Practice Lesson 22
Scale Drawings

Vocabulary

equivalent ratios: Two or more ratios that are equal to one another.

rate: A comparison of the first quantity in a ratio to only one of the second quantity.

Prerequisite: Find Equivalent Ratios

Study the example problem showing how to find equivalent ratios. Then solve problems 1–8.

Example

An art teacher needs to buy 5 boxes of markers to complete a project with a class of 20 students. How many boxes of markers will the teacher need to buy for a class of 28 students?

You can draw a diagram to represent this relationship.

From the diagram, you can see that for every 4 students the teacher needs one box of markers.

Use the diagram to write a ratio that represents the number of students per box of markers.

1. How can you use the ratio you wrote in problem 1 to find the number of boxes of markers needed for a class of 28 students? How many boxes of markers will the teacher need to buy for a class of 28 students?

You can also use a table to relate the number of students to the boxes of markers needed. Complete the table.

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>4</th>
<th>20</th>
<th>28</th>
<th>56</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxes of Markers</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>14</td>
<td>10</td>
</tr>
</tbody>
</table>

3. How many boxes of markers should the teacher buy for a class of 30 students? Explain your answer.

4. The ratio 30 : 7.5 is equivalent to 4 : 1. But the teacher can’t buy half of a box of markers, so he must buy 8 boxes.


6. Aya and Jenny are playing a game in which each correct answer is worth a certain number of points. Jenny got 4 correct answers for a total of 24 points, and then it was Aya’s turn. Aya scored 36 points during her turn. How many correct answers did Aya get? Explain.

7. A school has a pep band, a sports band, a marching band, and a concert band. In each band, there are 2 trombones for every 5 trumpets. Complete the table for the bands.

<table>
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<tr>
<th>Band</th>
<th>Trombones</th>
<th>Trumpets</th>
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<tr>
<td>Pep</td>
<td>2</td>
<td>5</td>
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8. At the Stop and Save grocery store, an 18-ounce box of Crunchy Oats costs $4.59, and a 15-ounce box costs $3.99.

a. Which box is the better buy? Explain.

b. How much money would you save if you bought 90 ounces of cereal in the larger boxes rather than 90 ounces of cereal in the smaller boxes? Explain.

Solve.

1. How can you use the ratio you wrote in problem 1 to find the number of boxes of markers needed for a class of 28 students? How many boxes of markers will the teacher need to buy for a class of 28 students?

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Lesson 22

Use Proportional Reasoning with Scale Drawings

Study the example showing how to use a scale drawing to find actual measurements. Then solve problems 1–7.

Example

An architect drew a scale drawing of a new art museum on centimeter grid paper. Each centimeter on the drawing represents 5 meters in the actual museum. What are the length and width of the sculpture room in the museum?

The sculpture room in the drawing is 6 centimeters long and 2 centimeters wide. The scale is 1 cm : 5 m.

One way to solve the problem is to use the scale to make a table of equivalent ratios.

<table>
<thead>
<tr>
<th>Distance on the Scale Drawing (cm)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance in the Museum (m)</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
</tr>
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</table>

The table shows, the length of the actual room is 30 meters and the width is 10 meters.

You can also write an equation for equivalent ratios.

The equation at the right can be used to find the actual length of the sculpture room.

From the equation, I see that I have to multiply 1 by 6 to get 6, so I can also multiply 5 by 6 to get \(\frac{1}{2} \times 6 = 3\) because \(\frac{1}{2} = \frac{6}{30}\) and \(x = 30\).

Write and solve an equation to find the actual width of the sculpture room.

The actual width is 10 meters.

Vocabulary

scale drawing: a drawing that shows an object with its measurements in proportion to the actual measurements of the object.

scale: a ratio that compares the measurements used in a scale drawing with the actual measurements.

Solve.

M 4 Trevor makes a scale drawing of a doghouse that he is building. The scale he uses is 1 in. : 0.4 ft. What is the actual area of the floor of the doghouse if the dimensions on the scale drawing are 8 in. by 10 in?

Show your work.

Possible work:

\[
\begin{align*}
1 \text{ in.} & = 8 \text{ in.} \\
0.4 \text{ ft} & = 10 \text{ in.}
\end{align*}
\]

\[
\begin{align*}
1 \times 8 & = 8 \\
0.4 \times 10 & = 4
\end{align*}
\]

The doghouse is 3.2 feet wide and 4 feet long. The area is \(3.2 \times 4 = 12.8\) square feet.

Solution: 12.8 square feet

M 5 Juanita says that a scale of 1 in. : 0.4 ft is equivalent to the ratio 6 in. : 2.4 ft. Do you agree? Explain why or why not.

I agree. Possible explanation: I can multiply 1 by 6 to get 6, and when I multiply 0.4 by 6, I get 2.4 so I know the scales are equivalent.

6 centimeters

1 centimeter

5 meters

\(x\) meters

A car is 12.8 feet long. Jane uses a scale of 1 in. : 2 ft to make a model of the car. How long is her model?

\[
\begin{align*}
1 \text{ in.} & = x \text{ in.} \\
2 \text{ ft} & = 6.4 \text{ in.}
\end{align*}
\]

Solution: 6.4 inches long.

M 7 Miko drew this scale drawing of two famous landmarks. Miko used a scale of 1 in. : 400 ft. Use equations to find the actual heights of the two structures. What is the approximate difference in their heights?

Show your work.

Answers should be close to the following heights.

Eiffel Tower: \(400 \times 1.5 = 600\) ft

Space Needle: \(400 \times 1 = 400\) ft

Solution: about 500 ft
Lesson 22

Redraw a Scale

Study the example showing how to redraw a scale drawing using a different scale. Then solve problems 1–9.

Example
Heather uses centimeter grid paper to draw a scale diagram of her garden. Her real garden is 32 meters by 48 meters and Heather uses a scale of 1 cm : 8 m. Heather needs a smaller scale drawing, so she changes the scale to 1 cm : 16 m. Now each centimeter represents 16 meters, not 8 meters.

1. Calculate the dimensions of the garden using the scale 1 cm : 16 m. Are the dimensions the same as they were using the scale 1 cm : 8 m?
   - 3 cm represents 48 m and 2 cm represents 32 m, so the dimensions are the same.

2. How do the side lengths of Heather’s new scale drawing compare to the side lengths of the original scale drawing? How can you compare the scales she used to explain this relationship?
   - The lengths in the new drawing are half the lengths in the original drawing because the new scale represents a distance that is twice as long as in the old scale.

3. You can also change the scale on a scale drawing to make the representation larger. Draw Heather’s garden using a scale of 1 cm : 4 m.

4. Would a scale drawing of a door with a scale of 1 in. : 3 ft be longer or shorter than a scale drawing of the same door with a scale of 1 in. : 6 ft? Why?
   - Longer because the new scale represents a distance that is half as long as in the old scale.

5. Solve.
   - Diagrams A and B are scale drawings of the same field. Each square is 1 centimeter long. If the scale of diagram A is 1 cm : 24 ft, what is the scale of diagram B?
   - If 1 cm : 24 ft, then 1 cm : 72 ft

6. What is the area of the actual field represented in problem 5? How did you find your answer?
   - 41,472 square feet; Possible explanation: I used scale drawing B to find that the length is 288 ft and the width is 144 ft, so the area is \(\frac{288 \times 144}{2} = 41,472\) square feet.

7. Jermaine draws a scale drawing of a porch on a grid with 1-centimeter squares. His drawing is a rectangle that is 6 cm by 9 cm, and he used the scale 1 cm : 4 ft. On this grid, redraw the scale drawing using a scale of 1 cm : 6 ft. Then find the actual area of the porch.
   - The porch is 36 ft long and 24 ft wide:
   - \(\frac{36}{24} = 1.5\) ft.

8. Anna designs model planes. Her latest scale drawing has a scale of 1 in. : 24 in. In this drawing, the wing of a plane is 4 inches long. For an advertisement, Anna has to make a larger drawing. In this drawing, the wing of the plane is 10 inches long.
   - a. What is the actual length of the wing in feet? Explain.
      - 8 ft; Possible explanation: \(\frac{4}{24} = \frac{1}{6} \times 96\) in., or 8 ft
   - b. What scale did Anna use on the advertisement drawing?
      - Possible answer: \(\frac{1}{6}\) in. ; 9.6 in.

9. Arty says that if you change a scale so that a unit represents a longer distance than in an original scale, then the lengths in the new scale drawing will be longer. Do you agree? Give an example of a scale and some measurements to support your answer.
   - No; Possible answer: If a scale changes from 1 in. : 4 ft to 1 in. : 8 ft, then the measurements in the new scale drawing will be half as long. A length of 2 inches in the original scale drawing will be a length of 1 inch in the new scale drawing.
Lesson 22

Scale Drawings

Solve the problems.

1. Sara uses a scale of 1 cm : 12 m to draw a floor plan of a new store. She has to redraw the drawing so that it is larger for her presentation. Could Sara use the following scales? Select Yes or No for each scale.
   - a. 1 cm : 8 m
   - b. 1 cm : 20 m
   - c. 2 cm : 24 m
   - d. 3 cm : 15 m
   - Solution:
     - a. Yes
     - b. No
     - c. No
     - d. No

2. Gregory draws a scale drawing of his room. The scale that he uses is 1 cm : 4 ft. On this drawing, the room is 3 centimeters long. Which equation can be used to find the actual length of Gregory’s room?
   - a. \( \frac{1}{3} = \frac{x}{4} \)
   - b. \( \frac{x}{3} = \frac{1}{4} \)
   - b. \( \frac{x}{4} = \frac{1}{3} \)
   - d. \( \frac{1}{3} = \frac{x}{4} \)
   - Rob chose option B as the correct answer. What did he do wrong?
   - Possible answer: He forgot that both ratios should compare centimeters to feet.

3. Jon planned a bicycle ride for several of his friends. On his map, 1 inch represents 2.5 miles of actual distance. Which statements are true? Select all that apply.
   - a. The scale of the map is 1 in : 2.5 mi.
   - b. A distance of 50 miles on the ride is represented by 20 inches on the map.
   - c. Every 20 miles of the ride is represented as 2.5 inches on the map.
   - d. A distance of 5 inches on the map represents 15 miles on the ride.
   - Solution:
     - Possible answer: The actual ladybug is 18 mm long.

4. The scale used to make a scale model of a volcano is 5 cm : 250 m. The height of the actual volcano is about 1,325 meters. How tall is the model?
   - a. 26.5 cm
   - b. 265 cm
   - c. 53 m
   - d. 26.5 m
   - Solution:
     - Write an equation to relate the ratios.

5. Petra wants to represent a distance of 400 miles on a piece of notebook paper that is 8.5 inches wide and 11 inches long. She wants to use a scale of 1 in : 20 mi. How are equivalent ratios used to create scales?
   - a. Can Petra make this scale drawing? Why or why not?
     - No; Possible explanation: With a scale of 1 in : 20 mi, a distance of 400 mi would be too large to fit on the paper. Accept any scale in which 1 in represents at least 36.3 mi, such as 1 in : 40 mi.
   - b. Give an example of a scale that Petra could use. Use the form of 1 in : \( \frac{mi}{5} \).

6. A science museum has a scale model of a ladybug. In the model, 9 millimeters represents 9 millimeters. The length of the model is 1 meter. How long is the actual ladybug?
   - Show your work.
   - Possible solution:
     - 50 cm = 100 cm
     - 9 mm = \( \frac{9}{10} \times \frac{mm}{cm} \)
     - \( 5 \times \frac{9}{10} = \frac{18}{10} \)
   - Solution: The actual ladybug is 18 mm long.