Question 3: $331 - 175 - 150 - 2 = 4$

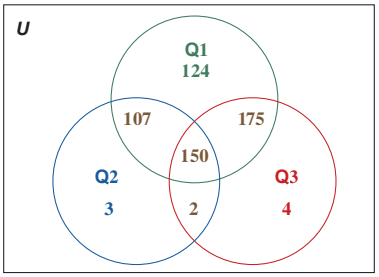


Figure 2.4.20

Finally, subtract all the numbers in the regions (1) through (7) from 1000 to determine how many residents answered No to all three questions.

$$1000 - 124 - 107 - 175 - 150 - 3 - 2 - 4 = 435$$

Figure 2.4.21 shows the completed Venn Diagram.

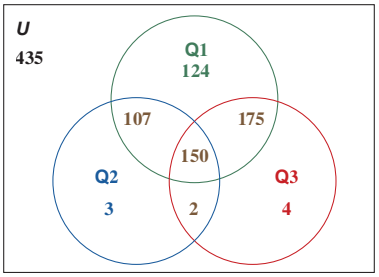
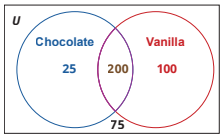


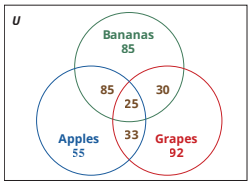
Figure 2.4.21

There were 435 residents who responded No to all three questions.

Skill Check Answers

1. 

75 like neither ice cream. **2. a.** $|A \cap C| = 8$ **b.** $|B \cap C| = 2$

3. 

405 shoppers in the survey.

2.4 Exercises

✔ CONCEPT CHECK

1. A two-set Venn diagram has a total of _____ regions.

2. A three-set Venn diagram has a total of _____ regions.

3. True or False: Region (8) of a three-set Venn diagram represents the complement of the union of the three sets.

4. True or False: If three sets are disjoint, then regions (4), (5), and (6) will be empty and regions (1), (2), (3), and (7) will contain elements.

PRACTICE

5. Construct a Venn diagram illustrating the following sets: $A = \{\text{apple, orange, grape, peach}\}$, $B = \{\text{grape, banana, apple, kiwi}\}$, and $C = \{\text{kiwi, apple, peach, banana}\}$ if $U = \{\text{apple, orange, peach, grape, banana, kiwi}\}$.

6. Construct a Venn diagram illustrating the sets: $A = \{1, 2, 3, 4\}$, $B = \{2, 4, 6, 8, 10\}$, and $C = \{3, 4, 6\}$ if $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.

APPLICATIONS

7. A survey of 400 college freshmen showed that 200 drink soda, 300 drink juice, and 150 drink both. Draw a Venn diagram to determine how many students responded that they drink neither.

8. A survey of 350 students showed that 225 listen to rap and 200 listen to rock and 135 listen to both. Draw a Venn diagram to determine how many students responded that they listen to neither.

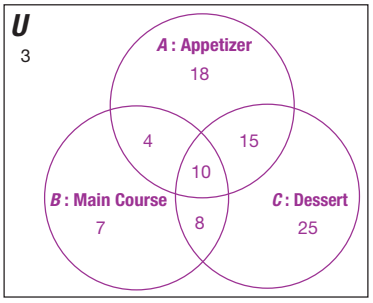
9. A researcher collecting data on 100 households finds that 47 have a DVD player; 52 have only streaming video, and 27 have both. Determine the answer to the following questions.

- **a.** How many do not have video streaming?
- **b.** How many have neither video streaming nor a DVD player?
- **c.** How many have a DVD player but not video streaming?

10. A survey of 600 workers yielded the following information: 417 belonged to the Auto Workers Union, 275 were Democrats, and 215 of the Auto Workers Union were Democrats.

- **a.** How many workers belonged to the Auto Workers Union or were Democrats?
- **b.** How many workers belonged to the Auto Workers Union but were not Democrats?
- **c.** How many workers were Democrats but did not belong to the Auto Workers Union?
- **d.** How many workers neither belonged to the Auto Workers Union nor were Democrats?

11. A three-course meal is served during the soft opening of a new restaurant. The three-course meal included an appetizer, the main course, and dessert. After the meal, diners were asked whether they enjoyed each course. The following Venn diagram summarizes the results.

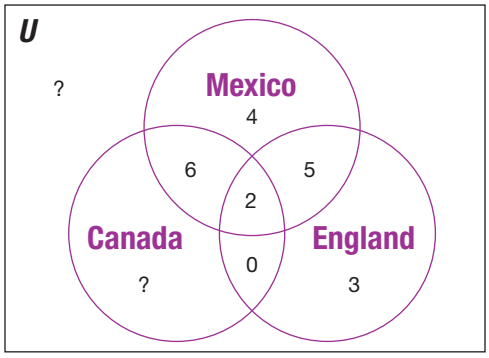


Use the information in the diagram to determine the following and describe what each represents.

a. $|(A \cup B \cup C)'|$

b. $|B \cup C|$

12. There are 43 students in the University Travel Club. They discovered that 17 members have visited Mexico, 10 have been to England, 28 have visited Canada, 8 have been to Mexico and Canada, 3 have only been to England, and 4 have only been to Mexico. No student has been to only England and Canada. Two students have been to all three countries. Some of the club members have not been to any of the three.



a. How many students have been to all three countries?

b. How many students have been only to Canada?

c. How many have been to Mexico or Canada but not England?

d. How many have been to none of the countries?

13. Students were polled on which of the three restaurants in the student center they have purchased food from in the past week. Out of those surveyed, 250 students made a purchase from Pizza Palace, 278 students made a purchase from Maing Wok, 226 students made a purchase from Salad Express, 87 students made a purchase from both Pizza Palace and Maing Wok, 57 students made a purchase from both Pizza Palace and Salad Expression, 95 students make a purchase from both Maing Wok and Salad Express, and 22 students made a purchase from all three restaurants. A total of 63 students replied that they had not made a purchase from any of the restaurants. Draw a Venn diagram to illustrate this survey and determine how many students were polled.

14. A variety show consisted of three acts: music, comedy, and magic. All audience members were asked which acts they enjoyed. Out of those surveyed, 105 enjoyed the music, 122 enjoyed the comedy, 95 enjoyed the magic, 50 enjoyed both the music and the comedy, 37 enjoyed both the music and the magic, 57 enjoyed both the comedy and the magic, and 15 enjoyed all three. Only 7 audience members did not enjoy any of the three acts. Assuming every audience member completed a survey, draw a Venn diagram to illustrate this survey and determine how many people were in the audience.

15. A survey of 125 freshman business students at a large university produced the following results:

35 read *Money*;
25 read *The Wall Street Journal*;
32 read *Fortune*;
21 read *Money* but not *The Wall Street Journal*;
11 read *The Wall Street Journal* and *Fortune*;
13 read *Money* and *Fortune*;
9 read all three.

Use this information to answer the following questions:

a. How many students read none of the publications?

b. How many read only *Fortune*?

c. How many students read *Money* and *The Wall Street Journal*, but not *Fortune*?

16. Taylor Swift, Drake, and BLACKPINK toured the United States. A large group of teenagers were surveyed about whether they went to any of the concerts and the following information was obtained: 825 saw Drake, 1033 saw Taylor Swift, 1247 saw BLACKPINK, 211 saw all three, 514 saw none, 240 saw only BLACKPINK, 677 saw BLACKPINK and Taylor Swift, and 201 saw Taylor Swift and Drake but not BLACKPINK.

a. What percent of the teenagers saw at least one concert?

b. What percent of the teenagers saw exactly one concert?

17. A book publishing company asked 400 random customers of a bookstore whether they purchased print books, e-books, or audiobooks in the past year. The results are summarized in the following table.

Bookstore Customer Book Format Preference	
Print Book	149
e-Book	281
Audiobook	215
Print Book and e-Book	98
Print Book and Audiobook	69
e-Book and Audiobook	153
Print Book, e-Book, and Audiobook	42

a. How many people purchased none of the three book formats in the past year?

b. How many people purchased e-books and audiobooks but not print books?

c. How many people purchased only print books?

18. An artist sent out a survey with her newsletter asking fans which type of merchandise they would be interested in buying. The options were art prints, T-shirts, and stickers. The results of the 326 fans who completed the survey are shown in the following table.

Merchandise Preference	
Art Prints	153
T-Shirts	121
Stickers	198
Art Prints and T-Shirts	37
Art Prints and Stickers	66
T-Shirts and Stickers	62
Art Prints, T-Shirts, and Stickers	12

a. How many fans indicated they would buy none of the options?

b. How many fans indicated they would buy art prints and stickers but not T-shirts?

c. How many fans indicated they would buy only T-shirts?

WRITING & THINKING

19. There are three types of blood antigens that determine blood type: A, B, and Rh+. An individual's blood type is determined by the specific combination of these antigens. In order to receive a blood transfusion, you can't receive blood from a donor who has an antigen that you don't have yourself. That means that people with AB+ blood can receive a transfusion from ANY donor, since they have all of the possible antigens. They can only donate to other people with AB+. People with O– blood (none of the antigens) can only receive type O– blood, since all other blood types have at least one of the antigens. However, they can donate their blood to anyone, since their blood does not have any of the antigens. A laboratory looked at blood samples for 200 patients and found the following information provided in the table. How many patients were classified as O–? Explain your reasoning.

Blood Antigen Survey Results	
Number of Samples	**Antigen in Blood**
80	A
36	B
82	Rh
10	A and B
62	A and Rh
22	B and Rh
4	A, B, and Rh

2.4 PROJECT

SET THEORY AND ALLOCATION OF RESOURCES

According to the job interviewing coaches Jeff & Mike *The Interview Guys*,

> Analytical skill is the ability for an individual to solve complex issues by gathering and then analyzing the information that is available to them through a variety of other skills including critical thinking, research, and attention to detail.

In this activity, you will solve a seemingly complex allocation of resources problem by using a mathematical model involving Venn diagrams.

A medium-size tech company has to staff 3 distinct departments: Social Media Outreach (SM), Information Technology (IT), and Web Development (WD). The fast-paced and innovative environment at the company may require an employee to be part of more than one department.

The company has the following staffing requirements.

- The total number of employees in the three departments must be exactly 40.
- There must be exactly 16 employees in Information Technology and exactly 20 employees in Social Media Outreach.
- No employee can work in Information Technology and Social Media Outreach without also being a part of Web Development.