

1. Determine whether the following is a well-defined set.

$\{x \mid x \text{ is a small counting number}\}$

- A) no
- B) yes

2. Use  $\in$  or  $\notin$  to indicate whether the given object is an element of the given set.

5  $\{1, 2, 3, 4, 5, 6\}$

- A)  $5 \in \{1, 2, 3, 4, 5, 6\}$
- B)  $5 \notin \{1, 2, 3, 4, 5, 6\}$

3. Write a description of the set  $\{9, 10, 11, 12\}$ .

- A) The set of all integers between 8 and 13.
- B) The set of all integers between 9 and 12.
- C) The set of all real numbers between 8 and 13.
- D) The set of all real numbers between 9 and 12.
- E) The set of all rational numbers between 9 and 12.

4. Write a verbal description of the following set.

$\{4, 6, 8, \dots, 24\}$

- A) The set containing all rational numbers from 4 to 24
- B) The set containing all prime numbers from 4 to 24
- C) The set containing all even numbers from 4 to 24
- D) The set containing all real numbers from 4 to 24
- E) The set containing all odd numbers from 4 to 24

5. Write the set using the listing (roster) method.

$\{n \mid n \text{ is a counting number greater than } 4\}$

- A)  $\{4, 5, 6, \dots\}$
- B)  $\{5, 6, 7, \dots\}$
- C)  $\{1, \dots, 4\}$
- D)  $\{1, \dots, 5\}$
- E)  $\{3, 4, 5, \dots\}$

6. Write the set using the listing (roster) method.

$\{ n \mid n \text{ is a counting number between } 2 \text{ and } 6 \}$

A)  $\{2, 4, 6\}$

B)  $\{2, 3, 4, 5, 6\}$

C)  $\{2, 6\}$

D)  $\{1, 2, 3, \dots, 6\}$

E)  $\{3, 4, 5\}$

7. State whether the sets A and B are equal or not equal.

$A = \{3n - 4 \mid n \text{ is a counting number}\}$

$B = \{3n + 4 \mid n \text{ is a counting number}\}$

A)  $\neq$

B)  $=$

8. Indicate whether the following sets are equal.

$A = \{x, h, a, w\}$ ,  $D = \{x, a, b, y\}$

A)  $A \neq D$

B)  $A = D$

9. Let  $A = \{g, r, e, a, t\}$ . Which of the following sets is equal to A?

A)  $B = \{r, g, a, t, e, a\}$ .

B)  $B = \{r, g, a, t, e\}$ .

C)  $B = \{g, r, a, d, e\}$ .

D)  $B = \{r, g, a, e\}$ .

10. Find the number of subsets of the set of all consonants in the alphabet.

A) 441

B) 2,097,152

C) 21

D) 512

11. Find a subset of the set  $\{12, 14, 16, 18, \dots, 4000\}$ .
- A) The set of even whole numbers.
  - B)  $\{3997, 3998, 3999, 4000\}$
  - C)  $\{12, 16, 20, 24, \dots, 4000\}$
  - D)  $\{-12, -10, -8, \dots, 8, 10, 12\}$
  - E) The set of positive real numbers between 12 and 4000.
12. If  $A = \left\{1, \frac{1}{2}, \frac{1}{3}, \dots, \frac{1}{10}\right\}$ , how many subsets does  $A$  have?
- A) 10
  - B) 20
  - C) 1023
  - D) 1024
  - E) 512
13. A set has 128 subsets. How many elements are there in the set?
- A) 32
  - B) 13
  - C) 128
  - D) 6
  - E) 7
14. An Italian food restaurant claims that with the choices of toppings that they offer on their pizzas, you can order about 16,400 different types of pizza. How many toppings do they offer?
- A) 16,400
  - B) 14
  - C) 16,384
  - D) 16
  - E) 18

15. Find  $A \cap B$ , the intersection of sets  $A$  and  $B$ .

$$A = \{2, 3, 4, 5, 6\} \text{ and } B = \{4, 6, 8, 10, 12\}$$

- A)  $A \cap B = \{4, 5, 7, 9, 11\}$
- B)  $A \cap B = \{3, 5\}$
- C)  $A \cap B = \{4, 6, 8, 10, 12\}$
- D)  $A \cap B = \{2, 3, 4, 5, 6\}$
- E)  $A \cap B = \{4, 6\}$

16. Find the intersection of the following sets.

$$\{1, 4, 7, 13, 15\} \cap \{3, 4, 5, 13, 17\}$$

- A)  $\{1, 3, 4, 5, 7, 13, 15, 17\}$
- B)  $\emptyset$
- C)  $\{4, 13\}$
- D) None of these

17. Find  $A \cup B$ , the union of sets  $A$  and  $B$ .

$$A = \{c, f, h, i, u\} \text{ and } B = \{a, b, c, d\}$$

- A)  $A \cup B = \{f, h, i, u\}$
- B)  $A \cup B = \{a, b, c, d\}$
- C)  $A \cup B = \{a, b, c, d, f, h, i, u\}$
- D)  $A \cup B = \{a, c, d, f, h, i, u\}$
- E)  $A \cup B = \{a, c, d, f, u\}$

18. Assume that

$$A = \{2, 3, 4, 7\}$$

$$B = \{5, 3, 4\}$$

$$C = \{2, 3, 5, 6\}$$

and that  $U$  is the universal set of natural numbers less than 11. Find  $A \cap (B \cup C)$ .

A)  $A \cap (B \cup C) = \{1, 3, 7, 9\}$

B)  $A \cap (B \cup C) = \{2, 3, 4\}$

C)  $A \cap (B \cup C) = \{3, 5, 7, 9\}$

D)  $A \cap (B \cup C) = \{1, 2, 4, 7, 9\}$

E)  $A \cap (B \cup C) = \{2, 7, 8\}$

19. Let  $A = \{\{a, b\}, \{a, b, c\}, a, b\}$  and  $B = \{\{a, b\}, a, b, c, \{b, c\}\}$ . Which of the following statements is correct?

A)  $\{b, c\} \in (A \cap B)$

B)  $\{a, b\} \subseteq (A \cap B)$

C)  $\{a, c\} \subseteq (A \cap B)$

D)  $a \notin (A \cup B)$

E)  $\{a, b\} \not\subseteq (A \cup B)$

20. Let  $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$  and  $T = \{2, 4, 6\}$ . Find  $T'$ .

A)  $T' = \{2, 4, 6\}$ .

B)  $T' = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ .

C)  $T' = \{1, 2, 2, 3, 4, 4, 5, 6, 6, 7, 8, 9, 10\}$ .

D)  $T' = \{1, 3, 5, 7, 8, 9, 10\}$ .

21. Assume that

$$A = \{2, 3, 4, 7\}$$

$$B = \{1, 2, 5, 7, 8\}$$

and that  $U$  is the universal set of natural numbers less than 11. Find  $A' \cap B'$ .

A)  $A' \cap B' = \{1, 5, 7, 8\}$

B)  $A' \cap B' = \{2, 4, 9, 10\}$

C)  $A' \cap B' = \{3, 6, 7\}$

D)  $A' \cap B' = \{6, 9, 10\}$

E)  $A' \cap B' = \{1, 3, 5, 7\}$

22. Assume that

$$A = \{1, 2, 3, 5, 8, 7\}$$

$$B = \{5, 3, 4\}$$

and that  $U$  is the universal set of natural numbers less than 11. Find  $(A \cap B)'$ .

A)  $(A \cap B)' = \{1, 2, 4, 6, 7, 8, 9, 10\}$

B)  $(A \cap B)' = \{1, 4, 7, 9, 10\}$

C)  $(A \cap B)' = \{1, 4, 5, 7, 9\}$

D)  $(A \cap B)' = \{2, 4, 6, 7, 9\}$

E)  $(A \cap B)' = \{3, 5, 7, 9\}$

23. Let  $U = \{3, 6, 9, 11, 13, 16\}$ ,  $A = \{3, 6, 11, 16\}$ , and  $B = \{13, 16\}$ . Find  $A \cap B'$ .

A)  $A \cap B' = \{3, 6, 11\}$

B)  $A \cap B' = \{13, 16\}$

C)  $A \cap B' = \{3, 6, 11, 16\}$

D)  $A \cap B' = \{3\}$

E)  $\emptyset$

24. Assume that

$$A = \{2, 3, 4, 7\}$$

$$B = \{5, 3, 4\}$$

and that  $U$  is the universal set of natural numbers less than 11. Find  $A \cap B'$ .

A)  $A \cap B' = \{2, 3, 4, 7\}$

B)  $A \cap B' = \{2, 3, 5, 6\}$

C)  $A \cap B' = \{2, 7\}$

D)  $A \cap B' = \{1, 2, 6, 7, 8, 9, 10\}$

E)  $A \cap B' = \{5, 3, 4, 9\}$

25. Set  $A = \{2, 3, 5, 7, 9\}$ , Set  $B = \{1, 3, 7, 8, 9\}$ . Find  $B - A$ .

A)  $\{3, 7, 9\}$

B)  $\{1, 8\}$

C)  $\{2, 5\}$

D)  $\{0\}$

26. Assume that  $A = \{1, 2, 3, 5, 8, 7\}$  and that  $U$  is the universal set of natural numbers less than 11. Find  $A'$

A)  $A' = \{1, 2, 3, 5, 8, 7\}$

B)  $A' = \{4, 6, 9, 10\}$

C)  $A' = \{5, 7, 3\}$

D)  $A' = \{1, 2, 4, 6, 8, 9, 10\}$

E)  $A' = \{1, 3, 5, 7\}$

27. A small company lists employees by a number code. The company classifies these employees according to the work they do.

$P = \{\text{the set of part-time employees}\}$

$F = \{\text{the set of full-time employees}\}$

$S = \{\text{the set of employees who do shop work}\}$

$O = \{\text{the set of employees who do outdoor field work}\}$

$I = \{\text{the set of employees who do indoor office work}\}$

The payroll department lists their employee codes as the following:

$P = \{07, 08, 011, 013\}$

$F = \{09, 010, 012, 014, 015, 016\}$

$S = \{07, 010, 011, 014\}$

$O = \{09, 010, 012, 015\}$

$I = \{08, 011, 013, 016\}$

Determine the set  $F \cap S$

A)  $\{07, 09, 010, 011, 012, 014, 015, 016\}$

B)  $\{010, 014\}$

C)  $\{010, 011\}$

D)  $\{014\}$

E)  $\{010, 011, 014\}$



28. The number of jobs in 2000, the number projected in 2025, and the projected annual growth rate for jobs in some cities are shown in the table below. Consider the following sets.

$A$  = Set of cities with at least 2,000,000 jobs in 2000 or in 2025

$B$  = Set of cities with at least 1,500,000 jobs in 2000

$C$  = Set of cities with projected annual growth rate of at least 2.5%

Cities	Jobs in 2000 (thousands)	Projected Jobs in 2025 (thousands)	Annual Rates of Increase (%)
O (Orlando)	1539	1923	0.89
M (Myrtle Beach)	133	256	2.65
L (Atlanta)	2715	4893	2.38
P (Phoenix)	1953	3723	2.61
D (Denver)	233	524	3.29

Find  $A \cap C$ .

- A)  $A \cap C = \{O, P\}$
- B)  $A \cap C = \{M\}$
- C)  $A \cap C = \{L, P\}$
- D)  $A \cap C = \{P\}$
- E)  $A \cap C = \{O, M, P\}$

29. The number of jobs in 2000, the number projected in 2025, and the projected annual growth rate for jobs in some cities are shown in the table on the next page. Consider the following sets.

$A$  = Set of cities with at least 2,000,000 jobs in 2000 or in 2025

$B$  = Set of cities with at least 1,500,000 jobs in 2000

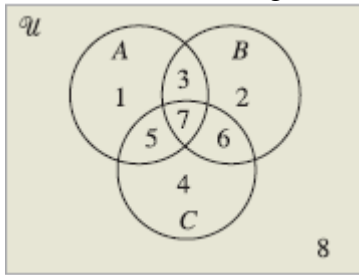
$C$  = Set of cities with projected annual growth rate of at least 2.5%

Cities	Jobs in 2000 (thousands)	Projected Jobs in 2025 (thousands)	Annual Rates of Increase (%)
O (Orlando)	1582	1923	0.78
M (Myrtle Beach)	133	256	2.65
L (Atlanta)	2715	4893	2.38
P (Phoenix)	1953	4182	3.09
B (Boulder)	233	420	2.38

Choose the correct verbal description of  $A \cap C$ .

- A) The set of cities with at least 2,000,000 jobs in 2000 or 2025 or projected annual growth rates of at least 2.5%
- B) The set of cities with at least 2,000,000 jobs in 2000 or 2025 and projected annual growth rates of at least 2.5%
- C) The set of cities with at least 2,000,000 jobs in 2000 or 2025 and projected annual growth rates of at least 2.5%
- D) The set of cities with at least 1,500,000 jobs in 2000 and projected annual growth rates of at least 2.5%
- E) The set of cities with at least 1,500,000 jobs in 2000 or projected annual growth rates of at least 2.5%

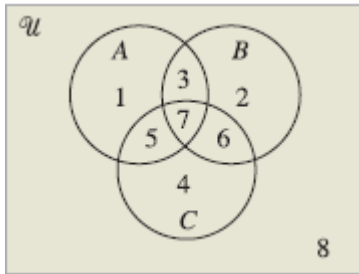
30. Use the numbered regions of the diagram below to identify the specified set.



$$A - (B \cup C)$$

- A)  $\{1\}$
- B)  $\{1, 7\}$
- C)  $\{4\}$
- D)  $\{2, 4\}$
- E)  $\{1, 6, 7\}$

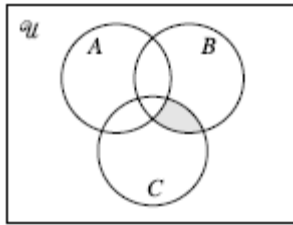
31. Use the numbered regions of the diagram below to identify the specified set.



$$C \cap (A \cup B)$$

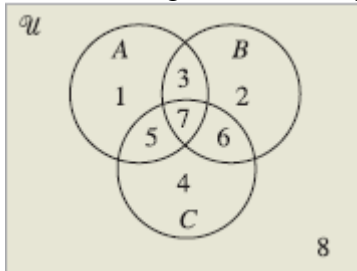
- A)  $\{5, 6, 7\}$
- B)  $\{3, 6, 7\}$
- C)  $\{7, 6, 1\}$
- D)  $\{4, 6, 1\}$
- E)  $\{7, 1, 2\}$

32. Which set describes the Venn Diagram?



- A)  $\{x \mid x \in A \text{ and } x \in B\}$
- B)  $\{x \mid x \in A \text{ and } (x \in B \text{ and } x \notin C)\}$
- C)  $\{x \mid x \notin A \text{ or } x \notin B\}$
- D)  $\{x \mid x \notin A \text{ and } (x \in B \text{ and } x \in C)\}$
- E)  $\{x \mid x \notin A \text{ or } x \notin B\}$

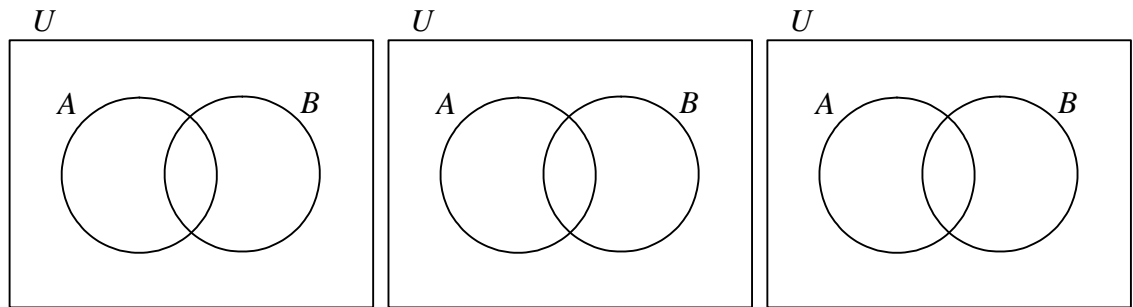
33. The set of regions  $\{5, 7\}$  represents which of the following?



- A)  $A \cap B \cap C$
- B)  $(A \cap B) \cup C$
- C)  $(A \cup B) \cap C$
- D)  $A \cup C$
- E)  $A \cap C$

34. Use Venn diagrams to determine which (if any) of the following expressions are equal for all sets  $A$  and  $B$ .

$$A' \cap B, \quad A' \cup A, \quad A' \cup B'$$

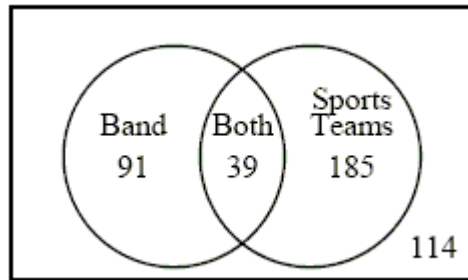


- A)  $A' \cap B, A' \cup A$   
 B)  $A' \cap B, A' \cup B'$   
 C) None are equal  
 D) All are equal  
 E)  $A' \cup A, A' \cup B'$

35. If, on checking with 100 families, it was found that 85 subscribe to *Time*, 41 to *Newsweek*, and 27 to both magazines, how many subscribe to neither?

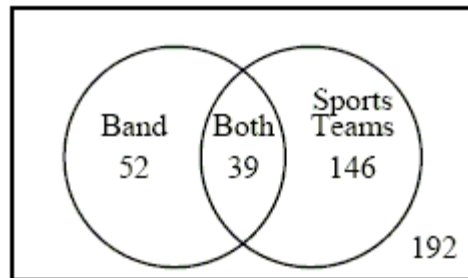
- A) 1  
 B) 126  
 C) 112  
 D) 14  
 E) 59

36. In a school of 429 students, 91 students participate in band, 185 students participate on sports teams, and 39 students participate in both activities. Choose the Venn diagram that correctly represents this information and then determine how many students are involved in neither band nor sports.



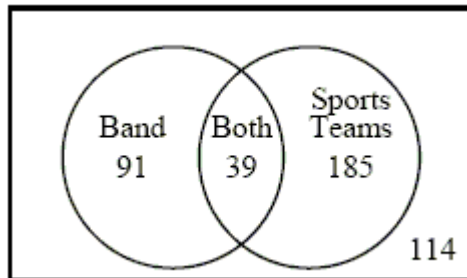
A)

153 students



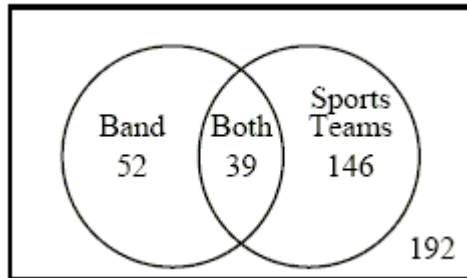
B)

153 students



C)

192 students



D)

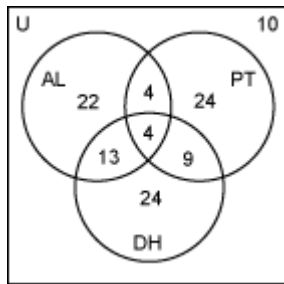
192 students

37. In a survey of the dining preferences of 110 dormitory students at the end of the spring semester, the following facts were discovered about Adam's Lunch (AL), Pizza Tower (PT), and the Dining Hall (DH).

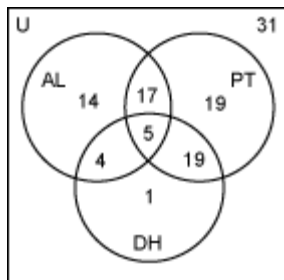
23 liked AL but not PT  
 19 liked AL only  
 42 liked AL  
 55 liked PT  
 29 liked DH  
 14 liked PT and AL but not DH  
 24 liked PT and DH

Choose the correct Venn diagram representing this survey.

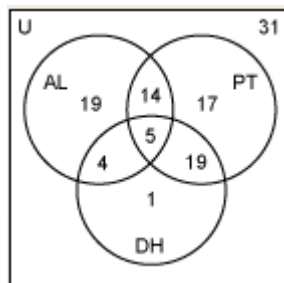
A)



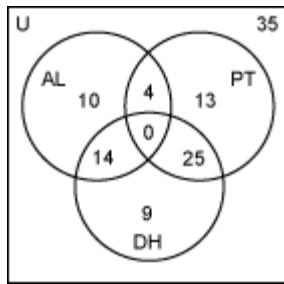
B)



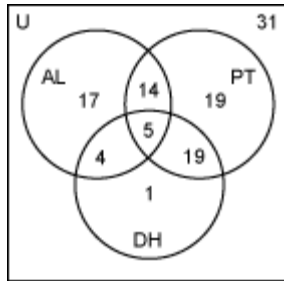
C)



D)



E)



38. Use the table to find the number of people in the set  $O \cap M$ .

**Personnel Distribution**

Department*	(A)	(C)	(O)	(SK)	(SS)	(U)
Purchasing (P)	1	14	7	0	0	0
Quality control (Q)	11	7	6	21	53	11
Sales (S)	8	8	40	0	0	0
Manufacturing (M)	5	7	0	9	23	37
Janitorial (J)	3	0	0	6	8	11

- A) 6
- B) 0
- C) 7
- D) 40
- E) 21



39. In a survey of the dining preferences of 110 dormitory students at the end of the spring semester, the following facts were discovered about Adam's Lunch (AL), Pizza Tower (PT), and the Dining Hall (DH).

15 liked AL but not PT  
10 liked AL only  
23 liked AL  
42 liked PT  
48 liked DH  
4 liked PT and AL but not DH  
25 liked PT and DH

How many liked PT or DH?

- A) 52
- B) 25
- C) 39
- D) 27
- E) 65

40. In a survey of the dining preferences of 110 dormitory students at the end of the spring semester, the following facts were discovered about Adam's Lunch (AL), Pizza Tower (PT), and the Dining Hall (DH).

19 liked AL but not PT  
10 liked AL only  
23 liked AL  
42 liked PT  
48 liked DH  
4 liked PT and AL but not DH  
25 liked PT and DH

How many liked only DH?

- A) 23
- B) 14
- C) 9
- D) 25
- E) 34

41. Suppose that a survey of 100 advertisers in *U.S. News*, *These Times*, and *World* found the following.

15 advertised in all three  
18 advertised in *These Times* and *U.S. News*  
39 advertised in *World* and *U.S. News*  
33 advertised in *World* and *These Times*  
49 advertised in *These Times*  
53 advertised in *U.S. News*  
68 advertised in *World*

How many advertised in none of these publications?

- A) 35
- B) 15
- C) 5
- D) 11
- E) 55

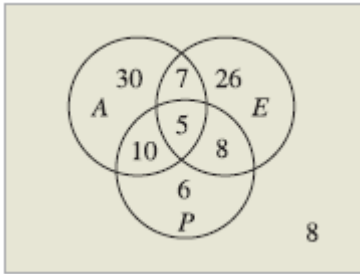
42. Suppose that a survey of 100 advertisers in *U.S. News*, *These Times*, and *World* found the following.

21 advertised in all three  
24 advertised in *These Times* and *U.S. News*  
57 advertised in *World* and *U.S. News*  
23 advertised in *World* and *These Times*  
51 advertised in *These Times*  
64 advertised in *U.S. News*  
65 advertised in *World*

How many advertised only in *These Times*?

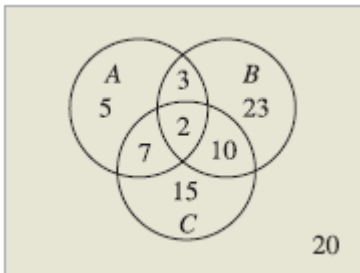
- A) 25
- B) 5
- C) 3
- D) 16
- E) 51

43. The number of students taking algebra (A), economics (E), and physics (P) in a certain school is shown in the diagram below.



How many students are taking algebra but not economics?

- A) 45
  - B) 23
  - C) 40
  - D) 42
  - E) 10
44. A number of people were interviewed to find out who buys products A, B, and C regularly. The results are shown in the diagram below.



How many people buy product B but not A?

- A) 33
- B) 12
- C) 5
- D) 22
- E) 9

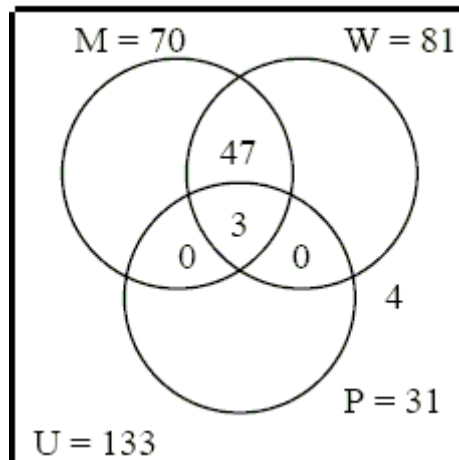
45. The Venn diagram below displays the results of a survey of 133 families regarding kitchen appliances.

**M** represents the number of families with a microwave.

**P** represents the number of families with a pasta maker.

**W** represents the number of families with a dishwasher.

**U** represents all the families surveyed.



How many families have a microwave and a dishwasher?

- A) 51  
B) 47  
C) 50  
D) 3
46. Find the cardinality of the set  $\{13, 17, 21, \dots, 85\}$ .
- A) 931  
B) 19  
C) 20  
D) 4  
E) 136
47. Find the cardinality of the set  $\{24, 48, 96, 192\}$ .
- A) 360  
B) 192  
C) 24  
D) 4  
E) 48

48. Show that the set  $\{8, 64, 512, \dots, 8^n, \dots\}$  has a cardinality of  $\aleph_0$  by establishing a one-to-one correspondence between the elements of this set and the elements of the set  $N$ .
- A) the general correspondence is given by  $n \leftrightarrow 8^n$
  - B) the general correspondence is given by  $n \leftrightarrow 8n$
  - C) the general correspondence is given by  $n \leftrightarrow n^8$
  - D) the general correspondence is given by  $n \leftrightarrow n + 8$
  - E) the general correspondence is given by  $n \leftrightarrow 8n + 8$
49. Choose the proper subset of  $S = \{3, 6, 9, 12, \dots, 3n, \dots\}$  that can be used to verify  $S$  as an infinite set.
- A)  $\{3, 6, 9, 12\}$
  - B)  $\{-3, -6, -9, -12, \dots, -3n, \dots\}$
  - C)  $\{6, 9, 12, 15\}$
  - D)  $\{6, 9, 12, 15, \dots, 3n + 3, \dots\}$
50. Determine whether sets  $A$  and  $B$  are equal but not equivalent, equivalent but not equal, both equal and equivalent, or neither equal nor equivalent.  
 $A$  is the set of all integers larger than 15 but smaller than 23  
 $B$  is the set of all whole numbers larger than 15.75 but smaller than 18.75
- A) both equal and equivalent
  - B) neither equal nor equivalent
  - C) equal but not equivalent
  - D) equivalent but not equal
51. Determine whether sets  $A$  and  $B$  are equal but not equivalent, equivalent but not equal, both equal and equivalent, or neither equal nor equivalent.  
 $A = \{33, 66, 132, 264\}$   
 $B = \{55, 110, 220, 440\}$
- A) equivalent but not equal
  - B) both equal and equivalent
  - C) equal but not equivalent
  - D) neither equal nor equivalent

## **Answer Key**

1. A
2. A
3. A
4. C
5. B
6. E
7. A
8. A
9. B
10. B
11. C
12. D
13. E
14. B
15. E
16. C
17. C
18. B
19. B
20. D
21. D
22. A
23. A
24. C
25. B
26. B
27. B
28. D
29. B
30. A
31. A
32. D
33. E
34. C
35. A
36. D
37. C
38. B
39. E
40. B
41. C
42. A
43. C
44. A

- 45. C
- 46. B
- 47. D
- 48. A
- 49. D
- 50. A
- 51. A