 255 | $(40 + 40 + 40 + 40) + 95$ | $(40 \times 4) + 95$ |
| 295 | $(40 + 40 + 40 + 40 + 40) + 95$ | $(40 \times 5) + 95$ |
- e) ii) $40(10) + 95$
 iii) $40n + 95$
- f) $v = 40n + 95$
15. a)
- | Gap $\times n$ | (v) |
|--------------------|-----|
| $11 \times 1 = 11$ | 94 |
| $11 \times 2 = 22$ | 105 |
| $11 \times 3 = 33$ | 116 |
- 83
 $v = 11n + 83$

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(continued)

b)

Gap \times n	(v)
50×1 $= 50$	41
50×2 $= 100$	91
50×3 $= 150$	141

+50

+50

9

$$v = 50n - 9$$

c)

Gap \times n	(v)
101×1 $= 101$	108
101×2 $= 202$	209
101×3 $= 303$	310

+101

+101

7

$$v = 101n + 7$$

d)

Gap \times n	(v)
100×1 $= 100$	-250
100×2 $= 200$	-250
100×3 $= 300$	-250

+100

+100

350

$$v = 100n - 350$$

16. a) i) 8
ii) 10
iii) 10
b) ii) -3
iii) -2
c) Teacher to check graphs.
A. $y = 10$
B. $y = 8$
C. $y = 10$
d) Teacher to check.

- e) A. iii)
B. i)
C. ii)

Sample answer:

I used the formula to find the value of y when $x = 2$ and matched the formula to the graph with that point.

17. a) 20 km
b) 40 km
c) Yes, Aki rested during her trip because the y value (distance) didn't change between 3 and 4 hours.
d) Sample answer: No, Aki did not always travel at the same speed, because the change in y as x increases is different between 0 to 3 hours and 4 to 6 hours.

Bonus

- a) yes
b) no