

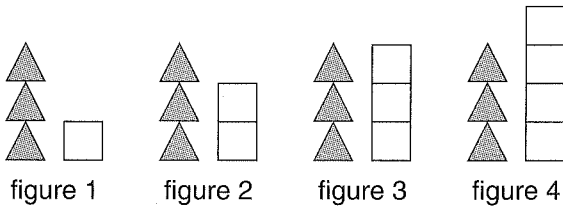
# 9.1

## Writing a Pattern Rule

### GOAL

Write a pattern rule using numbers and variables.

1. a) Use the pattern to complete the table below.



|                       |   |   |   |   |
|-----------------------|---|---|---|---|
| Figure Number         | 1 | 2 | 3 | 4 |
| Number of Triangles   | 3 | 3 |   |   |
| Number of Squares     | 1 |   |   |   |
| Total Number of Tiles | 4 |   |   |   |

- b)  $T$  represents the total number of tiles, and  $n$  represents the figure number. Fill in the missing number so the rule represents the pattern above.

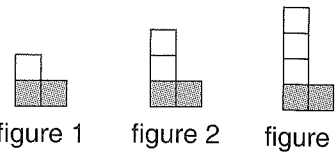
$$T = \underline{\quad} + n$$

- c) Use your pattern rule. How many tiles are in figure 5?

### At-Home Help

An **algebraic expression** is a combination of one or more variables. It may include numbers and operation signs. For example,  $2n + 5$ .

You can write a pattern rule for the number of tiles in each figure of a pattern. For example,



$$T = 2 + n$$

$T$  represents the number of tiles in each figure.

$n$  represents the figure number.

For figure 3,  $n = 3$ , and  $T = 2 + 3 = 5$ .

There are 5 tiles in figure 3.

2. Sarah and Jacob coloured the same pattern of tiles differently.

#### Sarah's colouring

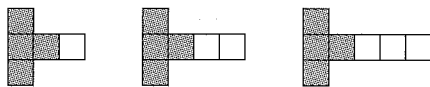


figure 1      figure 2      figure 3

#### Jacob's colouring

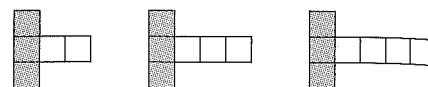


figure 1      figure 2      figure 3

- a) Fill in the blanks to write a pattern rule for Sarah's colouring.

$$T = \underline{\quad} + \underline{\quad}$$

- b) Fill in the blanks to write a pattern rule for Jacob's colouring.

$$T = \underline{\quad} + (\underline{\quad} + \underline{\quad})$$

- c) Will both pattern rules give the same results for figure 4?

# 9.2 Evaluating an Expression to Solve a Problem

## GOAL

Create and evaluate an expression to solve a problem.

- At the museum, students can pay \$6 each for lunch, or they can go as a group and pay \$3 per student plus \$10 for a group lunch. Which lunch is cheaper for a group of 3 students?
- At the art gallery, students can enter separately and pay \$8 each, or enter as a group and pay \$2 per student plus a \$15 group fee.
  - Write an algebraic expression for students who pay separately. \_\_\_\_\_
  - Write an algebraic expression for students who pay as a group. \_\_\_\_\_
  - Which method of payment is cheaper for a group of 10 students?
- Write an algebraic expression for each cost.
  - hot chocolate at \$2 per cup \_\_\_\_\_
  - \$10 per pizza plus \$3 delivery cost \_\_\_\_\_
  - jeans at \$35 each minus a one-time \$10 discount \_\_\_\_\_
- Evaluate the expression  $3 \times (x + 4)$ , for  $x = 5$ . Show and explain your steps.

## At-Home Help

You can use algebraic expressions to solve problems. For example,

**Problem:** At the museum, students can pay \$6 each for lunch, or they can go as a group and pay \$3 per student plus \$10 for a group lunch. Which lunch is cheaper for 5 students?

**Solution:** Use an algebraic expression to write a pattern rule for each lunch. Use  $s$  to represent the number of students.

$$\begin{aligned} \text{cost of} \\ \text{separate lunches} &= 6s \\ &= 6(5) \\ &= 30 \\ \text{cost of group lunch} &= 3s + 10 \\ &= 3(5) + 10 \\ &= 15 + 10 \\ &= 25 \end{aligned}$$

The group lunch is cheaper than the separate lunches.













# 9.3

## Exploring Possible Values

### GOAL

Explore solving a relation with more than one variable.

Megan and Denis bought fruit for a class lunch. They wrote this puzzle on the board for the rest of the class to solve during lunch:

|   |   |   |       |
|---|---|---|-------|
|    |    |    | = 75¢ |
|    |    |    | = 70¢ |
|   |   |   | = 80¢ |
|  |  |  | = 70¢ |
| = 105¢  | = 100¢  | = 90¢   |       |

How much does each piece of fruit cost?

# 9.4 Linear Relations and Their Graphs

## GOAL

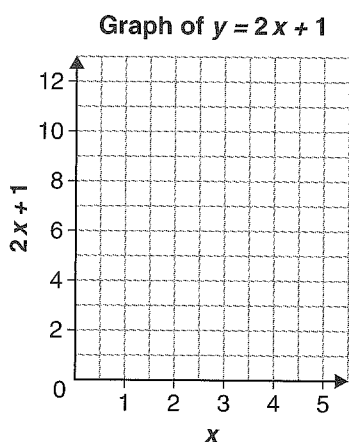
Graph a linear relation, and describe properties of the graph.

1. Oshana made a table of values for the linear relation  $y = 2x + 1$ .

a) Complete Oshana's table.

|              |   |   |   |   |   |
|--------------|---|---|---|---|---|
| $x$          | 1 | 2 | 3 | 4 | 5 |
| $y = 2x + 1$ | 3 | 5 |   |   |   |

- b) Use the table of values to graph the linear relation  $y = 2x + 1$ .



2. Graph these linear relations on the set of axes. Use a different colour for each relation.

a)  $y = 3x$

c)  $y = 3x + 2$

b)  $y = 3x + 1$

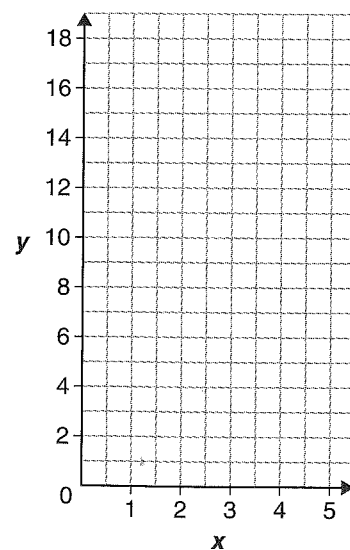
d)  $y = 3x + 3$

3. How are the graphs in question 2 alike?  
How are they different?

## At-Home Help

A **linear relation** is a relation whose plotted points lie on a straight line.

Graph of Linear Relations



# 9.5 Solving Equations Using Mental Mathematics

## GOAL

Solve a problem by solving a related equation.

1. Solve each equation.

a)  $x + 1 = 6$

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

b)  $\frac{a}{3} = 3$

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

c)  $8 - p = 6$

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

d)  $5 + b = 16$

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

e)  $2z - 1 = 3$

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

f)  $4 + 3d = 19$

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

2. Ravi solved an equation by the following steps:

$$\begin{aligned} 4t - 8 &= 16 \\ 4t &= 8 \\ t &= 2 \end{aligned}$$

a) Check Ravi's solution.

How can you tell that Ravi made a mistake? \_\_\_\_\_

\_\_\_\_\_

b) Solve the equation.

3. a) Write a pattern rule to represent the number of triangles in each figure of the pattern. \_\_\_\_\_

b) Sarah has 20 triangles. Write an equation you can solve to determine the number of the figure with 20 triangles.

\_\_\_\_\_

c) Solve your equation.

d) Verify your solution by drawing the figure and counting the triangles.

## At-Home Help

An **equation** is a statement that two quantities or expressions are equivalent.

For example,  
 $4 + 2 = 6$ , and  $6x + 2 = 14$ .

A **solution to an equation** is a value of a variable that makes an equation true.

For example, the solution to  $6x + 2 = 14$  is  $x = 2$ .



figure 1

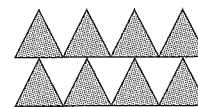


figure 2

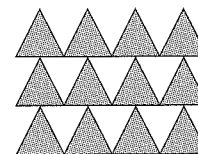


figure 3

# 9.6 Solving Equations Using Models and Drawings

## GOAL

Model and solve problems using pictorial and concrete methods.

You may need counters such as paperclips, tacks, or coins to answer these questions.

1. Draw counters to model each equation. Use differently shaped or coloured counters to represent different parts of the equation.

a)  $x + 5 = 9$

b)  $2b + 6 = 12$

2. Represent each equation using counters. Then, solve each equation.

a)  $p + 5 = 6$

b)  $4m + 1 = 13$

c)  $y + (-5) = (+3)$

3. a) Fill in the blanks to write an equation for the number of tiles ( $T$ ) in each figure of the pattern.

$$T = \underline{\quad} n + \underline{\quad}$$

( $n$  represents the figure number.)

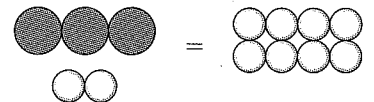
- b) Solve your equation for  $T = 16$ . Show your steps.
- c) Does any figure have exactly 20 tiles? Explain.

## At-Home Help

You can use counters to model and solve an equation.

For example, I want to solve  $3n + 2 = 8$ .

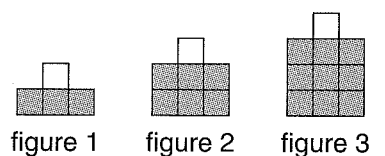
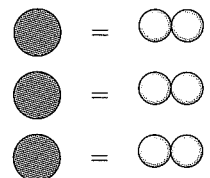
I used large counters to represent each  $n$ . I used small counters to represent each 1.



I removed counters that were on both sides of the equation.

I rearranged the counters, and split them into 3 equal groups.

My model shows that  $n = 2$ .

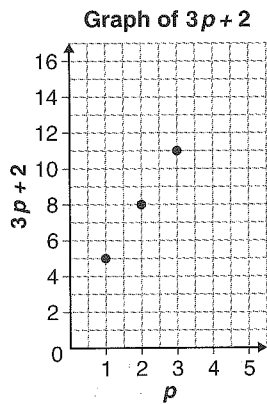


# 9.7 Solving Equations by Graphing

## GOAL

Model and solve problems using tables of values and graphs.

1. Use the graph to solve  $3p + 2 = 14$ .

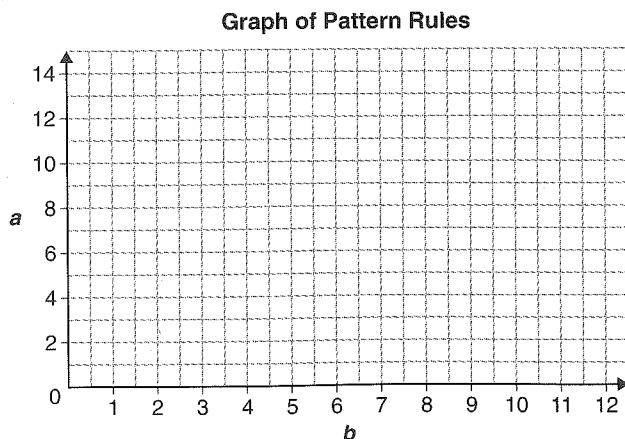


2. a) Fill in the table of values for each pattern rule.

| b | $a = b + 3$ |
|---|-------------|
| 1 |             |
| 2 |             |
| 3 |             |
| 4 |             |

| b | $a = 2b + 3$ |
|---|--------------|
| 1 |              |
| 2 |              |
| 3 |              |
| 4 |              |

- b) Graph each pattern rule on the set of axes below. Use a different colour for each rule.



## At-Home Help

You can use a graph to solve a pattern rule.

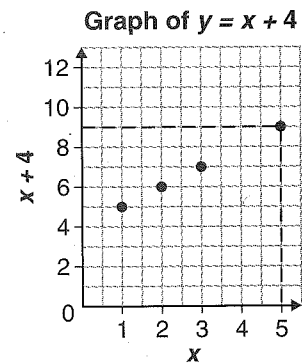
For example, I want to solve the pattern rule  $y = x + 4$ , for  $y = 9$ .

First, I made a table of values. Then, I graphed the points.

Next, I drew a horizontal dotted line at  $y = 9$ .

I put a ruler along the plotted points and looked for the intersection. I drew a new point there.

I drew a line down from the new point on the graph. The line met the  $x$ -axis at 5.



The graph shows that if  $y = 9$ , then  $x = 5$ .

- c) Use your graphs to solve each rule for  $a = 15$ .

$$b + 3 = 15, b = \underline{\hspace{2cm}}$$

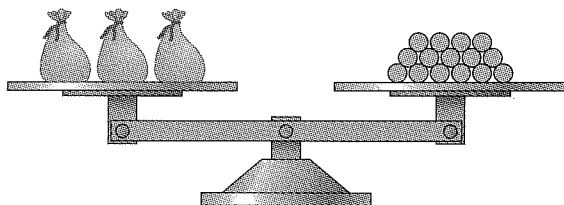
$$2b + 3 = 15, b = \underline{\hspace{2cm}}$$

# 9.8 Communicate the Solution of an Equation

## GOAL

Use models, words, and symbols to record and explain the steps in solving an equation.

1. The same number of marbles is in each bag.  
How many marbles are in each bag?



**Solution:**

$$3b = 15$$

$$3b \div 3 = 15 \div 3$$

$$b = 5$$

## At-Home Help

### Communication Checklist

- Did you show each step in your reasoning?
- Did you use a model or picture to illustrate or justify your reasoning?
- Did you record your solution using mathematical symbols?
- Did you use words and pictures that were clear and correct?

Explain what is happening in each step of the solution.

---



---

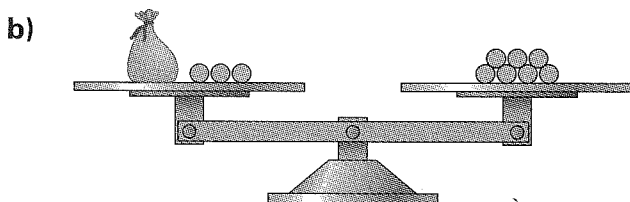
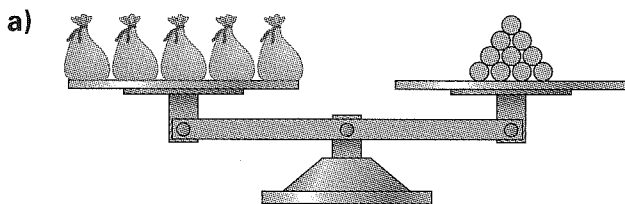


---



---

2. Write and solve an equation for each balance problem.  
Explain each step.

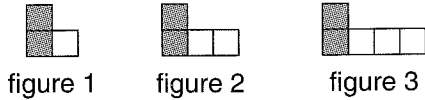




# Chapter 9 Test Yourself

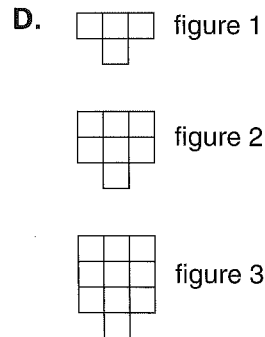
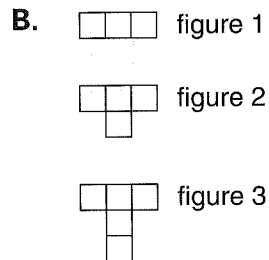
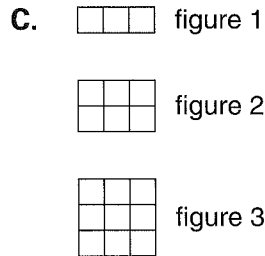
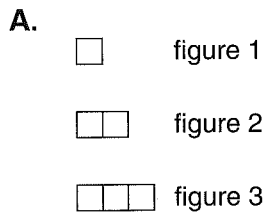
Circle the letter of the correct answer.

1. Which pattern rule matches the pattern below? ( $T$  represents the total number of tiles, and  $n$  represents the figure number.)



- A.  $T = n + 1$       B.  $T = 2n + 1$       C.  $T = n + 2$       D.  $T = 2n + 2$

2. Which set of figures matches the pattern rule  $3n + 1$ ?



3. The students in Megan's class have \$5 each. The teacher has \$10. Which algebraic expression represents the amount of money in total? ( $s$  represents the number of students in the class.)

- A.  $s + 10$       B.  $5s + 10$       C.  $10s + 5$       D.  $15s$

4. Which linear relation matches the graph on the right?
 

A.  $y = 2x$     B.  $y = 2x + 1$     C.  $y = x + 2$     D.  $y = 2x + 2$
5. Solve  $8a = 24$ .
 

A.  $a = 3$     B.  $a = 4$     C.  $a = 5$     D.  $a = 6$
6. Solve  $b + 5 = 18$ .
 

A.  $b = 10$     B.  $b = 13$     C.  $b = 16$     D.  $b = 23$
7. Solve  $2c + 3 = 15$ .
 

A.  $c = 2$     B.  $c = 4$     C.  $c = 6$     D.  $c = 8$
8. Solve  $d - 3 = 10$ .
 

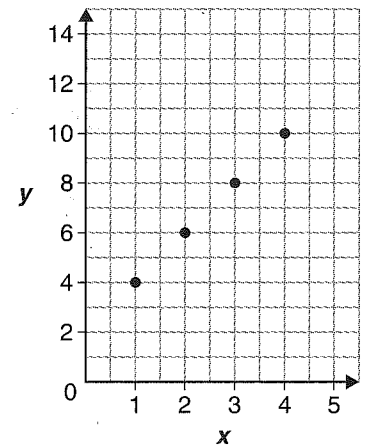
A.  $d = 13$     B.  $d = 10$     C.  $d = 7$     D.  $d = 5$
9. Solve  $\frac{e}{2} = 6$ .
 

A.  $e = 4$     B.  $e = 8$     C.  $e = 3$     D.  $e = 12$
10. Pavlo made a set of figures with the pattern rule  $T = 2n + 5$ . ( $T$  represents the number of tiles, and  $n$  represents the figure number.) Which figure number has 9 tiles?
 

A.  $n = 1$     B.  $n = 2$     C.  $n = 3$     D.  $n = 4$
11. Use the graph below to solve  $3n + 2 = 14$ .
 

A.  $n = 3$     B.  $n = 4$     C.  $n = 5$     D.  $n = 6$

Graph of Linear Relation



Graph of  $3n + 2$

