8.1 Investigate and Describe Patterns

Name: ______________________________  Date: ________ __

Part: A (Page 334)

Gilles and Aceena are arranging an academic and sports awards banquet. They want to know how many guests can be seated in different table arrangements.

The circles show where the guests can sit.

1. How many guests can sit in each arrangement, if the following number of tables are placed together as shown? 1 table _______________
   2 tables _______________
   3 tables _______________

2. Fill in and continue the pattern in the table below.

<table>
<thead>
<tr>
<th>Number of tables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of guests</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Look at the pattern and describe how the number of guests who can be seated changes for each table added.

   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

4. Complete this sentence: To find the number of guests for each arrangement, you would ____________________________ ___________
   ___________________________________________________________________
5. Use the table of values and produce a graph for the data. Use the number of tables along the x-axis and the number of guests along the y-axis. Plot each pair of values.

a) Describe the pattern formed by the points.

_____________________________________________________________________

_____________________________________________________________________

b) Should you join the points? Why or why not?

_____________________________________________________________________

_____________________________________________________________________

6. Use the graph to determine the number of guests who can be seated using:

a) 8 tables _______________________________

b) 10 tables _______________________________
7. Let's make an algebraic expression to mathematically express what is happening. HINT: We can question 4 to help us.

8. What is the meaning of the numerical coefficient and how it is related to the table diagrams?

9. What is the meaning of the constant and how is it related to the table diagrams?

10. Could we use the algebraic expression to help us find the number of guests who can be seated around a table arrangement? ________________
    Explain ___________________________________________ ________

    _______________________________________________________

    _______________________________________________________

    _______________________________________________________
8.1 Investigate and Describe Patterns

Count the number of toothpicks in each diagram of the following pattern

1. Describe the pattern in words. Describe how to build a train of squares of any length.

2. Fill in and continue the pattern in the table below

<table>
<thead>
<tr>
<th>Number of squares</th>
<th>Number of toothpicks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. How many toothpicks are required when you add on a square? _______

4. What toothpick remains the same or can be considered constant? ___

5. Complete this sentence: To find the number of toothpicks needed, you would ________________________________
6. Let's make an algebraic expression to mathematically express what is happening. We can use question 5 to help us.

7. What is the meaning of the numerical coefficient and how it is related to the toothpick diagrams?

8. What is the meaning of the constant and how it is related to the toothpick diagrams?

9. Could we use a drawing to help us find the number of toothpicks needed to have 10 squares? ___________. Draw the diagram

10. Could we extend the pattern of numbers in the table to help us find the number toothpicks needed have 10 squares?

<table>
<thead>
<tr>
<th>number of squares</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of toothpicks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Could we use the algebraic expression to help us find the number of toothpicks needed to have 10 squares? ________. How do we use the algebraic expression to do this? Explain. ________________________
Patterns in Tables

Example 2 (page 338): A new freezer has been plugged in. The temperature inside the freezer over time is shown in the table.

<table>
<thead>
<tr>
<th>hour</th>
<th>temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Describe the pattern and complete the chart.

Note: We can use the table of values and substitution to quickly find the algebraic expression to represent this pattern.

(1) How are the values changing?

_____________________________________________________________________

(2) This number represents the numerical coefficient. So, the algebraic expression could be:

__________________________________________

(3) Use substitution to see if anything needs to be added or subtracted to get the proper values.

Hour 1

<table>
<thead>
<tr>
<th>hour</th>
<th>temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(4) This is the constant. Let’s check a few more values to see if we did it correctly.

<table>
<thead>
<tr>
<th>Hour 2</th>
<th>Hour 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

So, we have the correct algebraic expression of:

Example: Find an algebraic expression for the following table of values.

1) | Money | ? |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We need to find the algebraic expression (?). As the money goes up by 1, the other values go up by one as well.

Let’s try “m”
2) 

<table>
<thead>
<tr>
<th>d</th>
<th>?</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-16</td>
</tr>
<tr>
<td>5</td>
<td>-20</td>
</tr>
<tr>
<td>6</td>
<td>-24</td>
</tr>
<tr>
<td>7</td>
<td>-28</td>
</tr>
</tbody>
</table>

We need to find the algebraic expression (?). As the $d$ goes up by 1, the other values go down by 4 (-4).

Let’s try “-4d”

3) 

<table>
<thead>
<tr>
<th>P</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>?</td>
<td>8</td>
<td>18</td>
<td>28</td>
<td>38</td>
</tr>
</tbody>
</table>

As “P” goes up by 5 then ? goes up by _____________________________

Now try and find an algebraic expression for:

1) 

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

2) 

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1</td>
<td>-2</td>
<td>-3</td>
<td>-4</td>
<td>-5</td>
</tr>
</tbody>
</table>

ASSIGN: WORKSHEETS “Number Patterns”
Number Patterns Worksheet #1

Use the algebraic expression to complete the following table of values.

1) \[
\begin{array}{c|c|c|c|c}
\hline
x & 3 & 5 & 7 & 9 \\
\hline
x + 2 & & & & \\
\hline
\end{array}
\]

2) \[
\begin{array}{c|c|c|c|c}
\hline
g & 2 & 4 & 6 & 8 \\
\hline
10 - g & & & & \\
\hline
\end{array}
\]

3) \[
\begin{array}{c|c|c|c|c}
\hline
e & 1 & 5 & 9 & 13 \\
\hline
e + 9 & & & & \\
\hline
\end{array}
\]

4) \[
\begin{array}{c|c|c|c|c}
\hline
v & 3 & 5 & 7 & 9 \\
\hline
4 + v & & & & \\
\hline
\end{array}
\]

5) \[
\begin{array}{c|c|c|c|c}
\hline
k & 30 & 45 & 60 & 75 \\
\hline
k - 15 & & & & \\
\hline
\end{array}
\]

6) \[
\begin{array}{c|c|c|c|c|c}
\hline
\quad & 13 & 28 & 43 & 58 \\
\hline
\quad + 37 & & & & \\
\hline
\end{array}
\]

7) \[
\begin{array}{c|c|c|c|c}
\hline
w & 91 & 82 & 73 & 64 \\
\hline
100 - w & & & & \\
\hline
\end{array}
\]

8) \[
\begin{array}{c|c|c|c|c|c}
\hline
f & 11 & 22 & 33 & 44 \\
\hline
99 + f & & & & \\
\hline
\end{array}
\]

Write the algebraic expression, then complete the table

1) \[
\begin{array}{c|c|c|c|c}
\hline
h & 5 & 6 & 7 & 8 \\
\hline
8 & 9 & 10 & 11 \\
\hline
\end{array}
\]

2) \[
\begin{array}{c|c|c|c|c|c}
\hline
J & 15 & 20 & 25 & 30 \\
\hline
16 & 21 & 26 & 31 \\
\hline
\end{array}
\]

3) \[
\begin{array}{c|c|c|c|c}
\hline
m & 10 & 12 & 14 & 16 \\
\hline
6 & 8 & 10 & 12 \\
\hline
\end{array}
\]

4) \[
\begin{array}{c|c|c|c|c|c}
\hline
p & 28 & 35 & 42 & 49 \\
\hline
21 & 28 & & & \\
\hline
\end{array}
\]

5) \[
\begin{array}{c|c|c|c|c}
\hline
r & 56 & 65 & 74 & 83 \\
\hline
46 & 55 & & & \\
\hline
\end{array}
\]

6) \[
\begin{array}{c|c|c|c|c|c}
\hline
v & 90 & 80 & 70 & 60 \\
\hline
& & & & \\
\hline
\end{array}
\]
Number Patterns Worksheet #2

Use the algebraic expression to complete the following table of values.

1)  
\[
\begin{array}{c|cccc}
 x & 5 & 6 & 7 & 8 \\
 3x & & & & \\
\end{array}
\]

2)  
\[
\begin{array}{c|cccc}
 y & 10 & 12 & 14 & 16 \\
 y/2 & & & & \\
\end{array}
\]

3)  
\[
\begin{array}{c|cccc}
 z & 5 & 10 & 15 & 20 \\
 6z & & & & \\
\end{array}
\]

4)  
\[
\begin{array}{c|cccc}
 b & 4 & 8 & 12 & 16 \\
 b/4 & & & & \\
\end{array}
\]

5)  
\[
\begin{array}{c|cccc}
 c & 30 & 45 & 60 & 75 \\
 2c & & & & \\
\end{array}
\]

6)  
\[
\begin{array}{c|cccc}
 f & 10 & 20 & 30 & 40 \\
 f/5 & & & & \\
\end{array}
\]

7)  
\[
\begin{array}{c|cccc}
 h & 91 & 82 & 73 & 64 \\
 h/10 & & & & \\
\end{array}
\]

Write the algebraic expression, then complete the table.

1)  
\[
\begin{array}{c|cccc}
 g & 1 & 2 & 3 & 4 \\
 3g & 3 & 6 & 9 & 12 \\
\end{array}
\]

2)  
\[
\begin{array}{c|cccc}
 i & 5 & 10 & 15 & 20 \\
 i/2 & 1 & 2 & 3 & 4 \\
\end{array}
\]

3)  
\[
\begin{array}{c|cccc}
 m & 10 & 12 & 14 & 16 \\
 1.5m & & & & \\
\end{array}
\]

4)  
\[
\begin{array}{c|cccc}
 n & 50 & 60 & 70 & 80 \\
 10n & 10 & 12 & & \\
\end{array}
\]
PATTERNS - ASSIGNMENT #

Part A

1. What is the variable in each expression?
   a) 7p   b) 15w   c) 0.2m  a) ____  b) _____  c) ______

2. What is the constant in each expression?
   a) 8q + 1  b) 16x – 3  c) 0.5n – 5  a) ____  b) _____  c) ______

3. Simplify each expression
   a) w + w + w + w + w + w + w + w  a) ______
   b) a + a + a + a  b) ______
   c) - h - h - h - h - h - h - h  c) ______

4. Write each expression as repeated addition.
   a) 3n  a) ___________________________
   b) 8p  b) ____________________________________________
   c) 5b  c) ____________________________________________

5. Identify each as a variable or a constant.
   5. ____________________

   6. the number of nickels in $1.00
   6. ____________________

   7. the number of roses you purchases
   7. ____________________

   8. the cost of one rose
   8. ____________________

   9. the number of days in a week
   9. ____________________

  10. the number of rainy days in a week
  10. ____________________
Part B: Match each word expression with an algebraic expression from the box.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>m + 5</td>
<td>b/4</td>
<td>4n</td>
<td>h - 5</td>
</tr>
<tr>
<td>n - 4</td>
<td>p/5</td>
<td>w + 4</td>
<td>3v - 2</td>
</tr>
<tr>
<td>5k</td>
<td>3k + 2</td>
<td>2a + 3</td>
<td>2h - 3</td>
</tr>
</tbody>
</table>

1. the product of a number and four ____________
2. a number divided by four ____________
3. the difference between a number and four ____________
4. the sum of a number and four ____________
5. a number increased by five ____________
6. a number decreased by five ____________
7. a number multiplied by five ____________
8. a number divided by five ____________
9. twice a number, decreased by three ____________
10. three times a number, increased by two ____________
11. double a number, increased by three ____________
12. triple a number, less two ____________

Part C: Evaluate these expressions for the value of the variables given.

a) 6n for n = 5  
b) 7k for k = 2  
c) 15 - m for m = 9  
___________  ___________  ______________

d) w + 11 for w = 0  
e) h / 9 for h = 27  
f) 18 / a for a = 2  
___________  ___________  ______________

g) 2m - 3 for m = 6  
h) 8(k + 1) for k = 3  
i) 0.5t - 1 for t = 12  
___________  ___________  ______________
Part D: Evaluate these expressions for the value of the variables given.

a) \( ab \) for \( a = 6 \) and \( b = 3 \)

b) \( g - h \) for \( g = 10 \) and \( h = 4 \)

c) \( mn - 9 \) for \( m = 7 \) and \( n = 8 \)

d) \( 3v - w \) for \( v = 5 \) and \( w = 7 \)

Part E: Examine the following figures

a) What is the pattern in words? _______________________________
_________________________________________________________________

b) Complete the following table.

<table>
<thead>
<tr>
<th>figure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of sides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


c) Write an algebraic expression to represent the number of side. _______

d) Use your algebraic expression to complete the sentences below:

Figure 7 has _______________ and is called a/an __________________.

Figure 10 has ________________ and is called a/an ________________.

Figure 6 has _________________ and is called a/an ________________.
Patterns Worksheet

For each of the four patterns answer the following questions below.

1. Predict and draw the next two diagrams in the pattern.

   □□□   □□□□□   □□□□□
   □□□   □□□□□   □□□□□

2. Describe the pattern in words. Describe how to build this pattern.

   ___________________________________________________________
   ___________________________________________________________

3. Create a table of values for each pattern.

<table>
<thead>
<tr>
<th>Number of dark squares</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of light squares</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Graph the following patterns.

5. What is the algebraic expression for the pattern? Check to make sure it works.

6. How many light squares are there when there is 10 dark squares? 50 dark squares?
1. Predict and draw the next two diagrams in the pattern.

2. Describe the pattern in words. Describe how to build this pattern.

3. Create a table of values for each pattern.

<table>
<thead>
<tr>
<th>Number of dark squares</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of light squares</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Graph the following patterns.

5. What is the algebraic expression for the pattern? Check to make sure it works.

6. How many light squares are there when there is 10 dark squares? 50 dark squares?
1. Predict and draw the next two diagrams in the pattern.

```
\[ \begin{array}{c}
\text{triangle} \\
\text{triangle} \\
\text{triangle}
\end{array} \]
```

2. Describe the pattern in words. Describe how to build this pattern.

3. Create a table of values for each pattern.

<table>
<thead>
<tr>
<th>Number of triangles</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of dots</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Graph the following patterns.

5. What is the algebraic expression for the pattern? Check to make sure it works.

6. How many dots are there when there is 10 triangles? 50 triangles?
1. Predict and draw the next two diagrams in the pattern.

2. Describe the pattern in words. Describe how to build this pattern.

3. Create a table of values for each pattern.

<table>
<thead>
<tr>
<th>Number of circles</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of squares</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Graph the following patterns.

5. What is the algebraic expression for the pattern? Check to make sure it works.

6. How many squares are there when there are 10 circles? 50 circles?