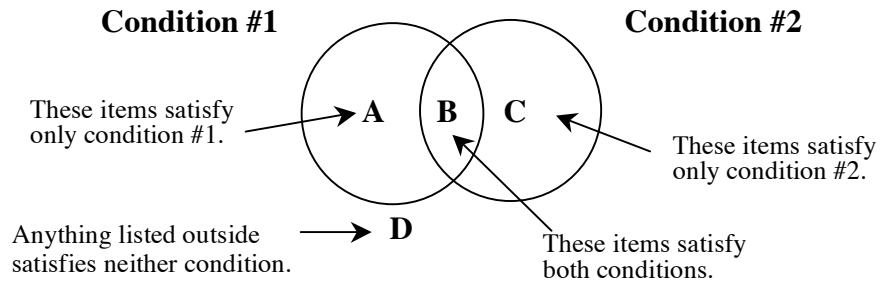


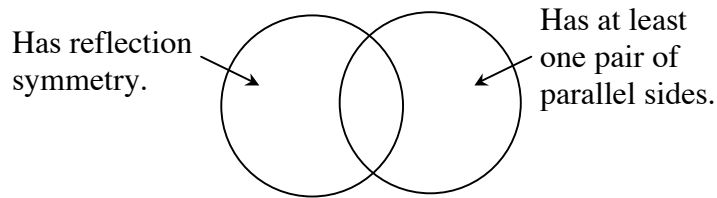
# VENN DIAGRAMS

## VENN DIAGRAMS AND CLASSIFICATIONS

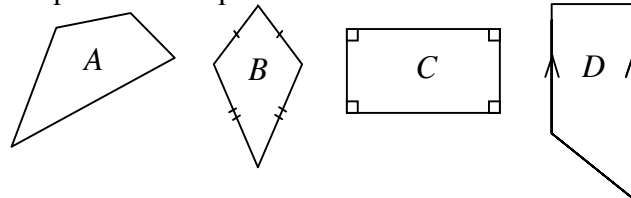
A **Venn diagram** is a tool used to classify objects. It is usually composed of two or more circles that represent different conditions. An item is placed or represented in the Venn diagram in the appropriate position based on the conditions it meets. See the example below:



### Example 1

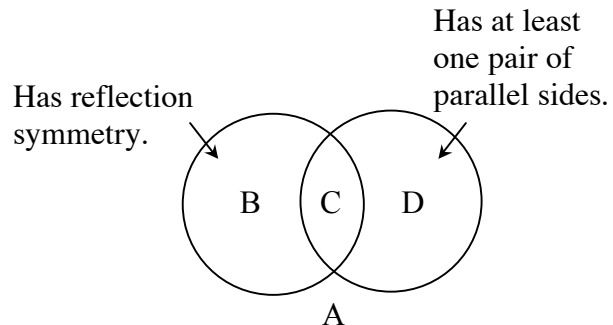


Use the Venn diagram above to place the shapes below:



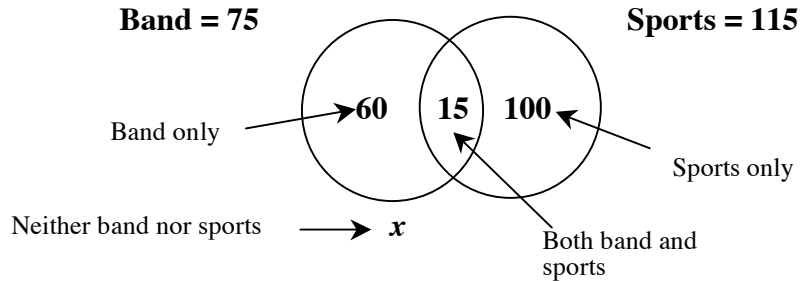
Answer: B and C have reflection symmetry. C and D have at least one pair of parallel sides.

The diagram is shown at right. It demonstrates that only shape C satisfies both conditions and shape A satisfies neither condition.



## Example 2

The sophomore class at Madison High has 400 students. If 75 students are band members, 115 belong to sports teams, and 15 do both, how many students are not involved with sports or band?



$$60 + 15 + 100 + x = 400; x = 225 \text{ students not in band or sports}$$

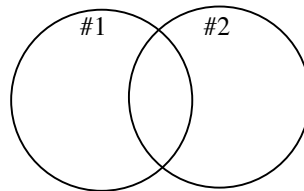
## Problems

For problems 1–3, using the Venn diagram given, place each of the following figures in the appropriate locations.

Rhombus, rectangle, square, kite, regular hexagon, isosceles triangle, parallelogram and a trapezoid.

1.

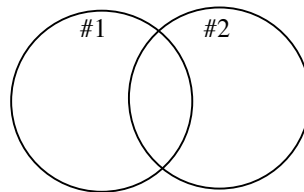
**#1: Has at least one pair of parallel sides.**



**#2: Has at least two sides of equal length.**

2.

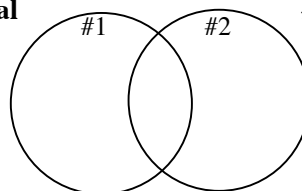
**#1: Has only three sides.**



**#2: Has a right angle.**

3.

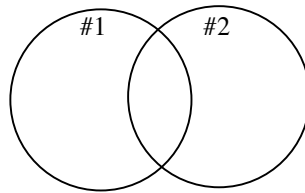
**#1: Quadrilateral**



**#2: Equilateral**

4. Copy the Venn diagram below on your paper. Then show where each person described should be represented in the diagram.

**#1: Studies a lot for class**



**#2: Has long hair**

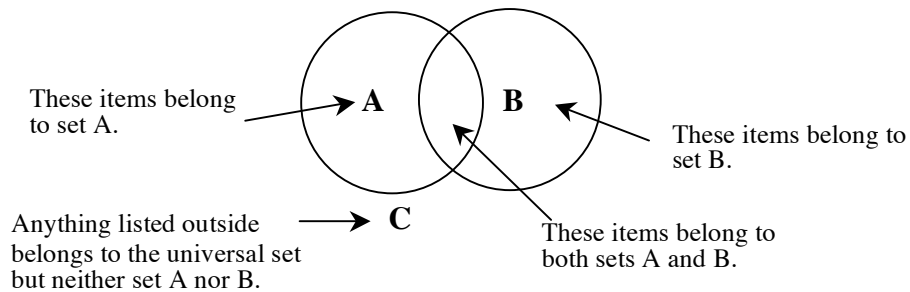
- Carol: *“I rarely study and enjoy braiding my long hair.”*
- Bob: *“I never do homework and have a crew cut.”*
- Pedro: *“I love joining after school study teams to prepare for tests and I like being bald!”*

In problems 5–7 use a Venn diagram to answer each question.

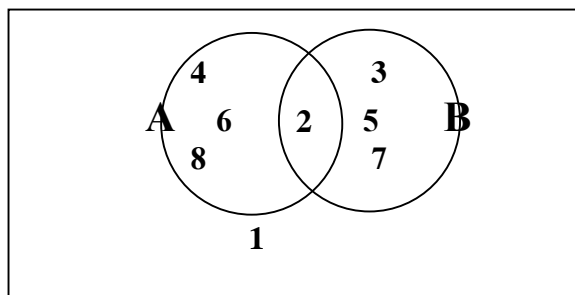
- A kindergarten teacher surveyed her 24 students about their pets. Fifteen have dogs, 10 have cats, and five have dogs and cats. How many students have no pets?
- During a two-hour period, a country-western station only played songs with the following themes: 15 songs about love, 18 songs about trucks, and 10 songs about love and trucks. How many songs were played?
- A survey of 43 people on a bus tour of Europe found that 20 speak Spanish, 25 speak German, and 17 speak French. Seven speak French and German, and of those, four speak all three languages. If eight only speak French and 13 only speak German, how many only speak Spanish?

## VENN DIAGRAMS AND SETS

A **Venn diagram** is also a tool used to show intersections, unions, and complements of sets.



**Example:** In this Venn diagram



The universal set =  $\{1, 2, 3, 4, 5, 6, 7, 8\}$

Set A =  $\{2, 4, 6, 8\}$

Set B =  $\{2, 3, 5, 7\}$

$A \cup B = \{2, 3, 4, 5, 6, 7\}$ : The union of A and B—everything that is in either A or B.

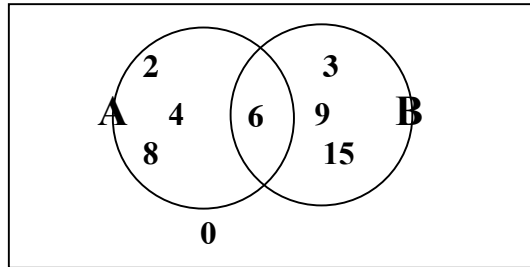
$A \cap B = \{2\}$ : The intersection of A and B—everything that is in both A and B.

$A^c = \{1, 3, 5, 7\}$ : The complement of A—everything in the universe and not in A.

$B^c = \{1, 4, 6, 8\}$ : The complement of B—everything in the universe and not in B.

## Problems

8. For the following Venn diagram, determine: universal set, set A, set B,  $A \cup B$ ,  $A \cap B$ ,  $A^c$ , and  $B^c$ .



In problems 9–11, for the given universal set, set A and set B, determine:

$A \cup B$ ,  $A \cap B$ ,  $A^c$ , and  $B^c$ .

9. The universal set =  $\{0, 1, 2, 3, 4, 6, 8, 9, 12, 16, 18\}$ , set A =  $\{2, 4, 8, 12, 16\}$ , set B =  $\{3, 6, 9, 12, 18\}$
10. The universal set =  $\{0, 2, 4, 6, 8, 10, 12, 14, 16, 18\}$ , set A =  $\{0, 4, 8, 12, 16\}$ , set B =  $\{0, 6, 12, 18\}$
11. The universal set =  $\{\text{counting numbers}\}$ , set A =  $\{\text{even counting numbers}\}$ , set B =  $\{\text{odd natural numbers}\}$
12. For the universal set =  $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$ , set A =  $\{0, 2, 4, 6, 8, 10, 12\}$ , set B =  $\{0, 3, 6, 9, 12\}$ , and set C =  $\{0, 6, 12\}$ , determine:  $A \cup B \cup C$ ,  $A \cap B \cap C$ ,  $(A \cup B)^c$ , and  $(B \cap C)^c$ .

## Answers

1. Left side: trapezoid; right side: kite, isosceles triangle; overlap: rhombus, rectangle, square, regular hexagon, parallelogram
2. Left side: isosceles triangle; right side: rectangle, square; outside: rhombus, kite, regular hexagon, parallelogram, trapezoid
3. Left side: rectangle, kite, parallelogram, trapezoid; right side: regular hexagon; overlap: square, rhombus; outside: isosceles triangle
4. Left side: Pedro; right side: Carol; outside: Bob
5. Four students have no pets.
6. 23 songs
7. Nine people speak only Spanish.
8.  $U = \{0, 2, 3, 4, 6, 8, 9, 15\}$ ;  $A = \{2, 4, 6, 8\}$ ;  $B = \{3, 6, 9, 12\}$ ;  
 $A \cup B = \{2, 3, 4, 6, 8, 9, 15\}$ ;  $A \cap B = \{6\}$ ;  $A^c = \{0, 3, 9, 15\}$ ;  $B^c = \{0, 2, 4, 8\}$
9.  $A \cup B = \{2, 3, 6, 8, 9, 12, 18\}$ ;  $A \cap B = \{12\}$ ;  $A^c = \{0, 1, 3, 6, 9, 18\}$ ;  
 $B^c = \{0, 1, 2, 4, 8, 16\}$
10.  $A \cup B = \{0, 2, 4, 6, 8, 10, 12, 14, 16, 18\}$ ;  $A \cap B = \{0, 12\}$ ;  $A^c = \{2, 6, 10, 14, 18\}$ ;  
 $B^c = \{2, 4, 8, 10, 14, 16\}$
11.  $A \cup B = \text{universal set}$ ;  $A \cap B = \{\}$ ;  $A^c = B$ ;  $B^c = A$
12.  $A \cup B \cup C = \{0, 2, 3, 4, 6, 8, 9, 10, 12\}$ ;  $A \cap B \cap C = \{0, 6, 12\}$ ;  
 $(A \cup B)^c = \{1, 5, 11\}$ ;  $(B \cap C)^c = \{1, 2, 3, 4, 5, 7, 8, 9, 10, 11\}$