Thinking
Mathematically **4** Edition

$X=1$

8.6×10^{11}

$\sim q \rightarrow \sim p$

Σ

$f(x) = x+b$

Foil

+ > Blitzer

Ch. 2 Basic Set Concepts

2.1 Basic Set Concepts

1 Use Three Methods to Represent Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Write a description of the set.

1) {January, February, March, April, May, June, July, August, September, October, November, December}

   A) months of the year   B) days of the year   C) days of the week   D) seasons of the year

2) {36, 38, 40, 42, ..., 100}

   A) even numbers from 36 to 100   B) all even numbers

   C) numbers from 36 to 100   D) odd numbers from 36 to 100

List the elements in the set.

3) The set of the days of the week

   A) {Friday, Monday, Saturday, Sunday, Thursday,
      Tuesday, Wednesday}

   B) {Saturday, Sunday}

   C) {Tuesday, Thursday}

   D) {Sunday, Monday, Tuesday, Wednesday, Thursday,
      Friday, Sunday}

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.
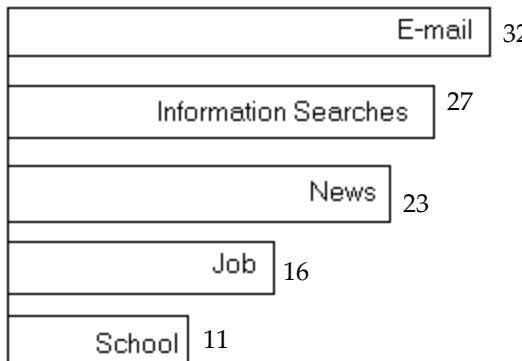
Express the set using the roster method.

4) {x | x is a city in the country where you live}

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The bar graph shows the percentage of adults that use the Internet for specific tasks. Use the graph to represent the given set using the roster method.

5) Percentage of Adults Using the Internet for a Specific Task
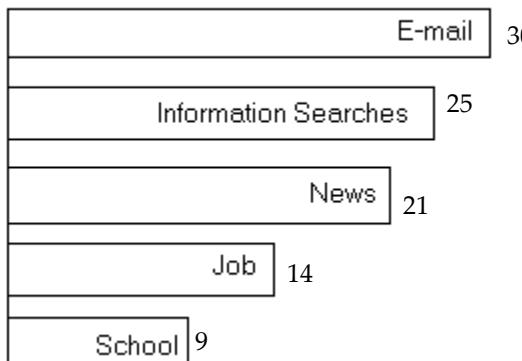
Task	Percentage
E-mail	32
Information Searches	27
News	23
Job	16
School	11

the set of tasks in which usage exceeds 21%

A) {e–mail, information searches, news}   B) {e–mail, information searches}

C) {e–mail, information searches, news, job}   D) {job, school}

6) Percentage of Adults Using the Internet for a Specific Task

Task	Percentage
E-mail	30
Information Searches	25
News	21
Job	14
School	9
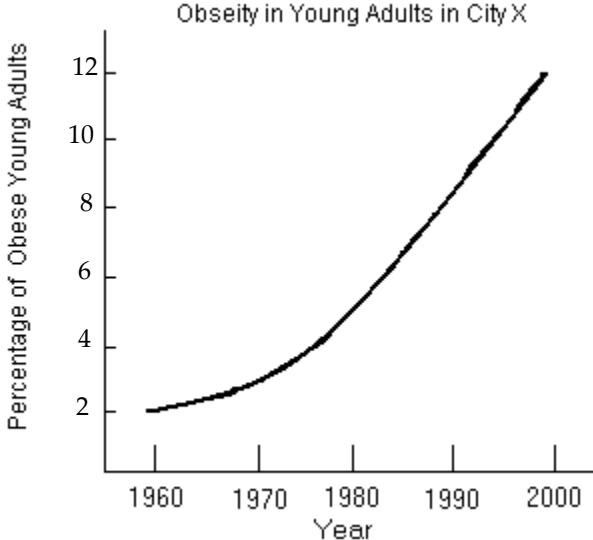
{x | x is a task in which usage lies between 11% and 29%}

A) {information searches, news, job}   B) {email, information searches, news, job, school}

C) {news}   D) {news, job}

The line graph shows the percentage of obese young adults in a certain city over time. Based on the information in the graph, represent the set using the roster method.

7)

Obseity in Young Adults in City X

{x | x is a year in which 8% of young Americans in city X are obese}

A) {1990}   B) {1970}   C) {1980}   D) {2000}

2 Define and Recognize the Empty Set

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Is the following the empty set?

1) $\{0, \emptyset\}$

   A) Yes   B) No

2) {x|x is a living U.S. president born after 1700}

   A) Yes   B) No

3) {x|x is the number of living U.S presidents born before 1700}

   A) Yes   B) No

4) {x|x is a day of the week whose name begins with thte letter Y}

   A) Yes   B) No

5) $\{x | x < 4 \text{ and } x > 8\}$

   A) Yes   B) No

6) $\{x | x \in N \text{ and } 2 < x < 6\}$

   A) Yes   B) No

7) {x|x is a number less than 2 or greater than 6}

   A) Yes   B) No

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3   Use the Symbols ∈ and ∉

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the statement is true or false.

    1) $3 \in \{1, 3, 5, 7, 9\}$

        A) True   B) False

    2) $9 \in \{1, 2, 3, ..., 15\}$

        A) True   B) False

    3) $9 \in \{2, 4, 6, ..., 20\}$

        A) True   B) False

    4) $16 \notin \{1, 2, 3, ..., 10\}$

        A) True   B) False

    5) $7 \notin \{1, 2, 3, ..., 40\}$

        A) True   B) False

Fill in the blank with either ∈ or ∉ to make the statement true.

    6) Nova Scotia _____ the set of states in the United States

        A) ∉   B) ∈

    7) 49,872 _____ the set of even natural numbers

        A) ∈   B) ∉

    8) 0 _____ ∅

        A) ∉   B) ∈

4   Apply Set Notation to Sets of Natural Numbers

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the set using the roster method.

    1) the set of natural numbers less than or equal to 8

        A) $\{1, 2, 3, ..., 8\}$ B) $\{0, 1, 2, 3, ..., 8\}$ C) $\{0, 1, 2, 3, ..., 7\}$ D) $\{1, 2, 3, ..., 7\}$

    2) the set of odd natural numbers less than 15

        A) $\{1, 3, 5, ..., 13\}$ B) $\{1, 3, 5, ..., 15\}$ C) $\{2, 4, 6, ..., 14\}$ D) $\{0, 1, 3, 5, ..., 13\}$

    3) $\{x \mid x \in N$ and x is greater than 7$\}$

        A) $\{8, 9, 10, ...\}$ B) $\{7, 8, 9, ...\}$ C) $\{8, 9, 10\}$ D) $\{8, 10, 12, ...\}$

4) {x | x ∈ N and x lies between 0 and 4}

    A) {1, 2, 3}   B) {0, 1, 2, 3, 4}   C) {0, 1, 2, 3}   D) {1, 2, 3, 4}

Express the set using set–builder notation. Use inequality notation to express the consition x must meet in order to be a member of the set.

5) A = {12, 13, 14, 15, 16,...}

    A) {x | x ∈ N and x ≥ 12}   B) {x | x ∈ N and x > 12}

    C) {x | x ∈ N and x ≥ 16}   D) {x | x ∈ N and x ≤ 12}

6) A = {600, 601, 602, . . ., 6000}

    A) {x | x ∈ N and 600 ≤ x ≤ 6000}   B) {x | x ∈ N and x ≤ 6000}

    C) {x | 600 < x < 6000}   D) {x | x ∈ N and x ≥ 600 }

5 Determine a Set's Cardinal Number

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the cardinal number for the set.

1) {27, 29, 31, 33, 35}

    A) 5   B) 6   C) 4   D) 27

2) {2, 4, 6, . . . , 60}

    A) 30   B) 20   C) 60   D) 15

3) {x | x is a day of the week that begins with the letter N}

    A) 0   B) 2   C) 1   D) 3

4) Determine the cardinal number of the set {x | x is a letter of the alphabet}

    A) 26   B) 25   C) 23   D) 30

6 Recognize Equivalent Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Are the sets equivalent?

1) A is the set of residents age 71 or older living in the United States
   B is the set of residents age 71 or older registered to vote in the United States

    A) Yes   B) No

2) A = {14, 15, 16, 17, 18}
   B = {13, 14, 15, 16, 17}

    A) Yes   B) No

3) A = {31, 33, 35, 37, 39}
   B = {32, 34, 36, 38, 40}

    A) Yes   B) No

4) A = {17, 18, 18, 19, 19, 19, 20, 20, 20, 20}
   B = {20, 19, 18, 17}

  A) Yes   B) No

5) A = {Larry, Moe, Curly. Shemp}
   B = {Posh, Sporty, Baby, Scary}

  A) Yes   B) No

7   Distinguish Between Finite and Infinite sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the set is finite or infinite.

1) {x | x ∈ N and x ≥ 1000}

  A) Finite   B) Infinite

2) {x | x ∈ N and x ≤ 100}

  A) Finite   B) Infinite

3) The set of natural numbers less than 100

  A) Finite   B) Infinite

4) The set of natural numbers less than 1

  A) Finite   B) Infinite

8   Recognize Equal Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Are the sets equal?

1) {e, f, g, h} = {f, h, g, e}

  A) Yes   B) No

2) {16, 18, 20, 22, 24} = {18, 20, 22, 24}

  A) Yes   B) No

3) {4, 4, 11, 11, 17} = {4, 11, 17}

  A) Yes   B) No

4) A is the set of residents age 74 or older living in the United States
   B is the set of residents age 74 or older registered to vote in the United States

  A) Yes   B) No

5) A = {13, 14, 15, 16, 17}
   B = {12, 13, 14, 15, 16}

  A) Yes   B) No

6) A = {13, 15, 17, 19, 21}
   B = {14, 16, 18, 20, 22}

   A) Yes   B) No

7) A = {14, 15, 15, 16, 16, 16, 17, 17, 17, 17}
   B = {17, 16, 15, 14}

   A) Yes   B) No

2.2 Subsets

1 Recognize Subsets and Use the Notation ⊆

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Write ⊆ or ⊄ in the blank so that the resulting statement is true.

1) {6, 8, 10} __ {5, 6, 7, 8, 10}

   A) ⊆   B) ⊄

2) {3, 25, 30} __ {16, 25, 30, 40}

   A) ⊆   B) ⊄

3) {red, blue, green} _____ {blue, green, yellow, black}

   A) ⊆   B) ⊄

4) {x | x is a tree} _____ {x | x is a spruce tree}

   A) ⊆   B) ⊄

5) {c, a, n, d, i, d, a, t, e} _____ {a, c, d, e, i, t, a, n, d}

   A) ⊆   B) ⊄

6) $\{\frac{8}{11}, \frac{5}{7}\}$ _____ $\{\frac{11}{8}, \frac{7}{5}\}$

   A) ⊆   B) ⊄

Determine whether the statement is true or false.

7) Ted ⊆ {Bob, Carol, Ted, Alice}

   A) True   B) False

8) {Ted} ⊆ {Bob, Carol, Ted, Alice}

   A) True   B) False

9) ∅ ⊆ {France, Germany, Switzerland}

   A) True   B) False

2 Recognize Proper Subsets and Use the Notation ⊂

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use ⊆, ⊄, ⊂, or both ⊂ and ⊆ to make a true statement.

1) {a, b} ___ {z, a, y, b, x, c}

    A) ⊂ and ⊆   B) ⊂   C) ⊆   D) ⊄

2) {11, 12, 13} ___ {11, 12, 13}

    A) ⊆   B) ⊂   C) ⊂ and ⊄   D) ⊄

3) {x | x is a male who is registered with Selective Service} _____ {x | x is a male who is in the Army}

    A) ⊄   B) ⊆   C) ⊆ and ⊂   D) ⊂

3 Determine the Number of Subsets of a Set

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

List all the subsets of the given set.

1) {Siamese, domestic shorthair}

    A) {Siamese, domestic shorthair}, {Siamese}, {domestic shorthair}, { }

    B) {Siamese}, {domestic shorthair}, { }

    C) {Siamese, domestic shorthair}, {Siamese}, {domestic shorthair},

    D) {Siamese, domestic shorthair}, {domestic shorthair}, { }

2) {4}

    A) {4}, { }   B) {4}   C) { }   D) {0}, {4}, { }

3) ∅

    A) ∅   B) no subsets   C) {∅}   D) { }, {0}

Calculate the number of subsets and the number of proper subsets for the set.

4) $\{\frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9}\}$

    A) 16; 15   B) 15; 16   C) 15; 14   D) 14; 15

5) {1, 3, 5, 7, 9, 11}

    A) 64; 63   B) 63; 64   C) 63; 62   D) 62; 63

6) the set of natural numbers less than 10

    A) 512; 511   B) 511; 512   C) 511; 510   D) 510; 511

7) the set of words describing the colors on a stoplight

    A) 8; 7   B) 7; 8   C) 16; 15   D) 15; 16

8) {x | x is a day of the week}

    A) 128; 127   B) 127; 126   C) 128; 129   D) 64; 65

Use the formula for the number of subsets of a set with n elements to solve the problem.

9) Pasta comes with tomato sauce and can be ordered with some, all, or none of these ingredients in the sauce: {onions, garlic, carrots, broccoli, shrimp, mushrooms, zucchini, green pepper}. How many different variations are available for ordering pasta with tomato sauce?

    A) 256   B) 128   C) 255   D) 127

10) A village has 4 fire engines. If a radio dispatcher receives a call, depending on the nature of the situation, no engines, one engine, two engines, three engines, or all four engines can be sent to a fire. How many options does the dispatcher have for sending the fire engines to the scene of the caller?
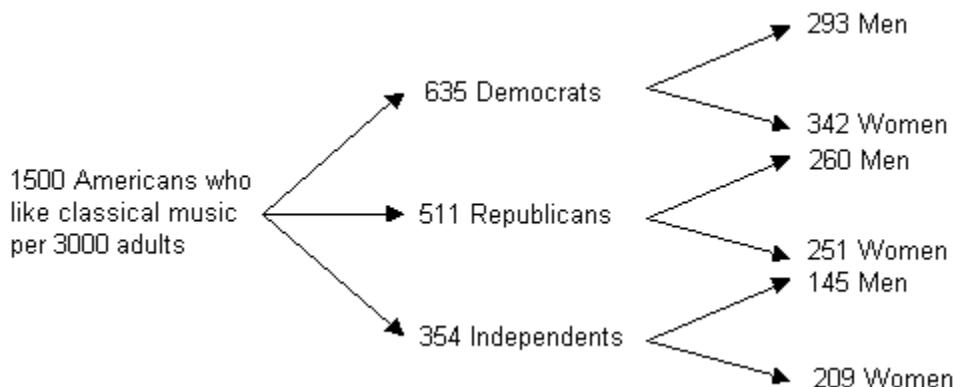
    A) 16   B) 8   C) 15   D) 7

4   Apply Concepts of Subsets and Equivalent Sets to Infinite Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Consider below the branching tree diagram based on the number per 3000 American adults.

Let T = the set of Americans who like classical music
      R = the set of Republicans who like classical music
      D = the set of Democrats who like classical music
      I = the set of Independents who like classical music

Determine whether the statement is true or false.

1) I ∈ T

    A) True   B) False

2) R ⊂ T

    A) True   B) False

3) Let M = the set of Independent men who like classical music
       W = the set of Independent women who like classical music
  W ⊂ T

    A) True   B) False

4) Let M = the set of Republican men who like classical music
   W = the set of Republican women who like classical music
   If x ∈ R, then x ∈ M.

   A) True   B) False

5) Let M = the set of Republican men who like classical music
   W = the set of Republican women who like classical music
   If x ∈ W, then x ∈ R.

   A) True   B) False

6) If x ∈ I, then x ∉ R.

   A) True   B) False

7) Let M = the set of Independant men who like classical music
   W = the set of Independant women who like classical music
   The set of elements in M and W combined is equal to set I.

   A) True   B) False

2.3   Venn Diagrams and Set Operations

1   Understand the Meaning of a Universal Set

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Describe a universal set U that includes all elements in the given sets. Answers may vary.
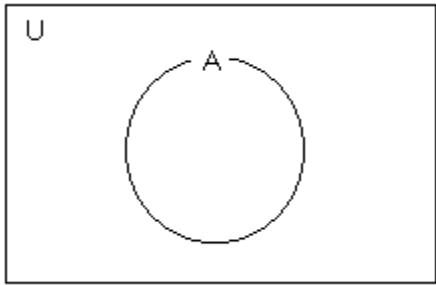
1) A = {Copeland, Gershwin, Bernstein}
   B = {Strauss, Mendlssohn}

2) A = {fruit juice, coffee}
   B = {tea, spring water}

2   Understand the Basic Ideas of a Venn Diagram

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.
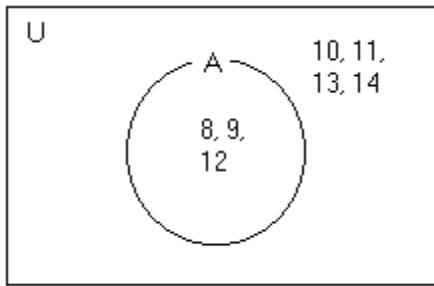
Place the various elements in the proper regions of the following Venn diagram.

1) Let U = {8, 9, 10, 11, 12, 13, 14} and A = {8, 9, 12}. Find A' and place the elements in the proper region.
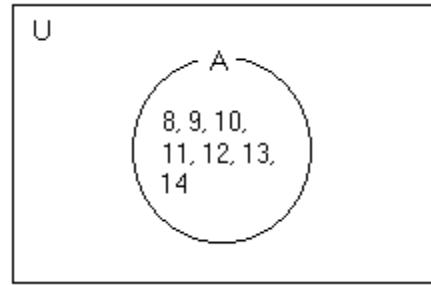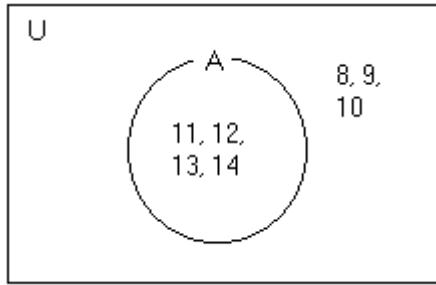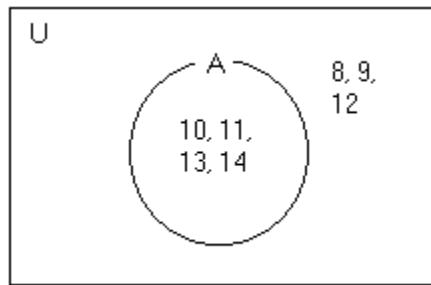
A) A' = {10, 11, 13, 14}

B) A' = {8, 9, 12}
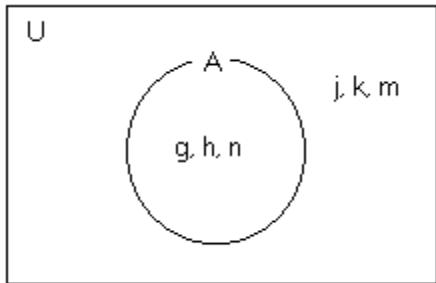
C) A' = {11, 12, 13, 14}

D) A' = {8, 9, 10, 11, 12, 13, 14}
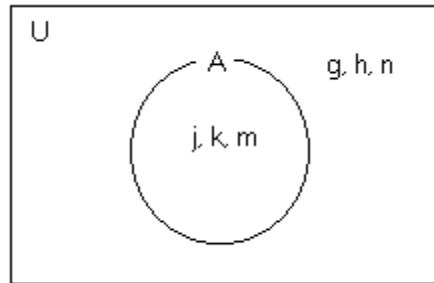
2) Let U = {g, h, j, k, m, n} and A = {g, h, n}. Find A'. Then use a Venn diagram to illustrate the relationship among the sets U, A, and A'.

A) A' = {j, k, m}

U
A
j, k, m
g, h, n

B) A' = {g, h, n}

U
A
g, h, n
j, k, m

C) A' = {g, h, m}

U
A
g, h, m
j, k, n

D) A' = ∅

U
A
g, h, j,
k, m, n
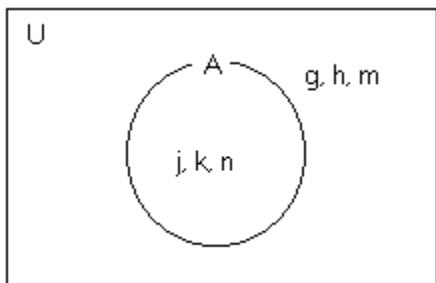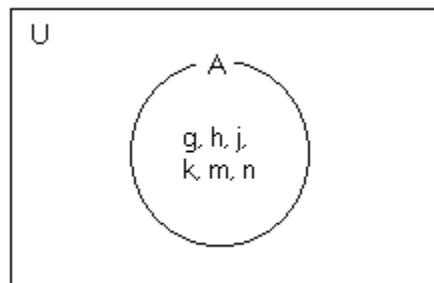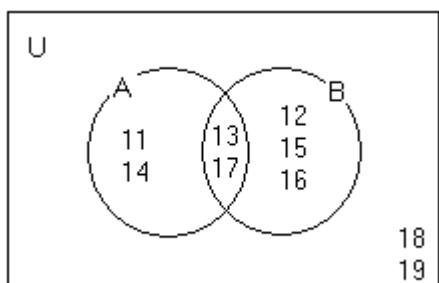
3   Use Venn Diagrams to Visualize Relationships Between Two Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the Venn diagram to list the elements of the set in roster form.

1)

U
A   B
11 13   12
14 17   15
         16
         18
         19

A
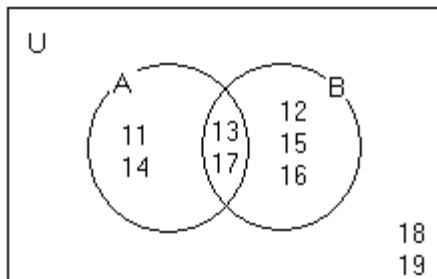
A) {11, 13, 14, 17}   B) {13, 17}   C) {12, 15, 16}   D) {11, 12, 13}
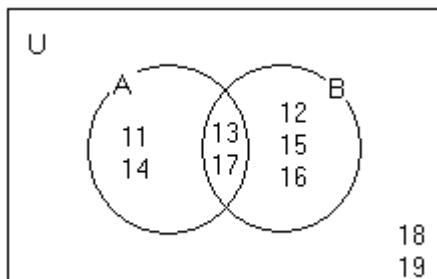
2)

B

    A) {12, 13, 15, 16, 17}   B) {11, 14}   C) {13, 17}   D) {14, 16, 17}
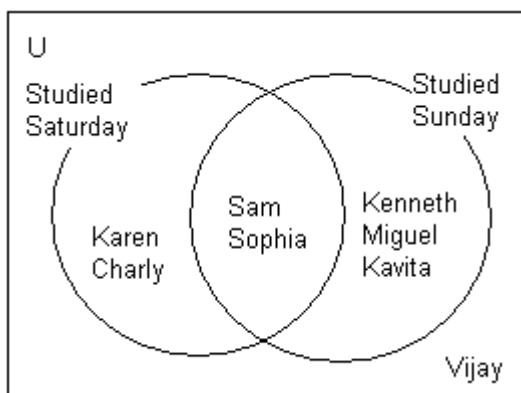
3)

U

    A) {11, 12, 13, 14, 15, 16, 17, 18, 19}   B) {11, 14}

    C) {12, 15, 16}   D) {13, 17}

Use the Venn diagram to list the elements of the set in roster form.

  4) The set of students who studied Saturday

    A) {Karen, Charly, Sam, Sophia}   B) {Karen, Charly}

    C) {Sam, Sophia}   D) {Karen, Charly, Vijay}

5) The set of students who studied Saturday and Sunday

A) {Sam, Sophia}

B) {Karen, Charly, Kenneth, Miguel, Kavita}

C) {Karen, Charly, Kenneth, Miguel, Kavita, Sam, Sophia}

D) {Sam, Sophia, Vijay}

6) The set of students who studied Saturday and not Sunday

A) {Karen, Charly}   B) {Kenneth, Miguel, Kavita}

C) {Sam, Sophia}   D) {Karen, Charly, Vijay}

7) The set of students who studied neither Saturday nor Sunday

A) {Vijay}   B) {}

C) {U, Vijay}   D) {Vijay, Karen, Charly}

Use the following definition to place the indicated natural number in the correct region of the Venn diagram.
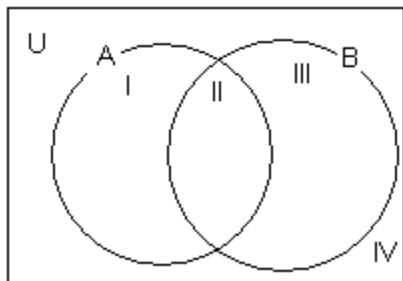
A palindromic number is a natural number whose values does not change if its digits are reversed.
U = the set of natural numbers
A = the set of palindromic numbers
B = the set of odd numbers
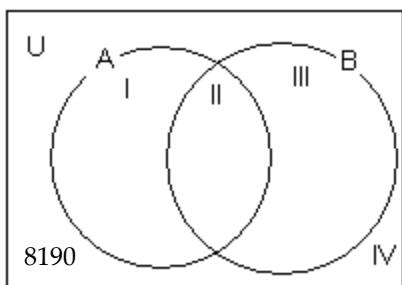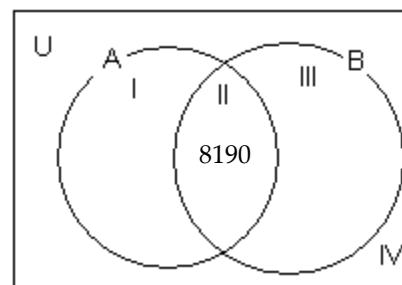
8) 8190
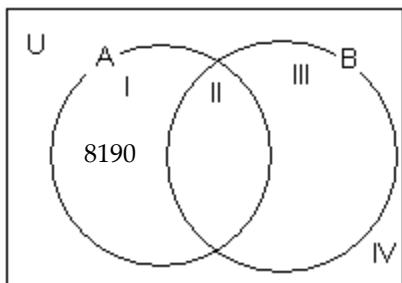
A)
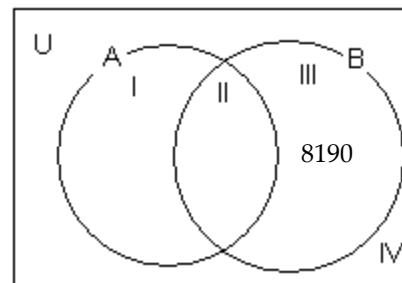
B)
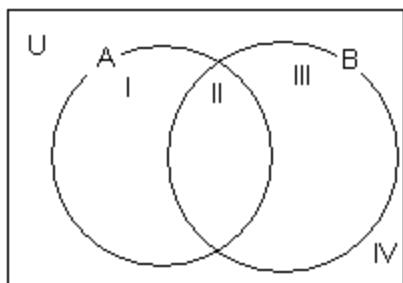
C)
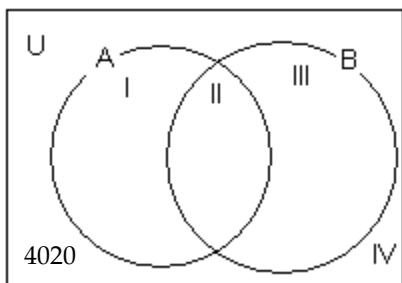
D)
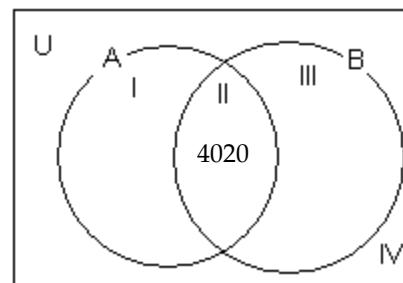
9) 4020
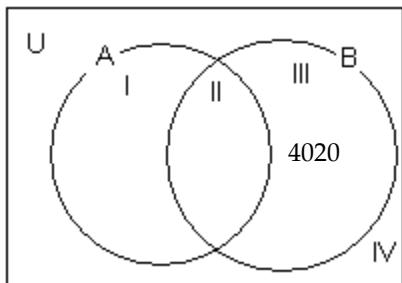
A)
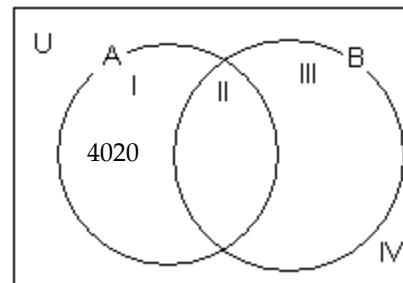


B)
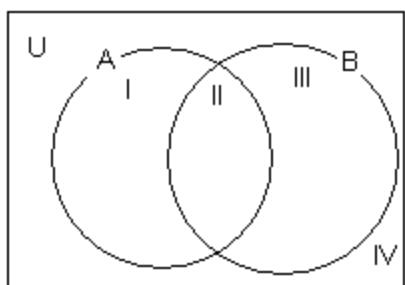
C)
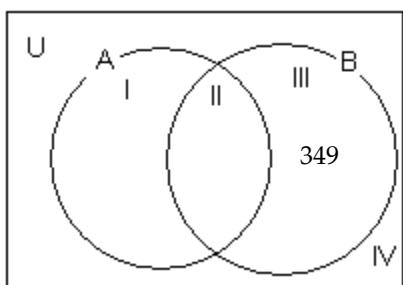
D)
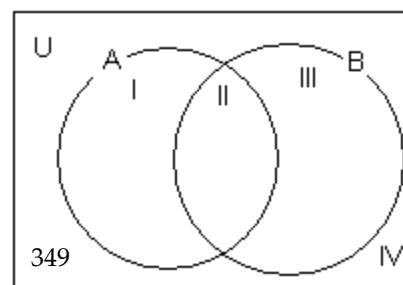
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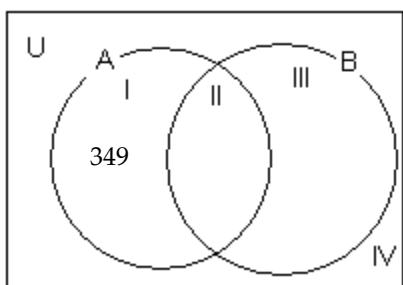
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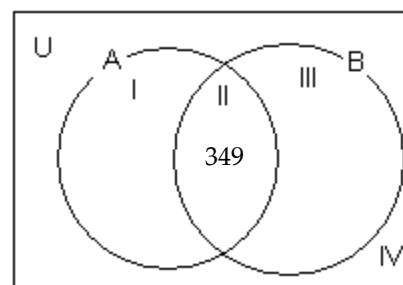
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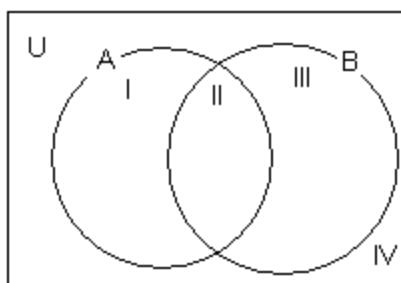


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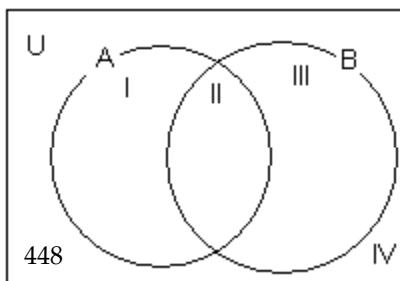
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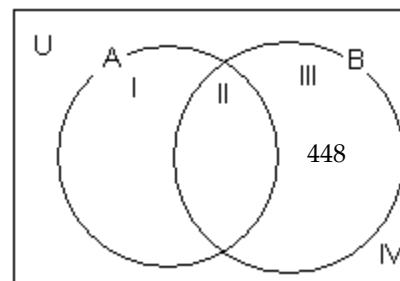
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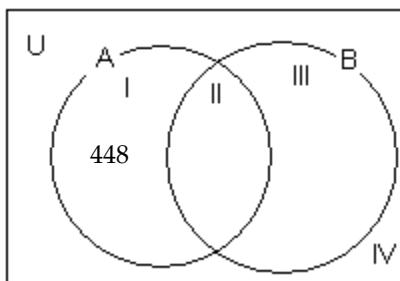
A)
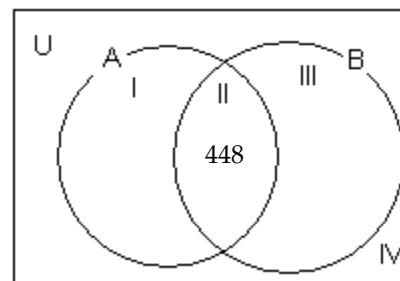

B)

C)

D)

4 Find the Complement of a Set

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Let U = {1, 2, 4, 5, a, b, c, d, e}. Use the roster method to write the complement of the set.

1) T = {2, 4, b, d}

A) {1, 5, a, c, e}   B) {1, 3, 5, a, c, e}

C) {1, 5, a, e}   D) {1, 2, 4, 5, a, b, c, d, e}

Let U = {21, 22, 23, ..., 40}, A = {21, 22, 23, 24, 25}, B = {26, 27, 28, 29}, C = {21, 23, 25, 27, ..., 39}, and D = {22, 24, 26, 28, ..., 40}. Use the roster method to write the following set.

2) A'

A) A' = {26, 27, 28, ... , 40}   B) A' = {26, 28, 30, ... , 40}

C) A' = {27, 29, 31, ... , 39}   D) A' = {21, 22, 23, ... , 40}

Let U = {21, 22, 23, 24, ...}, A = {21, 22, 23, 24, ..., 40}, B = {21, 22, 23, 24, ..., 50}, C = {22, 24, 26, 28, ...}, and
D = {21, 23, 25, 27, ...}. Use the roster method to write the following set.

3) C'

    A) C' = {21, 23, 25, 27, ...}
                                      B) C' = {22, 24, 26, 28, ...}

    C) C' = {21, 22, 23, 24, ...}
                                      D) C' = {21, 23, 25, 27, ..., 39}

Solve the problem.

4) If the universal set is the set of the days of the week and set A is the set of days that begin with the letter T,
write A' using the roster method. Describe A' in words.

    A) A' = {Sunday, Monday, Wednesday, Friday, Saturday}; A' is the days of the week that do not begin with
the letter T.

    B) A' = {Tuesday, Thursday}; A' is the days of the week that begin with the letter T.

    C) A' = {Sunday, Monday, Friday, Saturday}; A' is the days of the week that do not begin with the letter T.

    D) A' = {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}; A' is the days of the week
that do not begin with the letter T.

5   Find the Intersection of Two Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Let U = {q, r, s, t, u, v, w, x, y, z}
    A = {q, s, u, w, y}
    B = {q, s, y, z}
    C = {v, w, x, y, z}. List the elements in the set.

1) A ∩ B'

    A) {u, w}
                                          B) {q, s, t, u, v, w, x, y}

    C) {r, s, t, u, v, w, x, z}
                                      D) {t, v, x}

2) (A ∩ B)'

    A) {r, t, u, v, w, x, z}
                                    B) {t, v, x}

    C) {s, u, w}
                                        D) {q, s, t, u, v, w, x, y}

3) C' ∩ A'

    A) {r, t}
                                          B) {q, r, s, t, u, v, x, z}

    C) {w, y}
                                          D) {q, s, u, v, w, x, y, z}
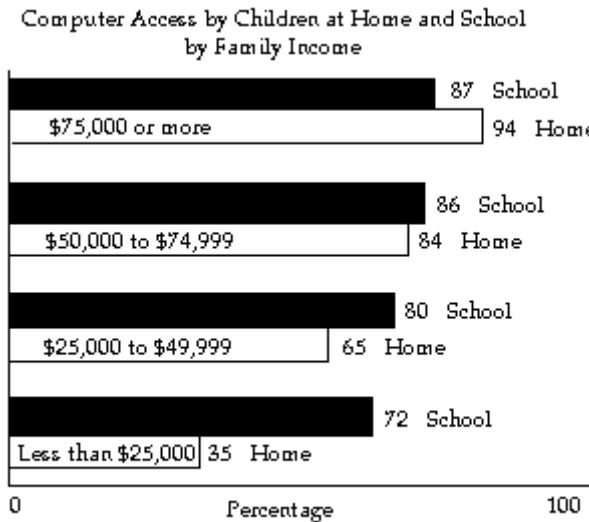
4) A ∩ B

    A) {q, s, y}
                 B) {r, t, u, v, w, x, z}
                 C) {q, s, u, w, y, z}
                 D) {v, w, x, y, z}

5) (A ∩ C)'

    A) {q, r, s, t, u, v, x, z}
   B) {w, y}

    C) {q, r, s, t, u, v, w, x, y, z}
                                D) {q, s, y, z}

Many children do not have access to computers at home. School has an equalizing effect. Family income is a strong factor in access. Use the information in the graph to write the set in the exercise in roster form or express the set as ∅.

Computer Access by Children at Home and School
by Family Income

$75,000 or more	87 School / 94 Home
$50,000 to $74,999	86 School / 84 Home
$25,000 to $49,999	80 School / 65 Home
Less than $25,000	72 School / 35 Home

0   Percentage   100

6) {x | x is home access by more than 34% of the students} ∩ {x | x is school access by less than 73% of the students}

    A) {Less than $25,000}   B) {$25,000 to $49,999}

    C) {$50,000 to $74,999}   D) {$75,000 or more}

7) the set of home access by more than 80% of the students and school access by less than 70% of the students}

    A) {$50,000 to $74,999, $75,000 or more}   B) {Less than $25,000}

    C) {$50,000 to $74,999}   D) ∅

Solve the problem.

8) Let U = the set of the days of the week, A = {Monday, Tuesday, Wednesday, Thursday, Friday} and B = {Friday, Saturday, Sunday}. Find (A ∩ B)'.

    A) {Monday, Tuesday, Wednesday, Thursday, Saturday, Sunday}

    B) {Friday}

    C) {Saturday, Sunday}

    D) ∅

6 Find the Union of Two Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Let U = {q, r, s, t, u, v, w, x, y, z}
    A = {q, s, u, w, y}
    B = {q, s, y, z}
    C = {v, w, x, y, z}. List the elements in the set.

    1) (A ∪ B)'

        A) {r, t, v, x}   B) {r, s, t, u, v, w, x, z}   C) {t, v, x}   D) {s, u, w}

2) A' ∪ B

    A) {q, r, s, t, v, x, y, z}   B) {s, u, w}

    C) {q, s, t, u, v, w, x, y}   D) {r, s, t, u, v, w, x, z}

3) C' ∪ A'

    A) {q, r, s, t, u, v, x, z}   B) {s, t}

    C) {w, y}   D) {q, s, u, v, w, x, y, z}

4) B ∪ C

    A) {q, s, v, w, x, y, z}   B) {v, w, x, y, z}

    C) {q, s, u, w, y}   D) {q, r, s, t, u, v, w, x, y, z}
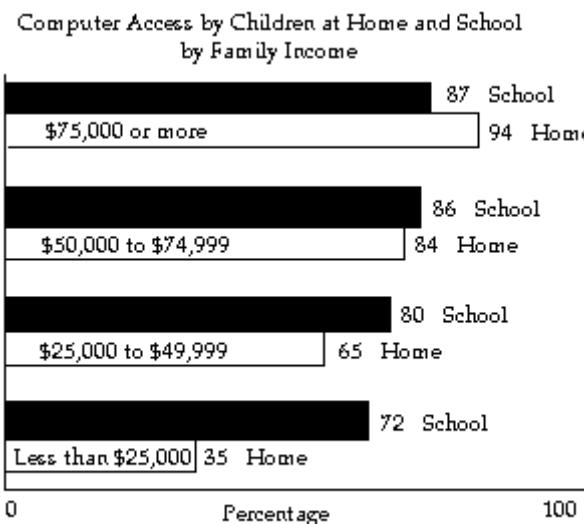
5) C ∪ ∅

    A) {v, w, x, y, z}   B) {   }   C) {q, s, u, w, y}   D) {q, s, y, z}

6) B ∪ U

    A) {q, r, s, t, u, v, w, x, y, z}   B) {q, s, y, z}

    C) {q, s, u, w, y}   D) {v, w, x, y, z}

Many children do not have access to computers at home. School has an equalizing effect. Family income is a strong factor in access. Use the information in the graph to write the set in the exercise in roster form or express the set as ∅.

Computer Access by Children at Home and School
by Family Income

Income	School	Home
$75,000 or more	87	94
$50,000 to $74,999	86	84
$25,000 to $49,999	80	65
Less than $25,000	72	35

0   Percentage   100

7) {x | x is home access by more than 34% of the students} ∪ {x | x is school access by less than 81% of the students}

    A) {Less than $25,000, $25,000 to $49,999}   B) {$25,000 to $49,999, $50,000 to $74,999}

    C) {$50,000 to $74,999, $75,000 or more}   D) {Less than $25,000, $75,000 or more}

8) the set of home access by more than 80% of the students or school access by less than 87% of the students}

    A) {$50,000 to $74,999, $75,000 or more}

    B) {Less than $25,000, $25,000 to $49,999}

    C) {Less than $25,000, $25,000 to $49,999, $50,000 to $74,999}

    D) {$25,000 to $49,999, $50,000 to $74,999, $75,000 or more}

7 Perform Operations with Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Let U = {q, r, s, t, u, v, w, x, y, z}
   A = {q, s, u, w, y}
   B = {q, s, y, z}
   C = {v, w, x, y, z}. List the elements in the set.

  1) $A \cap B'$

    A) {u, w}   B) {q, s, t, u, v, w, x, y}

    C) {r, s, t, u, v, w, x, z}   D) {t, v, x}

  2) $(A \cup B)'$

    A) {r, t, v, x}   B) {r, s, t, u, v, w, x, z}   C) {t, v, x}   D) {s, u, w}

  3) $(A \cap B)'$

    A) {r, t, u, v, w, x, z}   B) {t, v, x}

    C) {s, u, w}   D) {q, s, t, u, v, w, x, y}

  4) $A' \cup B$

    A) {q, r, s, t, v, x, y, z}   B) {s, u, w}

    C) {q, s, t, u, v, w, x, y}   D) {r, s, t, u, v, w, x, z}

  5) $C' \cup A'$

    A) {q, r, s, t, u, v, x, z}   B) {s, t}

    C) {w, y}   D) {q, s, u, v, w, x, y, z}

  6) $C' \cap A'$

    A) {r, t}   B) {q, r, s, t, u, v, x, z}

    C) {w, y}   D) {q, s, u, v, w, x, y, z}

  7) $A \cap B$

    A) {q, s, y}   B) {r, t, u, v, w, x, z}   C) {q, s, u, w, y, z}   D) {v, w, x, y, z}

  8) $B \cup C$

    A) {q, s, v, w, x, y, z}   B) {v, w, x, y, z}

    C) {q, s, u, w, y}   D) {q, r, s, t, u, v, w, x, y, z}

9) A'

    A) {r, t, v, x, z}   B) {q, s, y, z}

    C) {q, r, s, t, u, v, w, x, y, z}   D) {s, u, w, y}

10) (A ∩ C)'

    A) {q, r, s, t, u, v, x, z}   B) {w, y}

    C) {q, r, s, t, u, v, w, x, y, z}   D) {q, s, y, z}

11) C ∪ Ø

    A) {v, w, x, y, z}   B) { }   C) {q, s, u, w, y}   D) {q, s, y, z}

12) B ∪ U
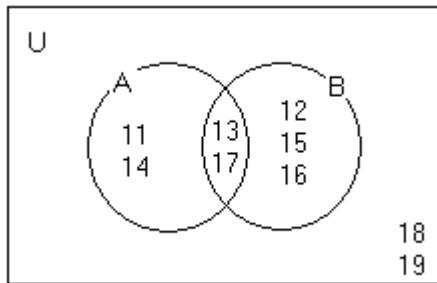
    A) {q, r, s, t, u, v, w, x, y, z}   B) {q, s, y, z}

    C) {q, s, u, w, y}   D) {v, w, x, y, z}

8   Determine Sets Involving Set Operations from a Venn Diagram

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the Venn diagram to list the elements of the set in roster form.
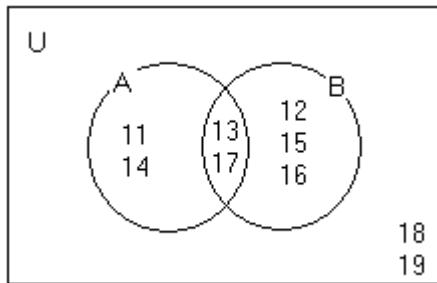
1)

A ∪ B

    A) {11, 12, 13, 14, 15, 16, 17}   B) {13, 17}

    C) {11, 12, 14, 15, 16}   D) {11, 12, 13, 14, 15, 16, 17, 18, 19}
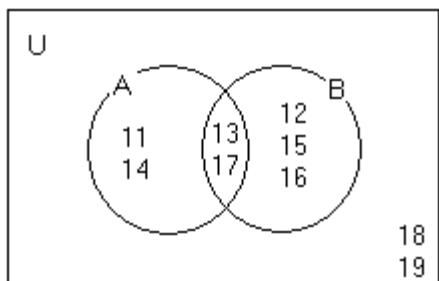
2)

A ∩ B
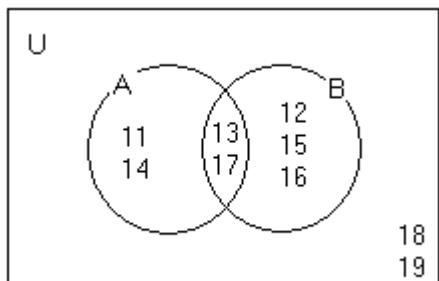
    A) {13, 17}   B) {11, 12, 13, 14, 15, 16, 17}

    C) {11, 12, 13, 14, 15, 16, 17, 18, 19}   D) {11, 12, 14, 15, 16}

3)

A'
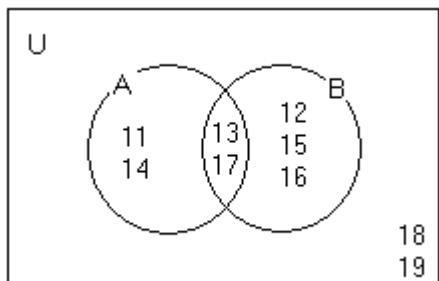
A) {12, 15, 16, 18, 19}   B) {11, 14, 18, 19}   C) {12, 15, 16}   D) {11, 13, 14, 17}

4)

B'
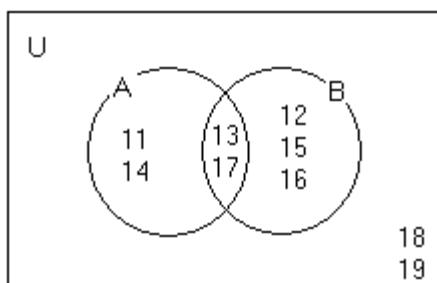
A) {11, 14, 18, 19}   B) {12, 15, 16, 18, 19}

C) {11, 14}   D) {11, 13, 14, 17, 18, 19}

5)

(A ∩ B)'

A) {11, 12, 14, 15, 16, 18, 19}   B) {13, 17}

C) {18, 19}   D) {11, 12, 14, 15, 16}
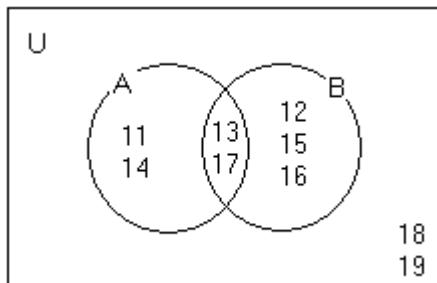
6)

(A ∪ B)'

A) {18, 19}   B) {11, 12, 13, 14, 15, 16, 17}

C) {11, 12, 14, 15, 16}   D) {13, 17}

7)

A' ∩ B

A) {12, 15, 16}   B) {11, 13, 14, 17, 18, 19}

C) {11, 14}   D) {12, 15, 16, 18, 19}

Use sets to solve the problem.

8) Results of a survey of fifty students indicate that 30 like red jelly beans, 29 like green jelly beans, and 17 like both red and green jelly beans. How many of the students surveyed like only red jelly beans?

   A) 13   B) 30   C) 17   D) 12

9) Mrs. Bollo's second grade class of thirty students conducted a pet ownership survey. Results of the survey indicate that 8 students own a cat, 15 students own a dog, and 5 students own both a cat and a dog. How many of the students surveyed own only a cat?

   A) 3   B) 8   C) 18   D) 15

10) Monticello residents were surveyed concerning their preferences for candidates Moore and Allen in an upcoming election. Of the 800 respondents, 300 support neither Moore nor Allen, 100 support both Moore and Allen, and 250 support only Moore. How many residents support Allen?

   A) 250   B) 100   C) 150   D) 400

9   Understand the Meaning of "and" and "or"

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) There are no exercises for this objective.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the formula for the cardinal number of the union of two sets to solve the problem.

1) Set A contains 5 elements, set B contains 11 elements, and 3 elements are common to sets A and B. How many elements are in A ∪ B?

    A) 13   B) 12   C) 14   D) 16

2) Set A contains 12 letters and 8 numbers. Set B contains 7 letters and 8 numbers. Four letters and 5 numbers are common to both sets A and B. Find the number of elements in set A or set B.

    A) 26   B) 44   C) 35   D) 29

3) Set A contains 35 elements and set B contains 22 elements. If there are 40 elements in (A ∪ B) then how many elements are in (A ∩ B)?

    A) 17   B) 5   C) 8   D) 13

2.4   Set Operations and Venn Diagrams with Three Sets

1   Perform Set Operations with Three Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Let U = {q, r, s, t, u, v, w, x, y, z}
   A = {q, s, u, w, y}
   B = {q, s, y, z}
   C = {v, w, x, y, z}. List the elements in the set.

1) A ∪ (B ∩ C)

    A) {q, s, u, w, y, z}   B) {q, w, y}   C) {q, y, z}   D) {q, r, w, y, z}

2) A ∩ (B ∪ C)

    A) {q, s, w, y}   B) {q, y, z}   C) {q, r, w, y, z}   D) {q, s, u, w, y, z}

3) (A ∪ B) ∩ (A ∪ C)

    A) {q, s, u, w, y, z}   B) {r, t, v, x}   C) {q, s, w, y}   D) {q, s, u, w, y}

4) (A ∩ B) ∪ (A ∩ C)

    A) {q, s, w, y}   B) {r, t, u, v, x, z}   C) {q, s, u, w, y}   D) {q, s, v, w, y}

5) A' ∩ (B ∪ C')

    A) {r, t, z}   B) {q, s, u, v, x, y}   C) {q, r, s, t, z}   D) {q, r, s}

6) (A' ∩ B) ∪ (A' ∩ C')

    A) {r, t, z}   B) {q, s, u, v, x, y}   C) {q, r, t, y, z}   D) {r, s, t, y, z}

7) (A ∪ B ∪ C)'

    A) {r, t}   B) {s, t}   C) {q, s}   D) {v, z}

8) (A ∩ B ∩ C)'

    A) {q, r, s, t, u, v, w, x, z}   B) ∅

    C) {q, s, u, w, z}   D) {r, t, v, x}

9) (A ∪ B)' ∩ C

    A) {v, x}   B) {q, v, x}   C) {s, u, v, z}   D) {r, w}
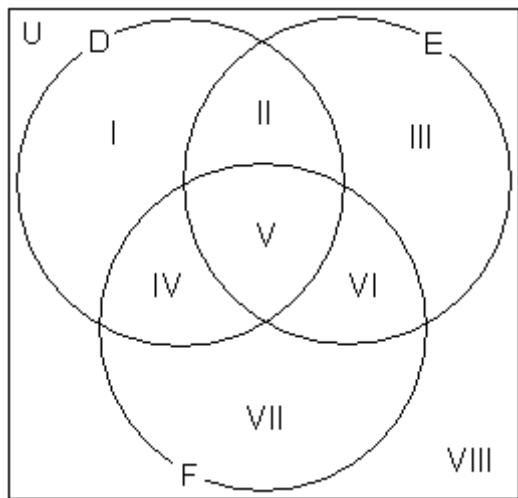
10) (B ∪ C)' ∩ A

    A) {u}   B) {w}   C) {v}   D) ∅

2 Use Venn Diagrams with Three Sets

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the Venn diagram shown to answer the question.

1) Which regions represent set E?

    A) II, III, V, VI   B) I, IV, VII   C) VIII   D) III

2) Which regions represent set D ∪ F?

    A) I, II, IV, V, VI, VII   B) III

    C) VIII   D) I, II, IV, V, VI, VII, VIII

3) Which regions represent set D ∩ E?
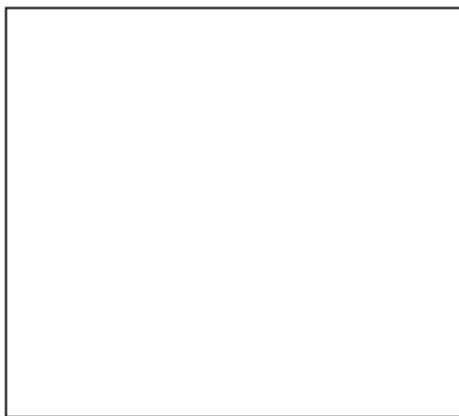
    A) II, V   B) I, III, IV, VI   C) VIII   D) IV, V

4) Which regions represent set E'?
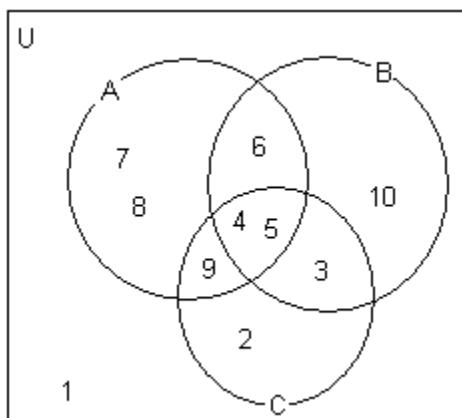
    A) I, IV, VII, VIII   B) II, III, V, VI   C) VIII   D) II, V, VI

Construct a Venn diagram illustrating the given sets.
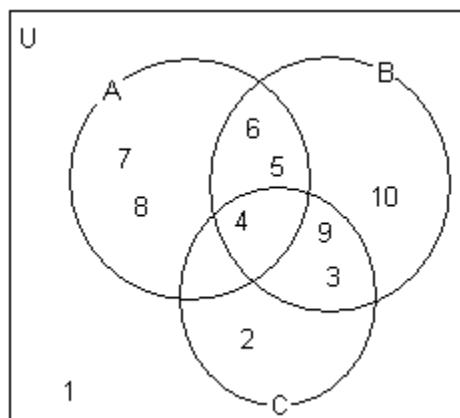
5) A = [4, 5, 6, 7, 8, 9], B = [3, 4, 5, 6, 10], C = [2, 3, 4, 5, 9], U = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
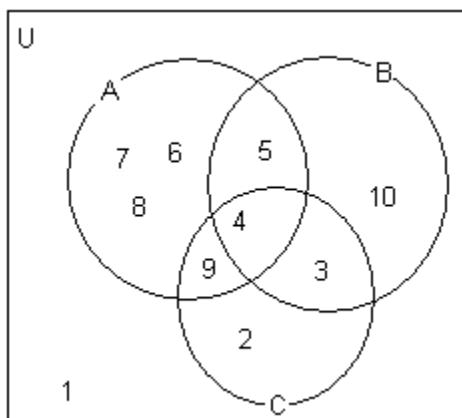
A)
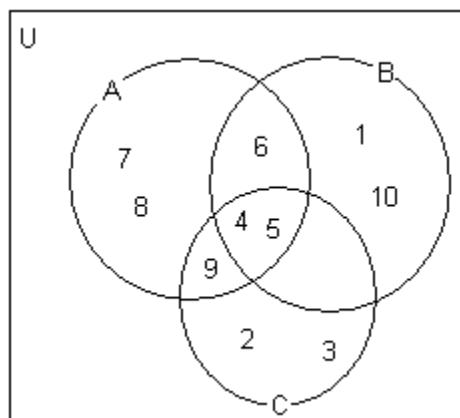
B)

C)
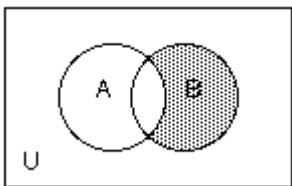
D)

Use set notation to identify the shaded region.

6)
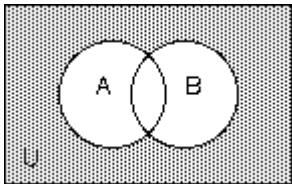
    A) B ∩ $\overline{A}$ B) A ∩ $\overline{B}$ C) A – B   D) B – $\overline{A}$

7)
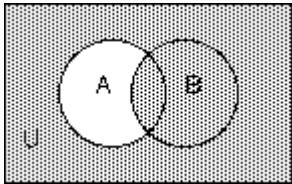
    A) $\overline{A}$ ∩ $\overline{B}$ B) A – B   C) $\overline{A \cap B}$ D) A ∪ B

8)
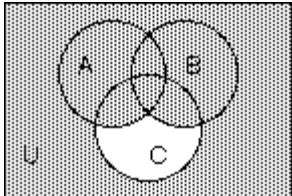
    A) A' ∪ B   B) B ∩ A'   C) A' ∩ B   D) (A ∩ B)'

9)
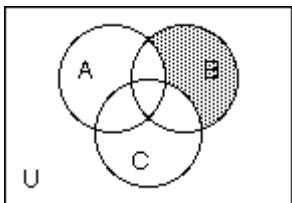
    A) (A ∪ B) ∪ C'   B) (A ∩ B) ∪ C'   C) (A ∪ B) ∩ C'   D) (A ∪ B ∪ C)'

10)
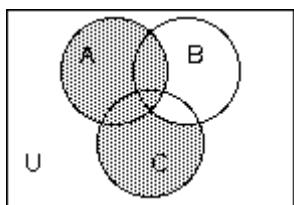
    A) A' ∩ C' ∩ B   B) B ∩ (A ∩ C)'   C) B' ∩ (A ∪ B)   D) A ∩ B ∩ C

11)
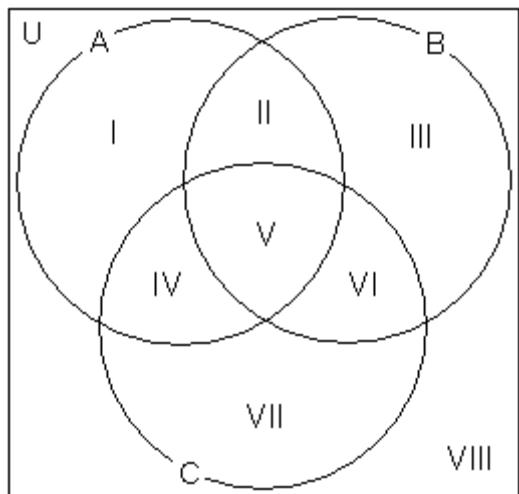
A) $(C \cap B') \cup A$ B) $A \cup C$ C) $(A \cup C) \cap B'$ D) $B' \cap (A \cup C)$

The chart shows the most common causes of death in certain areas of the United States.

Most Common Causes of Death in U.S.

Region A	Region B	Region C
1. heart disease	1. heart disease	1. heart disease
2. cerebrovascular	2. cerebrovascular	2. cerebrovascular
3. COPD	3. COPD	3. COPD
4. pneumonia	4. accidents	4. accidents
5. accidents	5. pneumonia	5. liver disease

Use the Venn diagram to indicate in which region each cause should be placed.

12) liver disease

A) VII B) V C) VI D) IV

13) pneumonia

A) II B) V C) VI D) IV

14) heart disease

A) V B) II C) VI D) IV

Use the following information to construct a Venn Diagram that illustrates the given sets.

Members of the bookclub	Numbers of books read	Numbers of books suggested	Year of membership
Carla	20	7	2001
Marge	25	5	2000
Sandy	5	1	2006
Laura	45	15	1998
Kim	42	9	1998
Peter	32	6	1999
Jim	33	4	2000
Ann	24	1	2000
Paul	17	3	2002

15)
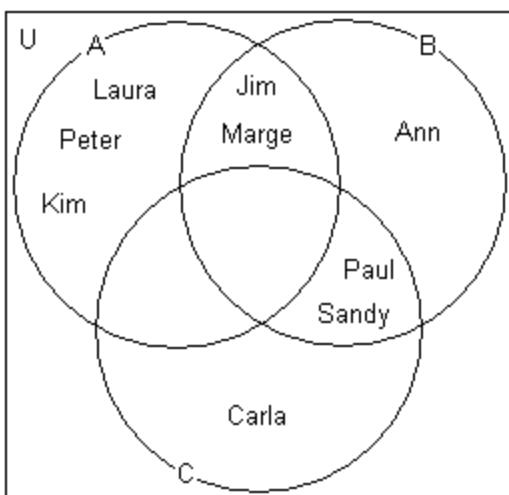
U = the set of members of the bookclub shown in the chart
A = the set of members of the bookclub who read at least 25 books
B = the set of members of the bookclub who suggested 5 or less books
C = the set of members of the bookclub who started their membership after 2000
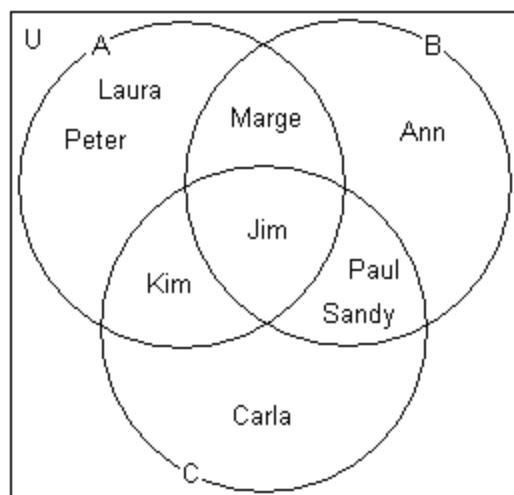
A)

U A   B
Laura   Jim
Peter   Marge   Ann
Kim
Paul
Sandy
Carla
C

B)

U A   B
Laura
Marge   Ann
Peter
Jim
Kim   Paul
Sandy
Carla
C

C)

U A   B
Laura   Jim
Peter   Marge   Ann
Kim
Paul
Sandy
Carla
C

D)

U A   B
Marge
Laura
Peter   Ann
Kim
Jim
Paul
Sandy
Carla
C

Page 48
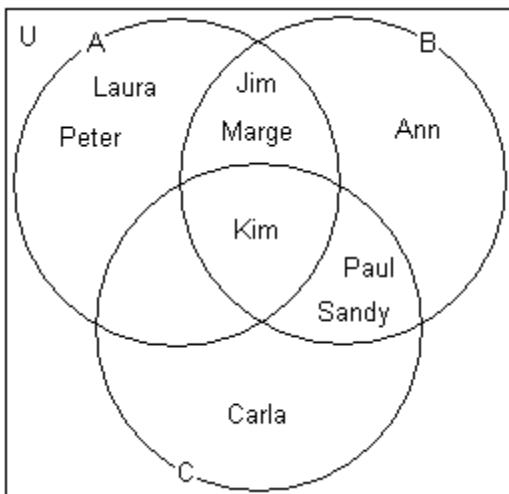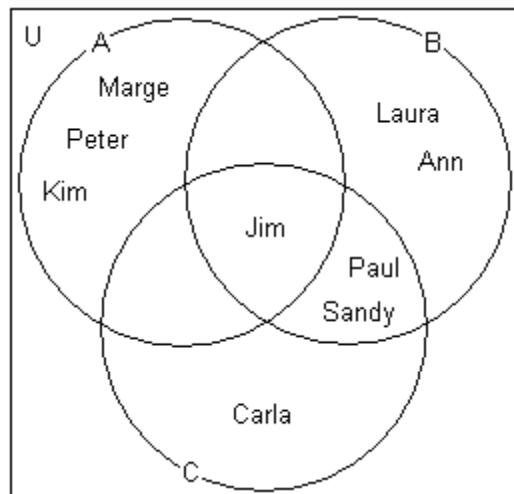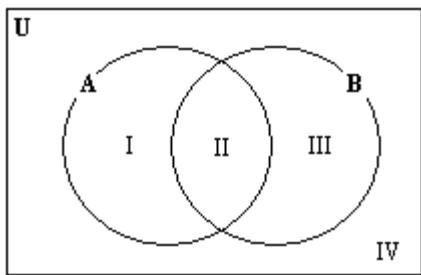
3   *Use Venn Diagrams to Prove Equality of Sets

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the Venn diagram shown below to solve the problem.

1) a) Which regions are represented by A ∩ B'?
   b) Which regions are represented by (A' ∪ B)'?
   c) Based on parts a) and b), what can you conclude about the relationship between A ∩ B' and (A' ∪ B)'?
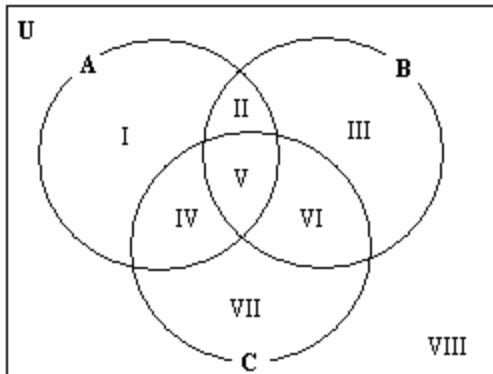
2) a) Which regions are represented by (A' ∩ B)'?
   b) Which regions are represented by A ∩ B'?
   c) Based on parts a) and b), what can you conclude about the relationship between (A' ∩ B)' and A ∩ B'?

3) a) Which regions are represented by (A ∪ B')'?
   b) Which regions are represented by A' ∩ B?
   c) Based on parts a) and b), what can you conclude about the relationship between (A ∪ B')' and A' ∩ B?

4) a) Which regions are represented by (A' ∪ B)'?
   b) Which regions are represented by A' ∩ B?
   c) Based on parts a) and b), what can you conclude about the relationship between (A' ∪ B)' and A' ∩ B?

5) Show that (A' ∩ B)' = A ∪ B'.

Use the Venn diagram shown below to solve the problem.

6) a) Which regions are represented by (A ∩ B) ∪ C?
   b) Which regions are represented by (A ∪ C) ∩ (A ∪ B)?
   c) Based on parts a) and b), what can you conclude about the relationship between (A ∩ B) ∪ C and
   (A ∪ C) ∩ (A ∪ B)?

7) a) Which regions are represented by B ∪ (A ∩ C)?
   b) Which regions are represented by (A ∪ B) ∩ (B ∪ C)?
   c) Based on parts a) and b), what can you conclude about the relationship between B ∪ (A ∩ C) and (A ∪ B) ∩ (B ∪ C)?

8) Show that B ∪ (A ∩ C) = (A ∪ B) ∩ (B ∪ C).
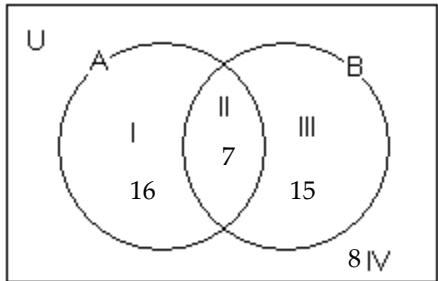
2.5 Survey Problems

1   Use Venn Diagrams to Visualize a Survey's Results

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the accompanying Venn diagram that shows the number of elements in regions I through IV to answer the question.

1)

How many elements belong to set A?
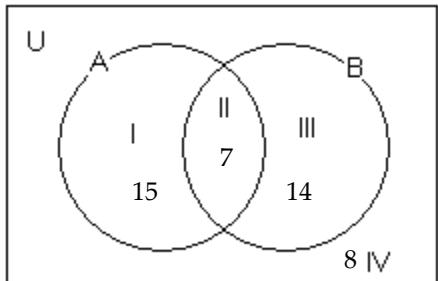
A) 23   B) 16   C) 7   D) 15

2)

How many elements belong to set B?
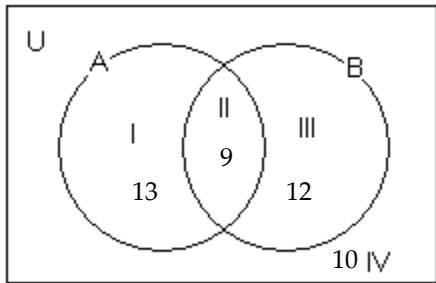
A) 21   B) 22   C) 14   D) 29

3)

How many elements belong to set A but not set B?
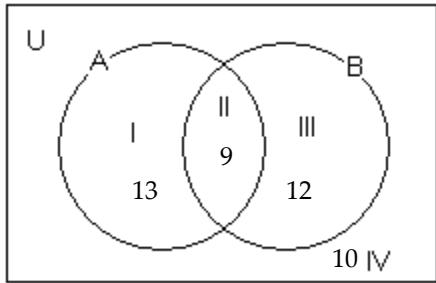
   A) 13   B) 9   C) 12   D) 10

4)

How many elements belong to set B but not set A?
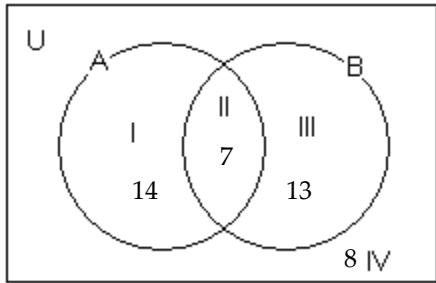
   A) 12   B) 13   C) 9   D) 10

5)

How many elements belong to set A or set B?
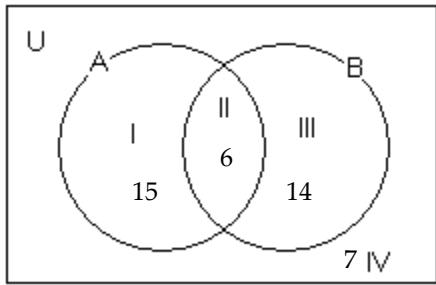
   A) 34   B) 42   C) 27   D) 7

6)

How many elements belong to set A and set B?
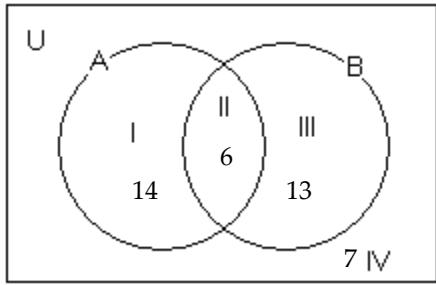
A) 6   B) 35   C) 7   D) 29

7)

How many elements belong to neither set A nor set B?
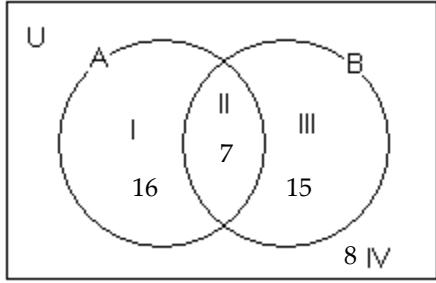
A) 7   B) 6   C) 13   D) 14

8)

How many elements are there in the universal set?
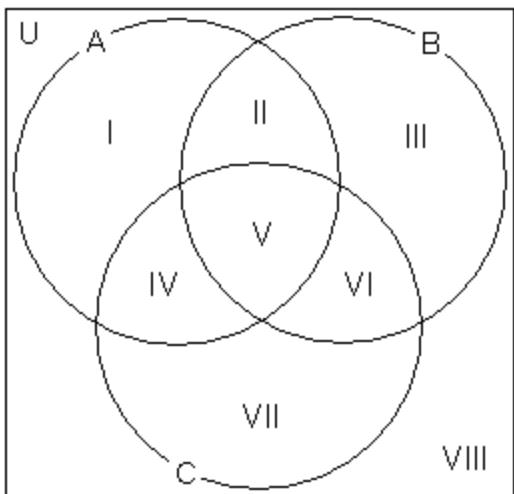
A) 46   B) 38   C) 31   D) ∅

Use the given cardinalities to determine the number of elements in the specific region.

9) n(U) = 246, n(A) = 84, n(B) = 104, n(C) = 91, n(A ∩ B) = 37, n(A ∩ C) = 40, n(B ∩ C) = 36, n(A ∩ B ∩ C) = 19
Find III.
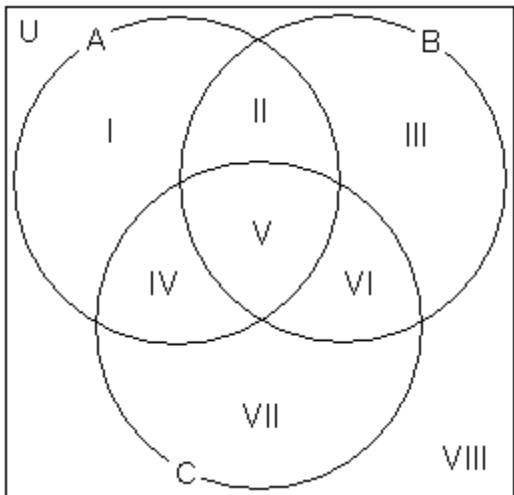

A) 50   B) 32   C) 53   D) 48

10) n(U) = 125, n(A) = 40, n(B) = 60, n(C) = 36, n(A ∩ B) = 15, n(A ∩ C) = 18, n(B ∩ C) = 14, n(A ∩ B ∩ C) = 8
Find VIII.
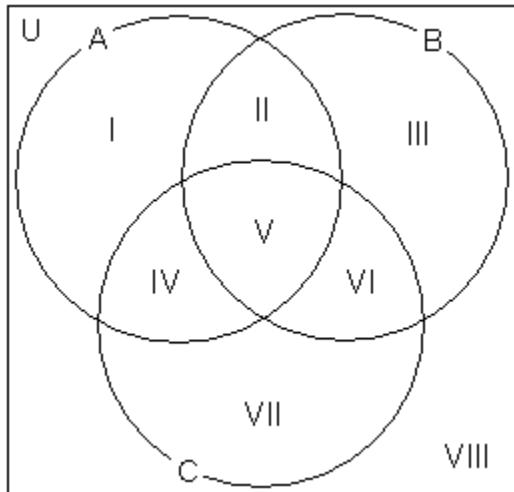
A) 28   B) 44   C) 40   D) 0

11) $n(U) = 157$, $n(A) = 106$, $n(B) = 78$, $n(C) = 76$, $n(A \cap B) = 44$, , $n(A \cap C) = 41$, $n(B \cap C) = 39$, $n(A \cap B \cap C) = 21$
Find VI.

A) 18 B) 17 C) 19 D) 20

Use a Venn diagram to answer the question.

12) At East Zone University (EZU) there are 924 students taking College Algebra or Calculus. 438 are taking College Algebra, 569 are taking Calculus, and 83 are taking both College Algebra and Calculus. How many are taking Algebra but not Calculus?

A) 355 B) 486 C) 841 D) 272

13) At East Zone University (EZU) there are 551 students taking College Algebra or Calculus. 210 are taking College Algebra, 389 are taking Calculus, and 48 are taking both College Algebra and Calculus. How many are taking Calculus but not Algebra?

A) 341 B) 162 C) 503 D) 114

14) A local television station sends out questionnaires to determine if viewers would rather see a documentary, an interview show, or reruns of a game show. There were 650 responses with the following results:
195 were interested in an interview show and a documentary, but not reruns;
26 were interested in an interview show and reruns, but not a documentary;
91 were interested in reruns but not documentaries or interviews;
156 were interested in an interview show but not a documentary;
65 were interested in a documentary and reruns;
39 were interested in an interview show and reruns;
52 were interested in none of the three.
How many are interested in exactly one kind of show?

A) 312 B) 322 C) 302 D) 292

2 *Use Survey Results to Complete Venn Diagrams and Answer Questions about the Survey

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

A pollster conducting a telephone poll asked three questions:
1. Are you religious?
2. Have you spent time with a person convicted of a crime?
**3. Are you in favor of the death penalty?**
Solve the problem.
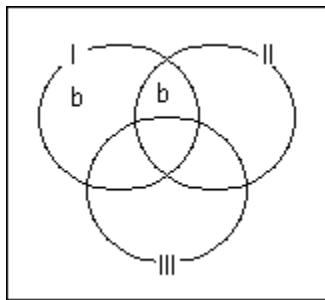
1) Construct a Venn Diagram with three circles that can assist the pollster in tabulating the responses to the three questions.
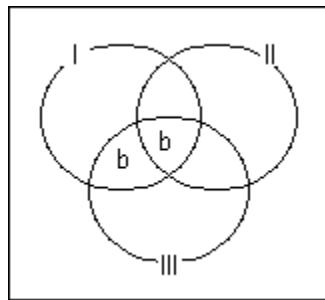
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) Write the letter b in every region of the diagram that represents all religious persons polled who are not in favored of death penalty.
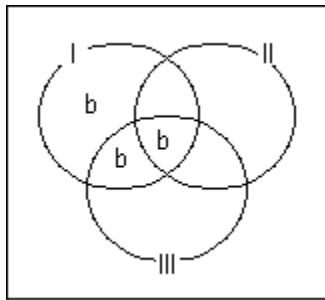
A)
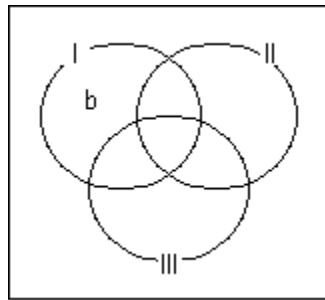
B)

C)
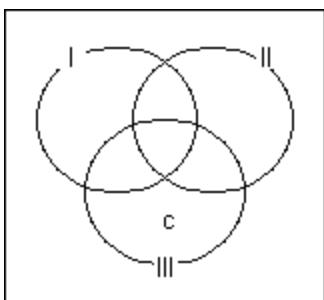
D)
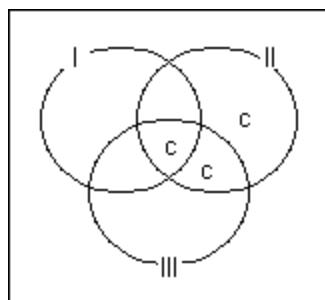
3) Write the letter c in every region of the diagram that represents the people polled who do not consider themselves religious, who have not spent time with aperson convicted with a crime, and who are in favor of the death penalty.
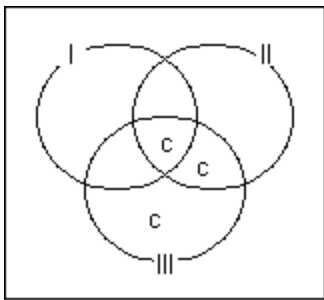
A)
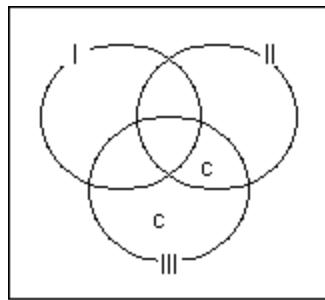
B)

C)

D)
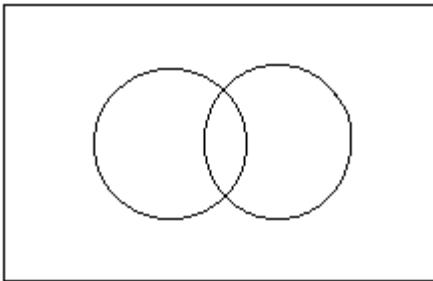
Solve the problem.

4) A pollster conducting a telephone poll asked two questions:
   1. Would you like to live to be 100 years old, if it was possible?
   2. Do you have confidence that medical science will find cures for major diseases during your lifetime?
   Construct a Venn diagram that allows the respondents to the poll to be identified by whether or not they want to live to be 100 and whether or not they believe cures for major diseases will be found.
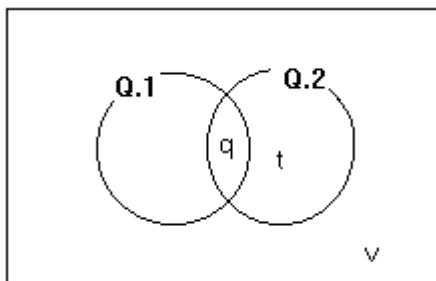

Write the letter q in the region of the diagram that identifies those would like to live to be 100 who believe cures will be found.
Write the letter t in the region of the diagram that identifies those would not like to live to be 100 who believe cures will be found.
Write the letter v in the region of the diagram that identifies those would not like to live to be 100 who believe cures will not be found.
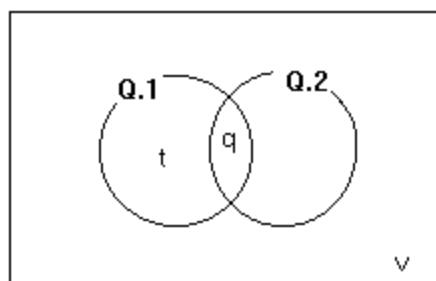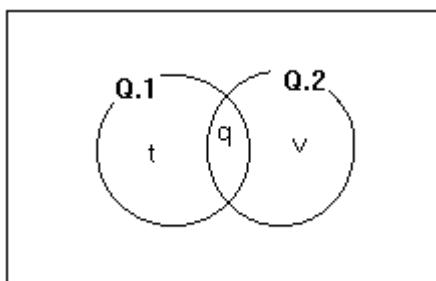
A)
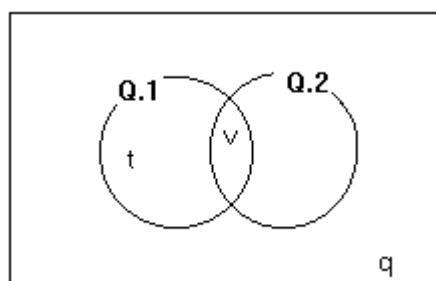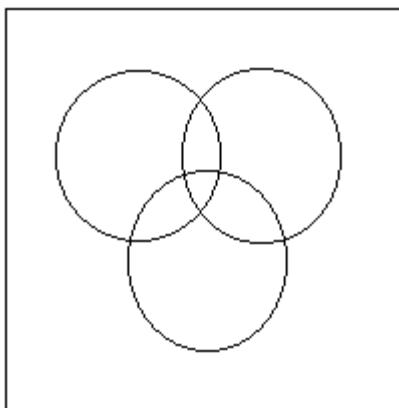
Q.1   Q.2

q   t

v

B)

Q.1   Q.2

t   q

v

C)

Q.1   Q.2

t   q   v

D)

Q.1   Q.2

t   v

q

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) A pollster conducting a telephone poll asked three questions:
   1. Are you a registered voter?
   2. Do you currently have any children in grades kindergarten through 12th grade?
   3. Would you support a tax increase to build a new school?

Construct a Venn diagram with three circles that can assist the pollster in tabulating the responses to the three questions.
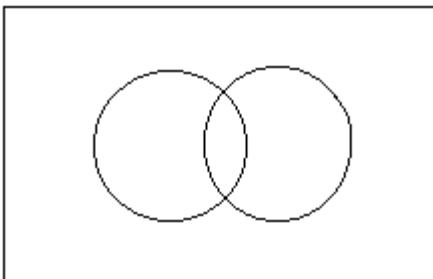
Write the letter h in the region of the diagram that identifies all registered voters polled who do not have children in school and who do not support a tax increase.
Write the letter j in the region of the diagram that identifies people who are not registered to vote, who do not have children in school, and who do not support a tax increase.
Write the letter k in the region of the diagram that identifies all registered voters polled who have children in school, and who do not support a tax increase.

6) There are 777,859 physicians in the United States.
177,030 are women.
33,947 physicians have cardiology as their specialty.
6,817 women physicians specialize in cardiology.

Identify the Venn diagram in which U is the set of all physicians, W is the set of all women physicians, and C is the set of all U.S. physicians specializing in cardiology. Fill in each of the four regions of the Venn diagram with the number of physicians who belong to that region.

Use your Venn diagram to answer the questions.

How many physicians in the United States are there who are men specializing in cardiology?
How many male physicians in the United States do not specialize in cardiology?

Ch. 2   Basic Set Concepts
Answer Key

2.1   Basic Set Concepts
1   Use Three Methods to Represent Sets
  1) A
  2) A
  3) A
  4) Answers may vary. Possible answers are:
     {Chicago}, {Los Angeles}, {New York City}, and {Springfield}
  5) A
  6) A
  7) A
2   Define and Recognize the Empty Set
  1) B
  2) B
  3) B
  4) A
  5) A
  6) B
  7) B
3   Use the Symbols $\in$ and $\notin$
  1) A
  2) A
  3) B
  4) A
  5) B
  6) A
  7) A
  8) A
4   Apply Set Notation to Sets of Natural Numbers
  1) A
  2) A
  3) A
  4) A
  5) A
  6) A
5   Determine a Set's Cardinal Number
  1) A
  2) A
  3) A
  4) A
6   Recognize Equivalent Sets
  1) B
  2) A
  3) A
  4) B
  5) A
7   Distinguish Between Finite and Infinite sets
  1) B
  2) A
  3) A
  4) A

8 Recognize Equal Sets

   1) A

   2) B

   3) A

   4) B

   5) B

   6) B

   7) A

2.2 Subsets

1 Recognize Subsets and Use the Notation ⊆

   1) A

   2) B

   3) B

   4) B

   5) A

   6) B

   7) B

   8) A

   9) A

2 Recognize Proper Subsets and Use the Notation ⊂

   1) A

   2) A

   3) A

3 Determine the Number of Subsets of a Set

   1) A

   2) A

   3) A

   4) A

   5) A

   6) A

   7) A

   8) A

   9) A

  10) A

4 Apply Concepts of Subsets and Equivalent Sets to Infinite Sets

   1) B

   2) A

   3) A

   4) B

   5) A

   6) A

   7) A

2.3 Venn Diagrams and Set Operations

1 Understand the Meaning of a Universal Set

   1) Answers may vary. One possible answer is: U = the set of all famous composers.

   2) Answers may vary. One possible answer is: U = the set of all non–carbonated beverages.

2 Understand the Basic Ideas of a Venn Diagram

   1) A

   2) A

3 Use Venn Diagrams to Visualize Relationships Between Two Sets

   1) A

   2) A

   3) A

   4) A

    5) A
    6) A
    7) A
    8) A
    9) A
   10) A
   11) A

4 Find the Complement of a Set

    1) A
    2) A
    3) A
    4) A

5 Find the Intersection of Two Sets

    1) A
    2) A
    3) A
    4) A
    5) A
    6) A
    7) D
    8) A

6 Find the Union of Two Sets

    1) A
    2) A
    3) A
    4) A
    5) A
    6) A
    7) A
    8) A

7 Perform Operations with Sets

    1) A
    2) A
    3) A
    4) A
    5) A
    6) A
    7) A
    8) A
    9) A
   10) A
   11) A
   12) A

8 Determine Sets Involving Set Operations from a Venn Diagram

    1) A
    2) A
    3) A
    4) A
    5) A
    6) A
    7) A
    8) A
    9) A
   10) A

9 Understand the Meaning of "and" and "or"

   1)

10   Use the Formula for n(A B)

   1) A

   2) A

   3) A

2.4   Set Operations and Venn Diagrams with Three Sets

1 Perform Set Operations with Three Sets

   1) A

   2) A

   3) A

   4) A

   5) A

   6) A

   7) A

   8) A

   9) A

  10) A

2 Use Venn Diagrams with Three Sets

   1) A

   2) A

   3) A

   4) A

   5) A

   6) A

   7) A

   8) A

   9) A

  10) A

  11) A

  12) A

  13) A

  14) A

  15) A

3 *Use Venn Diagrams to Prove Equality of Sets

   1) a) I   b) I   c) They are equal.

   2) a) I, II, and IV   b) I   c) They are not equal.

   3) a) III   b) III   c) They are equal.

   4) a) I   b) III   c) They are not equal.

   5) A' = III, IV

      B = II, III

      $(A' \cap B)$ = III

      $(A' \cap B)'$ = I, II, IV

      A = I, II

      B' = I, IV

      $A \cup B'$ = I, II, IV

   6) a) II, IV, V, VI, and VII   b) I, II, IV, V, and VI   c) They are not equal.

   7) a) II – VI   b) II – VI   c) They are equal.

8) $(A \cap C) = IV, V$
   $B = II, III, V, VI$
   $B \cup (A \cap C) = II, III, IV, V, VI$

   $(A \cup B) = I, II, III, IV, V, VI$
   $(B \cup C) = II, III, IV, V, VI, VII$
   $(A \cup B) \cap (B \cup C) = II, III, IV, V, VI$

## 2.5   Survey Problems
**1   Use Venn Diagrams to Visualize a Survey's Results**
   1) A
   2) A
   3) A
   4) A
   5) A
   6) A
   7) A
   8) A
   9) A
   10) A
   11) A
   12) A
   13) A
   14) A
2   *Use Survey Results to Complete Venn Diagrams and Answer Questions about the Survey
   1)
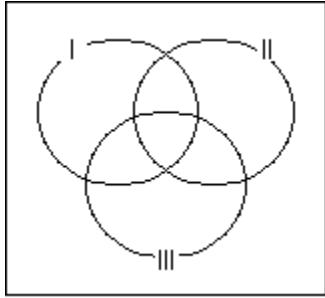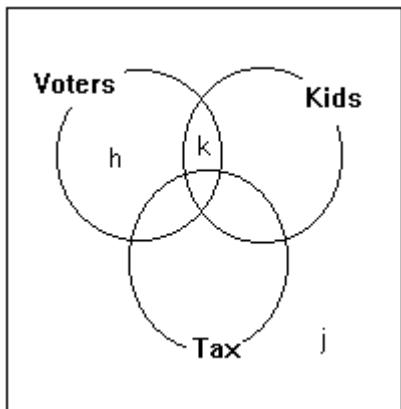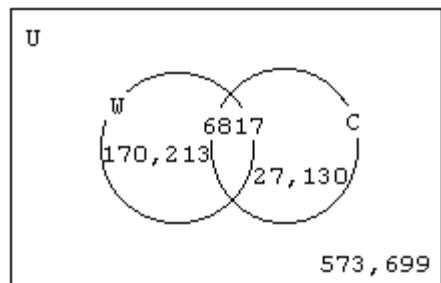
   2) A
   3) A
   4) A
   5)

6)

27,130 male physicians in the United States specialize in cardiology.
573,699 male physicians in the United States do not specialize in cardiology.