

PR7-1 Linear Sequences

1. Use the repeating action given to find the next three terms in the sequence.

- a) add 8 14, 22, 30, _____, _____, _____
- b) subtract 11 317, 306, 295, _____, _____, _____
- c) multiply by 3 5, 15, 45, _____, _____, _____
- d) divide by 4 5120, 1280, 320, _____, _____, _____
- Bonus ►** subtract 99 200, 101, 2, _____, _____, _____





2. Decide what you are adding, subtracting, multiplying by, or dividing by each time to get the next term. Extend the sequence to find the 8th term.

- a) multiply by _____ 7, 35, 175, _____
- b) subtract _____ 1008, 900, 792, _____
- c) divide by _____ 384, 192, 96, _____
- d) add _____ 905, 935, 965, _____
- Bonus ►** add _____ -300, -180, -60, _____



3. The sequences are made by adding or subtracting the same number each time, or by multiplying by or dividing by the same number each time. Determine the operation and the number.

- a) 50, 100, 150, 200 _____
- b) 50, 100, 200, 400 _____
- c) 2500, 2250, 2000, 1750 _____
- d) 2500, 500, 100, 20 _____
- Bonus ►** 2500, 500, -1500, -3500 _____

4. In the circles, write the number that is added or subtracted to each term to get the next term.

- a)  b) 
- c)  d) 

Bonus ►

- e)  f) 

In some sequences, the **gap**, or difference between each term and the next is always the same. These sequences are called **linear sequences**. Sequences where the gap is not always the same number are called **non-linear sequences**.

5. The sequence was made by repeating the identified action. In the circles, write the difference between each term and the next. Is the sequence linear? Fill in the blanks.

a) Sequence made by subtracting 12: 83, 71, 59, 47, 35

The gap is the same number each time. The sequence is linear.

b) Sequence made by multiplying by 3: 4, 12, 36, 108, 324

The gap is not the same number each time. The sequence is non-linear.

c) Sequence made by adding 8: 4, 12, 20, 28, 36

The gap is _____ each time. The sequence is _____.

d) Sequence made by dividing by 3: 324, 108, 36, 12, 4

The gap is _____ each time. The sequence is _____.

6. Use your answers to Question 5 to fill in the blank with “linear” or “non-linear.”

- a) Sequences made by adding or subtracting the same number each time are _____.
b) Sequences that are not made by adding or subtracting the same number each time are _____.

7. Is the sequence linear? Explain why or why not.

- a) 4000, 400, 40, 4, 1 b) 4000, 3000, 2000, 1000, 0
c) 25, 50, 100, 200, 400 d) 25, 50, 75, 100, 125

Bonus ► 95, 70, 55, 30, 5, 0

8. Describe how to get the next number in the sequence in two different ways.

a) 219, 203, 187, 171 Subtract 16 each time, or add -16 each time.

b) 100, 90, 80, 70 Subtract _____ each time, or add _____ each time.

Bonus ► -100, -125, -150, -175 Subtract _____ each time, or add _____ each time.

A sequence in which the terms get larger each time is called increasing.
A sequence in which the terms get smaller each time is called decreasing.

9. Is the sequence increasing or decreasing?

- a) 9000, 900, 90, 1 decreasing b) 4000, 5000, 6000, 7000 _____
c) 25, 50, 100, 200 _____ d) 200, 100, 50, 25 _____

Linear sequences are made by adding or subtracting the same number each time. In other words, linear sequences are made by adding the same gap each time, where this gap is a positive or negative number.

10. a) Write the gap as a positive or negative number. Is the sequence increasing or decreasing?

- i) 205, 198, 191, 184 -7 increasing / decreasing
ii) 184, 191, 198, 205 _____ increasing / decreasing
iii) 5, 0, -5, -10, -15 _____ increasing / decreasing
iv) -15, -10, -5, 0, 5 _____ increasing / decreasing

b) Write “positive” or “negative” in the blank: Linear sequences are increasing if the gap is _____ and decreasing if the gap is _____.

11. Use the pattern rule to write the first five terms of the sequence.

- a) Start at 8 and add 21 each time. _____
b) Start at 21 and add 8 each time. _____
c) Start at 100 and subtract 7 each time. _____
d) Start at 100 and add -7 each time. _____

12. State the starting number and gap for each sequence. Write a rule for the linear sequence.

- a) 260, 271, 282, 293 Starting number: 260 Gap: +11
Rule: Start at 260 and add 11 each time.
b) 410, 434, 458, 482 Starting number: _____ Gap: _____
Rule: _____

13. Write a rule for the linear sequence in two ways, using subtraction and addition.

- a) 590, 550, 510, 470 b) 100, 50, 0, -50

PR7-2 Variables and Expressions

A **variable** is a symbol (usually a letter) that represents a number. The number might be unknown or might change.

An **expression** is formed by combining one or more numbers or variables with operations and sometimes brackets. An expression can be as simple as a single number or variable.

Examples of expressions: 15 d $13x + 25$ $(108 - m) + (35N - 2)$

1. Write an expression for the distance a car would travel at the speed and in the time given.

a) Speed: 80 km per hour
Time: 4 hours

Distance: 80×4 km

b) Speed: 40 km per hour
Time: 5 hours

Distance: _____ km

c) Speed: 95 km per hour
Time: h hours

Distance: _____ km

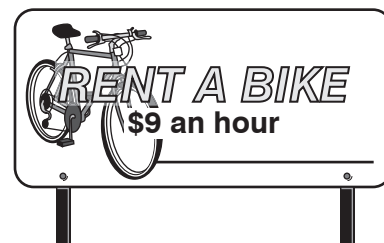
The multiplication sign is not usually written in the product of a number and a variable, the product of two variables, or the product of two expressions when one is in brackets. Examples:

$3 \times T$ can be written as $3T$, $7 \times (2 - m)$ can be written as $7(2 - m)$, $Z \times b$ can be written as Zb

2. Renting a bike costs \$9 per hour. Write two expressions for the cost of renting a bike for ...

a) h hours: $9 \times h$ or $9h$ b) n hours: _____ or _____

c) $(m + 1)$ hours: _____



3. Renting skates costs \$ r per hour. Write two expressions for the cost of renting skates for ...

a) h hours: $r \times h$ or rh b) z hours: _____ or _____ c) $(9 - Q)$ hours: _____

When **substituting** or replacing a variable with a number, use brackets.

Example: Substituting n with 7 in the expression $3n$ gives you $3(7)$, which is the same as 3×7 .

4. Substitute the given values for the variables and evaluate the expression.

a) $8n + 5$, $n = 20$

$$\begin{aligned} 8n + 5 &= 8(20) + 5 \\ &= 160 + 5 \\ &= 165 \end{aligned}$$

b) $30 - W$, $W = 97$

c) $3y + 5x$, $x = 10$, $y = 2$

d) $300 - 7y$, $y = 25$

e) $T - 24(5)$, $T = -9$

f) $45(3) - q$, $q = -23$

Bonus ► $40a - 50b - c$, $c = -20$, $b = 20$, $a = 6$

An **equation** is formed by joining two expressions with an equal sign.

Expressions: $5z - 8$, $14y$, 81

Equations: $5z - 8 = 14y$, $14y = 81$

An expression represents a numerical value, whereas an equation is a statement of equality that might be true or false, depending on what numbers are substituted for variables.

To remember what “equation” means, look at the common letters: equation equal sign

5. Fill in the blanks using “equation” or “expression.”

- Both an _____ and an _____ can contain numbers, variables, operations, and brackets.
- An _____ contains an equal sign, while an _____ never contains an equal sign.
- If you join an _____ and a number with an equal sign, you get an _____.
- A statement of equality that might be true or false is called an _____.
- When you substitute the values of variables into an _____ and perform the operations, you end up with a number.
- When you substitute the values of variables into an _____ and perform the operations, you end up with a statement of equality which might be true or false.

6. a) Substitute the values of the variables. What is the value of the expression?

i) $6a - 14$, $a = 8$

ii) $15 + 5m$, $m = 16$

iii) $g - 25p$, $p = 3$, $g = -10$

$$6a - 14 = 6(8) - 14$$

$$= 48 - 14$$

$$= 34$$

b) Substitute the values of the expressions from part a). Is the equation true or false?

i) $6a - 14 = 40$, $a = 8$

ii) $15 + 5m = 80$, $m = 16$

iii) $g - 25p = -85$, $p = 3$,
 $g = -10$

$$34 = 40 \text{ is false}$$

7. Substitute the values on each side of the equation. Is the equation true or false?

Use LS for left side of the equation and RS for right side of the equation.

a) $3n + 2 = 4n$, $n = 2$

b) $5x - 20 = 4x$, $x = 25$

$$LS = 3(2) + 2$$

$$RS = 4n$$

$$LS =$$

$$RS =$$

$$= 6 + 2$$

$$= 4(2)$$

$$= 8$$

$$= 8$$

Since $LS = RS$, the equation is true when $n = 2$.

c) $3a + 80 = 5a$, $a = 40$

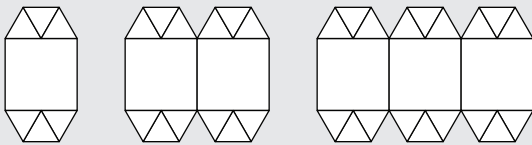
d) $T - 100 = -100 - T$, $T = -50$

PR7-3 Linear Relations

Eli makes a garden path using square and triangular tiles. Eli's pattern uses six triangular tiles for every one square tile.

They write a **formula**—an equation that shows how to calculate the **output** variable (in this case, the number of triangles, *t*) from the **input** variable (in this case, the number of squares, *s*).

$triangles = 6 \times squares$
or $t = 6 \times s$
or $t = 6s$



Squares (<i>s</i>)	$6 \times s = t$	Triangles (<i>t</i>)
1	$6 \times 1 = 6$	6
2	$6 \times 2 = 12$	12
3	$6 \times 3 = 18$	18

1. A shape is made using triangles and squares. Find a formula to calculate the number of triangles from the number of squares.

a)

Squares (<i>s</i>)	Triangles (<i>t</i>)
1	5
2	10
3	15

Formula: $t = 5s$

b)

Squares (<i>s</i>)	Triangles (<i>t</i>)
1	8
2	16
3	24

Formula: _____

c)

Squares (<i>s</i>)	Triangles (<i>t</i>)
3	33
6	66
9	99

Formula: _____

2. a) In a sequence, the term number is the input and the term value is the output. Use the rule for the sequence to write the first four terms. Fill in the table for the sequence.

- i) Start at 3 and add 3 each time.

Term Number (<i>n</i>)	Term Value (<i>v</i>)
1	
2	
3	
4	

- ii) Start at 9 and add 9 each time.

Term Number (<i>n</i>)	Term Value (<i>v</i>)
1	
2	
3	
4	

- iii) Start at 15 and add 1 each time.

Term Number (<i>n</i>)	Term Value (<i>v</i>)
1	
2	
3	
4	

- b) Use the table to find a formula for calculating the term value (*v*) from the term number (*n*).

i)

ii)

iii)

- c) Find the 5th term in the sequence and the 25th term in the sequence.

i) 5th term:

ii)

iii)

25th term:

- d) In part c), did you use the rule for extending the sequence or the formula? Explain your choice.

A **relation** exists when two sets of quantities have corresponding values. A relation can be described with words, an equation, or a table.

Example: To rent a canoe at Ed's store, you need to pay \$12 plus \$10 for each hour. The table and equation describe the relation between the time and the cost for renting the canoe.

Time (t)	Cost (c)
1 hour	\$22
2 hours	\$32
3 hours	\$42
4 hours	\$52

$$c = 12 + 10t$$

In this example, time (t) is the **input variable** and cost (c) is the **output variable**.

3. Complete the table to find the values of the output variable for the given input variable values.

a) $B = 25 - A$

Input (A)	Output (B)
1	$25 - (1) = 24$
2	
3	
4	

b) $y = 2n + 3$

Input (n)	Output (y)
1	
2	
3	
4	

c) $y = A \times A$

Input (A)	Output (y)
1	
2	
3	
4	

In a table where the gap between the input numbers is always the same (e.g., 1, 2, 3, 4, ...), the relation between input and output is linear if the gap between the output values is also always the same (e.g., 5, 7, 9, 11, ...).

4. Fill in the gap circles for Question 3. Is the relation linear or non-linear?

a) _____

b) _____

c) _____

For any sequence, there is a relation between the term numbers (the input) and the term values (the output). If a sequence is linear, so is the relation.

5. Make a table for the sequence. Find the gaps between the term values. Is the relation linear?

a) Start at 6 and multiply by 6 each time.

Input (A)	Output (B)
1	
2	
3	
4	

linear / non-linear

b) Multiply the term number by 8 to get each term.

Input (n)	Output (y)
1	
2	
3	
4	

linear / non-linear

c) 3, 6, 12, 24

Input (A)	Output (y)
1	
2	
3	
4	

linear / non-linear

PR7-4 Formulas for Linear Relations

1. Use the rule or the formula to write terms 1 to 5 of the sequence. The variable v represents the term value and n represents the term number.

- a) Start at 8 and add 8 each time.

8, 16, 24, 32, 48

b) $v = 8n$

c) $v = 10n$
- d) Start at 9 and add 9 each time.

e) $v = 9n$

f) $v = 150n$

2. A sequence is given by this rule: Start at 7 and add 7 each time.

a) Complete the table for the sequence.

Term Number (n)	Term Value (v)	Repeated Addition	Multiplication
1	7	7	7×1
2	14	$7 + 7$	7×2
3			
4			
5		$7 + 7 + 7 + 7 + 7$	

- b) What is the gap in this linear sequence? _____
- c) Write an expression for the given term of the sequence using multiplication.
- i) 4th term: 7×4 ii) 10th term: _____ iii) 108th term: _____ iv) n^{th} term: _____
- d) Write a formula to find the term value (v) from the term number (n).
- $v =$ _____

In a formula, the **coefficient** of a variable is the number by which the variable is multiplied.

In $v = 5n$, the coefficient of n is 5. In $y = 32x$, the coefficient of x is 32.

3. Refer to Question 2.

- a) In part d), what is the coefficient of n in the formula? _____
- b) How does the coefficient of n compare to the gap of the sequence?
- c) Use the sequence rule, repeated addition, and multiplication to explain why the gap and the coefficient of n are related in this way.

When the starting number is the same as the gap, the formula for the linear sequence is:

$$\text{term value} = \text{gap} \times \text{term number} \quad \text{OR} \quad v = \text{gap} \times n$$

4. Write a formula to find the term value (v) from the term number (n) just by looking at the sequence rule, without creating a table.

a) Start at 5 and add 5 each time. $v = 5n$ b) Start at 9 and add 9 each time. _____

c) Start at 200 and add 200 each time. _____ **Bonus ►** Start at C and add C each time. _____

5. Use the rule or the formula to write the first five terms of the sequence. The variable v represents the term value and n represents the term number.

a) Start at 2 and add 9 each time. b) $v = 9n - 7$

c) Start at 9 and add 2 each time. **Bonus ►** $v = 100n - 1$

6. Complete the sequence rule for the linear relation.

a) $v = 8n + 3$ **Bonus ►** $v = 100n - 5$
Start at _____ and _____ each time. _____

7. Consider the sequence given by this rule: Start at 7 and add 3 each time.

a) Write the first five terms of the sequence. _____

b) What is the gap for this linear sequence? _____

c) How can you write the starting number as the gap plus another number?

$$7 = 3 + \underline{\hspace{2cm}}$$

d) Complete the table for the sequence.

Term Number (n)	Term Value (v)	Repeated Addition	Multiplication
1	7	$3 + 4$	$(3 \times 1) + 4$
2	10	$(3 + 3) + 4$	$(3 \times 2) + 4$
3	13		
4		$(3 + 3 + 3 + 3) + 4$	
5			

e) Write an expression for the given term of the sequence using multiplication.

i) 5th term: $3(5) + 4$ ii) 10th term: _____ iii) n^{th} term: _____

f) Write a formula to find the term value (v) from the term number (n).

$$v = \underline{\hspace{2cm}}$$

8. Complete the table. Write the number you must add to or subtract from “gap $\times n$ ” to get the term value (v). Fill in the blanks to describe in words how to get the term value from the term number and write a formula for the sequence.

a)

Term Number (n)	Gap $\times n$	Term Value (v)
1	$4 \times 1 = 4$	11
2	$4 \times 2 = 8$	15
3	$4 \times 3 = 12$	19

Add 7

Multiply by 4 and then add 7.

Formula: $v = 4n + 7$

b)

Term Number (n)	Gap $\times n$	Term Value (v)
1		9
2		15
3		21

Add _____

Multiply by _____ and then add _____.

Formula: _____

c)

Term Number (n)	Gap $\times n$	Term Value (v)
1		4
2		14
3		24

Subtract _____

Multiply by _____ and then subtract _____.

Formula: _____

d)

Term Number (n)	Gap $\times n$	Term Value (v)
1		1
2		9
3		17

Subtract _____

Multiply by _____ and then subtract _____.

Formula: _____

9. Consider the sequence given by this rule: start at 30 and subtract 4 each time.

a) How can you write the starting number as some number minus 4?

$30 = \underline{\hspace{2cm}} - 4$

b) Complete the table for the sequence.

Term Number (n)	Term Value (v)	Repeated Addition	Multiplication
1	30	<u> </u> $- 4$	<u> </u> $- (4 \times 1)$
2		<u> </u> $- (4 + 4)$	<u> </u> $- (4 \times 2)$
3			
4			
5			

c) Write a formula to find the term value (v) from the term number (n).

$v = \underline{\hspace{2cm}}$

10. Fill in the table for the first four terms of the described pattern.

- a) The population of a new town is 150 people. The population doubles every year.
- b) The first house on a street has the address number 193. The address numbers increase by 2 each time.

Year (y)	Number of People (N)
1	
2	
3	
4	

House Position (p)	Address Number (A)
1	
2	
3	
4	

- c) Aki has \$400 saved at the end of Week 1. They spend \$35 each week.
- d) The volume of water in a tank is 3200 L. Each day, half of the remaining water is used.

Week Number (n)	Money Remaining (M)
1	
2	
3	
4	

Day Number (d)	Water Remaining (V)
1	
2	
3	
4	

11. For each part in Question 10, say whether the pattern is linear or non-linear. For the linear patterns, write a formula for calculating the output variable from the input variable.

- a)
- b)
- c)
- d)

12. A boat rental store charges \$25 to rent a boat for one hour and \$11 for each additional hour.

- a) Complete the table.
- b) Is the relation linear?

Number of Hours (n)	Cost (C)
1	
2	
3	
4	



- c) Write a formula to find the cost (C) of renting the boat for n hours. _____
- d) How much would it cost to rent the boat for the given length of time?

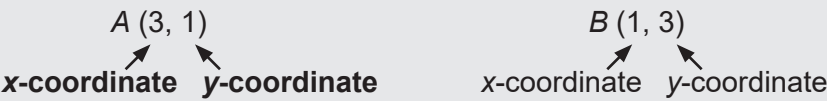
i) 10 hours _____

ii) 1 day _____

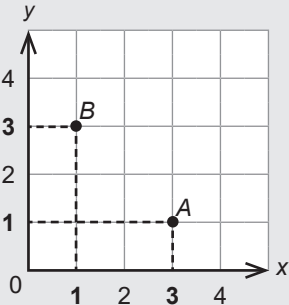
iii) 2 days _____

PR7-5 Introduction to Coordinate Grids

We use a pair of numbers in brackets to give the position of a point on a coordinate grid. The numbers are called the **coordinates** of the point.



The x-coordinate is always written first. The pair of numbers is also called an **ordered pair**.



1. a) Plot and label the points on the coordinate grid. Cross out the coordinates as you go.

~~A (1, 4)~~

B (4, 7)

C (6, 5)

D (6, 7)

E (5, 7)

F (5, 6)

G (7, 4)

H (7, 0)

I (3, 0)

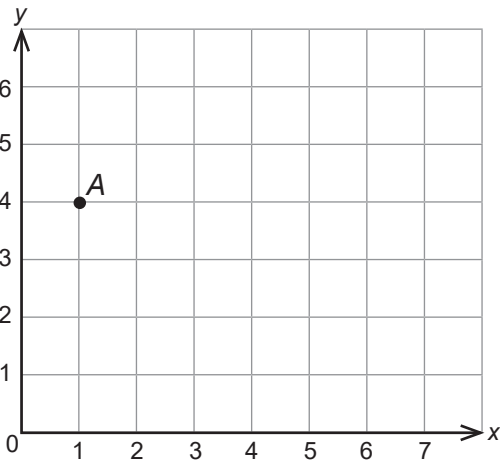
J (3, 3)

K (5, 3)

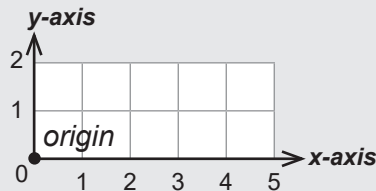
L (5, 0)

M (1, 0)

- b) Join the points in alphabetical order. Then join A to M.
c) What does the picture you made look like?



We use number lines to mark the grid lines. The number lines are called **axes**. One number line is called an **axis**. The axes meet at the point (0, 0), called the **origin**.



2. a) Fill in the coordinates for the given points.

A (1 , 3)

B (,)

C (,)

D (,)

E (,)

F (,)

G (,)

H (,)

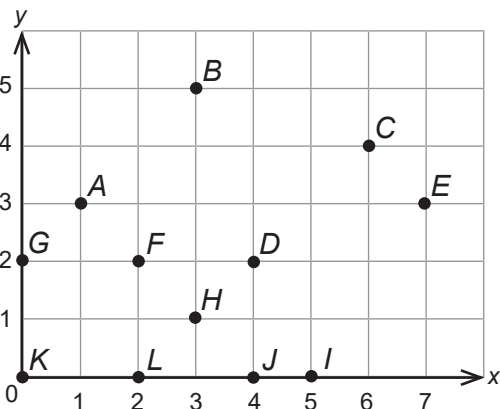
I (,)

J (,)

K (,)

L (,)

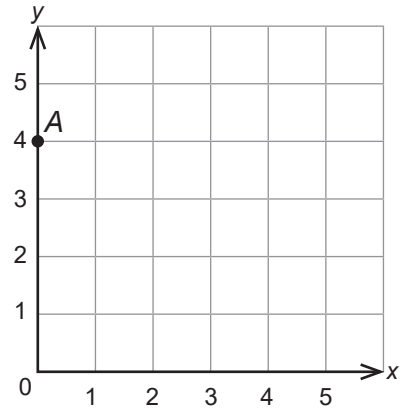
- b) Which points are on the x-axis? _____
c) Which points are on the y-axis? _____
d) Which point is the origin? _____



3. a) Plot and label the points on the coordinate grid. Cross out the coordinates as you plot them.

~~A (0, 4)~~ B (2, 4) C (2, 6)
D (6, 4) E (3, 4) F (3, 3)
G (2, 3) H (2, 0)

- b) Join the points in alphabetical order. Then join A to H.
c) What letter have you drawn? _____

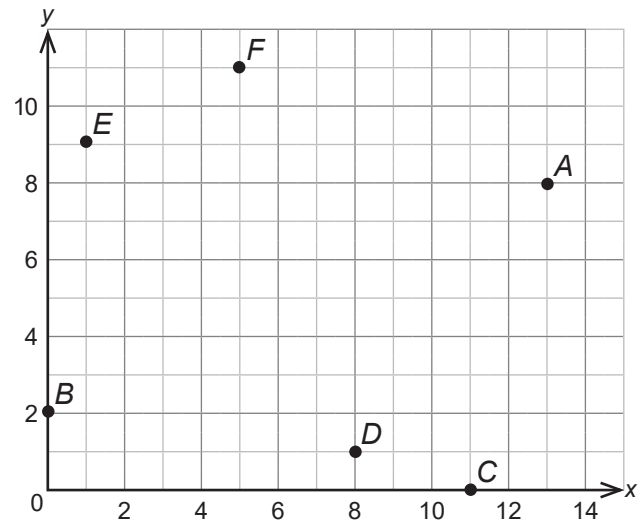


4. a) Find the coordinates of the points.

A (13 , 8) B (,)
C (,) D (,)
E (,) F (,)

- b) Plot and label the points.

G (4, 6) H (7, 12) I (10, 5)
J (5, 11) K (3, 0) L (0, 7)
M (15, 12) N (7, 7) O (0, 0)



5. a) Mark the points on the number line.

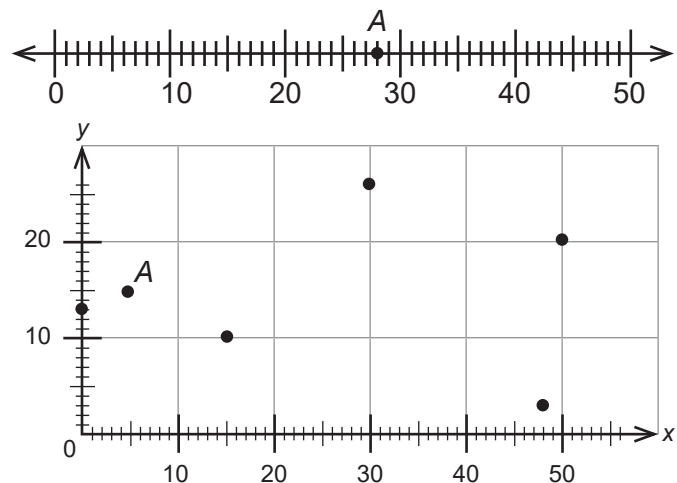
A 28 B 4 C 43 D 19

- b) Label the points marked on the coordinate grid. Use a ruler to line up the points with the axes.

A (5, 15) B (50, 20)
C (48, 3) D (0, 13)
E (15, 10) F (30, 26)

Bonus ► Use a ruler to mark the points on the coordinate grid.

G (5, 0) H (25, 10)
I (41, 26) J (56, 9)



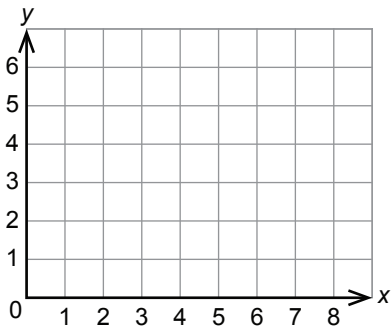
6. The number you skip count by on a number line is called the scale.

- a) Would you use a large or small scale if you want to show large numbers in a small space? _____
b) Would you use a large or small scale if you need to clearly see the difference between numbers that are close together? _____

PR7-6 Tables and Graphs

1. Write the ordered pairs for the relation.
Then plot the points on the grid.

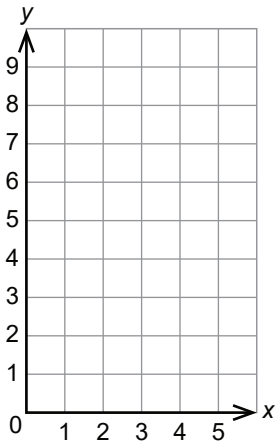
Input (x)	Output (y)	Ordered Pair
2	1	
4	3	
6	5	
8	7	



2. Fill in the table for the first four terms of the sequence. Then plot the points on the grid.

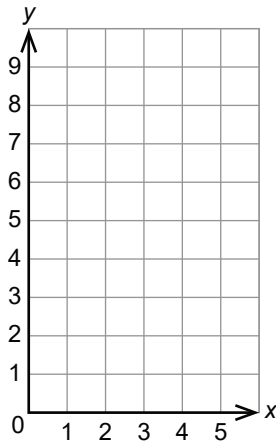
a) 1, 4, 7, 10

Input (x)	Output (y)
1	
2	
3	
4	



b) Start at 9 and subtract 2 each time.

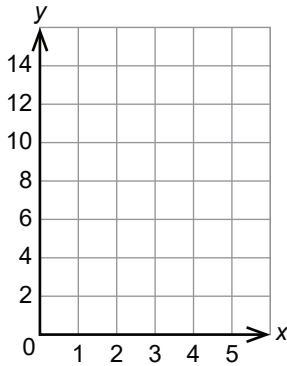
Input (x)	Output (y)
1	
2	
3	
4	



3. Use the formula for the relation to fill in the table. Then plot the points on the grid.

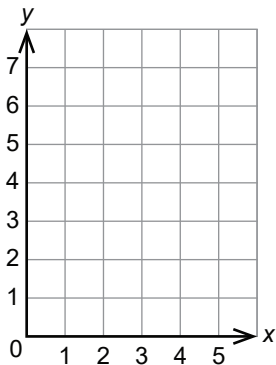
a) $y = 3x + 1$

Input (x)	Output (y)	Ordered Pair
0	$3(0) + 1 = 1$	$(0, 1)$
1		
2		
3		



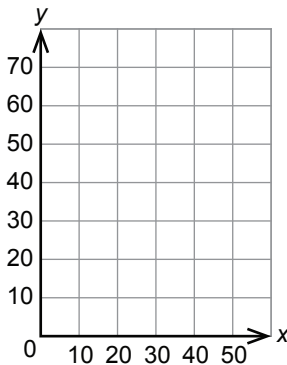
b) $y = 4 + x$

Input (x)	Output (y)
1	
2	
3	
4	



Bonus ► $y = 100 - 2x$

Input (x)	Output (y)
10	
20	
30	
40	



4. Complete the table for the relation and find the gaps between the output values.
Is the relation linear? Write “yes” or “no.”

a) Start at 12 and subtract 4 each time.

Input (x)	Output (y)
1	
2	
3	

b) Start at 3 and multiply by 2 each time.

Input (x)	Output (y)
1	
2	
3	

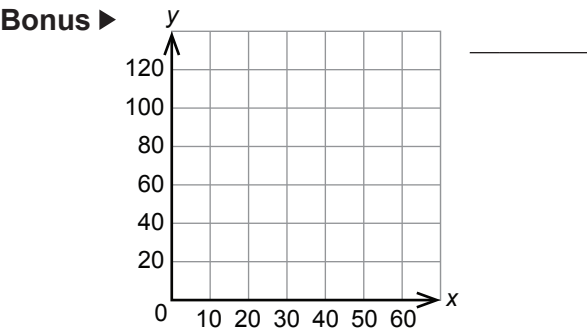
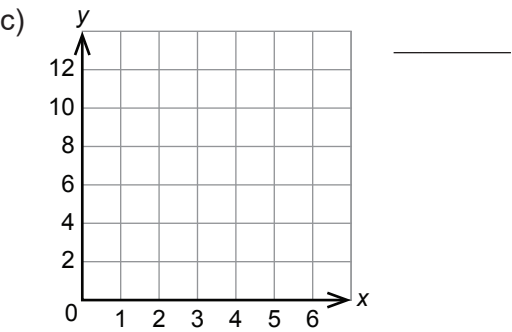
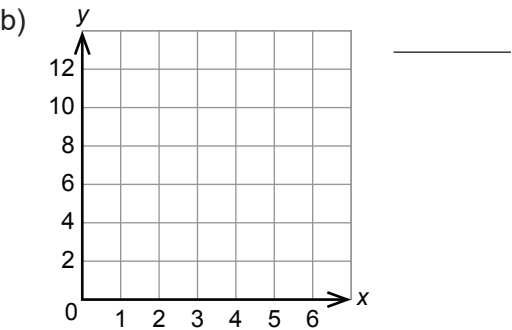
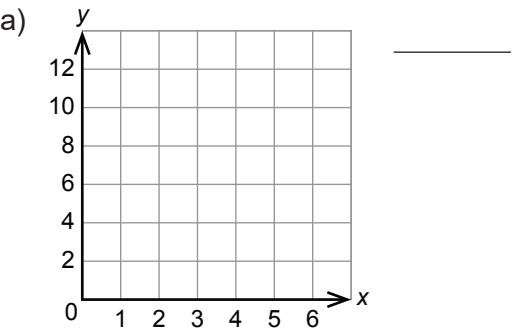
c) $y = 5x - 3$

Input (x)	Output (y)
1	
2	
3	

Bonus ▶ $y = 180 - 3x$

Input (x)	Output (y)
20	
40	
60	

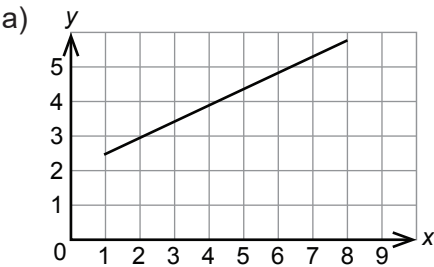
5. Graph each relation in Question 4 by plotting the ordered pairs as points on the grid.
Can you connect the points with a single straight line? Write “yes” or “no.” Use a ruler to check.



6. Compare your answers in Questions 4 and 5. How can you tell from the graph of a relation whether the relation is linear or not?

A relation is linear if its graph forms a straight line. If the graph does not form a single straight line, the relation is not linear.

7. Does the graph show a linear relation? Explain why or why not.

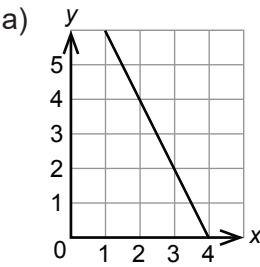


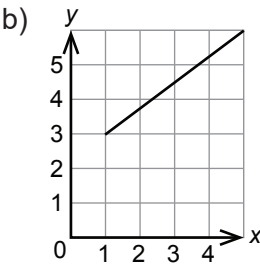




If the graph of a relation goes up from left to right, it is increasing.
If the graph of a relation goes down from left to right, it is decreasing.

8. Is the linear relation increasing or decreasing? How do you know?





9. Complete the table for the relation. Is the gap between the output values a positive or negative number? Is the relation increasing or decreasing?

A. $y = 5x - 4$

Input (x)	Output (y)
1	
2	
3	

The gap is: positive / negative

The relation is: increasing / decreasing

B. $y = 17 - 4x$

Input (x)	Output (y)
1	
2	
3	

The gap is: positive / negative

The relation is: increasing / decreasing

10. a) For each relation in Question 9, describe what you think the graph will look like.
b) Graph the relations on grid paper. Were your predictions in part a) correct?

PR7-7 Analyzing Relations and Graphs

1. The number that is multiplied by a variable is its coefficient. Identify the coefficient of x in the formula.

a) $y = 12x - 6$ +12

b) $y = 7 + 34x$ _____

c) $y = 14 - 9x$ _____

Bonus ►

d) $y = -2x + 100$ _____

e) $x + 5 = y$ _____

f) $y = 108 - x$ _____

Since the values of y on the graph of a linear relation are the same as the output values, as x increases by 1, the change in the value of y is equal to the gap between the output values.

Remember, this gap is equal to the coefficient in the formula.

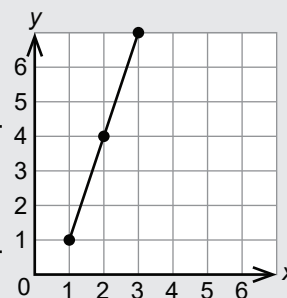
Input (x)	Output (y)
1	$3(1) - 2 = 1$
2	$3(2) - 2 = 4$
3	$3(3) - 2 = 7$

+3

+3

$$y = 3x - 2$$

y increases by 3 as x increases by 1



2. A linear relation is given by the formula $y = 2x + 1$.

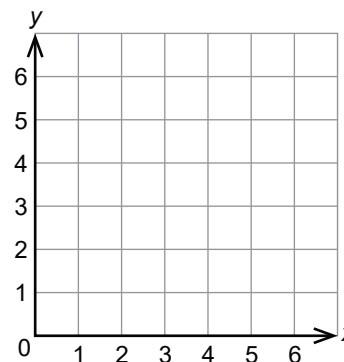
a) What is the coefficient of x in the formula? _____

b) What will be the y -coordinate of the point on the graph with $x = 1$?
Plot this point on the grid.

c) How will the value of y change in the graph when x increases by 1?
Plot another point on the grid, for $x = 2$, using this change in y .

d) Draw a line through the two points to sketch the graph of the linear relation. Use a ruler.

Extend the line to predict what will be the value of x when y is 7. _____

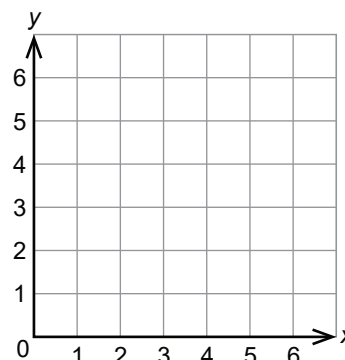
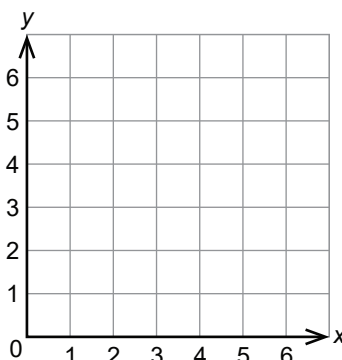
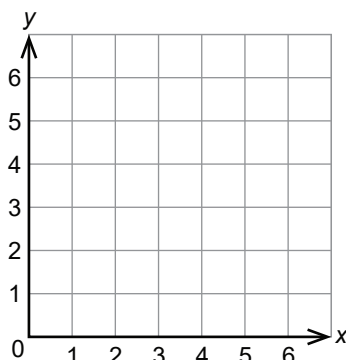


3. Sketch the graph of the linear relation. Start by plotting one point, and then use the coefficient of x to find another point. Use a ruler to draw a straight line connecting the two points.

a) $y = 7 - x$

b) $y = 3x - 3$

c) $y = 11 - 4x$



4. The graph of a linear relation is shown.

a) The graph represents a linear sequence. Use the graph to find the gap.

Hint: Look at the change in the value of y as x increases by 1. _____

b) Use the graph to find the starting value of the linear sequence.

Hint: Look at the value of y when $x = 1$. _____

c) Complete the sequence rule.

Start at _____ and _____ each time.

d) Combine the gap with another number using addition or subtraction to get the value of y when $x = 1$.

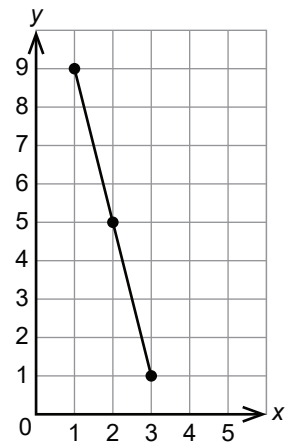
_____ $- 4 = 9$

e) Write a formula for the linear relation.

$y =$ _____

f) Use the graph to complete the table of values.

Do your answers to parts a) to e) match the table?



Input (x)	Output (y)
1	
2	
3	

5. a) Write the gaps between the output values in the table. Is the relation linear or non-linear?
Is the relation increasing or decreasing?

i)

Input (A)	Output (B)
1	2
2	4
3	6

increasing / decreasing

linear / non-linear

ii)

Input (n)	Output (y)
1	1
2	2
3	7

increasing / decreasing

linear / non-linear

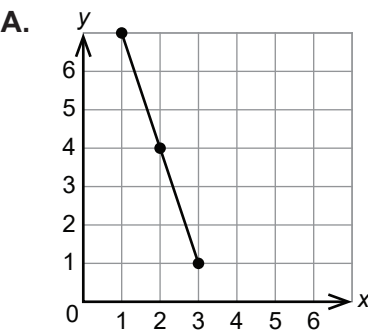
iii)

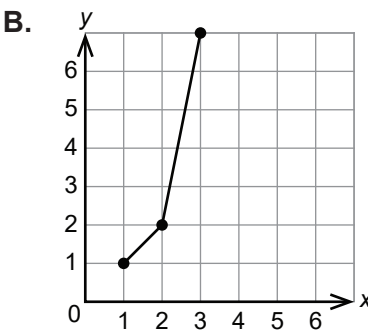
Input (A)	Output (y)
1	7
2	4
3	1

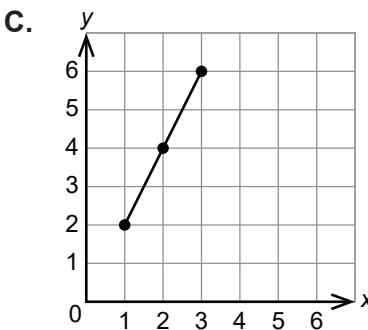
increasing / decreasing

linear / non-linear

b) Match each relation from part a) to its graph.







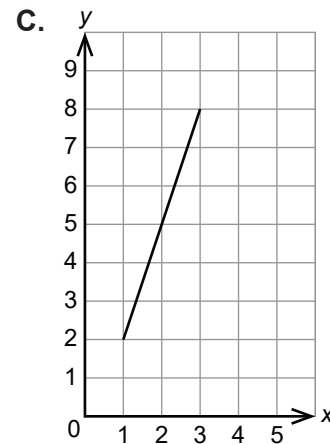
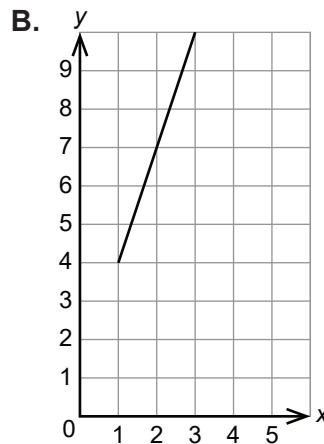
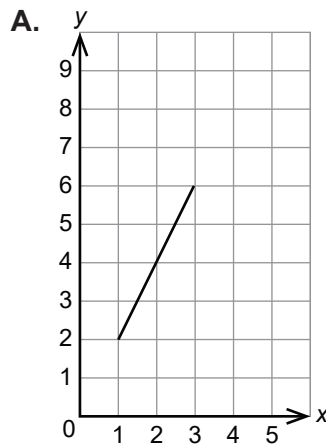
6. a) The formula represents a linear sequence. Find the value of y when $x = 1$ for the formula.

- i) $y = 3x - 1$ when $x = 1$, $y = \underline{\hspace{2cm}}$ ii) $y = 2x$ when $x = 1$, $y = \underline{\hspace{2cm}}$ iii) $y = 3x + 1$ when $x = 1$, $y = \underline{\hspace{2cm}}$

b) Write the coefficient of x for each formula from part a).

- i) $\underline{\hspace{2cm}}$ ii) $\underline{\hspace{2cm}}$ iii) $\underline{\hspace{2cm}}$

c) Each graph represents a linear sequence. Find the value of y when $x = 1$ for each graph. Plot the point.



d) Find the change in y as x increases by 1 in each graph from part c). Show it on the graph.

e) Each graph in part c) corresponds to a formula in part a). Match the formulas and graphs. Explain how you did the matching.

7. The graph shows the cost of renting a canoe from Aputik's store.

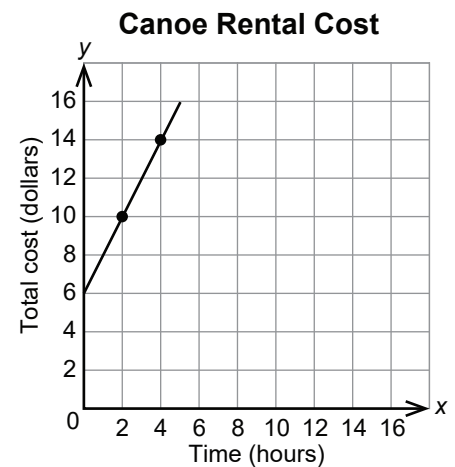
a) How much do you have to pay to rent a canoe for ...

- i) 2 hours? ii) 4 hours? iii) 3 hours?

b) Satra rented a canoe from Aputik's store and paid \$16.

How many hours did they rent it for? $\underline{\hspace{2cm}}$

c) How much would it cost to rent a canoe from Aputik's store for 6 hours? Extend the line to find out. $\underline{\hspace{2cm}}$



Bonus ► Ron's store charges \$25 to rent a canoe for one day. If you need a canoe for 8 hours, whose store would you rent from, Ron's or Aputik's? Explain.

PR7-8 Problems and Puzzles: Linear Relations

Ezra wants to find the 10th term in the sequence 3, 7, 11, 15, ... He makes a table and writes a formula for the sequence.

Term Number (n)	Gap × n	Term Value (v)
1	4 × 1 = 4	3
2	4 × 2 = 8	7
3	4 × 3 = 12	11

+4
+4

Formula: $v = 4n - 1$

Using the formula, Ezra can calculate the value of the 10th term:

$$\begin{aligned} v &= 4(10) - 1 \\ &= 40 - 1 \\ &= 39 \end{aligned}$$

Subtract 1

1. Fill in the table to find a formula for the sequence. Then find the value of the 10th term.

a) 4, 9, 14, 19, ...

Term Number (n)	Gap × n	Term Value (v)
1		
2		
3		

Subtract _____

Formula: _____

10th term: _____

b) 47, 44, 41, 38, ...

Term Number (n)	Gap × n	Term Value (v)
1		
2		
3		

Subtract from _____

Formula: _____

10th term: _____

2. What assumption did you need to make in Question 1 about the sequences? Explain.

3. A linear sequence is given by this pattern rule: Start at 4 and add 3 each time.

a) Let n be the term number and v be the term value. Complete the formula for the sequence.

$v = \text{_____} \times n + \text{_____}$

b) Find the 23rd term in the sequence in two ways.

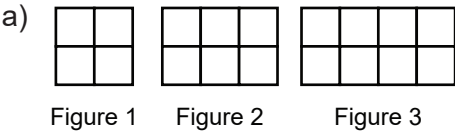
i) Substitute 23 for n in the formula. _____

ii) Substitute 20 for n to find the 20th term, and then extend the sequence using the pattern rule to find the 23rd term.

iii) Do you get the same answer both ways? _____

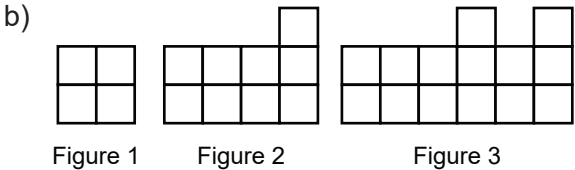
4. The number of blocks in Figures 1, 2, and 3 forms a linear pattern. Write the following:

- i) a sequence giving the number of blocks in each figure shown
- ii) a rule for extending the pattern
- iii) an expression for the number of blocks in the n^{th} figure
- iv) the number of blocks in the 15th figure

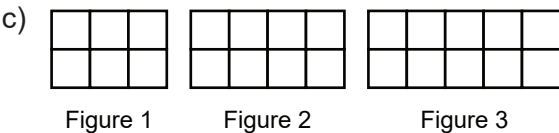


- i) 4, 6, 8
- ii) Start at 4 and add 2 each time.
- iii) $2n + 2$
- iv) $2(15) + 2 = 30 + 2$
 $= 32$

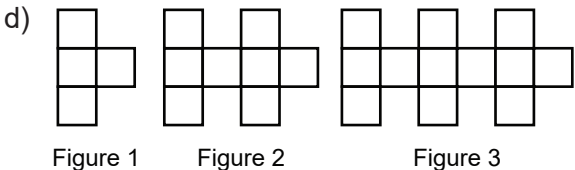
The 15th figure would have 32 blocks.



- i) _____
- ii) _____
- iii) _____
- iv) _____



- i) _____
- ii) _____
- iii) _____
- iv) _____



- i) _____
- ii) _____
- iii) _____
- iv) _____

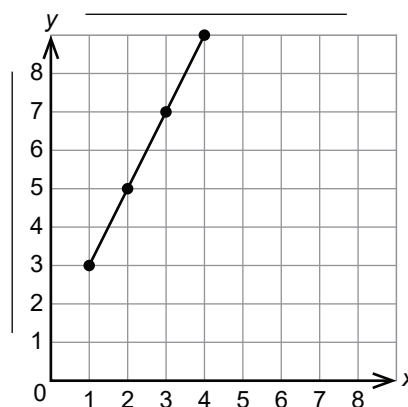
5. Water drains from two tanks, each following a pattern as shown in the table. Assume the pattern in the amount of water drained continues for each tank. Which tank do you think will empty first? Explain.

Minutes	Tank 1	Tank 2
1	500 L	500 L
2	460 L	490 L
3	420 L	470 L
4	380 L	440 L

6. a) The title and labels for this graph are missing. Which of these relations could it represent? Circle your answer and explain your reasoning.

A. The cost (in \$) of renting a bicycle for n hours.

B. The area (in cm^2) of a square of side length n cm.



- b) What else could this graph represent?
Add your own title to the graph. Label both axes.

7. The graph shows Sima's distance from home as she bikes home from school.

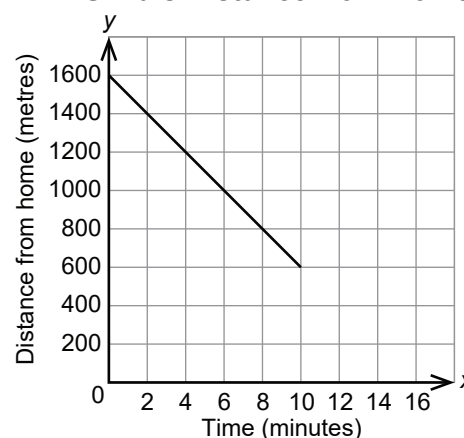
- a) How far is Sima from home after ...

i) 2 minutes? ii) 10 minutes? iii) 7 minutes?

- b) How far is Sima's school from home? Explain how you know.

- c) How long does it take Sima to get home? Extend the line to find out.

Sima's Distance from Home



8. The graph shows the cost of making a telephone call to Cuba.

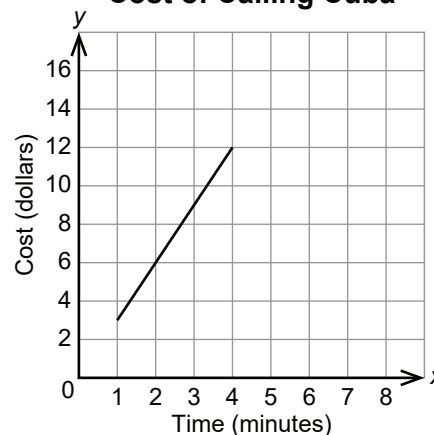
- a) If you talked for 2 minutes, how much would you have to pay?

- b) How much does the cost rise every minute?

- c) If you paid \$9, how long would you be able to talk?

- d) How much does it cost to talk for 6 minutes? Extend the line to find out.

Cost of Calling Cuba



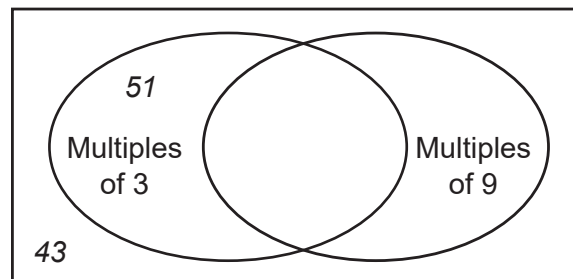
Bonus ► How much would it cost to talk for half an hour?

PR7-9 Cumulative Review: Units 1 and 3

1. a) Find the sum of the digits for each number in the table below.

Number	43	51	72	96	186	270	428	792	939	1422
Sum of Digits	7	6								

- b) Sort the numbers using the Venn diagram.
c) Which region of the Venn diagram is empty? Why?



2. Celine has 390 marbles and she wants to divide the marbles into smaller groups with none left over. She wants to put the same number of marbles in each bag. Circle each number of bags that she can use.

2 bags

3 bags

5 bags

6 bags

9 bags

3. Write the answer (or **X** when there is no answer) in the box.

a) $9 \div \boxed{\text{X}} = 0$

b) $\boxed{} = 5 \times 0$

c) $1 \div 0 = \boxed{}$

d) $0 \div 1 = \boxed{}$

e) $0 \div 0 = \boxed{}$

f) $\boxed{} \div 9 = 1$

g) $\boxed{} = 0 \div 16$

h) $0 = 6 \div \boxed{}$

4. Join the factor pairs of the number with arcs.

a) **8**: 1 2 3 4 5 6 7 8

b) **14**: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

c) **9**: 1 2 3 4 5 6 7 8 9

d) **16**: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

5. Find the prime factorization for the number.

a) 10 _____

b) 24 _____

c) 26 _____

Bonus ► 82 _____

6. Compare the positive integers using $>$ or $<$. Then compare the negative integers.

a) 82 064 $\boxed{}$ 3064

b) 526 $\boxed{}$ 51 182

c) 94 318 $\boxed{}$ 94 321

so $-82\,064 \boxed{} -3064$

so $-526 \boxed{} -51\,182$

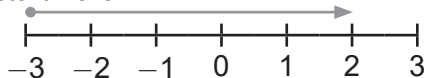
so $-94\,318 \boxed{} -94\,321$

7. Add.

- a) $(-5) + (+7) + (-6) + (+2) =$ _____ b) $(+9) + (-12) + (+5) =$ _____
 c) $(+8) + (-11) + (-4) + (-13) =$ _____ d) $(-13) + (+13) + (-8) =$ _____

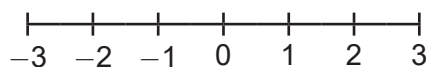
8. Use the number line to add or subtract.

a) *start here*



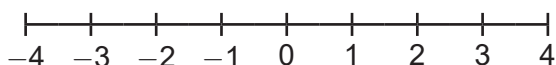
$(-3) + (+5) =$ +2

b)



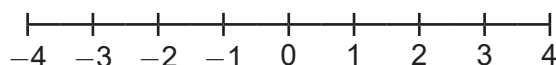
$(+1) + (-3) =$ _____

c)



$-2 - (-6) =$ _____

d)



$-1 - (+3) =$ _____

9. Without using a number line, add or subtract the integers by first dropping the brackets.

- | | | | |
|--------------------------------|------------------|------------------|------------------|
| a) $(-8) - (-6)$ | b) $(+9) + (-7)$ | c) $(-8) + (+3)$ | d) $(+6) - (+7)$ |
| $=$ <u>$-8 + 6$</u> | $=$ _____ | $=$ _____ | $=$ _____ |
| $=$ <u>-2</u> | $=$ _____ | $=$ _____ | $=$ _____ |

10. Evaluate.

- a) $11 - (2 + 6) \times 3 + (3 - 8)$ b) $(3 \times 14) \div (1 + 3 \times 2) - (6 - 10)$

11. One of the lowest temperatures ever seen in Yellowknife is about -51°C . One of the highest temperatures ever seen in the city is 83°C warmer. What is the higher temperature?

Write an equation to show your answer. _____

12. Use the sequence rule to write the first five terms of the sequence.

- a) Start at 495 and add -35 each time. _____
 b) Start at -495 and add 35 each time. _____

13. Complete the sequence rule for the linear pattern.

- a) $-435, -345, -255, -165, \dots$ Start at _____ and _____ each time.
 b) $-435, -525, -615, -705, \dots$ Start at _____ and _____ each time.

14. Consider the sequence given by this rule: Start at 135 and add 40 each time.

- a) Write the first five terms of the sequence. _____
- b) What is the gap for this linear sequence? _____
- c) How can you write the starting number as the gap plus another number? $135 = 40 +$ _____
- d) Complete the table for the sequence.

Term Number (<i>n</i>)	Term Value (<i>v</i>)	Repeated Addition	Multiplication
1	135	$40 + 95$	$(40 \times 1) + 95$
2	175	$(40 + 40) + 95$	$(40 \times 2) + 95$
3			
4		$(40 + 40 + 40 + 40) + 95$	
5			

- e) Write an expression for the given term of the sequence using multiplication.
- i) 6th term: $40(6) + 95$ ii) 10th term: _____ iii) *n*th term: _____
- f) Write a formula to find the term value (*v*) from the term number (*n*). $v =$ _____

15. Complete the table by finding the gap of the linear sequence first. Then write the number that must be added to or subtracted from “gap × *n*” to get the term value (*v*). Write a formula to calculate the term value, *v*, from the term number, *n*.

a)

Term Number (<i>n</i>)	Gap × <i>n</i>	Term Value (<i>v</i>)
1		94
2		105
3		116

Add _____

Formula: _____

b)

Term Number (<i>n</i>)	Gap × <i>n</i>	Term Value (<i>v</i>)
1		41
2		91
3		141

Subtract _____

Formula: _____

c)

Term Number (<i>n</i>)	Gap × <i>n</i>	Term Value (<i>v</i>)
1		108
2		209
3		310

Add _____

Formula: _____

d)

Term Number (<i>n</i>)	Gap × <i>n</i>	Term Value (<i>v</i>)
1		−250
2		−150
3		−50

Subtract _____

Formula: _____

16. a) The formula represents a linear sequence. Find the value of y when $x = 1$ for the formula.

i) $y = 10 - 2x$

when $x = 1$, $y =$ _____

ii) $y = 13 - 3x$

when $x = 1$, $y =$ _____

iii) $y = 12 - 2x$

when $x = 1$, $y =$ _____

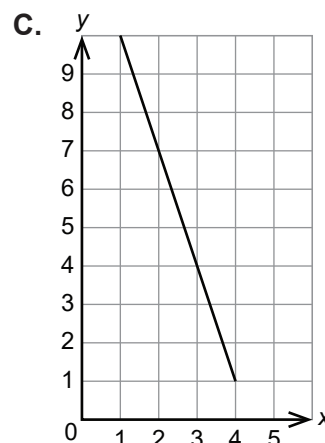
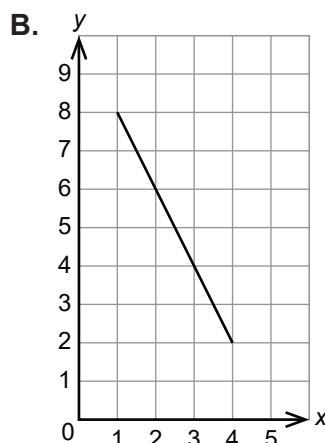
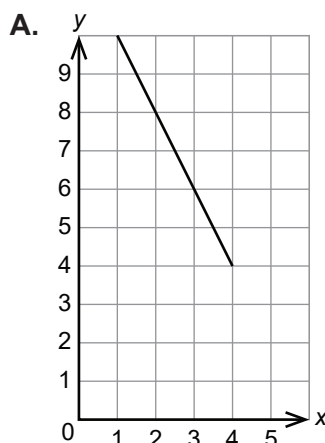
b) Write the coefficient of x for each formula from part a).

i) −2

ii) _____

iii) _____

c) Each graph represents a linear sequence. Find the value of y when $x = 1$ for each graph. Plot the point.



d) Find the change in y as x increases by 1 in each graph from part c). Show it on the graph.

e) Each graph in part c) corresponds to a formula in part a). Match the formulas and graphs. Explain how you did the matching.

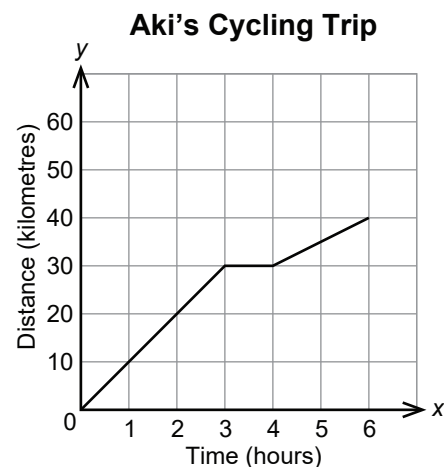
17. The graph shows the distance Aki travelled on a cycling trip.

a) How far had Aki cycled after 2 hours? _____

b) How far had Aki cycled after 6 hours? _____

c) Did Aki rest at all during her trip? How do you know?

d) When Aki was cycling, did she always travel at the same speed? Explain how you know.



Bonus ► Use what you know about divisibility rules, integers, and linear sequences to predict whether 405 will be in the sequence.

a) Start at -27 and add 9 each time.

b) Start at -35 and add 9 each time.