

Important Concepts . . .

# Preview Review



**Mathematics    Grade 6    TEACHER KEY**

**W3 - Lesson 4: Number Patterns,  
Magic Squares, and Problem Solving**

## Important Concepts of Grade 6 Mathematics

|                     |  |
|---------------------|--|
| W1 - Lesson 1 ..... | Basic Facts, Basic Operations, and Integers                |
| W1 - Lesson 2 ..... | Place Value, Whole Numbers, Decimals, and Common Fractions |
| W1 - Lesson 3 ..... | Improper Fractions and Mixed Numbers                       |
| W1 - Lesson 4 ..... | Ratios and Percents  |
| W1 - Lesson 5 ..... | Number Operations with Decimals                            |
| W1 - Quiz           |  |
| W2 - Lesson 1 ..... | Factors, Multiples, and Prime Factorizations               |
| W2 - Lesson 2 ..... | Metric Measurement   |
| W2 - Lesson 3 ..... | Perimeter and Area   |
| W2 - Lesson 4 ..... | Surface Area and Volume                                    |
| W2 - Lesson 5 ..... | Working with Angles and Drawing Objects and Shapes         |
| W2 - Quiz           |  |
| W3 - Lesson 1 ..... | Transformations  |
| W3 - Lesson 2 ..... | Bar Graphs, Line Graphs, and Circle Graphs                 |
| W3 - Lesson 3 ..... | Collecting and Analyzing Data                              |
| W3 - Lesson 4 ..... | Number Patterns, Magic Squares, and Problem Solving        |
| W3 - Lesson 5 ..... | Probability and Outcomes                                   |
| W3 - Quiz           |  |

**Materials Required: A textbook is not needed. This is a stand-alone course.**

Mathematics Grade 6

Version 5

Preview/Review W3 - Lesson 4 TEACHER KEY

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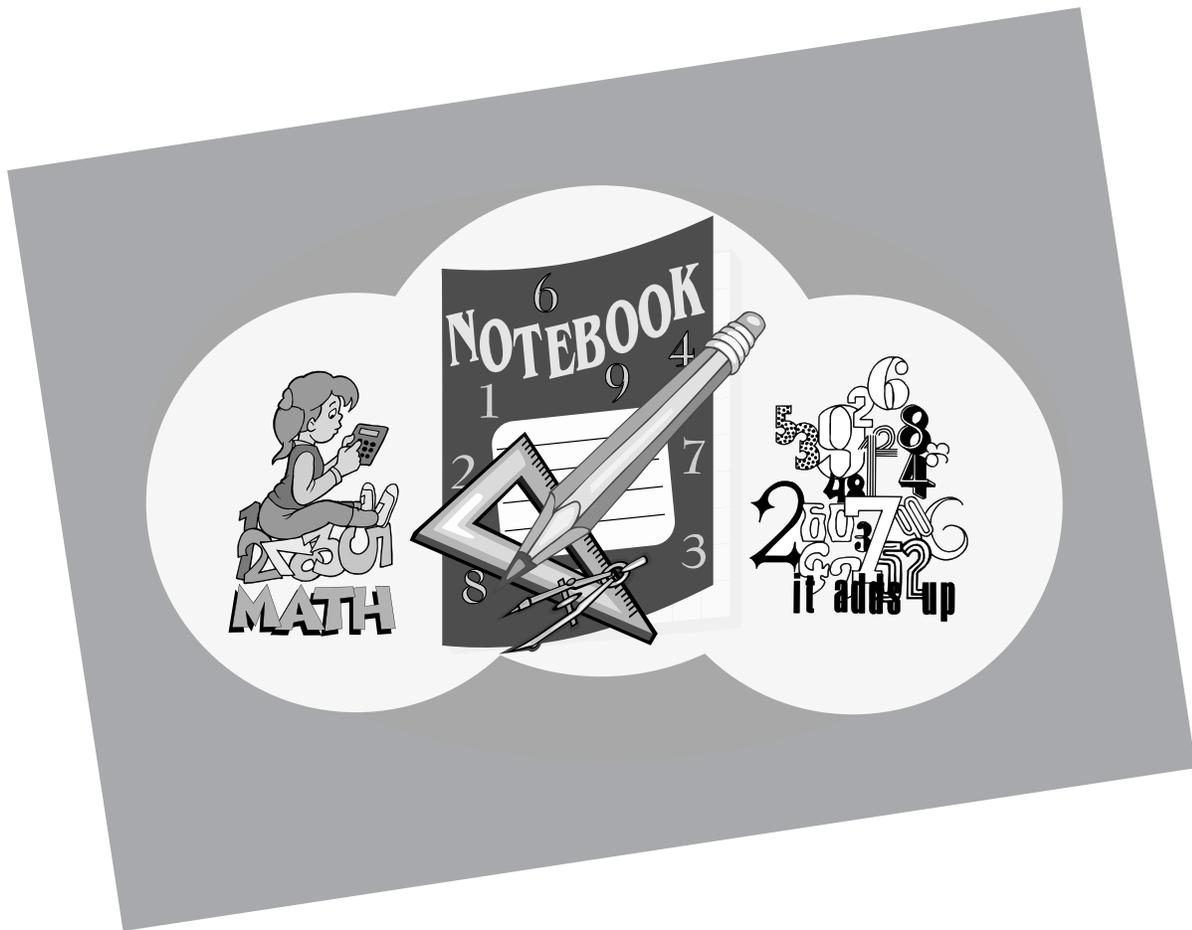
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# Preview/Review Concepts for Grade Six Mathematics

## *TEACHER KEY*



*W3 - Lesson 4: Number  
Patterns, Magic Squares,  
and Problem Solving*

# OBJECTIVES

By the end of this lesson, you should

- discover patterns in groups of numbers
- use magic squares
- find solutions to problems using patterns
- write rules to explain number patterns

## GLOSSARY

**magic square** - a square of numbers in which the sum of each column and each row is the same

**pattern** - repeated design; repetition of a sequence of numbers

## W3 - Lesson 4: Number Patterns, Magic Squares, and Problem Solving

Welcome to W3 - Lesson 4! Patterns of numbers can be fascinating! In this lesson, you will use Magic Squares, T-tables, and charts. You will solve problems by using patterns, and you will write rules to explain various patterns of numbers.

### Number Patterns and Rules to Predict the Outcome

1. Interesting Number Patterns: Complete the number charts below. The example demonstrates the procedure.

**Example:**

$$\begin{aligned}
 1 \times 9 + 2 &= 11 \\
 12 \times 9 + 3 &= 111 \\
 123 \times 9 + 4 &= 1\ 111 \\
 1\ 234 \times 9 + 5 &= 11\ 111 \\
 12\ 345 \times 9 + 6 &= 111\ 111
 \end{aligned}$$

a.

$$\begin{aligned}
 1 \times 8 + 1 &= \underline{\quad 9 \quad} \\
 12 \times 8 + 2 &= \underline{\quad 98 \quad} \\
 123 \times 8 + 3 &= \underline{\quad 987 \quad} \\
 1\ 234 \times 8 + 4 &= \underline{\quad 9\ 876 \quad} \\
 12\ 345 \times 8 + 5 &= \underline{\quad 98\ 765 \quad} \\
 123\ 456 \times 8 + 6 &= \underline{\quad 987\ 654 \quad}
 \end{aligned}$$

b.

$$\begin{aligned}
 9 \times 9 + 7 &= \underline{\quad 88 \quad} \\
 9 \times 98 + 6 &= \underline{\quad 888 \quad} \\
 9 \times 987 + 5 &= \underline{\quad 8\ 888 \quad} \\
 9 \times 9\ 876 + 4 &= \underline{\quad 88\ 888 \quad} \\
 9 \times 98\ 765 + 3 &= \underline{\quad 888\ 888 \quad} \\
 9 \times 987\ 654 + 2 &= \underline{\quad 8\ 888\ 888 \quad}
 \end{aligned}$$



c.  $37 \times 3 = \underline{111}$   
 $37 \times 6 = \underline{222}$   
 $37 \times 9 = \underline{333}$   
 $37 \times 12 = \underline{444}$   
 $37 \times 15 = \underline{555}$   
 $37 \times 18 = \underline{666}$

d.  $9 \times 1 - 1 = \underline{8}$   
 $9 \times 21 - 1 = \underline{188}$   
 $9 \times 321 - 1 = \underline{2888}$   
 $9 \times 4321 - 1 = \underline{38888}$   
 $9 \times 54321 - 1 = \underline{488888}$   
 $9 \times 654321 - 1 = \underline{5888888}$



2. Write the next three numbers in each of the number sequences listed below.

**Example:** 5, 10, 15, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ (Answer: 20, 25, 30)

- a. 1, 2, 3, 4, 5, 6, 7,
- b. 2, 4, 6, 8, 10, 12, 14,
- c. 1, 2, 3, 10, 4, 5, 6, 20, 7, 8, 9, 30,
- d. 5, 9, 17, 33, 65, 129, 257,
- e. 3, 6, 9, 12, 15, 18, 21, 24,
- f. 3, 4, 6, 9, 13, 18, 24, 31, 39,
- g. 6, 20, 8, 22, 10, 24, 12, 26, 14, 28,
- h. 10, 21, 43, 87, 175, 351, 703,
- i. 100, 99, 97, 94, 90, 85, 79, 72, 64,
- j. 1, 4, 9, 16, 25, 36, 49,

3. Write a rule that explains the number pattern that relates the first two columns to the third column.

**Example 1**

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 1        | 2        | 3        |
| 5        | 3        | 8        |
| 2        | 3        | 5        |
| 4        | 4        | 8        |
| 6        | 3        | 9        |

**Rule:** Add the number in Column 1 to the number in Column 2 to get the number in Column 3.

**Example 2**

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 1        | 2        | 3        |
| 5        | 3        | 16       |
| 2        | 3        | 7        |
| 4        | 4        | 17       |
| 6        | 3        | 19       |

**Rule:** Multiply the number in Column 1 by the number in Column 2 and add 1 to get the number in Column 3.

a.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 4        | 2        | 7        |
| 1        | 4        | 3        |
| 3        | 2        | 5        |
| 5        | 3        | 14       |
| 2        | 8        | 15       |

Rule:

***Multiply the # in column 1 times the # in column 2, and subtract 1 to get the # in column 3.***

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b.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 1        | 4        | 7        |
| 2        | 3        | 9        |
| 3        | 4        | 15       |
| 4        | 5        | 23       |
| 5        | 5        | 28       |

Rule:

*Multiply the # in column 1 times the # in column 2, and  
add 3 to get the # in column 3.*

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c.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 50       | 5        | 9        |
| 40       | 5        | 7        |
| 30       | 6        | 4        |
| 20       | 5        | 3        |
| 10       | 5        | 1        |

Rule:

*Divide the # in column 1 times the # in column 2, and  
subtract 1 to get the # in column 3.*

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d.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 2        | 4        | 12       |
| 5        | 3        | 16       |
| 4        | 8        | 24       |
| 6        | 7        | 26       |
| 8        | 9        | 34       |

Rule:

***Add column 1 and column 2, then multiply by 2 to get column 3.***

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e.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 24       | 8        | 5        |
| 30       | 6        | 7        |
| 48       | 8        | 8        |
| 54       | 6        | 11       |
| 72       | 8        | 11       |

Rule:

***Divide column 1 by column 2, and add 2 to get column 3.***

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f.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 7        | 6        | 3        |
| 9        | 7        | 4        |
| 12       | 8        | 6        |
| 13       | 5        | 10       |
| 14       | 5        | 11       |

Rule:

***Subtract column 2 from column 1, then add 2 to get column 3.***

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g.

| Column 1 | Column 2 | Column 3 |
|----------|----------|----------|
| 2        | 3        | 15       |
| 4        | 3        | 21       |
| 5        | 4        | 27       |
| 6        | 4        | 30       |
| 7        | 8        | 45       |

Rule:

***Add columns 1 and 2, and then multiply by 3 to get column 3.***

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4. For the following T-tables, write the rule that relates the number in the first column with the number in the second column. Then, complete the T-table by filling in the blank spaces with the correct numbers.

**Example:**

| A | B  |
|---|----|
| 2 | 5  |
| 3 | 7  |
| 4 | 9  |
| 5 | 11 |

**Rule:** Double the number in column A and add one to get the number in column B.

| A | B           |
|---|-------------|
| 1 | \$0.50      |
| 2 | 1.00        |
| 3 | 1.50        |
| 4 | <b>2.00</b> |
| 5 | <b>2.50</b> |
| 6 | <b>3.00</b> |

a. Rule:

***Multiply  $A \times \$0.50 = B$ .***

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| A  | B         |
|----|-----------|
| 10 | 50        |
| 11 | 55        |
| 12 | 60        |
| 13 | <b>65</b> |
| 14 | <b>70</b> |
| 15 | <b>75</b> |

b. Rule:

***Multiply  $A \times 5 = B$ .***

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| A | B             |
|---|---------------|
| 1 | 75 km         |
| 2 | 150 km        |
| 3 | 225 km        |
| 4 | <b>300 km</b> |
| 5 | <b>375 km</b> |
| 6 | <b>450 km</b> |

c. Rule:

***Multiply  $A \times 75 = B$ .***

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| A | B         |
|---|-----------|
| 9 | 28        |
| 8 | 25        |
| 7 | 22        |
| 6 | 19        |
| 5 | <b>16</b> |
| 4 | <b>13</b> |
| 3 | <b>10</b> |

d. Rule:

***Multiply  $A \times 3 + 1 = B$ .***

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| <b>A</b> | <b>B</b> |
|----------|----------|
| 44       | 9        |
| 40       | 8        |
| 36       | 7        |
| 32       | 6        |
| 20       | <b>3</b> |
| 16       | <b>2</b> |
| 12       | <b>1</b> |

e. Rule:

***Divide*  $A \div 4 - 2 = B.$**

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| <b>A</b> | <b>B</b>  |
|----------|-----------|
| 2        | 9         |
| 4        | 13        |
| 7        | 19        |
| 8        | 21        |
| 11       | <b>27</b> |
| 12       | <b>29</b> |
| 13       | <b>31</b> |

f. Rule:

**$2 \times A + 5 = B.$**

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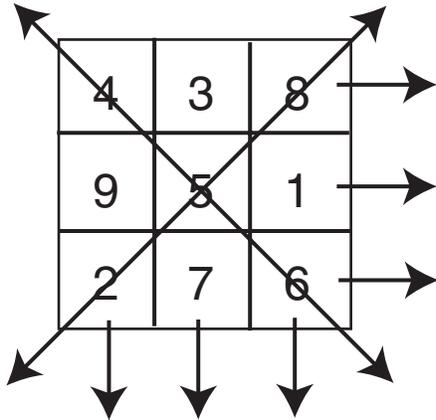


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## Magic Squares

In a **magic square**, the sum of each column and each row is the same. When the magic square has nine cells, the sums of the diagonal numbers are also identical to the sums of the rows and columns.



All columns and rows add up to 15. Even the diagonals add up to 15.

- The rows and the columns of this magic square have a sum of 36. The diagonals also add up to 36. Use these numbers to complete the Magic Square: 2, 4, 6, 10, 12, 14, 18, 20, 22.

Write the values below.

A = 10

B = 6

C = 22

D = 18

E = 14

|   |    |    |
|---|----|----|
| A | B  | 20 |
| C | 12 | 2  |
| 4 | D  | E  |

2. Each of the rows and the columns of this magic square has a sum of 36. The diagonals do NOT add up to 36. Use these numbers to complete the Magic Square: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16.

Write the values below.

F = 8

G = 14

H = 5

R = 2

J = 10

|    |    |    |    |
|----|----|----|----|
| F  | G  | 3  | 11 |
| 17 | H  | 12 | R  |
| 1  | 13 | 6  | 16 |
| J  | 4  | 15 | 7  |

3. Each row and column of this magic square has a sum of 180. The diagonals do NOT add up to 180. Use these numbers to complete the Magic Square: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85.

Write the values below.

K = 55

L = 5

M = 80

N = 75

P = 35

|    |    |    |    |
|----|----|----|----|
| 40 | 70 | 15 | K  |
| 85 | 25 | 60 | 10 |
| L  | 65 | 30 | M  |
| 50 | 20 | N  | P  |

4. Arrange the following numbers to create a magic square that has a sum of 45 in each column and row. The diagonals also have a sum of 45. Put the number 15 in the middle square. Use the following numbers: 11, 12, 13, 14, 15, 16, 17, 18, 19.

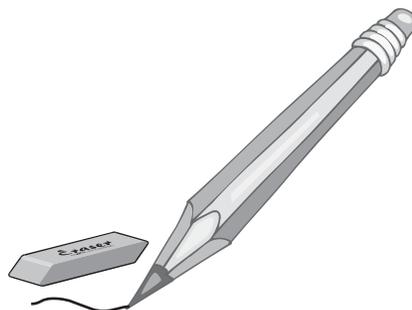
|           |           |           |
|-----------|-----------|-----------|
| <b>18</b> | <b>13</b> | <b>14</b> |
| <b>11</b> | 15        | <b>19</b> |
| <b>16</b> | <b>17</b> | <b>12</b> |

### Assignment 3: Problem Solving

1. Find the correct numbers to make true statements of these addition and subtraction questions.

#### Addition

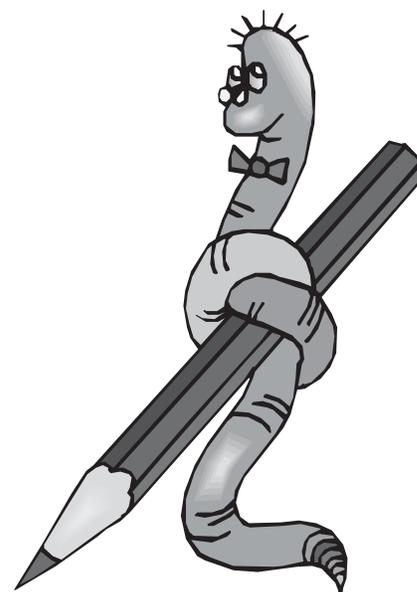
- a. Find the value for
- |                  |         |
|------------------|---------|
| A = <u>  4  </u> | A 937   |
| B = <u>  6  </u> | 8B      |
| C = <u>  3  </u> | 109     |
| D = <u>  1  </u> | + 3 C85 |
|                  | 8 5D7   |



- b. Find the value for
- |                     |                 |
|---------------------|-----------------|
| $E = \underline{6}$ | 6 74E           |
| $F = \underline{3}$ | 2 F7            |
| $G = \underline{1}$ | 63              |
| $H = \underline{4}$ | <u>+ 38 G28</u> |
| $I = \underline{5}$ | HI 174          |

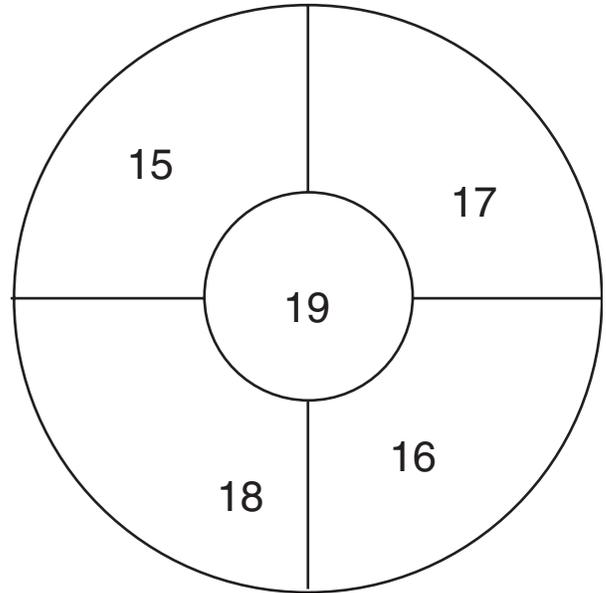
**Subtraction**

- c. Find the value for
- |                     |                |
|---------------------|----------------|
| $A = \underline{7}$ | 9A 74B         |
| $B = \underline{0}$ | <u>- 6 C23</u> |
| $C = \underline{6}$ | E1 1D7         |
| $D = \underline{1}$ |                |
| $E = \underline{9}$ |                |
- d. Find the value for
- |                     |                |
|---------------------|----------------|
| $F = \underline{4}$ | J6 FG7         |
| $G = \underline{5}$ | <u>- H 975</u> |
| $H = \underline{6}$ | 79 48I         |
| $I = \underline{2}$ |                |
| $J = \underline{8}$ |                |



2. Archery Contest: Using this target, William Tell was able to score exactly 100 points. How many arrows were necessary to get 100 points and on what numbers did the arrows stick?

***6 arrows are needed. There are 3 different solutions.***



- 1) 19, 19, 16, 15, 15, 16
- 2) 17, 18, 16, 19, 15, 15
- 3) 18, 18, 17, 17, 15, 15

3. Coins: Darlene has 27 coins in her pocket. The coins are a mixture of pennies, nickels, dimes, and quarters. The coins have a total value of \$3.22. What coins does Darlene have? (There is more than one correct answer.)

***There are 4 possible answers***

1) 9Q, 7D, 4N, 7P

3) 8Q, 7D, 10N, 2P

2) 6Q, 15D, 4N, 2P

3) 10Q, 3D, 7N, 7P



4. A theatre had 100 adults, teens, and children in the audience. The prices of the tickets were Adults \$10.00, Teens \$3.00, and Children (under 12) \$0.50. The theatre collected a total of \$100.00 from the 100 people. How many adults, teens, and children were in the audience?

***94 children, 5 men and 1 woman***

***(This may be solved by trial and error.)***



5. Age Problem: The other day Bob met an old friend named Sally whom he had not seen in years. “You don’t look a day older than you did 20 years ago,” said Bob. Sally replied, “The last time I saw you, I was 4 times as old as you were then, and I’m still twice as old as you are now.” Can you find the ages of Bob and Sally?

***Bob is 30 years old, Sally is 60 years.***

***(Students will probably have to use trial and error.)***

## Homework Assignment

1. Write the next three numbers in each of the number sequences below.

- a. 4, 10, 22, 46, 94, 190, 382
- b. 99, 97, 94, 90, 85, 79, 72
- c. 7, 14, 21, 28, 35, 42
- d. 21, 23, 25, 41, 43, 27, 29, 31, 45, 47, 33, 35
- e. 516, 256, 128, 64, 32, 16, 8
- f. 3 645, 1 215, 405, 135, 45, 15, 5
- g. 5, 10, 9, 18, 17, 34, 33, 66, 65, 130
- h. 8, 16, 24, 32, 40, 48
- i. 7, 35, 30, 150, 145, 725, 720, 3600, 3595

2. Complete the T-tables.

| A | B         |
|---|-----------|
| 1 | 13        |
| 2 | 24        |
| 3 | 35        |
| 4 | 46        |
| 5 | <u>57</u> |
| 6 | <u>68</u> |
| 7 | <u>79</u> |

a. Rule:

$$(A \times 11) + 2$$

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| <b>A</b> | <b>B</b>   |
|----------|------------|
| 2        | 20         |
| 4        | 36         |
| 6        | 52         |
| 8        | 68         |
| 10       | <b>84</b>  |
| 12       | <b>100</b> |
| 14       | <b>116</b> |

b. Rule:

$$(A \times 8) + 4 = B$$

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| <b>A</b> | <b>B</b>  |
|----------|-----------|
| 15       | 29        |
| 14       | 27        |
| 12       | 23        |
| 11       | 21        |
| 6        | <b>11</b> |
| 5        | <b>9</b>  |

c. Rule:

$$(A \times 2) - 1 = B$$

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| <b>A</b> | <b>B</b> |
|----------|----------|
| 120      | 15       |
| 110      | 14       |
| 90       | 12       |
| 80       | 11       |
| 30       | <b>6</b> |
| 20       | <b>5</b> |

d. Rule:

$$(A \div 10) + 3$$

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3. Money Problem: A boy named Muscle Jones was hired by Mrs. Boss to work 2 hours a day for 15 days. Mrs. Boss gave Muscle Jones a choice. He could be paid \$5.00 an hour (\$10.00 a day) or he could be paid 1¢ for day one, 2¢ for day two, 4¢ for day three, 8¢ for day four ... (the value doubling each day for 15 days).

a. How much money will Muscle Jones make at \$5.00 an hour?

$$\mathbf{\$150.00 = 10 / day \times 15 days.}$$

b. How much will Muscle Jones make at 1¢ the first day and doubled daily for 15 days?

$$\mathbf{Week\ 1 - 0.01 + 0.02 + 0.04 + 0.08 + 0.16 = 0.31}$$

$$\mathbf{Week\ 2 - 0.32 + 0.64 + 1.28 + 2.56 + 5.12 = 9.92}$$

$$\mathbf{Week\ 3 - 10.24 + 20.48 + 40.96 + 81.92 + 163.84 = 317.44}$$

$$\mathbf{Total = \$327.67}$$

*Muscle Jones would make \$327.67.*

c. What is the difference in the two values in 3a and 3b?

$$\mathbf{\$177.67}$$

## Self-Evaluation

Ask yourself some important questions. Write your answers in sentences for your teacher.

1. In this lesson, what part of your work was **excellent**?

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2. In this lesson, what part of your work **needs improvement**?

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3. If you want help for some of the work in this lesson, ask your teacher in this space.

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