

### Exercises for Section 1.3

- Suppose  $A$  and  $B$  are subsets of  $U$  with  $n(U) = 38$ ,  $n(A) = 17$ ,  $n(B) = 22$ , and  $n(A \cap B) = 8$ .  
(a) Find  $n(A')$                       (b) Find  $n(A \cup B)$                       (c) Find  $n((A \cup B)')$
- Suppose  $A$  and  $B$  are subsets of  $U$  with  $n(U) = 60$ ,  $n(A) = 40$ ,  $n(B') = 25$ , and  $n(A \cap B) = 22$ .  
(a) Find  $n(B)$                       (b) Find  $n(A \cup B)$                       (c) Find  $n((A \cap B)')$
- Let  $A$  and  $B$  be subsets of  $U$  with  $n(U) = 100$ ,  $n(A) = 60$ ,  $n(B') = 30$ , and  $n(A \cup B) = 75$ . Find  $n(A \cap B)$ .
- Suppose  $E$  and  $F$  are subsets in a universal set  $U$  with  $n(U) = 60$ ,  $n(E) = 32$ ,  $n(E \cap F) = 8$ , and  $n(E' \cap F) = 18$ . Find  $n(F)$ .
- Let  $A$  and  $B$  be subsets of  $U$  with  $n(U) = 150$ ,  $n(B') = 70$ ,  $n(A \cap B') = 30$ , and  $n(A \cap B) = 75$ . Find  $n(A \cup B)$ .
- Let  $A$  and  $B$  be disjoint subsets of  $U$  with  $n(U) = 45$ ,  $n(A) = 12$ , and  $n(B') = 22$ . Find  $n(A' \cap B)$ .
- A state legislature is considering increases in the gas tax and additional spending for highways, and 50 likely voters are asked their views. Of these voters, 25 favor additional spending for highways, 10 favor a gas tax increase, and 8 favor both. How many of these voters favor neither a gas tax increase nor additional spending for highways?

*Voter preferences*

- Product performance* 8. An item is said to be defective if it has a major defect or minor defect or both. In a batch of 25 defective items, 20 have major defects and 14 have minor defects. How many items in the batch have both major and minor defects?
- College life* 9. Fifty students are asked about their plans for the weekend. Thirty-five plan to go to a football game, twenty plan to attend a concert, and fifteen plan to do both. How many plan to do neither?
- Course enrollments* 10. Let  $A$  and  $B$  be subsets of a universal set  $U$ :  $n(U) = 60$ ,  $n(B) = 25$ , and  $n(A \cup B) = 45$ . Find  $n(A \cap B)$  and  $n(A' \cap B)$ .
- Course enrollments* 11. At the local high school, 34 students take a course in mathematics, 26 take a course in psychology, and 12 take both. How many students take exactly one of these two courses?
- Data surveys* 12. A survey of 150 college students results in the following data:  
 100 read the student paper published by their school.  
 20 read the local city paper.  
 85 who read the student paper *do not* read the city paper.  
 (a) How many of the students surveyed read the city paper but not the student paper?  
 (b) How many read *at least one* of the papers?
- Product performance* 13. A quality control analyst for Wonder Widget Company is reviewing the performance of 15 different types of widgets. He finds that in comparison with the previous year, 12 have improved reliability and 8 have improved durability. Only 2 types have improved neither reliability nor durability. How many types of widgets have improved both reliability and durability?
- Product performance* 14. An automobile tested by a national highway traffic safety commission was found to have 20 production defects. Of these, 11 were classified as major defects and 8 were design defects; 4 were neither major defects nor design defects. How many of the design defects were major?
- Careers* 15. There were 100 premedical students who were not admitted to medical school. Asked whether they would be interested in careers as medical technicians or registered nurses, 54 of these students expressed an interest in medical technology, 32 in nursing, and 23 in both. How many students were interested in neither of these careers?
16. A sports enthusiasts' club has 123 members. Of the members, 102 like basketball, 69 like football, 17 like baseball, 7 like basketball and baseball, 9 like football and baseball, 52 like basketball and football, and only 2 like all three sports. How many members of the sports enthusiasts' club like none of these three sports?
17. Let  $A$  and  $B$  be subsets of  $U$ , with  $n(U) = 50$ . If  $n(A) = 24$ ,  $n(B) = 30$ , and there are 8 elements of  $U$  in  $A$  which are not in  $B$ , find the number in  $B$  which are not in  $A$ .
18. Let  $A$  and  $B$  be subsets of  $U$  with  $n(U) = 50$ ,  $n(A' \cap B') = 20$ , and  $n(A \cap B) = 6$ . Find the number of elements which are in  $A$  or in  $B$  but not in both.
19. Let  $A$  and  $B$  be subsets of a universal set  $U$ :  $n(U) = 60$ ,  $n(B) = 25$ , and  $n(A \cup B) = 45$ . Find  $n(A \cap B)$ .
- Course enrollments* 20. In a mathematics class with 250 students, 100 are also taking accounting, 150 are taking economics, and 200 are in an English composition class. Of those students in the mathematics class who are also taking economics, 25 are *not* taking either

accounting or English, 75 are taking both accounting and English, and 25 are taking English but not accounting.

- (a) How many of the mathematics students are taking accounting and economics but not English?  
 (b) How many are taking mathematics and accounting but neither English nor economics?

*Data surveys*

21. The local pet store surveyed 50 people about pets. Eleven of these people owned dogs, 13 owned cats, and 6 owned fish. One person owned all three types of pets, 2 people owned only fish and dogs, 3 people owned only fish and cats, and 5 people owned only cats and dogs. How many people owned none of these pets?

22. A survey of 50 college men gave the following results:

20 subscribed to *Men's Health*

15 subscribed to *Sports Illustrated*

10 subscribed to *Forbes*

5 subscribed to both *Men's Health* and *Sports Illustrated*

7 subscribed to both *Men's Health* and *Forbes*

3 subscribed to all three magazines

18 subscribed to none of the three magazines

How many students subscribe to *Sports Illustrated* and *Forbes* but not *Men's Health*?

*Business*

23. An accounting firm has partners who are specialists in specific areas. The areas of specialization and the number of partners with each specialty are shown in Table 1.1. If every partner is a specialist in at least one area, how many partners are there?

**TABLE 1.1**

Specialization	Number
Auditing	11
Consulting	9
Tax	12
Auditing and consulting	5
Auditing and tax	8
Consulting and tax	7
All three	3

*Data surveys*

24. There are 288 university bookstores which offer at least one of the following: early bird discounts, buyback plans, and a pizza coupon for purchases over \$20. Of these schools, 129 offer discounts, 242 offer buyback plans, 103 offer a pizza coupon, 36 offer both a pizza coupon and buyback plan, and 51 offer discounts and pizza coupons. How many stores offer buyback plans and discounts but not pizza coupons?

*Marketing*

25. A market analyst at Healthful Drug Corporation is analyzing the results of a market survey on a new product, Acheaway pain reliever. Each individual surveyed was asked to respond (positively, neutral, or negatively) to the effectiveness of the drug, the side effects (if any), and its cost. There are 150 completed surveys. Of those surveyed, 60 responded positively to effectiveness, 50 responded positively to side effects, and 40 responded positively to cost. Also, 20 responded positively to both

effectiveness and side effects, 15 to side effects and cost, 10 to cost and effectiveness, and 37 to none of the items. Find the number that responded positively to all three.

- Product performance* 26. Eighty-two individuals have complained to the Consumer Protection Agency about the 2003 Joltmobile. The information contained in the letters of complaint is summarized below.
- 25 complained about steering.
  - 23 complained about comfort.
  - 22 complained about visibility.
  - 11 complained about steering and comfort.
  - 7 complained about steering and visibility.
  - 5 complained about all three.
  - 33 complained about none of the three.
- (a) How many people complained about comfort and visibility but not about steering?
- (b) How many complained about *exactly* one of the three items: steering, comfort, and visibility?
27. Sets  $A$ ,  $B$ , and  $C$  are subsets of a universal set  $U$ . Suppose  $n(U) = 80$ ,  $n(A) = 15$ ,  $n(A \cap B) = 2$ ,  $n(C) = 30$ ,  $n((A \cup B)') = 35$ , and  $(A \cup B) \cap C = \emptyset$ . Find:
- (a)  $n(C')$
  - (b)  $n(A \cap C)$
  - (c)  $n(A' \cap B)$
28. Suppose  $A$ ,  $B$ , and  $C$  are subsets of a universal set  $U$ . Also suppose  $n(A) = 15$ ,  $n(B) = 25$ ,  $n(C) = 35$ ,  $n(A' \cap B' \cap C') = 55$ , and  $n(A \cap B) = n(A \cap C) = n(B \cap C) = n(A \cap B \cap C) = 10$ . Find  $n(U)$ .
- Recreation* 29. Each of the students in the Outdoor Club at Gigantic State University likes at least one of the activities of hiking, camping, and canoeing. Of these students, 90 like either hiking or camping or both, 60 like canoeing, and 30 like all three. What can be said about the number of students who like canoeing and exactly one of hiking or camping?
- Business* 30. A corporation employs 95 people in the areas of sales, research, and administration. Some of the employees can function in more than one area; indeed, 10 can function in any of the three areas, 30 can function in sales and administration, 20 can function in sales and research, and 15 can function in administration and research. There are twice as many people in sales as in research and the same number in sales and in administration.
- (a) How many can function in exactly one area?
  - (b) How many of these employees can function in sales?
  - (c) How many can function only in sales?
- (There really is enough information to answer these questions.)
- Data surveys* 31. Data, including geographic location, city size, and marital status, on 200 recent graduates of Gigantic State University are collected by the Alumni Association. The results are as follows:
- 108 live in the west.
  - 86 live in a large city.
  - 68 are married.

- 41 live in the west in a large city.
- 23 are married and live in a large city.
- 19 are married and live in the west.
- 12 are married and live in a large city in the west.

How many are unmarried, do not live in a large city, and do not live in the west?

*Data surveys*

32. The Transportation and Parking Committee at Gigantic State University collects data from 100 students on how they commute to campus. The following data are obtained:
- 8 drive a car at least part of the time.
  - 20 use the bus at least part of the time.
  - 48 ride a bicycle at least part of the time.
  - 38 do none of these.
- No student who ever drives a car also uses the bus.
- How many students who ride a bicycle also drive a car or use the bus?
33. The 2500 students at Mathematically Limited University (MLU) may take at most two mathematics courses. Available courses are Algebra, Big Numbers, and Common Fractions. Recent enrollment numbers show that 400 students opted to take no math classes, 600 chose Algebra, 1100 chose Big Numbers, 200 chose Algebra and Big Numbers, 300 chose Algebra and Common Fractions, and 500 chose Big Numbers and Common Fractions. What is the maximum possible number who chose to take Common Fractions?