

Example 4.1.12**Finding Proportions and Ratios**

Suppose you earned a B on your last History 102 test by getting 80% of the questions correct.

- If there were 60 equally weighted questions on the test, how many did you answer correctly?
- What was your ratio of correct to incorrect answers on the test?

Solution

- a. We know that you correctly answered 80%, or $\frac{80}{100}$, of the questions. We can find 80% of the 60 questions by multiplying the two numbers together as shown.

$$\frac{80}{100} \cdot 60 = 48$$

Therefore, you correctly answered 48 questions on the test.

- b. Since we know from part a. that you correctly answered 48 questions, we can subtract this from the total number of questions to find the number of questions that you answered incorrectly

$$60 - 48 = 12 \text{ incorrect answers}$$

Therefore, the ratio of correct to incorrect answers would be written as 48 : 12, or 4 : 1.

Skill Check Answers

- $\frac{5}{12} \approx 41.67\%$
- 15 : 1 children to providers

4.1 Exercises

✓ CONCEPT CHECK

- A proportion is a _____ of a whole.
- To write a proportion as a fraction in lowest terms, divide both the numerator and the denominator by the _____.
- A _____ is an amount per 100.
- True or False: If a flag has the colors green and purple in the ratio 1 : 2, there is twice as much purple as there is green.
- True or False: The ratio 3 : 1 is equivalent to the ratio 1 : 3.

 PRACTICE

Change each fraction to a percentage. Round your answer to the nearest hundredth when necessary.

6. $\frac{20}{45}$

7. $\frac{1}{5}$

8. $\frac{2}{3}$

9. $\frac{61}{212}$

10. Which is greater, half of 22 or one-fifth of 95?

11. Which is greater, a third of 36 or one-sixth of 138?

12. Which is greater, half of 42 or twenty-five percent of 120?

13. Which is greater, one-third of 93 or thirty percent of 110?

14. The ratio of 9.2 to 24 is the same as the ratio of ____ to 6.

15. The ratio of 1.2 to 32 is the same as the ratio of 3.6 to ____.

Find the equivalent ratio.

16. a. $1:7 = _ : 14$

b. $1:7 = _ : 21$

c. $1:7 = 4: _$

d. $1:7 = 5: _$

17. a. $2:5 = 4: _$

b. $2:5 = _ : 35$

18. a. $10:3 = _ : 9$

b. $10:3 = 5: _$

19. a. $5:9 = 2.5: _$

b. $5:9 = _ : 13.5$

For each ratio, write two equivalent ratios, one of which is in the lowest terms possible.

20. $25 : 45$

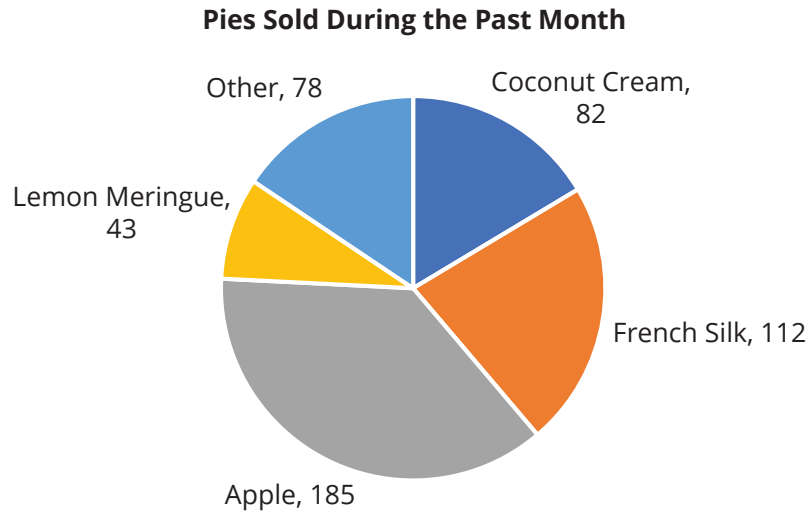
21. $24 : 60$

22. $12 : 36 : 72$

23. $25 : 75 : 45$

APPLICATIONS

24. For their social media account, a local bakery created a pie chart indicating the popularity of the pies they sold over the past months. Use the pie chart to determine the proportion of pies sold that were **a.** apple and **b.** French silk. Write each proportion in lowest terms.



25. A Richardson’s family monthly budget for necessary expenses is shown in the table. Use the table to determine the proportion of the budget assigned to **a.** childcare and **b.** groceries. Write each proportion in lowest terms.

Richardson Family Monthly Budget

Childcare	\$750
Groceries	\$800
Utilities	\$300
Vehicle Loan Payment and Expenses	\$525
Other	\$425

26. Alexander expects to spend \$10,500 on college tuition and expenses for the next school year. Of that total amount, he expects to spend \$1200 on textbooks and course supplies. Write the proportion of textbooks and course supplies to college tuition and expenses in lowest terms.
27. A 950 calorie meal from a fast food restaurant is made up of a cheeseburger (520 calories), fries (220 calories), and a fountain drink (210 calories). Write the calories in the cheeseburger and the calories in the entire meal as a proportion in lowest terms.
28. If there are 48 students in a class and 32 are seniors, what proportion of students are *not* seniors?
29. In a survey, 99 out of 100 people are *not* left-handed. What proportion of people are left-handed according to this survey?
30. Nearly two-in-ten American women end their childbearing years without having borne a child. What proportion of American women end their childbearing years with having borne a child?

31. A survey indicated that 11 out of 100 students studying at a university reported having a disability. What proportion of students did *not* report having a disability?
32. If the drinks portion of a bill costs \$18 and the total bill was \$30, what percentage of the total was the cost of the drinks?
33. College University sent out 2000 requests to alumni for scholarship fund donations. In response, the university received 325 donations. What percent of alumni donated to the scholarship fund?
34. A student at a state college is expected to spend \$7400 per semester on tuition, fees, and other expenses. If a student at the same college is expected to spend \$700 on textbooks and course supplies, what percentage of the total is the cost of textbooks and course supplies?
35. If the monthly expense for a car is \$600 and the cost of fuel for a month is \$180, what percentage of the total expenses is the cost of fuel?
36. A city parks and recreation department is planning to build a new community park with a playground in one of three possible locations. The park will be built only in an area where at least 60% of the residents approve of the location. The table shows the results of a survey of city residents. Determine which locations meet the minimum approval requirement.

Citizen Approval of Park Location

	Location A	Location B	Location C
Approve of Location	17,739	13,298	15,265
Disapprove of Location	5628	9766	7947
No Opinion	1416	1719	1571
Total	24,783	24,783	24,783

37. A brand of cookie is planning to release a new special edition flavor selected by fans, but will only release a flavor if at least 75% of fans think the potential flavor is delicious and not gross. The table shows the results of an online poll. Determine which flavors meet the minimum approval requirement.

Fan Flavor Poll Results

	Green Tea	Toffee	Peach Mango
Delicious	6341	8826	9402
Gross	4227	2753	3283
Total	10,568	11,579	12,685

38. From 2006 to 2016, the number of people in the US age 65 and older increased by 33%. Six of the states that experienced a large increase are given below along with the proportion of their state population that is age 65 and older and the number of residents in the state. Determine the number of residents age 65 and older in each of the states listed, and then use these numbers to order the states from largest to smallest. (Round your answer to the nearest whole number of residents.)

State	Proportion of Residents Age 65 and Older	# of Residents
Utah	10.5%	3,058,705
Colorado	13%	5,719,415
Nevada	15%	2,940,947
Idaho	15%	1,699,927
South Carolina	16.7%	4,971,449
Delaware	17.5%	954,000

39. In the 2020 election, 66.7% of the Eligible Voting Population in the country voted. The proportion of eligible voters who voted is given for five states, as well as the number of eligible voters in the state. Determine the number of votes cast in each of the states listed, and then use these numbers to order the states from largest to smallest. (Round your answer to the nearest whole number of votes.)

State	Proportion of Eligible Voters who Voted	# of Eligible Voters
Tennessee	59.81%	5,124,867
Louisiana	64.61%	3,373,932
Illinois	67.02%	9,027,082
Iowa	73.25%	2,321,131
Minnesota	79.96%	4,118,462

40. A car's weight depends on all of its component materials, with steels, aluminum, plastics, and rubber being some of the biggest contributors. Approximately 53.41% of the weight comes from steels, 9.96% from aluminum, 8.24% from plastics, 4.93% from rubber, and 23.46% from other materials. If a car weighs 3994 lb, what is the weight of the plastics used in the car?
41. A website reports that 14% of the world's population is Hindi and 33% are Christian. If there are approximately 6,840,507,000 people in the world, how many are Hindi and how many are Christian according to the website?
42. There is a herd of cattle out on the range. Fifty-two percent of the cattle are male. If the herd consists of 1175 animals, how many are female?
43. Seventy percent of the animals in a zoo are herbivores. If there are 821 animals in the zoo, how many are *not* herbivores? Round your answer to the nearest whole number.

44. According to a survey by Airlines for America taken in 2017, 88% of Americans had flown on a commercial airline in their lifetime. If there are 75 people in Room A and 50 people in Room B, estimate how many people in each room had flown on a commercial airline in their lifetime.
45. The US Census Bureau's Educational Attainment report released in 2020 stated that approximately 23% of people 25 and older had earned a bachelor's degree. If City A has 10,726 citizens aged 25 and older and City B has 8253 citizens aged 25 and older, approximately how many citizens aged 25 and older from each city have a bachelor's degree?
46. Approximately 1.5% of the population have a peanut allergy. If East Central Middle School has 1180 students and West Chester Middle School has 1373 students, approximately how many students at each school have a peanut allergy?
47. Approximately 2% of the population has naturally red hair. The population of Utah is approximately 3.2 million and the population of South Dakota is approximately 885,000. Approximately how many people with naturally red hair live in each state?
48. Three-fourths of the students at the local community college live in the county. If there are 2004 students enrolled, how many do *not* live in the county?
49. At a recent education conference, one-fourth of the total participants came to learn about online courses. The rest came to learn about other educational practices. If 92 participants showed up, how many were *not* there to learn about online courses?
50. A general guideline for making cocktails at home is to follow the ratio 2 : 1 : 1—spirit : sweet : tart.
- Write a fraction to represent the relationship of spirit to tart as indicated by the ratio.
 - If 4 ounces of spirit was used to mix a drink, how much of the tart ingredient would be required?
51. The Wilton icing coloring color chart states that to create burgundy colored icing, you need to add food coloring in the ratios 3 : 2 : 2—rose : red-red : black.
- Write a fraction to represent the relationship of rose to red-red as indicated by the ratio.
 - If 12 drops of rose food coloring were added to the icing, how many drops of black food coloring should be added to make burgundy icing?

52. A website claims that the ideal fertilizer for flowering shrubbery is created by combining two different fertilizers with water at a ratio of 5 : 3 : 2—water : Sunny Shrub fertilizer : Flower Friends fertilizer.
- Write a fraction to represent the relationship of Flower Friends fertilizer to water as indicated by the ratios.
 - If a gardener fills a container with 40 fluid ounces of water, how many fluid ounces of Sunny Shrub fertilizer should be added to create this ideal fertilizer for flowering shrubbery?
53. A recipe for hard candy indicates that the ingredients should be mixed at a ratio of 8 : 6 : 2—granulated sugar : corn syrup : water.
- Write a fraction to represent the relationship of corn syrup to the whole as indicated by the ratio.
 - If someone following the recipe only had 4 cups of sugar, how many cups of corn syrup would be needed to make the hard candy?
54. Each week, a city-run afterschool tutoring program has 72 tutor volunteers and helps 243 students. Write the ratio of tutor volunteers to students and determine the number of people who participate in the afterschool tutoring program.
55. A recent population study of elephants revealed that due to population declines there are only 50,000 wild Asian elephants and 415,000 wild African elephants in the world. Write the ratio of Asian elephants to African elephants and calculate the total number of elephants living in the wild according to this study.
56. As part of a weeklong fundraising campaign, club members sold 476 brownies and 392 cupcakes during bake sales. Write the ratio of cupcakes to brownies and determine the total number of baked goods sold during the bake sales.
57. At a state college, a recent survey performed by the campus technology department revealed that 10,473 students had a phone with a Google Android operating system and 12,748 students had a phone with an Apple iOS operating system. Write a ratio of students with Apple iOS to students with Google Android and determine the total amount of students surveyed.
58. If 9 of the 21 members of a tour group are children, what is the ratio of children to adults on the trip?
59. Triangles A and B are *similar* triangles. In other words, triangle B has exactly the same shape as Triangle A, just a different scale. Triangle A has sides 45 cm, 54 cm, and 99 cm. If Triangle B has sides of lengths 90 cm, 108 cm, and 198 cm, what is the ratio of the lengths of the sides of Triangle A to the lengths of the sides of Triangle B?

60. A bag contains the following marbles: 8 black marbles, 17 blue marbles, 7 brown marbles, and 14 green marbles.
- What is the ratio of brown marbles to black marbles?
 - What is the ratio of brown marbles to all the marbles in the bag?
61. A recent study showed that in American universities there were 18 million college students and 1.3 million faculty. Write the overall student to faculty ratio for universities across America in lowest terms.
62. Christopher had acquired 12 of the 20 items requested by his supervisor. Write the ratio of acquired items to nonacquired items in lowest terms.
63. Almost 30% of the world's billionaires live in 15 major cities. The city with the most billionaires is New York City with 113 billionaires among its population of approximately 8.4 million. This equates to 1 billionaire for each 74,336 residents, which we can write as 1 : 74,336. The data for five other cities is given below.

City	# of Billionaires	Population
Mumbai, India	38	20,000,000
Los Angeles, USA	44	4,000,000
Beijing, China	57	20,400,000
London, UK	66	9,300,000
Moscow, Russia	73	12,500,000

- Write a unit ratio for each of the given cities, rounding to the nearest whole person.
 - Compare the ratio of billionaires for each city to New York City.
64. An 8 oz cup of brewed coffee contains 96 mg of caffeine. The caffeine content of four other beverages is given below.

Beverage	Size in oz	Caffeine in mg
Espresso	1	64
Black tea	16	94
Green tea	12	42
Cola	24	66

- Write an equivalent ratio for the caffeine content of each beverage.
 - Compare the caffeine content of each beverage to that of brewed coffee.
65. If the ratio of tourists to locals is 2 : 3 and there are 40 tourists at the opening of a new museum, how many locals are at the opening?
66. A powdered drink mix calls for 3 scoops powder to 8 ounces water. How much powder do you need if you have 32 ounces of water?
67. It was recently estimated that uninsured vehicles outnumber insured ones by about six to five. If there are 2002 vehicles in a county, how many of them are uninsured?

68. One group (A) contains 125 people. One-fifth of the people in group A will be selected to win \$15.00 grocery cards. There is another group (B) in a nearby town that will receive the same number of grocery cards, but there are 585 people in that group.
- What will be the ratio of nonwinners in group A to nonwinners in group B after the selections are made?
 - What is the ratio of winners to people for group B?

4.1 PROJECT

PROPORTIONS, PERCENTAGES, AND ELECTIONS

Our political system is based on a voting method called the plurality method. In the plurality method, voters are presented with a list of candidates and each voter selects their first-choice candidate. The choice with the greatest number of first place votes is declared the winner.

A small town decided to ask voters to do something slightly different during an election to fill a town council seat: they were asked to rank the four candidates in order of preference, from first to fourth. The following table, called a preference table, summarizes all of the votes that were cast during the election. For example, the first column shows that 540 voters picked Smith as their first choice, Thomas as their second choice, Orlando as their third choice, and Patel as their last choice.

Preference Table for the Town Council Election

	540	250	160	140
1st choice	Smith	Thomas	Patel	Orlando
2nd choice	Thomas	Patel	Thomas	Thomas
3rd choice	Orlando	Orlando	Orlando	Patel
4th choice	Patel	Smith	Smith	Smith

- Determine the total number of voters who participated in this election.
- How many voters chose Smith as their first choice? How many chose Smith as their last choice?
- What proportion of voters chose Smith as their first choice? What proportion of voters chose Smith as their last choice? Write each proportion as a fraction of the total number of voters, reduced to lowest terms.
- What percentage of voters chose Smith as their first choice? What percentage of voters chose Smith as their last choice? Round your answer to the nearest hundredth, if necessary.
- According to the plurality method, which candidate should be declared the winner?
- Considering the entire preference table, is there anything that strikes you as odd about the chosen winner?
- Is there a candidate that would be less polarizing?