Draw a Line Through It

Your Challenge

What pattern do you notice when you plot the ordered pairs that represent equivalent ratios on a graph?

➤ **Use graphing technology to explore patterns in equivalent ratios in the coordinate plane.***

a. Open the graphing technology program.

b. Plot the ordered pairs from the table on a graph.

c. Determine which ordered pairs represent equivalent ratios. Use a different color point for each set of equivalent ratios.

1. How many different colors did you use on your graph? How did you find the equivalent ratios?

d. Draw line segments through pairs of equivalent ratios. Start each line segment at the ordered pair in a set of equivalent ratios that is closest to the origin. End the line segment at the ordered pair in a set that is farthest from the origin.

2. What do you notice about the equivalent ratios and the line segments?

x	*y*
2	3
2	4
3	3
3	4
3	5
6	6
6	8
6	9
6	10
6	12
7	7
8	12
8	16
9	12
9	15
10	10
10	20
12	18
12	20
12	24
14	14
15	20
15	25
16	24
18	24

*** You may need to adjust the steps depending on which graphing program you use. If needed, use Help or Support menus or online tutorials.**

Draw a Line Through It

e. Use the graph to determine if ratios are equivalent.

3 Niko says that the ratio 12 : 15 is equivalent to the ratio 18 : 24. Is he correct?

4 How can you use your graph to check your answer to problem 3?

f. Explore the point (0, 0).

5 Sheila wants to know if any of the lines will go through the origin, (0, 0). She says she can use division to find out. What mistake did Sheila make?

6 Describe two different ways Sheila could find out if any lines will go through the origin.

7 Which of the lines, if any, go through the origin? Explain your answer.

Spin Doctor

Your Challenge

➤ **Your company is designing 20 new wind turbines for a wind farm. You need to determine how many blades your turbines should use to get the most energy from each turbine. Here is the information you know so far:**

- Each blade will be 60 meters long.
- The tip of a blade travels 376.8 meters in one revolution.
- The blades can spin at a rate between 12 and 15 revolutions per minute.
- The wind usually blows between 40 and 70 miles per hour.
- There are about 1,609 meters in 1 mile.
- There are 60 minutes in 1 hour.

To select the number of blades, you need to calculate the Tip Speed Ratio (TSR). The TSR is the ratio of the tip speed to the wind speed. You calculate the value of the TSR by dividing the tip speed of the blade by the wind speed.

$$\text{TSR} = \frac{\text{Tip Speed}}{\text{Wind Speed}}$$

The table shows the ideal TSR for turbines with different numbers of blades. The closer you are to the ideal TSR, the more energy you will get from your wind turbine.

Number of Blades	Ideal TSR
2	6.28
3	4.19
4	3.14
6	2.09

To calculate the TSR, the tip speed and the wind speed must be in the same units. For example, they could both be in meters per hour. To find the TSR, you need to find the tip speed. The tip speed is the rate that the tip of the blade travels in one revolution.

$$\text{Tip Speed} = \frac{\text{distance of one revolution}}{\text{time for one revolution}}$$

Use this information to answer the questions on the next page.

Spin Doctor

1. Start by finding the time for one revolution. Choose a rate of spin between 12 and 15 revolutions per minute. How many minutes does it take a blade to make one revolution?

2. What is the tip speed in meters per minute? What is the tip speed in meters per hour? Show your work.

3. Choose a wind speed between 40 and 70 miles per hour. Convert the wind speed to meters per hour. Show your work.

4. What is the TSR for your tip speed and wind speed? Round to the nearest hundredth. Show your work.

5. How many blades should your turbines use? Explain your reasoning.

Display Time

Your Challenge

➤ **You are in charge of designing the display screen for a color printer. The customers want a printer that displays the percent of ink left in each ink cartridge. You start by adding a sensor to the printer that can tell the volume of ink in each cartridge. The table shows how much ink each cartridge holds when full.**

Your job is to write formulas that the printer can use to display the volume of ink in each cartridge as a percent.

Ink Color	Volume (mL)
Black	14.0
Cyan	7.5
Magenta	8.0
Yellow	9.0

1. What formula could you use to display the volume of black ink as a percent?

2. What formula could you use to display the volume of cyan ink as a percent?

3. What formula could you use to display the volume of magenta ink as a percent?

4. What formula could you use to display the volume of yellow ink as a percent?

5. The volumes of the inks for one printer are shown below. What percents would be displayed on this printer? If necessary, round to the nearest whole number.

   black: 8 mL cyan: 2 mL magenta: 6 mL yellow: 1.8 mL