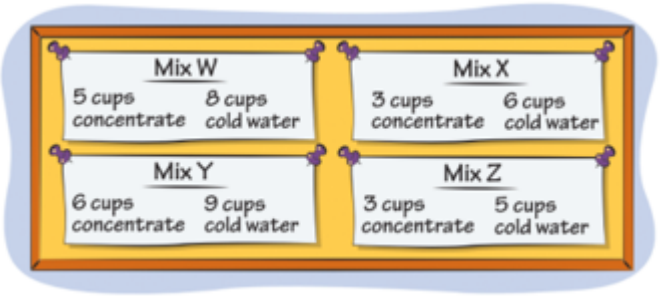
Comparing and Scaling
Applications-Connections-Extensions
With Answers & Problem Correlations

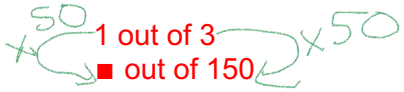
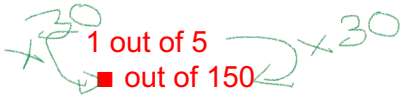
Investigation 1

	Applications	Connections	Extensions	Total
1.1	4	4	3	11
1.2	6	4	2	12
1.3	4	5	2	11
Total	14	13	7	34

Probl	Exercise and Answer	CMP4 Problem	Note
1	Compare these four mixes for apple juice.  Which mix would make the most "appley" juice? Explain your reasoning. Mix Y is the most appley given it has the highest concentrate-to-juice ratio. The ratios of concentrate to juice are the following: Mix W = 5 : 13, Mix X = 3 : 9, Mix Y = 6 : 15, and Mix Z = 3 : 8.	1.1	
2	Examine these statements about the apple juice mixes in Exercise 1. Decide whether each is accurate. Give reasons for your answers. Mix Y has the most water per batch, so it will taste the least "appley". Not accurate since both water and concentrate contribute to the least appley taste. A mix with 9 cups of water that had 1 cup of concentrate would taste much less appley. Mix Z is the most "appley" because the difference between the concentrate and water is 2 cups. It is 3 cups for each of the others. Not accurate. Mix Y is the most appley. Also, being the most appley is not	1.1	

	dependent on the difference between the two ingredients, but on the fraction or percent of concentrate of the total cups of liquid. Mix Y is the most "appley" because it has only $1\frac{1}{2}$ cups of water for each cup of concentrate. The others have more water per cup. Accurate. Mix Y is the most appley because it has the greatest ratio of concentrate to water. Mix X and Mix Y taste the same because you just add 3 cups of concentrate and 3 cups of water to turn Mix X into Mix Y. Not accurate. The taste is determined by the ratio of concentrate to water. Since Mix Y has more concentrate per cup of water, it will have the most appley taste.		
3	If possible, write each comparison of concentrate to water as a ratio. If not possible, explain why. a. The mix is 60% concentrate 6 : 4 (or 3 : 2) b. The fraction of the mix that is water is $\frac{3}{5}$ 2 : 3 c. The difference between the amount of concentrate and water is 4 cups. Not possible. This is discussing difference and to make a ratio, one would also have to know one of the amounts. Differences can be the same even when ratios between two quantities are different.	1.1	
4	The 7th grade students at Neilson Middle School are planning an end - of- year event. Of the 150 students in the school, 100 would like an athletic event and 50 would like a concert. Several students rewrote this information in the statements below. 1. Does each statement accurately report the results of the Neilson Middle School survey? Why? 2. Which of these statements represent ratios? Explain why or why not. Uno's Statement Dalawa's Statement San's Statement	1.1	

	At Neilson Middle School, $^1/_3$ of the students prefer a concert to an athletic event. Apat's Statement Then number of students who prefer an athletic event is 50 more than the number who prefer a concert. For every 2 students who prefer an athletic even, 1 student prefers a concert. Tano's Statement The number of students who prefer an athletic event is two times the number who prefer a concert. The unit rate of students who prefer a concert to students who prefer an athletic event is 1 to 2. Che's Statement At Neilson Middle School, 50% of the students prefer a concert to an athletic event. Statement 1: Yes. The total number of students is 150 and 50 of those students prefer a concert , $\frac{50}{150} = \frac{1}{3}$ Statement 2: Yes. 100 students prefer and athletic event and 50 prefer a concert which is the ratio of 100 : 50 and it is equivalent to the ratio of 2:1. Statement 3: Yes. 50 students prefer a concert and 100 students prefer and athletic event with is the ratio of 50:100. As a unit rate this would be 1:2. Statement 4: Yes. 100 – 50 = 50. Statement 5: Yes 50 students prefer a concert and 50 x 2 = 100 which is the number of students that prefer an athletic event. Statement 6: No. The total students are 150. 50 out of 150 students prefer a concert. $\frac{50}{150} = \frac{1}{3}$ which is ~ 33% not 50%. Statement 1 is a part to whole ratio. Statement 2 is a part to part ratio. Statement 3 is a part to part ratio. Statement 4 is a difference statement. Statement 5 is a scaling statement. Statement 6 is a part to whole ratio.		
5	The 150 students at Neilson Middle School were surveyed about the time for school lunch. The principal reported the results with the following ratios: 3 out of 5 students wanted lunch earlier in the day 1 out of 3 students wanted lunch to remain the same 1 out of 5 students wanted lunch later in the day a. Use the data to determine how many students responded to each time slot for lunch. b. Write a comparison statement about the survey. a. 3 out of 5	1.2	

	■ out of 150 **90 students**  **50 students**  **30 students** b. Answers will vary. Some possible statements: 3 times as many students want an earlier lunch than a later lunch. Ratio of students that want a later lunch to lunch staying the same is 30 to 50. Ratio of student wanting an earlier lunch to a later lunch is 3 to 1.		
	A can of concentrated grapefruit juice includes the instructions: **Mix one can of concentrate with 4 cans of cold water.** **For exercises #6 - 10 use those mixing instructions.**		
6	Write a ratio for each situation. Then decide whether the situation is part-to-part or part-to-whole. a. Water to concentrate 4 : 1, part-to-part b. Concentrate to juice 1 : 5, part-to-whole c. Water to juice 4 : 5, part-to-whole	1.2	
7	Determine which of the situations described in Exercise 6 can be represented by the following ratios. Explain your reasoning. a. 12 to 60 Ratio of concentrate to juice b. $\frac{3}{12}$ Ratio of concentrate to water c. 2 : 2 ½ Ratio of water to juice	1.2	

	d. $\frac{5}{10}$ This fraction does not represent a ratio from this situation		
8	Jonathan and Samantha are making grapefruit juice from concentrate for a carnival. Jonathan mixes 10 cans of concentrate with 40 cans of water. Samantha mixes 8 cans of concentrate with 32 cans of water. Their teacher asks them to combine the two mixes into one large container. Is the new mixture less "grapefruity", more "grapefruity" or the same as the original recipe? Explain your reasoning. The mixture will be the same as the original. Because the original two mixtures were the same ratio as the original mixing instructions, adding these two batches together will result in the same ratio. Interestingly, fractional notation may cause some difficulty if students consider this problem as $\frac{1}{4} + \frac{1}{4}$ instead of $\frac{(10+8)}{(32+40)} = \frac{1}{4}$.	1.2	
9	Find the missing value in each situation. State the scale factor you used. a. 24 cans concentrate: ■ cans water Scale Factor is 24; 4 × 24 = 96 cans of water. b. 24 cans concentrate : ■ cans juice Scale Factor is 5; 24 × 5 = 120 cans of juice. c. 24 cans juice : ■ cans water Scale Factor is $\frac{24}{5}$= 4.8; 4.8 × 4 = 19.2 cans of water. d. 24 cans juice : ■ cans concentrate Scale Factor is $\frac{24}{5}$= 4.8; 4.8 × 1 = 4.8 or $4\frac{4}{5}$ cans of water.	1.2	
10	Raina, Amelia, and Krista wanted to find the number of cans of concentrate they would need if they used 128 cans of water. They knew the problem they were trying to solve was $\frac{1}{4} = \frac{x}{128}$. Which of the following strategies would work? Explain.	1.2	

	Raina's Strategy I was looking for $\frac{1}{4}$ of 128. I took 128 and divided it by 4 to find the value of x. $x = 32$ **Amelia's Strategy** I wrote a series of equivalent fractions by doubling the numerator and denominator. $\frac{1}{4} = \frac{2}{8} = \frac{4}{16} = \frac{8}{32} = \frac{16}{64} = \frac{32}{128}$ so $x = 32$ **Krista's Strategy** I factored the denominator of the right side of the equation to determine x. $\frac{1}{4} = \frac{x}{128} = \frac{1 \cdot 1 \cdot 8}{4 \cdot 4 \cdot 8}$ Raina's strategy works. 32 : 128 is equivalent to 1 : 4. Amelia's strategy works. She is simply applying a scale factor of 2 at each step. Krista's strategy is incorrect. This fraction would be $\frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{64} \neq \frac{1}{4}$		
11	Jared and Pedro walk 1 mile in 15 minutes. They can keep up this pace for several hours. a. About how far can they walk in 90 minutes? 6 miles; Using a proportion $\frac{15}{1} = \frac{90}{x}$ The scale factor is 6. b. About how far can they walk in 65 minutes? About 4.3 miles; The scale factor is $\frac{13}{3}$, or 4.333	1.3	
12	Swimming $\frac{1}{4}$ of a mile uses about the same number of calories as running 1 mile. a. Gilda ran a 26 mile marathon. About how far would her sister have to swim to use the same number of calories Gilda used during the marathon? 6.5 miles: using a proportion, $\frac{0.25}{1} = \frac{x}{26}$. The scale factor is 26. b. Juan swims 5 miles a day. About how many miles would he have to run to use the same number of calories used during his swim?	1.3	

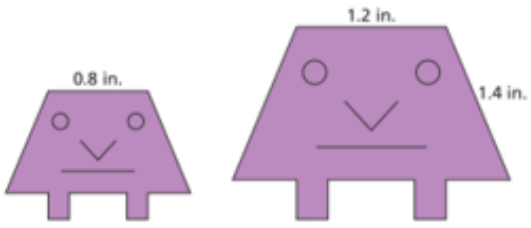
	20 miles; using a proportion $\frac{0.25}{1} = \frac{5}{x}$. The scale factor is 20.		
13	After testing many samples, an electric company determined that approximately 2 of every 1,000 light bulbs on the market are defective. Americans buy more than 1 billion light bulbs every year. Estimate how many of these bulbs are defective. About 2,000,000; Using equivalent fractions, $\frac{2}{1{,}000} = \frac{x}{1{,}000{,}000{,}000}$. The scale factor is 1 million.	1.3	
14	The organizers of an environmental conference order buttons for the participants. They pay $18 for 12 dozen buttons. Write and solve proportions to answer each question below. (Assume that the price is proportional to the size of the order.) a. How much do 4 dozen buttons cost? $6; $\frac{\$18}{12\ dozen} = \frac{x}{dozen}$. The scale factor is $\frac{1}{3}$. 18 x $\frac{1}{3}$ = 6. b. How much do 50 dozen buttons cost? $75; $\frac{\$18}{12\ dozen} = \frac{x}{12\ dozen}$. The scale factor is $\frac{25}{6}$. 18 x $\frac{25}{6}$ = 75. c. How many dozens of buttons can the organizers buy for $27? 18 dozen; $\frac{\$18}{12\ dozen} = \frac{\$27}{x}$. The scale factor is 1.5. 12 x 1.5 = 18. d. How many dozens of buttons can the organizers buy for $63? 42 dozen; $\frac{\$18}{12\ dozen} = \frac{\$63}{x}$. The scale factor is 3.5. 12 x 3.5 = 42.	1.3	

Connections

Problem #	Exercise and Answer	CMP4 Problem #	Note
15	In a taste test of new ice creams invented at Moo University, 750 freshmen preferred Cranberry Bog ice cream, while 1,250 freshmen preferred Coconut Orange ice cream. Complete each statement below: a. The fraction of freshmen who preferred Cranberry Bog is _____. $\frac{750}{2{,}000}$ or $\frac{3}{8}$ b. The percent of freshmen who preferred Coconut Orange is ■.	1.1	

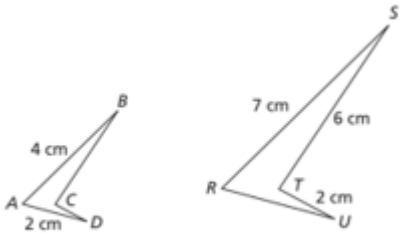
	62.5%; Here students need to recognize that the fraction they need is $\frac{5}{8}$, and $5 \div 8 = 0.625$. c. The ratio of freshmen preferring Coconut Orange to those who preferred Cranberry Bog was ■ to ■. 5 to 3 OR 1,250 to 750		
16	The Business Club at Neilson Middle School is studying surveys and other marketing strategies. One of the surveys is about people's preferences for two different kinds of cola. Club members have various opinions about ways to report the results from the cola taste test. Here are four statements about the cola taste-test results. **Daya's Statement** In a taste test, people who preferred Bolda Cola outnumbered those who preferred Cola-Nola by a ratio of 17,139 to 11,426. **Deux's Statement** In a taste test, 5,713 more people preferred Bolda Cola. **Tres's Statement** In a taste test, 60% of the people preferred Bolda Cola. **Shi's Statement** In a taste test, people who preferred Bolda Cola outnumbered those who preferred Cola-Nola by a ratio of 3 to 2. • Which statement(s) do you think would be best in an advertisement for Bolda Cola? Why? • Do the statements represent ratios? Explain why or why not. • Suppose you surveyed 1,000 cola drinkers. What numbers of Bolda Cola and Cola-Nola drinkers would you expect? Explain your reasoning • Is it possible that all four statements accurately represent the same survey data? Explain. Yes, it is possible that all four statements represent the same survey data. The ratio of 17,139 to 11,426 (which have a difference of 5,713) can be approximated as 3 to 2, which is equivalent to 60% of the people surveyed choosing Bolda Cola over Cola-Nola. Notice that 60% = $\frac{3}{5}$ not $\frac{3}{2}$ It is important to keep asking whether we are comparing part-to-part or part-to-	1.1	

	whole in a given situation. Part-to-part ratios and part-to-whole ratios are explored further in Problem 1.3. The ratio 3 to 2 or the 60% might be the most effective advertisements because the numbers are smaller and easier to relate to. You can easily use the ratio of 3 to 2 to predict what you would expect preferences to be in your class or in some other group of people. Or, the greater numbers may make a more powerful impression; the difference between 3 and 2 is only 1, while the difference between17,139 and 11,426 is 5,713. Statement 2 reports the difference in numbers between the two groups of people. We can't tell how many people were surveyed or how many people preferred Cola Nola. We only know that 5,713 more people prefer Bolda Cola so it is not a ratio. Statement 3 means that 60% of the sample chose Bolda Cola as their preference. 60% means that if there were 100 people, 60 would prefer Bolda Cola this is a part to whole ratio. 600 people would prefer Bolda Cola and 400 would prefer Cola Nola. Using Statement 3 students could find that 60% of 1,000 is 600. Using Statement 4 students could use the 3 to 2 part to part ratio and change it to 3 to 5 a part to whole ratio and then scale it up: $\frac{3}{5} = \frac{600}{1000}$. Using Statement 1, students could change the part to part ratio of 17,139 to 11,426 to a part to whole ratio and then scale it down: $\frac{17,139}{28,565} = \frac{600}{1000}$.		
17	In a comparison taste test of two juice drinks, 780 people preferred Cranberry Blast. Only 220 people preferred Melon Splash. Complete each statement. a. There were ■ more people who preferred Cranberry Blast. 560 b. In the taste test, ____% of the people preferred Cranberry Blast. 8% c. People who preferred Cranberry Blast outnumbered those who preferred Melon Splash by a ratio of ■ to ■. 39 to 11 (or 780 to 220)	1.1	
18	A town is debating whether to put in curbs along the streets. The ratio of town residents who support putting in curbs to those who oppose it is 2 to 5. a. What fraction of the residents oppose putting in curbs? $\frac{5}{7}$ b. If 210 people in the town are surveyed, how many do you expect to favor putting in curbs? 60 people c. What percent of the residents oppose putting in curbs? about 71% (71.429%)	1.1	

19	Orlando and Tanya are experimenting with different grapefruit mix ratios. Determine whether each mix below will result in a more concentrated (more "grapefruity") or a less concentrated (less "grapefruity") mix than the original mix instructions of "Mix one can of concentrate with 4 cans of cold water." Mix A: 3 cans concentrate : 15 cans water Mix B: 3 cans concentrate : 15 cans juice Mix C: 10 cans cold water : 7 cans concentrate Mix D: $\frac{1}{4}$ can concentrate : $1\frac{1}{2}$ cans water Mix A: Less concentrated (less grapefruity); Using the original mix, and scaling by 3, three cans of concentrate should be mixed with 12 cans of water. So, 15 cans of water makes the mix more watered down. Mix B: The same concentration as the original; As stated in part (a), 12 cans of water plus 3 cans of concentrate would give 15 cans of juice. Mix C: More concentrated (more grapefruity); Using the original mix and scaling by 2.5, 10 cans of water should be mixed with 2.5 cans of concentrate. Students might say the same concentration if they are mistakenly thinking of scaling as additive, that is, adding 6 cans of water and 6 cans of concentrate will give the same concentration. If students say this, you can point out that the ratio of concentrate to water in Mix C is over $\frac{1}{2}$, but the original is less than $\frac{1}{2}$. Mix D: Less concentrated (less grapefruity); Using a scale factor of $\frac{1}{4}$, $\frac{1}{4}$ can of concentrate should be mixed with 1 can of water.	1.2	
	The sketches below show two members of the Grump family. The Grumps are geometrically similar. **Use the figures for Exercises # 20-22.** 		

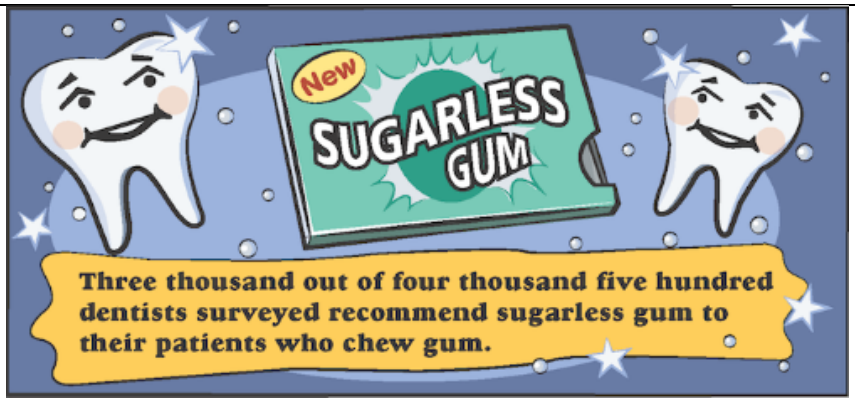
20	Write statements comparing the lengths of corresponding segments in the Grumps. Use each concept at least once. a. Ratio The ratio of the lengths of the top sides of the two Grumps is 0.8 to 1.2 or 2 to 3. b. Fraction Since they are similar, any side of the small Grump is $\frac{2}{3}$ the length of the corresponding side of the larger Grump. c. Percent The top side of the small Grump is about 67, of the length of the top side of the larger Grump. d. Scale Factor The scale factor from the small Grump to the large Grump is 1.5.	1.2	
21	How long is the segment in the smaller Grump that corresponds to the 1.4 inch segment in the larger Grump? 0.93 in.; Possible explanations: The scale factor is 1.5. Therefore, 1.4 ÷ 1.5 ≈ 0.93; or the scale factor is $\frac{2}{3}$; $\frac{2}{3}$ of 1.4 ≈ 0.93.	1.2	
22	**Multiple Choice** The mouth of the smaller Grump is 0.6 inches wide. How wide is the mouth of the larger Grump? **A.** 0.4 in. **B.** 0.9in. **C.** 1 in. **D.** 1.2in. B (0.6 times the scale factor of 1.5 equals 0.9.)	1.2	
23	Find a value that makes each sentence correct. Explain your reasoning in each case. a. $\frac{3}{4} = \frac{\_\_}{12}$ 9; The scale factor is 3 (12 ÷ 4 = 3 and 3 × 3 = 9). b. $\frac{3}{4} < \frac{\_\_}{12}$ 10; The numerator must be greater than 9 because $\frac{9}{12} = \frac{3}{4}$ c. $\frac{3}{4} > \frac{\_\_}{12}$	1.3	

	8; $\frac{9}{12} = \frac{3}{4}$, so the numerator must be less than 9 d. $\frac{9}{12} = \frac{12}{\quad}$ 16; The scale factor is $\frac{4}{3}$ ($12 \div 9 = \frac{4}{3}$ and $\frac{4}{3} \times 12 = 16$).		
24	**Multiple Choice** Choose the value that makes this proportion $\frac{18}{32} = \frac{\quad}{16}$ correct. A. 7 B. 8 C. 9 D. 10	1.3	
25	**Multiple Choice** Choose the value that makes $\frac{\quad}{30} \leq \frac{6}{20}$ correct. A. 9 B. 10 C. 11 D. 12	1.3	
26	Students at Neilson Middle school were asked to record how they spend their time from midnight on Friday to midnight on Sunday. This is Carlos' record of how he spent his weekend. **Weekend Activities** Activity / Number of Hours Sleeping: 18 Eating: 2.5 Sports: 8 Internet: 2 Watching Television: 6 Homework: 2 Other: 9.5 Decide whether each statement is an accurate description of how Carlos spent his time that weekend. Explain your reasoning.	1.3	

	a. Carlos spent one-sixth of his time watching television. No, $\frac{6\ hours\ of\ tv}{48\ hours\ total} \neq \frac{1\ hour\ tv}{6\ hours\ total}$ b. The ratio of hours spent watching television to hours spent doing chores or homework was 3 to 1. Yes, 6 : 2 = 3 : 1. c. Sports, internet, and watching television took about 33% of his time. Yes, 8 + 2 + 6 = 16 and $\frac{16}{48} \approx 0.333$, or 33%. d. Time spent doing homework was only 20% of the time spent watching television. No, $\frac{2}{6} \approx 0.333$, $0.333 \approx 33\% \neq 20\%$. e. Sleeping, eating, and "other" activities took up 12 hours more than all other activities combined. Yes, 18 + 2.5 + 9.5 = 30; 48 – 30 = 18; 30 – 18 = 12.		
27	The polygons below are similar  a. What is the length of side BC? Explain your reasoning. *BC* ≈ 3.42. Possible strategies: $\frac{BC}{4} = \frac{6}{7}$ *BC* = $\frac{6}{7} \times 4 \approx 3.42$. $\frac{7}{6} = \frac{4}{BC}$ The scale factor is about 0.57. $0.57 \times 6 = 3.42$. b. What is the length of side RU? Explain your reasoning. *RU* = 3.5. Possible strategies: $\frac{RU}{7} = \frac{2}{4}$. *RU* = $\frac{2}{4} \times 7 = 3.5$. $\frac{4}{2} = \frac{7}{RU}$ The scale factor is 1.75. $1.75 \times 2 = 3.5$. c. What is the length of side CD? Explain your reasoning. *CD* ≈ 1.14. Possible strategies: $\frac{CD}{4} = \frac{2}{7}$ *CD* = $\frac{2}{7} \times 4 \approx 1.14$. The scale factor is about 0.57. $0.57 \times 2 = 1.14$.	1.3	

Extensions

Problem #	Exercise and Answer	CMP4 Problem #	Note
28	A fruit bar is 5 inches long. The bar will be split into two pieces. For each situation, find the lengths of the two pieces. a. One piece is $\frac{3}{10}$ of the whole bar One piece will be 1.5 inches, and the other will be 3.5 inches. A ratio of 3 : 7 also means that one piece will be 0.3 of the fruit bar and the other piece will be 0.7 of the fruit bar. Thus, 0.3 × 5 = 1.5 and 0.7 × 5 = 3.5. b. One piece is 60% of the bar. One piece will be 3 inches long, and the other will be 2 inches long (60% = 0.6, 0.6 × 5 = 3). c. One piece is 1 inch longer than the other. One piece will be 3 inches long, and the other will be 2 inches long.	1.1	
29	Exercise # 28 includes several numbers or quantities: 5 inches, $\frac{3}{10}$, 60%, and 1 inch. Determine whether each number or quantity refers to the whole, a part, or the difference between two parts. The 3 in the numerator in part (a) and the 60, in part (b) each represent a part; the 5 inches in the problem text and the 10 in the denominator in part (a) represent a whole; and 1 inch in part (c) represents the difference between parts. **For the Teacher** Discuss what techniques students used to arrive at each of the answers. Which part was easiest to answer? Which way of phrasing the question (in terms of fractions, ratios, percents, differences) made the most sense for solving these problems?	1.1	
30	Rewrite this ad so that it will be more effective.		



1.1

Possible answer: About 67% of dentists recommend sugarless gum to their patients who chew gum. 2 out of 3 dentists recommend sugarless gum to their patients who chew gum.

31

The United States uses the English system of measurement. The English system has many old conversions that are rarely used.

English System Measurement Conversions

1 foot = 12 inches	1 furlong = 220 yards	1 rod = 5.5 yards
1 yard = 3 feet	1 furlong = 10 chains	1 yard = 16 nails
1 mile = 5,280 feet	1 furlong = 1,000 links	1 foot = 4 palms
1 mile = 1,760 yards	1 furlong = 40 rods	1 foot = 3 hands

Use the measurement conversions to complete the table below.

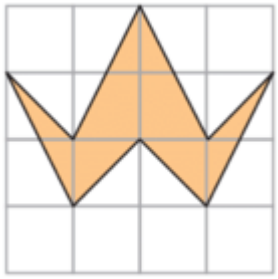
Time Predictions

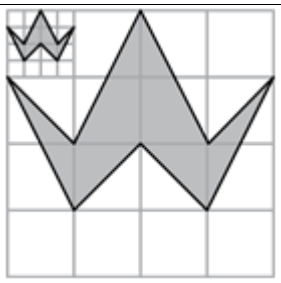
	Distance and Time	Prediction
a.	1,584 feet in 3 minutes	1 mile in ■
b.	2 furlongs in 10 minutes	1 mile in ■
c.	1,500 links in 12 minutes	1 mile in ■
d.	4 rods in 11 seconds	1 mile in ■
e.	5 chains in 1 minute	1 mile in ■

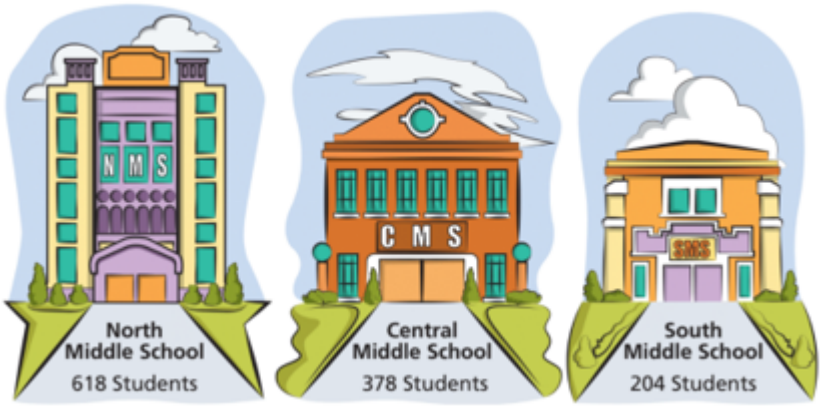
a. $\frac{1{,}584\ feet}{3\ minutes} = \frac{5{,}280}{}$ using a scale factor of 3.33… to get **10 minutes**

b. 2 furlongs would be 440 yards; $\frac{440\ yards}{10\ minutes} = \frac{1{,}760\ yards}{}$ using a scale factor of 4 to get **40 minutes**

1.2

	c. $\frac{1\ furlong}{1{,}000\ links} = \frac{\quad}{1{,}500\ links}$; 1.5 furlongs; $\frac{1\ furlong}{220\ yards} = \frac{1.5\ furlong}{\quad}$; 330 yards; $\frac{330\ yards}{12\ minutes} = \frac{1{,}760\ yards}{\quad}$ using a scale factor of 5.33… to get **64 minutes** **d.** $\frac{1\ furlong}{40\ rods} = \frac{\quad}{4\ rods}$; 0.1 furlongs; $\frac{1\ furlong}{220\ yards} = \frac{.1\ furlong}{\quad}$; 22 yards $\frac{22\ yards}{11\ seconds} = \frac{1{,}760}{\quad}$ using a scale factor of 80 to get **880 seconds** **e.** $\frac{1\ furlong}{10\ chains} = \frac{\quad}{5\ chains}$; 0.5 furlongs; $\frac{1\ furlong}{220\ yards} = \frac{.5\ furlong}{\quad}$; 110 yards $\frac{110\ yards}{1\ minute} = \frac{1{,}760\ yards}{\quad}$ using a scale factor of 16 to get **16 minutes**		
32	The picture below is drawn on a centimeter grid.  a. On a grid made of larger squares than those shown here, draw a figure similar to this figure. What is the scale factor from the original figure to your drawing? Answers will vary. Sample answer: If you think of the small figure as the original, then the large figure is the image drawn on grid paper which scales the original up by a scale factor of 4. b. Draw another similar figure but use a grid of smaller squares than those shown here. What is the scale factor from the original figure to your drawing? Answers will vary. If you think of the large figure as the original, then the small figure is the image drawn on grid paper which scales the original down by a factor of $\frac{1}{4}$.	1.2	

	 c. Compare the perimeters and areas of the original figure and its copy in each case (enlargement and reduction). Explain how these values are related to the scale factor in each case. The perimeter of the similar figures can be found by multiplying the original scale factor by the corresponding scale factor of either the enlargement or the reduction. In the above example, the scale factor for the perimeter of the enlargement is 4 and the scale factor for the perimeter of the reduction is $\frac{1}{4}$. The area of the two similar figures is found by multiplying the area of one figure by the square of the scale factor to determine the area of the other similar figure. In the example above, the scale factor for the area of the enlargement is 4^2 and the area for the reduced figure is $\left(\frac{1}{4}\right)^2$ or $\frac{1}{16}$.		
33	Middletown sponsors a two-day conference for selected middle school students to study government. There are three middle school is Middletown. Suppose 20 student delegates will attend the conference. Each school should be represented fairly in relation to its population. How many should be selected from each school?	1.3	

	 10.3 (10) from North, 6.3 (6) from Central, and 3.4 (4) from South. The total from all schools is 1,200. The fraction of North to total is $\frac{618}{1,200}$, of Central is $\frac{378}{1,200}$, and of South is $\frac{204}{1,200}$. Using proportions $\frac{618}{1,200}=\frac{x}{20}$. The scale factor is $\frac{1}{60}$ $618 \times \frac{1}{60} = 10.3$, $378 \times \frac{1}{60} = 6.3$, and $204 \times \frac{1}{60} = 3.4$.		
34	The people of the United States are represented in Congress, which is made up of the House of Representatives and the Senate. a. In the House of Representatives, the number of representatives from each state varies. From what you know about Congress, how is the number of representatives from each state determined? The number of representatives from each state is determined by the ratio of the population of the state to the population of the United States. Therefore, the greater the population of a state, the more representatives that state will have. **Note:** There is a minimum number of representatives, so small states are still better represented proportionately than large states. b. How is the number of senators from each state determined?	1.3	

	The number of senators is the same for every state, regardless of size or population. It is 2 per state. c. Compare the two methods of determining representation in Congress. What are the advantages and disadvantages of these two forms of representations for states with large populations? How about for state with small populations? With the same number for every state, small states can get an equal say/voice/vote, in terms of the Senate. However, with the method of the House of Representatives, the large states get more representation or voice, thus the Congress would be reflecting the voice of the people.		

Investigation 2

	Applications	Connections	Extensions	Total
2.1	3	3	2	8
2.2	2	4	1	7
2.3	4	4	1	9
Total	9	11	4	24

Applications

Problem #	*Exercise and Answer*	*CMP4 Problem # Correlation*	*Note*
1	Guests at a pizza party are seated at three tables. The small table has 5 seats and 2 pizzas. The medium table has 7 seats and 3 pizzas. The large table has 12 seats and 5 pizzas. The pizzas at each table are shared equally. At which table does a guest get the most pizza? The medium table; at the medium table, each person gets about $\frac{3}{7}$, or 43%, of a pizza. In other words, there are about 2.3 people per pizza. At the small table, each person gets only 40% of a pizza. At the small table, there are 2.5 people per pizza. At the large table, each person gets about $\frac{5}{12}$, or 42%, of a pizza. There are 2.4 people per pizza.	2.1	

2	Suppose a news story about the Super Bowl claims, "Men outnumbered women in the stadium by a ratio of 9 to 5." Haru thinks that this means there were 14 people in the stadium- 9 men and 5 women. Do you agree with Haru? Why or Why not? No. If there were only 14 people, then 9 would have been male and 5 would have been female. It means for every 9 men in the entire stadium, there were 5 females. So if there were 9,000 males, there were 5,000 females. The total of 14 is just the sum of the ratio's terms in simplest form.	2.1	
3	**Multiple Choice** Which of the following is a correct interpretation of the statement "Men outnumbered women by a ratio of 9 to 5"? A. There were four more men than women. B. The number of men was 1.8 times the number of women. C. The number of men divided by the number of women was equal to the quotient of 5 ÷ 9. D. In the stadium, five out of nine fans were women.	2.1	
4	Franky's Trail Mix Factory gives customers the information in the table below. Use the pattern in the table to answer the questions. **Caloric Content of Franky's Trail Mix** Grams of Trail Mix / Calories 50 / 150 150 / 450 300 / 900 500 / 1,500 a. Fiona eats 75 grams of trail mix. How many calories does she eat? 225 Calories; You can scale down the ratio 150 grams of trail mix contains 450 Calories to 75 : 225 by using a scale factor of $\frac{1}{2}$, which means that 75 grams of trail mix contains 225 Calories. b. Rico eats trail mix containing 1,00 calories. How many grams of trail mix does he eat? Approximately 333 grams; The ratio of calories to grams is 3 to 1. An equivalent ratio is 1,000 : 333.33 … Or, 1,000 Calories is $\frac{2}{3}$ of 1,500 Calories,	2.2	

so Rico ate $\frac{2}{3}$ of 500 grams, or about 333 grams.

c. Write an equation to represent the number of calories in any number of grams of trail mix.
number of calories = 3 × number of rams ($C = 3g$)

d. Write an equation to represent the number of grams of trail mix that will provide any given number of calories.
number of grams = number of Calories ÷ 3 ($g = C \div 3$, or $g = \frac{C}{3}$)

5 | 2.2

Carter wants to join a gym. He is looking at two gyms in his neighborhood.

CardioPlus charges $55 per month
Run and Fun charges a $30 sign-up fee and then $50 per month

Which gym do you think Carter should join? Explain your reasoning.

In six months, the price is the same: $330. If Carter is going to stay with the gym longer than 6 months then he should choose Run and Fun. If he plans to quit before the end of 6 months then he should choose CardioPlus.

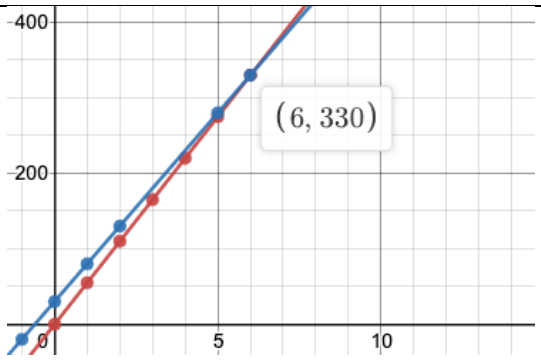
Students might solve this with guess and check, using equations, using a rate table or creating a graph.

CardioPlus

Months	Cost
1	55
2	110
3	165
4	220
5	275
6	**330**

Run and Fun

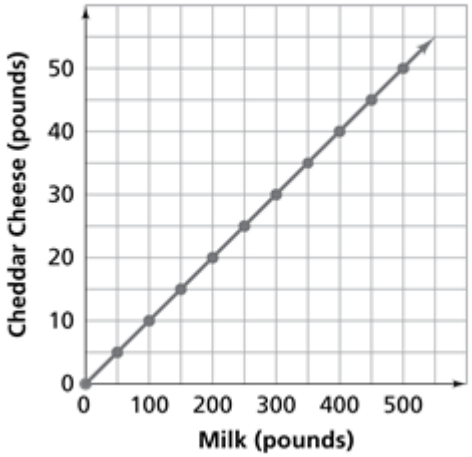
Months	Cost
1	80
2	130
3	180
4	230
5	280
6	**330**

			
6	Mia found oranges on sale at another store instead of the Foodfresh store in Problem 2.3. She wrote the equation C = 0.30N. 1. Does the new store have a cheaper price for oranges? No. The oranges at this new store are $.30 each and they were $.20 each at Foodfresh. 2. How would the graphs and tables compare to the graphs and tables f Foodfresh? Explain your reasoning. The graph for C = 0.30N would be steeper than the graph for C = 0.20N because the rate of change is higher. The table of data for C = 0.30N would have values that were larger that the values in the table for C = 0.20N due to the unit rate (constant of proportionality) being higher.	2.3	
7	The dairy uses 50 pounds of milk to make 5 pounds of cheddar cheese.  a. Make a rate table showing the amount of milk needed to make 5, 10, 15, 20, …, and 50 pounds of cheddar cheese. Answer:	2.3	

Milk Needed to Make Cheddar Cheese

Cheese (pounds)	Milk (pounds)
5	50
10	100
15	150
20	200
25	250
30	300
35	350
40	400
45	450
50	500

b. Graph the relationship between pounds of milk and pounds of cheddar cheese. First, decide which variable should go on each axis.
Answer:



c. Write an equation relating pounds of milk *m* to pounds of cheddar cheese *c.*

$\frac{1}{10}m = c$, or $m = 10c$

d. What is the constant of proportionality in your equation from part (c)?

$\frac{1}{10}$ for the equation $\frac{1}{10}m = c$
10 for the equation $m = 10c$

	e. Explain one advantage of each method (the graph, the table, and the equation) to express the relationship between milk and cheddar cheese production. Possible answers: The graph visually shows the relationship between amounts of milk and cheese. The table allows one to look up how much milk is needed to yield any given amount of cheese. The equation allows for quick calculation of the amount of milk needed for any amount of cheese.		
8	a. Several students wonder which is a better buy, a 40-pack of pencil-top erasers for $2.82 or a 2-pack of pencil-top erasers for $0.12. They use different methods to arrive at an answer. Which of these methods are correct? Which method do you prefer? Explain. **Courtney** Compare the two unit rates to determine which unit rate is cheaper. $\frac{2.82}{40} = \frac{x}{1}$ $x = 0.0705 = \$.07$ per eraser $\frac{0.12}{2} = \frac{x}{1}$ $x = 0.06 = \$.06$ per eraser The 2-packs have a cheaper per-eraser price. **Elliot** If I buy 40 of the 2-packs of erasers, the total cost will be $40 \times 0.12 = 4.8 = \$4.80$ That is more expensive than spending $2.82 for a 40-pack of erasers. The 40-pack is the better deal. **Julio** If a 2-pack costs $.12, then twenty 2-packs would have the same number of erasers as the 40-pack. Twenty 2-packs cost $20 \times 0.12 = 2.4 = \$2.40$ Since a 40-pack costs $2.82, the price per eraser of the 2-packs is cheaper. **Kimi** If a 40-pack costs $2.82, then half of the pack (20 erasers) should cost $1.41. Ten 2-packs (also 20 erasers) should cost $1.20. This is cheaper. The price per eraser is cheaper using the 2-packs.	2.3	

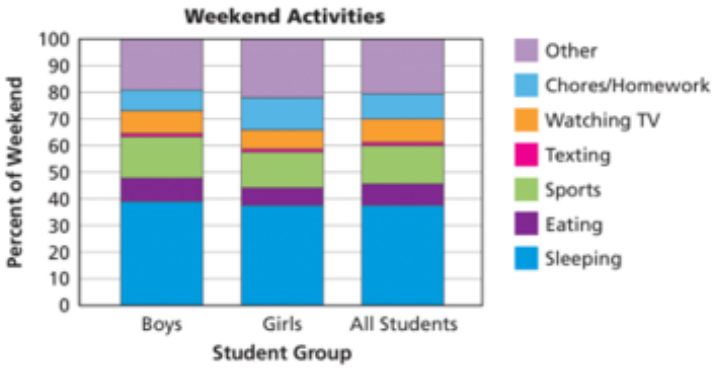
	Courtney's, Julio's, and Kimi's methods are correct. Answers will vary on which method is most convincing. Elliot's method is incorrect because he compares the prices of forty 2-packs (80 erasers) and one 40-pack (40 erasers). b. Describe another method you can use to determine which is the better buy. As alternative methods, students might scale to a different value similar to methods 3 and 4, or they might set up their proportion to the rate of cost to erasers. Students might also reason using different representations—for example, graphing their solutions or setting up a table.		
9	For each situation, find a unit rate and write an equation relating the two quantities. a. 3 dozen apples for $4.50 $1.50 per dozen apples, or about $.13 per apple $C = 1.5d$ b. 30 bottles of water for $4.80 $.16 per bottle $C = 0.16b$ c. 24 ounces of mozzarella cheese for $2.88 $.12 per ounce of mozzarella cheese $C = 0.12m$	2.3	

Connections

Problem #	Answer	CMP4 Problem #	Note
10	**Multiple Choice** Choose the value that makes this proportion correct: $\frac{18}{30} = \frac{\_\_}{15}$ A. 7 B. 8 C. 9 D. 10	2.1	

11	If possible, change each comparison of red paint to white paint to a percent comparison. If not possible, explain why. a. The fraction of a mix that is red paint is ¼. 25% red paint b. The ratio of red to white paint in a different mix is 2 to 5. 28.6% red paint and 71.4% white paint	2.1	
12	If possible, change each comparison to a fraction comparison. If it is not possible, explain why. a. A nut mix is 30% peanuts. $\frac{3}{10}$ peanuts b. The ratio of almonds to other nuts in a mix is 1 to 7. $\frac{1}{8}$ almonds and $\frac{7}{8}$ other nuts	2.1	
	For Exercises 13-16, rewrite each equation. Replace the variable with a number that makes a true statement.		
13	$\frac{4}{9} \times n = 1\frac{1}{3}$ $\frac{4}{9} \times 3 = 1$; $n = 3$	2.2	
14	$n \times 2.25 = 90$ $40 \times 2.25 = 90$; $n = 40$	2.2	
15	$n \div 15 = 120$ $1{,}800 \div 15 = 120$; $n = 1{,}800$	2.2	
16	$180 \div n = 15$ $180 \div 12 = 15$; $n = 12$	2.2	
17	These diagrams show floor plans for two different dorm rooms. One room is for two students. The other is for one student.	2.3	

	 a. Are the floor plan designs similar rectangles? If so, what is the scale factor? If not, why not? Yes; the scale factor between the large room and small room is 0.75. The ratio is 4 : 3. b. What is the ratio of the floor areas of the two rooms (including the space under the beds and desks)? 192 : 108, or in simplified form, 16 : 9 c. Which room gives more space per student? The room for one student gives more space per student, as it gives 108 square feet per person. The two-person room gives 192 ÷ 2 = 96 square feet per person.		
18	Solve each proportion. a. $\frac{x}{15} = \frac{20}{30}$ b. $\frac{18}{x} = \frac{4.5}{1}$ c. $\frac{0.1}{48} = \frac{x}{960}$ d. $\frac{10}{900} = \frac{3.5}{x}$ a. 10 b. 4 c. 2 d. 315	2.3	
	For Exercises 19 and 20, use both the table and the graph below.		

	The table shows the mean times that students in one seventh-grade class spend on several activities during a weekend. The data are also displayed in the stacked bar graph. **Weekend Activities (hours)** 	Category	Boys	Girls	All Students
Sleeping	18.8	18.2	18.4
Eating	4.0	2.7	3.1
Sports	7.8	6.9	7.2
Texting	0.5	0.7	0.6
Watching TV	4.2	3.0	3.4
Chores and Homework	3.6	5.8	5.1
Other	9.1	10.7	10.2 |  		
19	The stacked bar graph was made using the data from the table. Explain how it was constructed. Percents were calculated for boys, girls, and all students in each category. Each percent was found by considering the portion of the time spent on a certain activity out of the whole (100%) 48 hours in a weekend. Then the percents were stacked on top of each other in the same order to show the whole 100%.	2.3	
20	Suppose you are writing a report summarizing the class's data. You have space for either the table or the graph, but not both. What is one advantage of including the table? What is one advantage of including the bar graph? The table makes it easy to compare exact hours spent on each activity. The bar graph is a quick, visual way of comparing the percentage of time spent in each category by each group. You can see from the graph that both boys and girls spend the most amount of time sleeping. Also, comparing the heights of corresponding bars is a quick way to compare the percentage of time spent in each category between boys and girls.	2.3	

Extensions

Problem #	Answer	CMP4 Problem #	Note
21	Chemistry students analyzed the contents of rust. They found that it is made up of iron and oxygen. Tests on samples of rust gave the data in the table below. **Contents of Rust** Amount of Rust (g) / Amount of Iron (g) / Amount of Oxygen (g) 50 / 35.0 / 15.0 100 / 70.0 / 30.0 135 / 94.5 / 40.5 150 / 105.0 / 45.0 a) Is the ratio of iron to oxygen the same in each sample? Explain. Yes; in each sample, the ratio is 7 : 3. b) Is the ratio of iron to total rust the same in each sample? Explain. Yes; in each sample, the ratio is 7 : 10. c) The students analyze 400 grams of rust. How much iron and how much oxygen should they find? 280 grams of iron and 120 grams of oxygen. The fraction of oxygen to rust is $\frac{3}{10}$. The fraction of iron to rust is $\frac{7}{10}$.	2.1	
22	Use the table below. **Money Spent on Food** Where Food Is Eaten / 2002 / 2010 Home / $471,533,000,000 / $617,475,000,000 Away from Home / $295,341,000,000 / $446,442,000,000 Source: U.S. Census Bureau a. Compare money spent on food eaten at home and food eaten away from home to the total amount spent on food each year. Write statements for each year. In 2002, about 61% of money spent on food was spent on food eaten at home. 39% was spent on food eaten away from home. (The total amount	2.1	

	of money spent on food in 2002 was $766,874,000,000). In 2010, about 58% of money spent on food was for food eaten at home. 42% was spent on food eaten away from home. b. Explain how the statements you wrote in part (a) show the money spent on food away from home increasing or decreasing in relation to the total spent on food. The amount of money spent on food eaten away from home is increasing in relation to the total amount spent on food. 39% was spent on food eaten away from home in 2002 as compared to 42% in 2010. **Note:** You may want to discuss this chart further with your students. Explain that students can use the significant, nonzero digits as the basis for comparison instead of the entire numbers.		
23	Mammals vary in the length of their pregnancies, or gestations. Gestation is the time from conception to birth. Use the table to answer the questions below. **Gestation Times and Life Spans of Selected Mammals** Source: *The World Almanac and Book of Facts* a. For each mammal listed in the table, compare life span to gestation. Answers may vary. Sample answer: You first need to change life span, which is measured by years, to be measured by days. This can be done by multiplying the number of years for life span by 365 (or you can convert the number of gestation days into years). You can then compare the magnitude of the multiplicative increase by converting the ratio into a decimal (See Figure 2). **Note:** Students may also use strategies	2.2	

Animal	Gestation (days)	Life Span (years)
Chipmunk	31	6
Cat	63	12
Fox	52	7
Lion	100	15
Black Bear	219	18
Gorilla	258	20
Moose	240	12
Giraffe	425	10
Elephant (African)	660	35

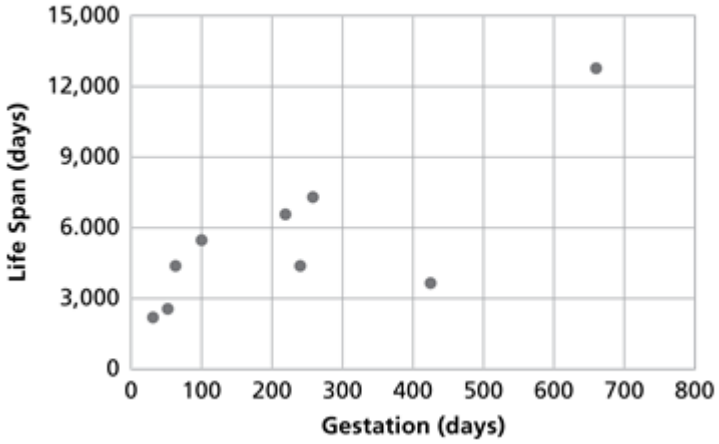
such as fractions or percentages to make this comparison. For any of these strategies, the life span does not have to be converted to days to make a comparison

Gestations and Life Spans of Selected Mammals

Animal	Gestation (days)	Life Span (years)	Life Span (days)	Ratio of Life Span to Gestation (days)
Chipmunk	31	6	2,190	2,190 : 31, or 70.6
Cat	63	12	4,380	4,380 : 63, or 69.5
Fox	52	7	2,555	2,555 : 52, or 49.1
Lion	100	15	5,475	5,475 : 100, or 54.75
Black Bear	219	18	6,570	6,570 : 219, or 30
Gorilla	258	20	7,300	7,300 : 258, or 28.3
Moose	240	12	4,380	4,380 : 240, or 18.25
Giraffe	425	10	3,650	3,650 : 425, or 8.6
Elephant (African)	660	35	12,775	12,775 : 660, or 19.4

b. Which animal has the greatest ratio of life span to gestation time? Which has the least ratio?
The greatest life span–to–gestation time ratio is the chipmunk, which has a ratio of 2,190 to 31, or 70.6. The least life span–to–gestation time ratio is the giraffe, which has a ratio of 3,650 : 425, or 8.6.

c. Plot the data on a coordinate graph using (gestation, life span) as data points. Describe any patterns that you see. Is there a relationship between the two variables? Explain.
Most of the coordinates follow the pattern that as gestation increases, life span increases. This is true except for two of the mammals, the moose and giraffe. From the pattern, there does appear to be a roughly proportional relationship between the gestation and the life span.



d. What pattern would you expect to see in a graph if each statement were true?

i. Longer gestation time implies longer life span.

The points would go up from the left to the right, to illustrate that as *x* (gestation) increases, *y* (life span) increases.

ii. Longer gestation time implies shorter life span.

The points would go down from left to right; so as *x*, or gestation, increases, *y* (life span) decreases.

24

A cranberry bog owner has pressed 240 liters of cranberry juice. He has many sizes of container in which to package the juice.

a. The owner wants to package all the cranberry juice in identical containers. Copy and complete the table to show the number of containers of each size the owner would need to package the juice.

(See Figure 1.)

Containers Needed by Volume

Volume of Container (liters)	10	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{10}$
Number of Containers Needed							

Figure 1

Containers Needed by Volume

Volume of Container (liters)	10	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{10}$
Number of Containers Needed	24	60	120	240	480	960	2,400

2.3

	b. Write an equation that relates the volume V of a container and the number of containers n needed to hold 260 liters of cranberry juice $n = 240 \div V$, $n = \frac{240}{V}$, $V = 240 \div n$, or $V = \frac{240}{n}$		

Investigation 3

	Applications	Connections	Extensions	Total
3.1	5	3	1	9
3.2	3	2	2	7
3.3	3	3	2	8
3.4	4	4	2	10
Total	15	12	7	34

Applications

Problem #	*Exercise and Answer*	*CMP4 Problem # Correlation*	*N*
1	Find the sales tax a. A sweater for $36.00 at 7% sales tax. b. A skateboard for $62.80 at 6% sales tax. c. A baseball hat for $22.90 at 5% sales tax. d. A digital camera for $249.99 at 4% sales tax. e. A board game for $29.95 at 8% sales tax. a. 0.07 × $36.00 = $2.52 b. 0.06 × $62.80 = $3.77 (rounded value) c. 0.05 × $22.90 = $1.15 (rounded value) d. 0.04 × $249.99 = $10.00 (rounded value)	3.1	

	0.08 × $29.95 = $2.40 (rounded value)	
2	Bennet tried to solve #1 a few different ways. Which of his methods are correct? Of the correct methods, which makes the most sense to you? Explain. A. 5% sales tax means that for every dollar you spend, you need to pay a nickel in tax. If you buy something for $21, you need to pay 21 nickels in tax. B. You can set up a proportion and solve for the missing value: $\frac{\$.05}{\$1.00} = \frac{x}{\$21.00}$ C. I know that 10% of $21.00 is $2.10, so 5% would be half of $2.10. D. 5% is equal to $\frac{1}{20}$. To find the amount of tax on $21.00, find $21 ÷ 20. E. 1% of $21.00 is $.21, so 5% of $21.00 is 5 x $.21. All five strategies are correct. Students' opinions as to which strategy makes the most sense will vary. For example, strategies (C) and (D) describe simple patterns, but they cannot be generalized as easily as strategies (A), (B), and (E).	3.1
	For Exercises 3-5 identify which estimate seems the most reasonable. Explain your choice.	
3	5% tax on a $42.00 purchase Under $2.00 Exactly $2.00 Over $2.00 over $2.00; 5% of $40.00 is $2.00, so 5% of $42.00 would be over $2.00.	3.1
4	9% tax on a $59.99 purchase Under $6.00 Exactly $6.00 Over $6.00 under $6.00; 10% of $60.00 is $6.00, so 9% of $59.99 would be less than $6.00.	3.1
5	5.5% tax on a $309.95 purchase Under $15.00 Exactly $15.00 Over $15.00 over $15.00; 5% of $300.00 is $15.00, so 5.5% of $309.95 would be over $15.00.	3.1

6	Jeffrey ate dinner at his favorite restaurant. The cost of the meal was $22.75 before tax and tip. What would the total cost be if the tax was 5% and then he left a 15% tip on top of that? $22.75 x 1.05≈ $23.89 $23.89 x 1.15 ≈ **$27.48**	3.2
7	Frida went to Joseph's Neighborhood Restaurant. She ordered tableside guacamole, fajitas, a side of sour cream, and a beverage. What is the total bill if the tax is 6% and she leaves a 15% tip on top of that?  $11 + $17.50 + $1.00 +$1.00 = $30.50 $30.50 x 1.06 ≈ $32.33 $32.33 x 1.15 ≈ **$37.18**	3.2
8	A group of friends order pizza at a restaurant. Each person gives some money to Lennon before they order. a. Lennon has $63 to spend on the order, including tax. The tax at the restaurant is 5%. What is the maximum cost of food the group can order and not go over $63? Explain your reasoning. $60; Sample explanation: $\frac{\$63}{105\%} = \frac{x}{100\%}$ where 105% and $63 represent the total amount of money the group can spend, including tax. *x* and 100% represent the cost of the food before tax. *x* = $60	3.2

	b. Lennon wants to leave a 15% tip on the price of the food, calculated before sales tax. What is the maximum cost of food the group can order and not go over $63? Explain. $52.50; Sample explanation: $\frac{\$63}{120\%} = \frac{x}{100\%}$ where $63 and 120% represent the total amount of money the group can spend, including tax and tip. Since tax (5%) and tip (15%) are both calculated from the cost of the food, 100% + 5% + 15% = 120% the total amount spent. x and 100% represent the total cost of the food before tax and tip. x = $52.50	
9	a. Alicia, Brandon, and Charlene wanted to solve the proportion $\frac{x}{4.24} = \frac{6.82}{2.2}$. Which of the students used a correct method? **Alicia** First, I simplified the fraction on the right. $\frac{x}{4.24} = 3.1$ Then, I multiplied 3.1 by 4.24 to find x. **Charlene** I figured out that 6.82 − 2.2 = 4.62. So, the numerator in the right fraction was 4.62 greater than the denominator. This means that $x = 4.24 + 4.62$, or 8.86. **Brandon** I multiplied all the values by 100 to eliminate the decimals. $\frac{100x}{424} = \frac{682}{220}$ Then I multiplied both sides by 424. $100x = \frac{682 \cdot 424}{220}$ I simplified the fraction on the right. $100x = 1{,}314.4$ Then I divided both sides by 100. $x = \frac{1{,}314.4}{100}$ Both Alicia's and Brandon's methods are correct. In Alicia's method, simplifying one side allows you to solve the problem by "undoing" the division on the left side. Brandon's method works because he simply scales each of the values by 100, which does not change the multiplicative relationship between quantities in the proportion.	3.3

	Note: There is nothing special about 100. Any nonzero quantity will work the same way. Charlene's method does not work because the proportion has a multiplicative, not additive, relationship. b. Of the correct methods, which makes the most sense to you? Explain your choice. Answers will vary	
10	Find the unit rate for the chimp food mix. Consider the unit rate to be the number of scoops of high fiber food per 1 scoop of high-protein food. a. 75% high-fiber chimp food to 25% high-protein chimp food b. 80% high-fiber chimp food to 20% high-protein chimp food c. 85% high-fiber chimp food to 15% high-protein chimp food d. 95% high-fiber chimp food to 5% high-protein chimp food a. unit rate = 3 b. unit rate = 4 c. unit rate = $5\frac{2}{3}$ d. unit rate = 19	3.3
11	Find the percentage of the chimp food mix that is high fiber and the percentage of the mix that is high protein. **Note: the unit rate is the number of scoops of high-fiber food per 1 scoop of high protein food.** a. Unit rate is 1 b. Unit rate is $\frac{1}{3}$ c. Unit rate is 9 a. 50% high-fiber food to 50% high-protein food b. 25% high-fiber food to 75% high-protein food c. 90% high-fiber food to 10% high-protein food	3.3
12	A group of students recorded the following data when they conducted the Leaky Faucet Experiment:	3.4

Number of Seconds	Amount of Water (ml)
0	8
5	17
10	25
15	33
20	41
25	48
30	56
35	64
40	72
45	80
50	89
55	97
60	105

a. What is the rate of water dripping in ml per minute?
b. At this rate how much water is lost in a day? A Year?

a. Answers will vary. Many students will choose 8ml per minute because that is the interval amount that occurs most often
b. Answers will vary depending on the rate of water per minute chosen in letter a. For 8ml per minute:

$$\frac{8ml}{1\ minute} = \frac{480ml}{60\ minutes}$$

$$\frac{480ml}{1\ hour} = \frac{\mathbf{11,520\ ml}}{24\ hours}$$

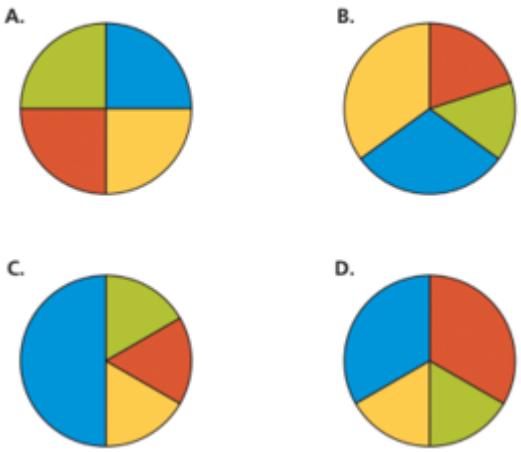
$$\frac{11{,}520\ ml}{1day} = \frac{\mathbf{4,204,800}ml}{365\ days}$$

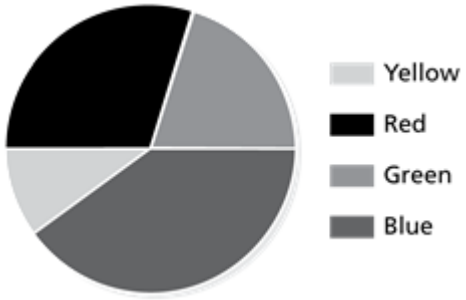
13	Rachael's watch can check her pulse rate. It told her that her pulse rate was 17 beats in 15 seconds. What is her pulse rate in one minute?	3.4

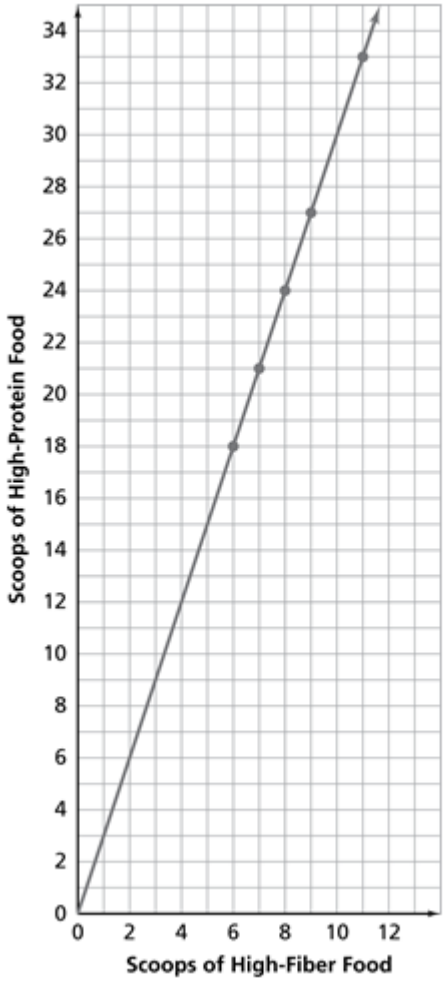
	$\frac{17\ beats}{15\ seconds} = \frac{\mathbf{68\ beats}}{60\ seconds}$	
14	At camp, Miriam uses a pottery wheel to make 3 bowls in 2 hours. Duane makes 5 bowls in 3 hours. a. Who makes bowls faster, Miriam or Duane? Duane; he can make about 1.7 (5 ÷ 3) bowls per hour. Miriam can make only 1.5 bowls per hour. b. How long will it take Miriam to make a set of 12 bowls? 8 hours; $\frac{2\ hours}{3\ bowls} = \frac{8\ hours}{12\ bowls}$ c. How long will it take Duane to make a set of 12 bowls? 7.2 hours; Possible strategy: $5 \div 3 = 1\frac{2}{3}$, and $12 \div 1\frac{2}{3} = 7.2$.	3.4
15	Denzel makes 10 of his first 15 shots in a basketball free-throw contest. His success rate stays about the same for his next 100 free throws. Write and solve a proportion for each part. Round your answer to the nearest whole number. **Free-Throw Contest Contest** Player / Attempts / Baskets Denzel / 15 / 10 Mitchell / 10 / 5 Rachael / 15 / 7 Zoe / 15 / 6 a. About how many baskets do you expect Denzel to make in his next 60 attempts? 40; Using a proportion, $\frac{10}{15} = \frac{x}{60}$. The scale factor is 4. b. About how many free throws do you expect him to make in his next 80 attempts? About 53.3, or 53; The scale factor is about 5.3. c. About how many attempts do you expect Denzel to take to make 30 free throws? 45 attempts; Using a proportion, $\frac{10}{15} = \frac{30}{x}$. The scale factor is 3. d. About how many attempts do you expect him to take to make 45 free throws? About 68 attempts; Using a proportion, $\frac{10}{15} = \frac{45}{x}$. The scale factor is 4.5.	3.4

Connections

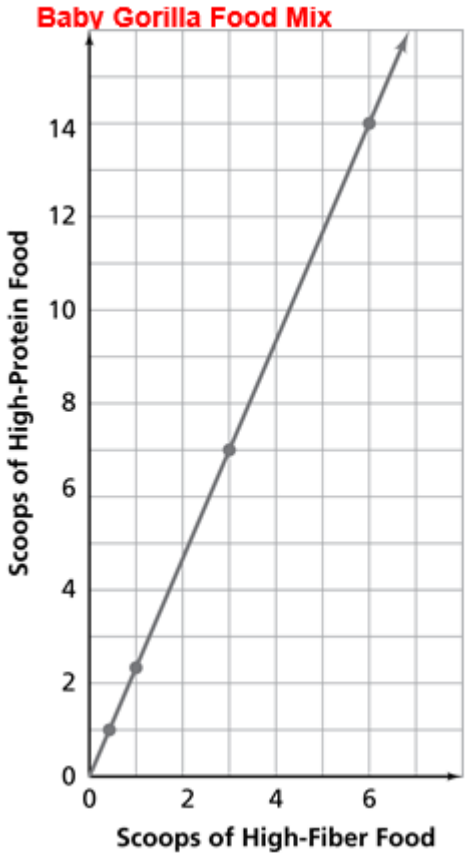
Problem #	Answer	CMP4 Problem #	Note
16	Erin is buying a shirt that costs $21 and has a 5% sales tax. She calculates the tax as $0.05 x 21 = 1.05, or $1.05 Erin notices that she can add 21 + 1.05 = 22.05 to find the total cost, $22.05. She used th3e Distributive Property to write (1 x 21) + (0.05 x 21) = 1.05 x 21. For each item below, write the total cost of the item as the product of two numbers.  **a.** 1.07 × $45.90 **b.** 1.06 × $67.50 **c.** 1.08 × $299.99 **d.** 1.04 × $39.95	3.1	
17	In Exercise # 16 you used the Distributive Property to find the total cost of a product and sales tax. You can also use the Distributive Property to find the total cost after a discount. Suppose there is a 5% discount on a shirt that was originally priced at $21. Write an expression that shows the discounted price of the shirt as the product of two numbers. Explain your reasoning. 0.95 × $21; Since this situation involves a discount, you need to subtract 5%. $21 − (0.05 × $21) = 0.95 × $21	3.1	

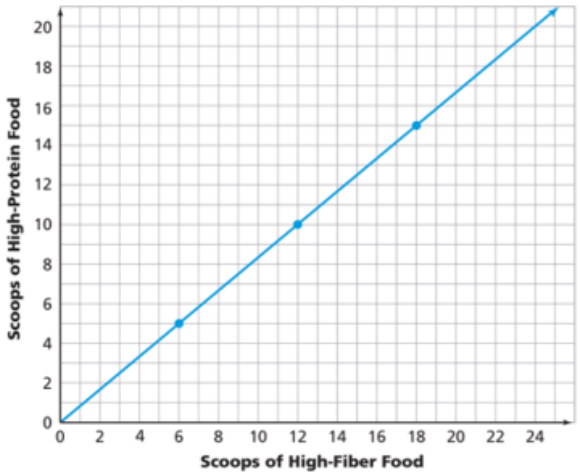
18	Bill's bike shop has a sale where the bike shop pays the customer's sales tax. By law, Bill has to charge a 6% sales tax, so he finds a different way to take the tax off the bill. Bill decides to give each customer a 6% discount. a. The customer pays the discounted price plus tax. Will this amount be the same as the original price? Explain your reasoning. No, Bill's method will not work. Students may provide an example, such as a $100 item. The discount on a $100 item would be $6. The tax would then be calculated from the $94 discounted price, not on the original $100. So, the final sale price would be $99.64. b. Does it matter which is applied first, the discount or the tax? Explain. It does not matter which is applied first, the discount or the tax. Take an item with a starting price of P. If you take the discount before the tax, the equation is $1.06 \times (0.94P) = 0.9964P$. If you calculate the tax and then the discount, the equation is $0.94 \times (1.06P) = 0.9964P$. This is because the expression is the product of three values. The values can commute.	3.1	
19	**Multiple Choice** Ayanna is making a circular spinner to be used at the school carnival. She wants the spinner to be divided so that 30% of the area is blue, 20% is red, 15% is green, and 35% is yellow. Choose the spinner that fits the description. B  	3.2	

20	Hannah is making her own circular spinner. She makes the ratio of green to yellow 2 : 1, the ratio of red to yellow 3 : 1, and the ratio of blue to green 2 : 1. Make a sketch of her spinner. Answer:  	3.2	
	Exercises # 21-23 are about ways to mix food for different primates at the zoo.		
21	Mackenzie mixes the primate food. For the orangutans, she uses the information in the table below. **Orangutan Food Mix** Scoops of High-Protein Food: 21, 24, 27, 18, 33 Scoops of High-Fiber Food: 7, 8, 9, 6, 11 a. What is the ratio of high-protein food to high-fiber food? 21 : 7, or 3 : 1 b. Write an equation that relates the number of scoops of high-protein food to the number of scoops of high-fiber food. $P = 3F$ or $P \div 3 = F$ c. If Mackenzie mixes 12 scoops of high-protein food, how many scoops of high-fiber food should she add? 4; Substitute 12 for P, and solve for F *or scale up the ratio 3:1 by multiplying each by the scale factor of 4, or solve the proportion* $\frac{3}{1} = \frac{12}{x}$. d. For every 1 scoop of high-protein food, how many scoops of high-fiber does Mackenzie need? $\frac{1}{3}$scoop e. Draw a graph with the amounts of high-protein food on the y-axis and the amounts of high-fiber food on the x-axis.	3.3	



22	The ratio of high-fiber food to high-protein food for baby gorillas is 30% to 70%. a. What is the unit rate for this mixture? $\frac{3}{7} \approx 0.43$ or $\frac{7}{3} = 2.333\ldots$ b. Copy and complete the table below. **Baby Gorilla Food Mix** 	Scoops of High-Protein Food	■	14	1	■	x
---	---	---	---	---	---
Scoops of High-Fiber Food	3	■	■	1	■ | | ScoopsofHigh-ProteinFood	7	14	1	$\frac{7}{3}$	x
---	---	---	---	---	---
Scoops of High-Fiber Food	3	6	$\frac{3}{7}$	1	$\frac{3}{7}x$	 Baby Gorilla Food Mix	3.3	

	c. Graph the relationship of the high-protein food to high-fiber food for baby gorillas.  d. Write an equation relating the number of scoops of high-protein food to the number of scoops of high-fiber food. $P = \frac{7}{3}F$ or $F = \frac{3}{7}P$		
23	Mackenzie was given the following graph of the mix ratio for adult baboon food at the zoo.	3.3	



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a. What is a good estimate for the number of scoops of high-protein food Mackenzie should use with 5 scoops of high-fiber food?
About 4 scoops

b. Mackenzie wants to remember a ratio of high-protein food to high-fiber food that uses small whole numbers. What ratio should she remember?
5 scoops of high-protein food: 6 scoops of high-fiber food

c. Write an equation that represents the graph above
$P = \frac{5}{6}F$

d. Mackenzie uses 45 scoops of high protein food in a mix. How many scoops of high-fiber food should she use?
54 scoops

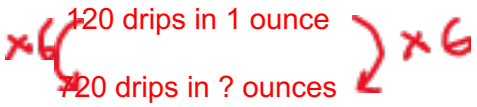
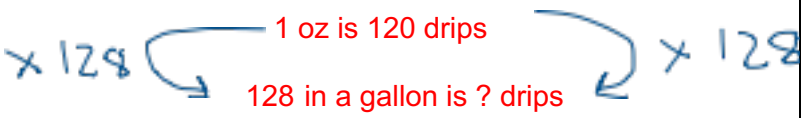
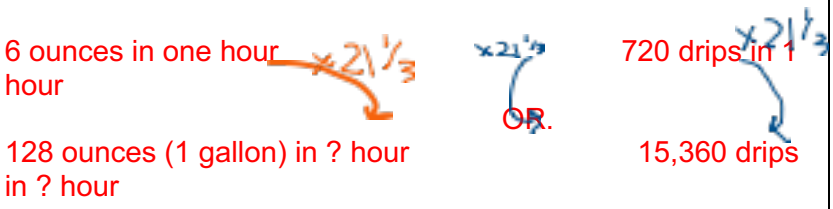
24

a. Paula hears the water dripping in a faucet. She counts one drip every 5 seconds. How many drips are there in an hour?
720 drips in one hour

x12 1 drip in 5 sec x 12
12 drips in a minute (60 sec)
x 60 720ips in an hour (60 min or 3600 sec) x 60

b. If there are 120 drips of water in 1 ounce, how many ounces of water is dripping out of the faucet in an hour?
6 ounces in one hour

3.4

	 c. How many drips in a gallon? 15,360 drips  d. How long does it take for a gallon of water to drip out of the sink? $21^{1}/_{3}$ hours  e. How much water drips out in one week (7 days)? 120,960 drips or 7.875 gallons 		
25	Which of these items is the better buy? a. An 8-pack of glue sticks for $3.99 or 1 glue stick for $.54 The 8-pack is the better deal; each glue stick is about $.50. b. A 12-pack of tape for $2.50 or 1 roll of tape for $.19 The single roll is the better deal; each roll in the 12-pack is about $.20. c. A 100-pack of pencils for $4.88 or 1 pencil for $.05 The 100-pack is the better deal; 100 single pencils for $.05 a piece	3.4	

	would cost $5.00, which is more than the 100-pack price. d. A 50-pack of paper clips for $.89 or a 25-pack of paper clips for $.45 Buying the 50-pack of paper clips is cheaper; two 25-packs (50 total) would cost $.45 × 2 = $.90, which is more than the $.89 it costs to buy a 50-pack.		
26	Half an avocado has about 160 calories. How many calories do a dozen avocados have? 3,840 calories	3.4	
27	There are about 1.5 grams of fat in 1 tablespoon of hummus. How many grams of fat are in $2\frac{1}{2}$ cups of hummus? (Note: 16 tablespoons = 1 cup) 60 grams of fat	3.4	

Extensions

Problem #	Answer	CMP4 Problem #	Note
28	The city of Spartanville runs two summer camps, the Green Center Camp and the Blue Center Camp. The table shows recent attendance at the two camps. a. Use differences to compare the two centers' camp programs for boys and girls. Which center seems to offer a program that appeals more to girls? Answers will vary. Sample answer: The camps were relatively close in terms of the difference between boys and girls. 45 more girls attended Camp Green than Camp Blue. 55 more boys attended Camp Green than Camp Blue. There were 50 more boys than girls at Camp Green and 40 more boys than girls at Camp Blue. Since 45 more girls attended Camp Green than Camp Blue, Camp Green must appeal more to girls.	3.1	

	Green	Blue
Boys	125	70
Girls	75	30

b. Use fractions to compare the two centers camp programs for boys and girls. Which center seems to offer a program that appeals more to girls?

Answers will vary. Sample answer: The total number of campers at Camp Green is 125 + 75 = 200. The fraction of boys at Camp Green is then $\frac{125}{200} = \frac{5}{8}$. The fraction for girls at Camp Green is $\frac{75}{200} = \frac{3}{8}$. The total for Camp Blue is 70 + 30 = 100. The fraction of boys at Camp Blue is $\frac{70}{100} = \frac{7}{10}$ and the fraction of girls at Camp Blue is $\frac{30}{100} = \frac{3}{10}$. You can then compare fractions with like denominators, for example, compare $\frac{5}{8} = \frac{25}{40}$ for boys at Camp Green to $\frac{3}{8} = \frac{15}{40}$ for girls at Camp Green. $\frac{7}{10}$ and $\frac{3}{10}$ for Camp Blue become $\frac{28}{40}$ boys and $\frac{12}{40}$ girls for Camp Blue. Since $\frac{15}{40}$ of the campers at Camp Green were girls, and only $\frac{12}{40}$ of the campers at Camp Blue were girls, then Camp Green must appeal more to girls than Camp Blue.

c. Use percents to compare the two centers' camp programs for boys and girls. Which center seems to offer a program that appeals more to girls?

Answers will vary. Sample answer: 62.5% of campers at Camp Green were boys, and 70% of campers at Camp Blue were boys. 37.5% of campers at Camp Green were girls and 30% at Camp Blue were girls. The percentage of campers who were girls is greater for Camp Green than Camp Blue, so Camp Green must appeal more to girls.

d. Use ratios to compare the appeal of the two centers' camp programs for boys and girls. Which center seems to offer a program that appeals more to girls?

Answers will vary. Sample answer: The ratio of 5 to 3 describes boys to girls at Camp Green. A ratio of 7 to 3 describes boys to girls at Camp Blue. The ratio of boys to girls is greater at Camp Blue than Camp Green, so Camp

	Green must appeal more to girls than Camp Blue.		
	For Exercises #29-32 use the following information. **Bill's Bikes sells used bikes. Bill buys used bikes, fixes them, and marks up the prices by 80%. The salesperson selling the bikes gets a 25% commission on the markup.**		
29	Roberto is a salesperson at Bill's Bikes. Find the missing values in the table for Roberto's sales. **Costs and Revenue for Roberto's Sales** Buying Price / Markup (80% of buying price) / Selling Price / Commission (25% of markup) / Profit (money the shop makes on the sale) $100 | $80 | $180 | $20 | $60 $10 | ■ | ■ | ■ | ■ $55 | ■ | ■ | ■ | ■ $125 | ■ | ■ | ■ | ■ Costs and Revenue for Roberto's Sales Buying Price / Markup (80% of buying price) / Selling Price / Commission (25% of markup) / Profit (money the shop makes on the sale) $100 | $80 | $180 | $20 | $60 $10 | $8 | $18 | $2 | $6 $55 | $44 | $99 | $11 | $33 $125 | $100 | $225 | $25 | $75	3.2	
30	Linda is a salesperson at Bill's Bikes. Find the missing values in the table for Linda's sales. **Costs and Revenue for Linda's Sales** Buying Price / Markup (80% of buying price) / Selling Price / Commission (25% of markup) / Profit (money the shop makes on the sale) ■ | $48 | ■ | ■ | ■ ■ | ■ | $252 | ■ | ■ ■ | ■ | ■ | $14.40 | ■ ■ | ■ | ■ | ■ | $54 $N | ■ | ■ | ■ | ■	3.2	

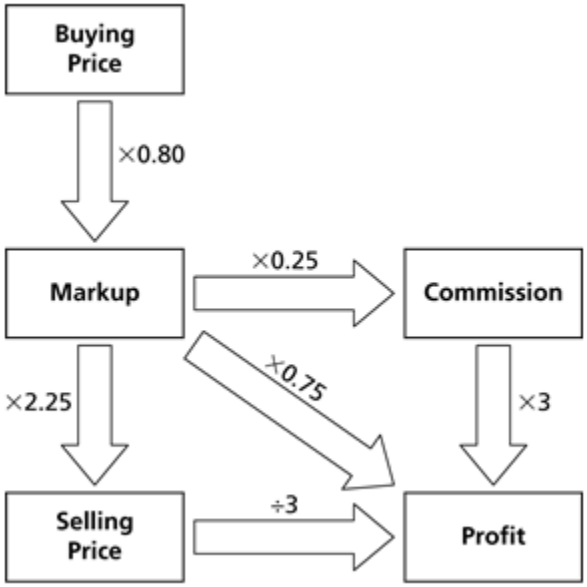
Costs and Revenue for Linda's Sales

Buying Price	Markup (80% of buying price)	Selling Price	Commission (25% of markup)	Profit (money the shop makes on the sale)
$60	$48	$108	$12	$36
$140	$112	$252	$28	$84
$72	$57.60	$129.60	$14.40	$43.20
$90	$72	$18	$18	$54
$N	$0.8N$, or $\$\frac{4}{5}N$	$1.8N$, or $\$\frac{9}{5}N$	$0.2N$, or $\$\frac{N}{5}$	$0.6N$, or $\$\frac{3}{5}N$

31 For each arrow in the figure below, write a mathematical rule describing how to get from one value to the next value. The first one is done for you.

3.3

Answer:

			
32	For each part in the diagram in # 33 , write two equations for the listed relationship. a. The markup amount and the buying price markup = 0.8 × buying; buying = markup × 1.25 b. The buying price and the selling price selling = buying × 0.8 × 2.25 = buying × 1.8; buying = selling × $\frac{5}{9}$ c. The commission and the markup amount commission = 0.25 × markup; markup = commission × 4 d. The profit and the commission profit = commission × 3; commission = profit ÷ 3	3.3	
33	Use the table to answer the questions about participation in team sports.	3.4	

	Participation in Team Sports at Springbrook Middle School | Sport	Girls	Boys
---	---	---
Basketball	30	80
Footbal	10	60
Soccer	120	85
Total surveyed	160	225 | a. In which sport do boys most outnumber girls? football; The ratio of boys to girls is 6 : 1, the most extreme ratio of all the sports b. In which sport do girls most outnumber boys? soccer c. The participation in these team sports is about the same for students at Key Middle School. i. Suppose 250 boys at Key Middle School play sports. How many boys would you expect to play each of the three sports? rounded to the nearest whole number, basketball = 89, football = 67, soccer = 94 ii. Suppose 240 girls at Key Middle School play sports. How many girls would you expect to play each of the three sports? rounded to the nearest whole number, basketball = 45, football = 15, soccer = 180		
34	Rita wants to estimate the number of beans in a large jar. She takes out 100 beans and marks them. Then she returns them to the jar and mixes them with the unmarked beans. She then gathers some data by taking a sample of beans from the jar. Use her data to predict the number of beans in the jar. **Sample** **Number of marked beans: 2** **Beans in sample: 30** About 1,500 beans; Using equivalent fractions, $\frac{x}{100} = \frac{30}{2}$. The scale factor is 50.	3.4	