Math 9 **Unit 6: Linear Relations** Name: _____

6. 1 Representing Patterns

Prescribed Learning Outcomes (PLO'S):

- Write a linear expression representing a given pictorial, oral, or written pattern
- Write a linear equation to represent a given context
- Describe a context for a given linear equation
- Solve using a linear equation, a given problem that involves pictorial, oral, and written linear patterns
- Write a linear equation representing the pattern in a given table of values and verify the equation by substituting values from the table
- Determine, by substitution, whether a given rational number is a solution to a given linear equation

Terminology

+5 = d

0, 5, 10, 15 ...

Linear patterns: a sequence of numbers in which the pattern only involves addition or subtraction.

Common Difference d **:** is the difference between any two consecutive numbers in a linear pattern.

d = 5

Observing a **Pattern**

Draw the Figure 5 by continuing the pattern shown below. How is the number of circles related to the figure number? Show the relationship in a table.

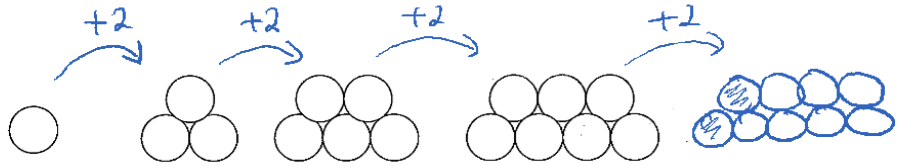


Figure 1 Figure 2 Figure 3 Figure 4 Fig 5

input output

Figure #	# of circles
1	1
2	3
3	5
4	7
5	9

d = 2

What do you notice as we move from figure to figure? What is changing? How is it changing? Look at the table. Do you see any patterns?

(Fig #)(d)	# of circles
1·2 = 2	1
2·2 = 4	3
3·2 = 6	5
4·2 = 8	7
	9 d

Make a new table of values. This time multiply the figure # by the change in the number of circles and put this on the left-hand side of your table. The right-hand side should stay the same. What can you see now?

d · input ..... = output

Write an **equation** relating:
the figure # (call it "N") and the # of circles (call it "C")

$2 \cdot N - 1 = C$

$2 - 1 = 1$

$4 - 1 = 3$

How can we use the **equation** to predict other data?

a) How many circles are in Figure 71?

N # of circles

$2(71) - 1 = C$

$142 - 1 = C$

$141 = C$

141 circles in Figure 71

$2(71) - 1 = C$
$142 - 1 = C$
$141 = C$

141 circles in Figure 71

b) Which figure number has 83 circles?

$N = ?$ $C = 83$

$2N - 1 = 83$
$+1 \quad +1$
$\frac{2N}{2} = \frac{84}{2}$

$N = 42$
Figure #42 has 83 circles.

#2) Number Patterns

25, 21, 17, 13, ... 9, 5, 1 – Term value
1 2 3 4 5 6 7 – Term # =

a) Make a table of values for the first five terms. Use the table to create the equation for this pattern.

d·N	N: Term #	V: Term value	
−4	1	25	−4
−8	2	21	−4
−12	3	17	
−16	4	13	
−20	5	9	

$d = -4$

$d \cdot N + 29 = V$
$-4 \quad +29 = 25$
$-8 \quad +29 = 21$
$-20 \quad +29 = 9$

$\rightarrow -4N + 29 = V$

b) Use the equation to answer the following:

i. What is the value of the 11th term?

$V = ?$ N

$-4(11) + 29 = V$
$-44 + 29 = -15 =$ Value of the 11th term

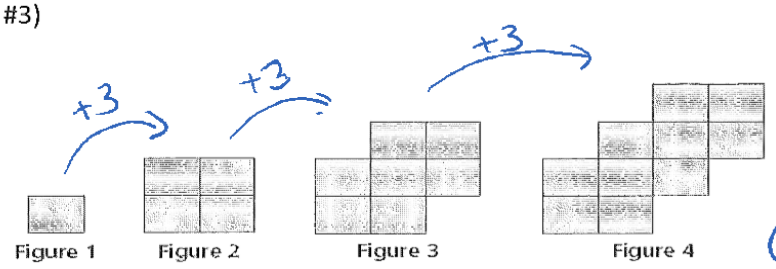
ii. Which term has the value of -47?

$N = ?$ V

$-4N + 29 = -47$
$-29 \quad -29$
$-4N = -76$

$\frac{-4N}{-4} = \frac{-76}{-4}$
$N = 19^{th}$ term is -47

#3)



① Find the difference to go from one term to the next. $d = \_\_$

② Multiply the difference with the term #, N

③ relate $d \cdot N$ to the value of the term by adding or subtracting

④ Eqn $d \cdot N \pm \_\_ = V$

a) Describe the pattern in the figures above. $d = +3$

b) Create a table of values to represent the figure number and the number of squares for the first 4 figures.

3N	Fig #	#of Squares (Q)	
3	1	1	+3
6	2	4	+3
9	3	7	+3
12	4	10	

Eqn: $dN \pm \_\_ = Q$ ← # of squares

$3N - 2 = Q$

Q = # of squares
N = Figure #

c) Write a linear equation to represent this pattern.

d) How many squares are in Figure 12 (Q, N)

$3N - 2 = Q$
$3(12) - 2 = Q$
$34 = Q$

In figure 12, there are 34 squares

e) Which figure number has 106 squares? (Q)

$\frac{3N}{3} = \frac{6}{3}$

34 = Q

e) Which figure number has 106 squares?

N = ? Q

$3N - 2 = Q$

$3N - 2 = 106$

$+2 \quad +2$

$\frac{3N}{3} = \frac{108}{3}$

$N = 36$

Fig 36 has 106 squares.

$\frac{3N}{3} = \frac{6}{3}$

$N = 2$

Homework: p. 217 #4 (b, c, d, e), 5 &6 (a, c, d, e), ~~7, 9, 10, 14 (a, b, c)~~

(plus the "More Practice" on pg 4) →

(3)

(4)

More Practice

1) Determine the common difference of the following linear patterns and use it to find the next 3 numbers.

a) 5, 8, 11, 14, ... b) -5, 1, 7, 13, ...

2) Write an equation relating C to n. (Verify it works for every pair of values)

a)

n	1	2	3	4
C	5	8	11	14

b)

n	1	2	3	4
C	−5	−11	−17	−23

3) Determine the 30th number in the following linear pattern. Write the equation first.

a) -8, -3, 2, 7...

4) The fare for a taxi ride is $1.50 per kilometre plus a fixed cost of $2.40.

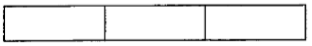
a) Write an equation for the fare F in terms of the fixed cost and the cost per n kilometres.

b) What is the fare for an 11km ride?

c) If you cost was $32.40, how many km was the ride?

1. A banquet table seats 8 people, three on each side, and two at the ends. Tables can be

1. A banquet table seats 8 people, three on each side, and two at the ends. Tables can be connected end to end, as shown.



a) How many additional people can be seated when a table is added?

b) Make a table to show how many people can sit at 1-4 tables.

c) Find a pattern and write an equation. Use *n* for the number of tables and *P* for the number of people.

d) Use your equation to determine how many people can be seated at 10 tables.

e) How many tables are needed to seat 344 people?

2. Joseph is considering two different payment plans for his gym membership. **Plan A** charges a flat fee of $45.00 each month. **Plan B** charges a flat fee of $25.00 each month plus $2.50 per visit.

a) Write a linear relation to represent each plan
b) Graph the two linear relations
c) Use the graph to help you identify at what month the two plans would have the same cost
d) If Joseph planned to visit the gym 10 times per month, which plan would cost less? How much would it cost him?