

Chapter 4 Linear Relations

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- ___ 1. In the equation $P = 7n + 6$, determine the value of P when $n = 9$.
a. 69 b. 22 c. 105 d. 96
- ___ 2. In a table of values for a pattern, $P = 12$ when $n = 3$. Determine the equation that might represent the pattern.
a. $P = 4n + 6$ b. $P = 24 - 3n$ c. $P = 4(6 - n)$ d. $P = 4(n + 6)$
- ___ 3. The cost to print stickers is \$6.55, plus \$0.55 per sticker.
Determine an equation that relates the total cost, C dollars, to the number of stickers, s .
a. $C = 0.55s$ b. $C = 6.55 + s$ c. $C = 6.55 + 0.55s$ d. $C = 7.1s$
- ___ 4. A pattern can be represented by the equation $H = 6n - 1$.
Which equations could represent the same pattern?
i) $H = 6(n - 1) + 5$
ii) $H = 5(n + 1) + n$
iii) $H = 7n - (n + 1)$
iv) $H = 5n - (1 - n)$
a. i, ii, and iii b. i, iii, and iv c. i, ii, and iv d. All of these
- ___ 5. This pattern of unit squares continues.
Which equation below relates the perimeter, P , to the figure number, n ?



Figure 1

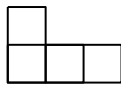


Figure 2

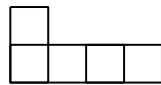
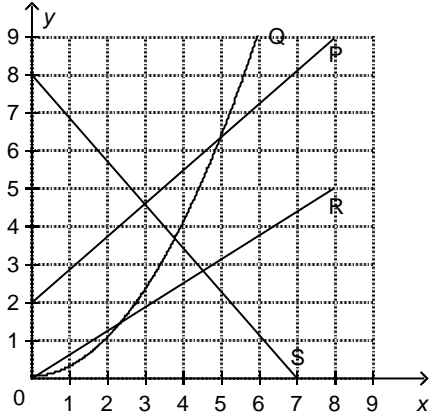


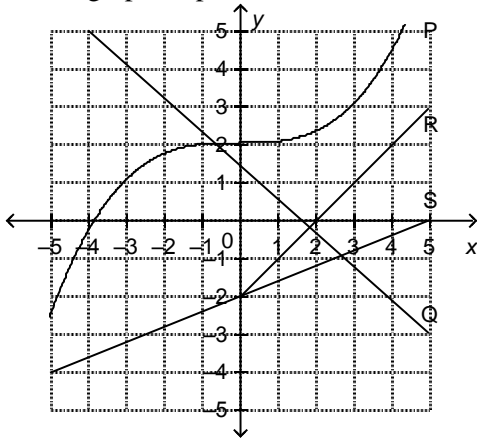
Figure 3

- i) $P = 6n + 2$
ii) $P = 2n + 4$
iii) $P = 2n + 6$
iv) $P = 2n + 8$
- a. iv b. i c. iii d. ii
- ___ 6. Which graphs represent a linear relation?



- a. P only b. P, R, and S c. P and S d. P and R

7. Which graphs represent a linear relation?



- a. P and R c. Q and S
b. Q, R, and S d. Q and R

8. Which tables of values represent a linear relation?

i)

x	1	2	3	4	5
y	4	7	12	19	28

ii)

x	0	1	2	3	4
y	0	5	10	15	20

iii)

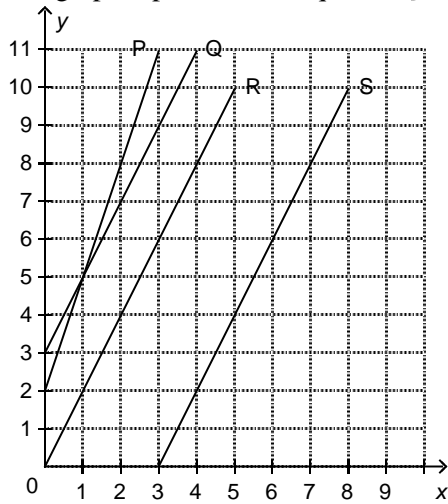
x	1	2	3	4	5
y	5	9	13	17	21

iv)

x	0	1	2	3	4
y	12	11	10	9	8

- a. ii, iii, and iv b. ii and iii c. All of these d. i and iv

9. Which graph represents the equation $y = 2x + 3$?



- a. Line S b. Line Q c. Line P d. Line R

10. Which table of values represents the equation $y = 11 - 4x$?

a.

x	-2	-1	0	1	2
y	5	6	7	8	9

c.

x	-2	-1	0	1	2
y	3	7	11	15	19

b.

x	-2	-1	0	1	2
y	19	15	11	7	3

d.

x	-2	-1	0	1	2
y	-14	-7	0	7	14

11. For the equation $4x - 2y = 8$, make a table of values for $x = -2, 0$, and 2 .

a.

x	-2	0	2
y	-8	-4	0

c.

x	-2	0	2
y	8	4	1

b.

x	-2	0	2
y	-8	0	1

d.

x	-2	0	2
y	0	-4	8

12. Which equation describes a horizontal line?

- i) $x + 9 = 2$
 ii) $y + x = 9$
 iii) $y - x = 0$

iv) $y + 2 = 9$

a. iv

b. ii

c. i

d. iii

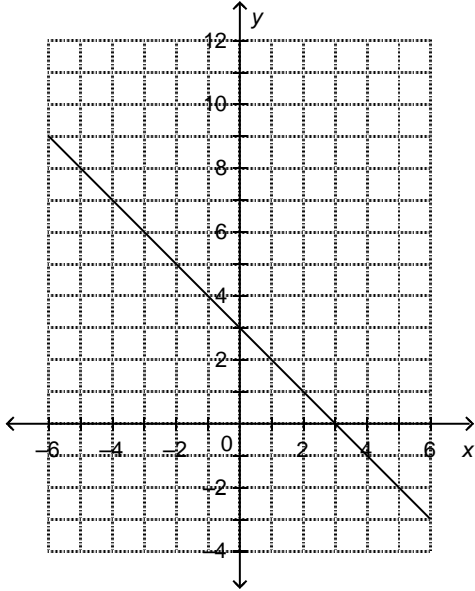
13. Which equation describes the graph?

i) $x + y = 3$

ii) $x - y = 3$

iii) $y - x = 3$

iv) $x + y = -3$



a. i

b. ii

c. iii

d. iv

14. Which equations describe vertical lines?

i) $x + 5 = 12$

ii) $y - 12 = 5$

iii) $x + y = 5$

iv) $12x = 5$

a. i and iii

b. ii and iii

c. ii and iv

d. i and iv

15. Which equations describe oblique lines?

i) $5x + 9 = 14$

ii) $5x + 9y = 14$

iii) $9y + 5 = 14$

iv) $5x = 9y$

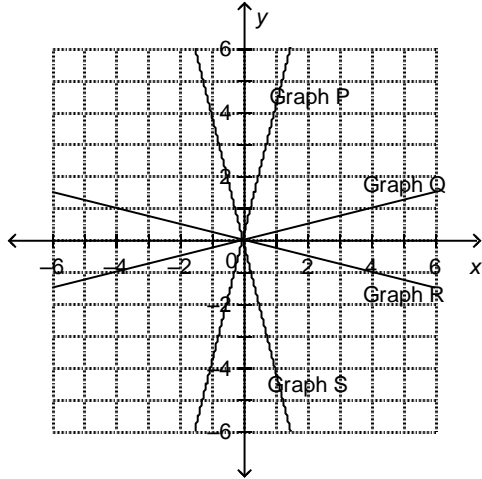
a. iii and iv

b. ii and iv

c. i and iii

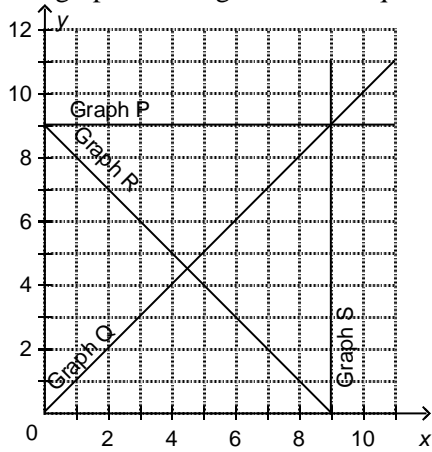
d. i and iv

16. Which graph on this grid has the equation $y = -0.3x$?



- a. Graph S b. Graph R c. Graph Q d. Graph P

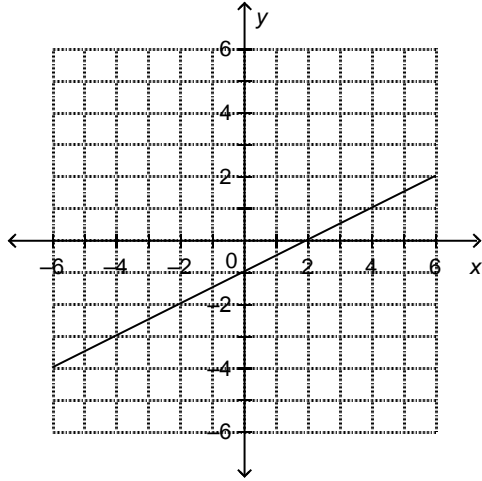
17. Which graph on this grid has the equation $x = 9$?



- a. Graph S b. Graph Q c. Graph R d. Graph P

18. Which equation describes the graph below?

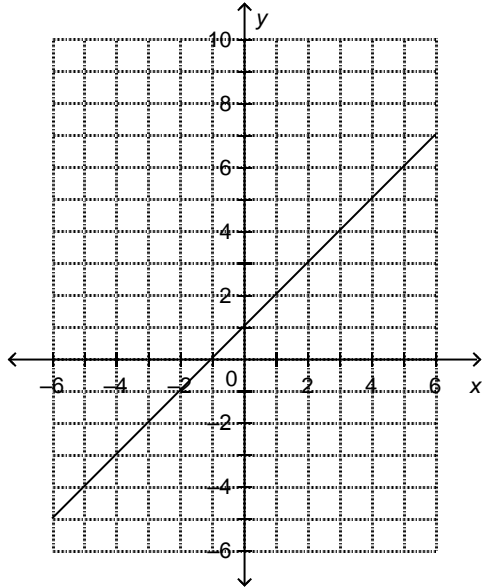
- i) $y = \frac{1}{2}x + 1$
- ii) $y = \frac{1}{2}x - 1$
- iii) $y = -2x - 1$
- iv) $y = 2x - 1$



- a. iii b. i c. ii d. iv

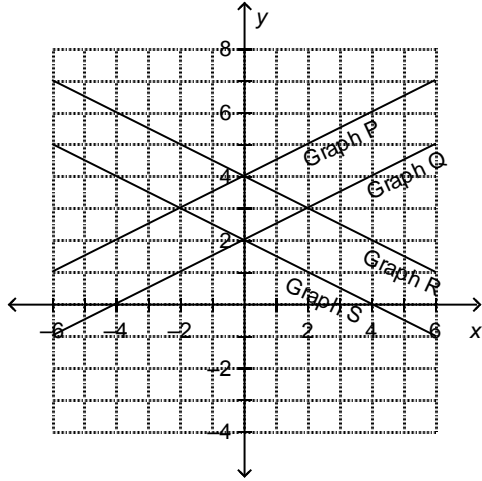
_____ 19. Which equation describes the graph below?

- i) $x + y = -1$
- ii) $x - y = -1$
- iii) $x + y = 1$
- iv) $x - y = 1$



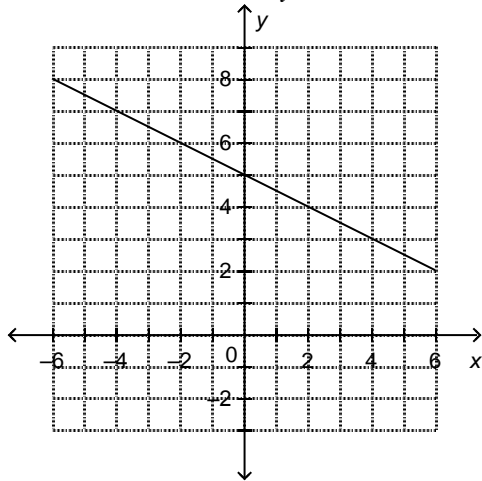
- a. iii b. i c. ii d. iv

_____ 20. Which graph on this grid has the equation $x + 2y = 4$?



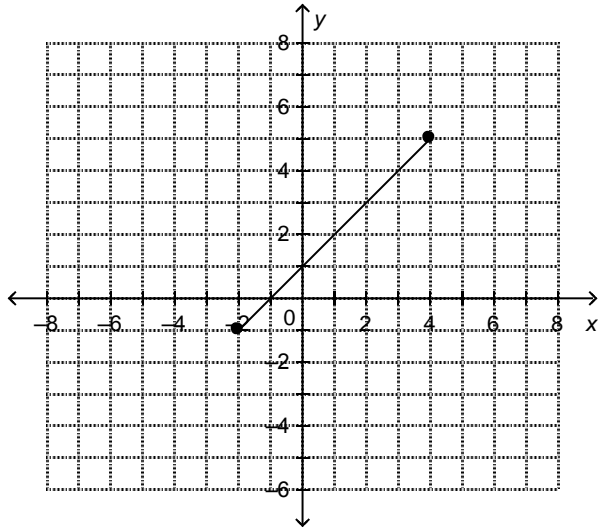
- a. Graph Q b. Graph P c. Graph S d. Graph R

21. This graph represents a linear relation. Determine the value of y when $x = 3$.



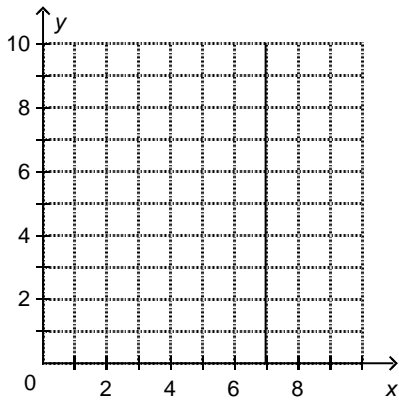
- a. 5 b. 6.5 c. 3.5 d. 10

22. This graph represents a linear relation. Determine the value of x when $y = 7$.



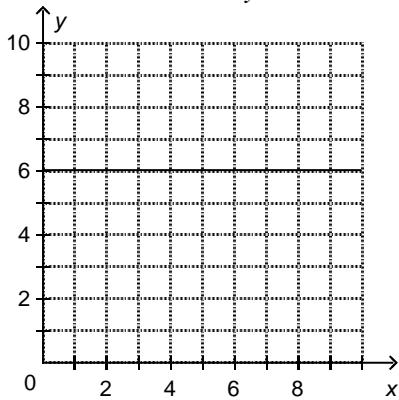
- a. 6 b. -1 c. 8 d. 1

23. This graph represents a linear relation.
Determine the value of x when $y = 5$.



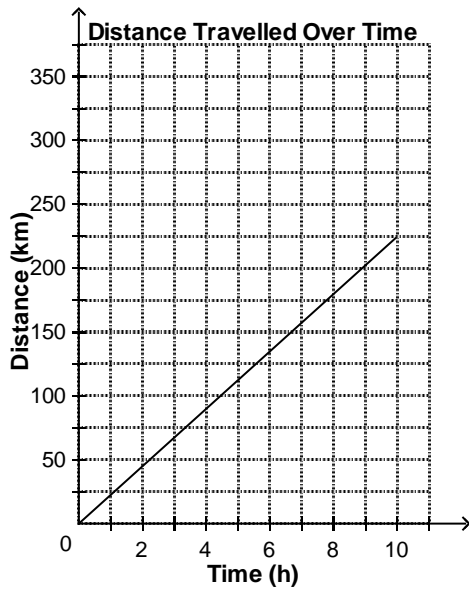
- a. 12 b. 5 c. 0 d. 7

24. This graph represents a linear relation.
Determine the value of y when $x = 9$.



- a. 15 b. 6 c. 9 d. 0

25. A car travels at a constant speed.
The graph shows how the distance of the car changes with time.
Estimate the time it takes to travel 270 km.



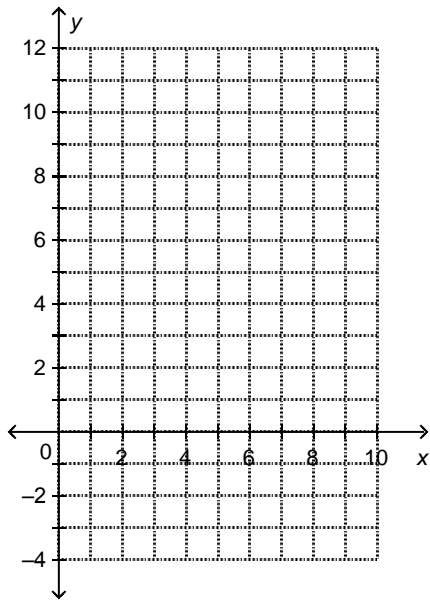
- a. 1 h b. 12 h c. 13 h d. 11 h

Short Answer

26. In the equation $R = 6(w - 1) + 4$, determine the value of R when $w = 13$.
27. This table shows the perimeters and areas of squares with different side lengths.

Side Length, n (cm)	1	2	3	4	5
Perimeter, P (cm)	4	8	12	16	20
Area, A (cm²)	1	4	9	16	25

- a) Write an equation that relates the perimeter, P , to the side length, n .
- b) Write an equation that relates the area, A , to the side length, n .
- c) Determine the perimeter and the area of a square with side length 20 cm.
28. Graph the following lines on the same grid. What shape do they form?
- i) $y = x$
- ii) $x + y = 8$
- iii) $y = 2$



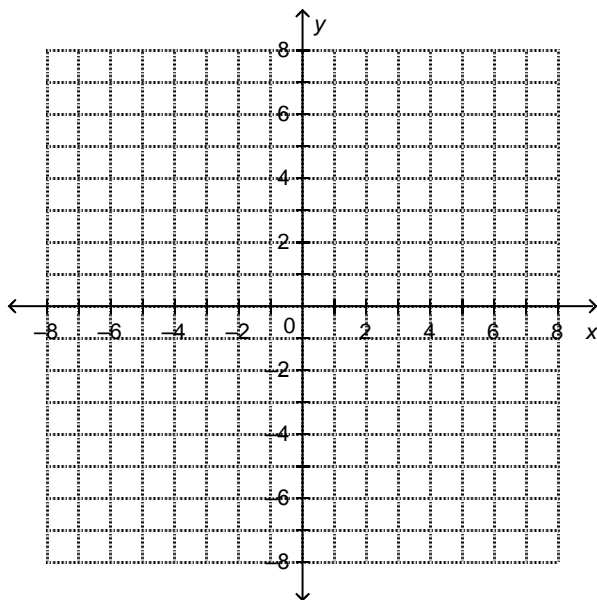
29. Graph the following lines on the same grid. What shape do they form?

i) $x - 2y = 6$

ii) $x - 2y = -6$

iii) $x + 2y = 6$

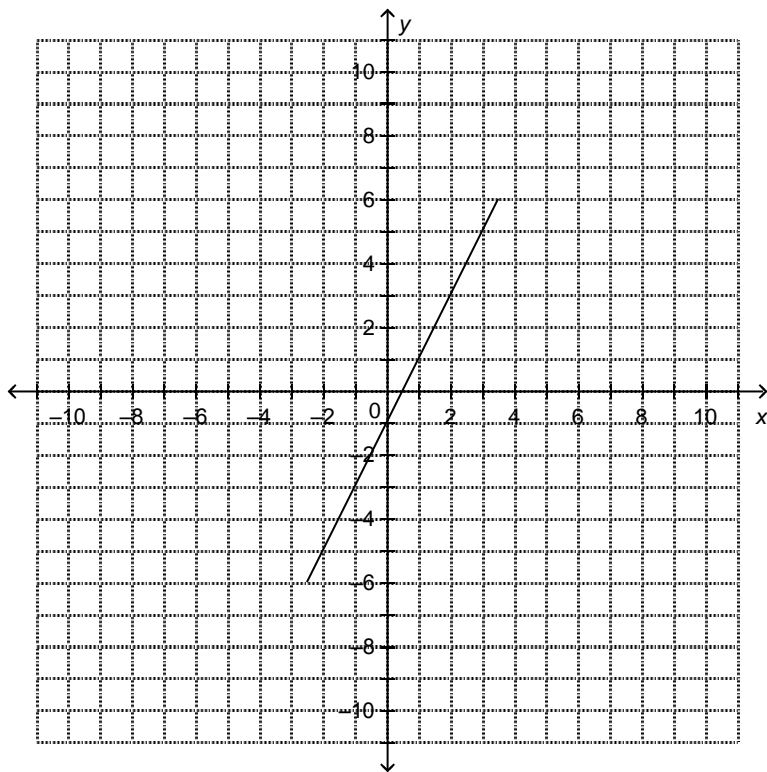
iv) $x + 2y = -6$



30. This graph represents a linear relation.

a) Estimate the value of y when $x = -5$.

b) Estimate the value of x when $y = 10$.



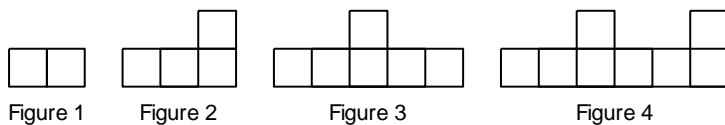
Problem

31. The pattern in the table continues.

n	1	2	3
P	7	11	15

- a) Describe the pattern that relates P to n .
- b) Write an equation that relates P to n .

32. This pattern is made using 1-cm squares tiles. The pattern continues.



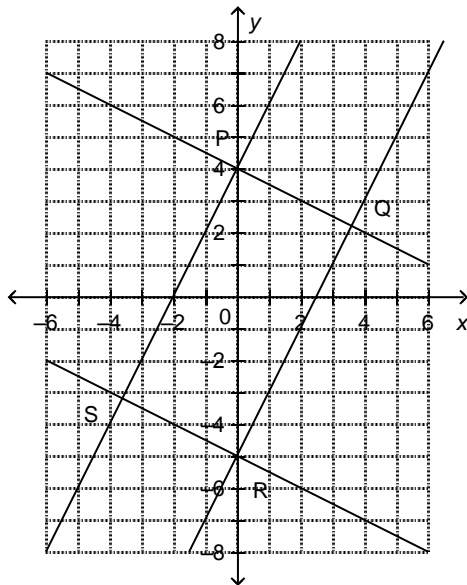
- a) Write an equation that relates the area, A cm², to the figure number, n .
- b) Write an equation that relates the perimeter, P cm, to the figure number, n .
- c) Determine the area and perimeter of figure 25. Explain your work.

33. The pattern in this table continues.

Term Number, n	1	2	3	4	5
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Term Value, v	-5	-2	1	4	7
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- a) Write an equation that relates the term value, v , to the term number, n . Describe the pattern.
 b) Determine the value of v when $n = 21$.
 c) Which term number has a term value of 82?
34. Ian has to buy muffins and drinks for a basketball tournament. He estimates that he will need $1\frac{1}{2}$ muffins and 2 drinks for each person at the tournament. Muffins cost \$0.58 each and drinks cost \$0.65 a bottle.
- a) Write an equation that relates the total cost of the muffins and drinks, C dollars, to the number of people at the tournament, p .
 b) Calculate the total cost of muffins and drinks for 70 people.
35. The lines on the grid below intersect to form rectangle PQRS. The equations of the lines are:
 $y = 2x + 4$; $y = 2x - 5$; $y = -\frac{1}{2}x + 4$; and $y = -\frac{1}{2}x - 5$
- What is the equation of the line on which each side of the rectangle lies?
 a) PQ b) QR c) RS d) PS



Chapter 4 Linear Relations

Answer Section

MULTIPLE CHOICE

1. ANS: A PTS: 1 DIF: Easy
REF: 4.1 Writing Equations to Describe Patterns LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
2. ANS: C PTS: 1 DIF: Easy
REF: 4.1 Writing Equations to Describe Patterns LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
3. ANS: C PTS: 1 DIF: Easy
REF: 4.1 Writing Equations to Describe Patterns LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
4. ANS: B PTS: 1 DIF: Moderate
REF: 4.1 Writing Equations to Describe Patterns LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
5. ANS: C PTS: 1 DIF: Easy
REF: 4.1 Writing Equations to Describe Patterns LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
6. ANS: B PTS: 1 DIF: Easy REF: 4.2 Linear Relations
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
7. ANS: B PTS: 1 DIF: Easy REF: 4.2 Linear Relations
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
8. ANS: A PTS: 1 DIF: Moderate REF: 4.2 Linear Relations
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
9. ANS: B PTS: 1 DIF: Moderate REF: 4.2 Linear Relations
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
10. ANS: B PTS: 1 DIF: Moderate REF: 4.2 Linear Relations
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
11. ANS: A PTS: 1 DIF: Easy
REF: 4.3 Another Form of the Equation for a Linear Relation LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
12. ANS: A PTS: 1 DIF: Moderate
REF: 4.3 Another Form of the Equation for a Linear Relation LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
13. ANS: A PTS: 1 DIF: Moderate
REF: 4.3 Another Form of the Equation for a Linear Relation LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
14. ANS: D PTS: 1 DIF: Moderate
REF: 4.3 Another Form of the Equation for a Linear Relation LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
15. ANS: B PTS: 1 DIF: Moderate
REF: 4.3 Another Form of the Equation for a Linear Relation LOC: 9.PR1
TOP: Patterns and Relations (Patterns) KEY: Conceptual Understanding
16. ANS: B PTS: 1 DIF: Easy REF: 4.4 Matching Equations and Graphs
LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
17. ANS: A PTS: 1 DIF: Easy REF: 4.4 Matching Equations and Graphs

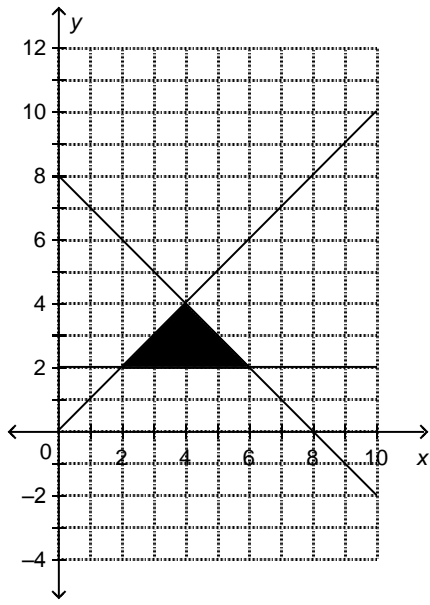
- LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 18. ANS: C PTS: 1 DIF: Moderate REF: 4.4 Matching Equations and Graphs
 LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 19. ANS: C PTS: 1 DIF: Moderate REF: 4.4 Matching Equations and Graphs
 LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 20. ANS: C PTS: 1 DIF: Moderate REF: 4.4 Matching Equations and Graphs
 LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 21. ANS: C PTS: 1 DIF: Easy
 REF: 4.5 Using Graphs to Estimate Values LOC: 9.PR2
 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 22. ANS: A PTS: 1 DIF: Moderate
 REF: 4.5 Using Graphs to Estimate Values LOC: 9.PR2
 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 23. ANS: D PTS: 1 DIF: Moderate
 REF: 4.5 Using Graphs to Estimate Values LOC: 9.PR2
 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 24. ANS: B PTS: 1 DIF: Moderate
 REF: 4.5 Using Graphs to Estimate Values LOC: 9.PR2
 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 25. ANS: B PTS: 1 DIF: Moderate
 REF: 4.5 Using Graphs to Estimate Values LOC: 9.PR2
 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge

SHORT ANSWER

26. ANS:
 $R = 76$

 PTS: 1 DIF: Easy REF: 4.1 Writing Equations to Describe Patterns
 LOC: 9.PR1 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge
 27. ANS:
 a) $P = 4n$
 b) $A = n^2$
 c) Perimeter: 80 cm
 Area: 400 cm²

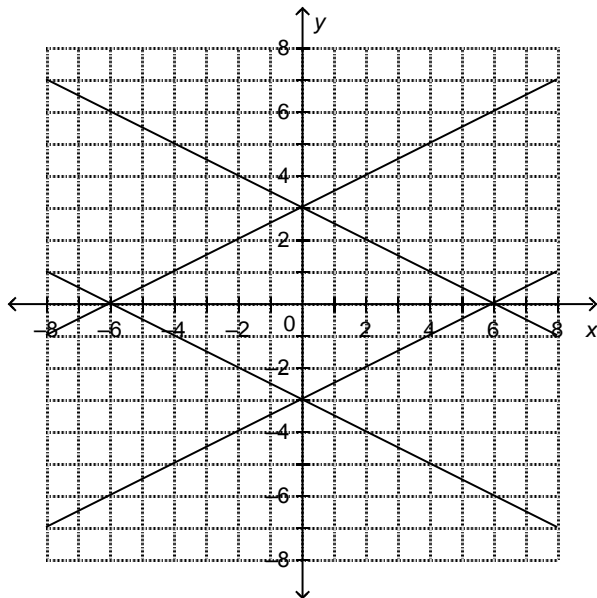
 PTS: 1 DIF: Moderate REF: 4.1 Writing Equations to Describe Patterns
 LOC: 9.PR1 TOP: Patterns and Relations (Patterns)
 KEY: Conceptual Understanding | Procedural Knowledge
 28. ANS:



The lines intersect to form a triangle.

PTS: 1 DIF: Moderate REF: 4.3 Another Form of the Equation for a Linear Relation
 LOC: 9.PR1 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge

29. ANS:



The lines intersect to form a diamond/quadrilateral.

PTS: 1 DIF: Moderate REF: 4.3 Another Form of the Equation for a Linear Relation
 LOC: 9.PR1 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge

30. ANS:

- a) $y = -11$
- b) $x = 5.5$

PTS: 1 DIF: Moderate REF: 4.5 Using Graphs to Estimate Values
 LOC: 9.PR2 TOP: Patterns and Relations (Patterns) KEY: Procedural Knowledge

PROBLEM

31. ANS:

- a) As n increases by 1, P increases by 4.
- b) The equation that relates P to n is $P = 3 + 4n$.

PTS: 1 DIF: Moderate REF: 4.1 Writing Equations to Describe Patterns
LOC: 9.PR1 TOP: Patterns and Relations (Patterns)
KEY: Problem-Solving Skills | Communication

32. ANS:

- a) $A = 2n$
- b) $P = 4n + 2$
- c) Substitute $n = 25$ into the equation $A = 2n$.
 $A = 2(25)$
 $= 50$

The area of figure 25 is 50 cm^2 .

Substitute $n = 25$ into the equation $P = 4n + 2$.
 $P = 4(25) + 2$
 $= 102$

The perimeter of figure 25 is 102 cm.

PTS: 1 DIF: Difficult REF: 4.1 Writing Equations to Describe Patterns
LOC: 9.PR1 TOP: Patterns and Relations (Patterns)
KEY: Problem-Solving Skills | Communication

33. ANS:

- a) $v = 3n - 8$.
When n increases by 1, v increases by 3.
- b) Substitute $n = 21$ into the equation $v = 3n - 8$.
 $v = 3(21) - 8$
 $= 55$
- c) Substitute $v = 82$ into the equation $v = 3n - 8$.
 $82 = 3n - 8$
 $82 + 8 = 3n$
 $90 = 3n$
 $n = 30$

Term 30 has a value of 82.

PTS: 1 DIF: Difficult REF: 4.1 Writing Equations to Describe Patterns
LOC: 9.PR1 TOP: Patterns and Relations (Patterns) KEY: Problem-Solving Skills

34. ANS:

- a) The cost per person is: $(1 \frac{1}{2} \times \$0.58) + (2 \times \$0.65) = \$2.17$
The cost for p people is: $C = 2.17p$
- b) For 70 people, substitute $p = 70$ into $C = 2.17p$.
 $C = 2.17(70) = 151.9$

The cost of muffins and drinks for 70 people is \$151.90.

PTS: 1

DIF: Moderate REF: 4.2 Linear Relations

LOC: 9.PR2

TOP: Patterns and Relations (Patterns) KEY: Problem-Solving Skills

35. ANS:

a) PQ: $y = -\frac{1}{2}x + 4$

b) QR: $y = 2x - 5$

c) RS: $y = -\frac{1}{2}x - 5$

d) PS: $y = 2x + 4$

PTS: 1

DIF: Difficult REF: 4.4 Matching Equations and Graphs

LOC: 9.PR2

TOP: Patterns and Relations (Patterns) KEY: Problem-Solving Skills