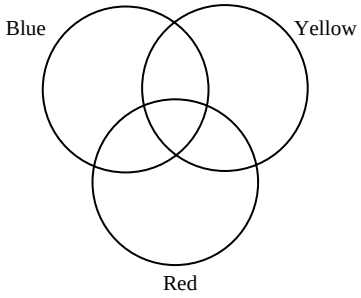
Venn Diagrams

The art department at Gilbert Elementary surveyed 100 of their students to find out their favorite colors:

48 students like the color blue,
35 students like yellow,
36 students like red,
15 students like blue and yellow,
12 students like yellow and red,
20 students like red and blue,
5 students like blue, yellow, and red

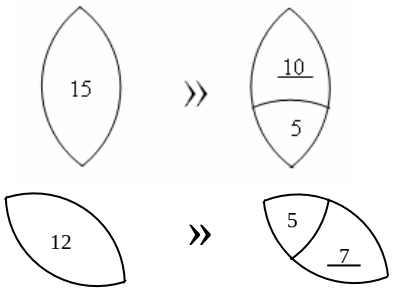


Contruct a Venn diagram to represent this information.

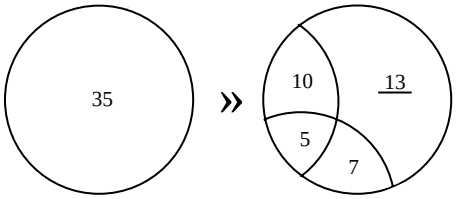
Solution:

1) Always start with the number describing *three* things (5 people like Blue, Yellow and Red). Place this number in the center of the Venn diagram, which is the intersection of the three circles.

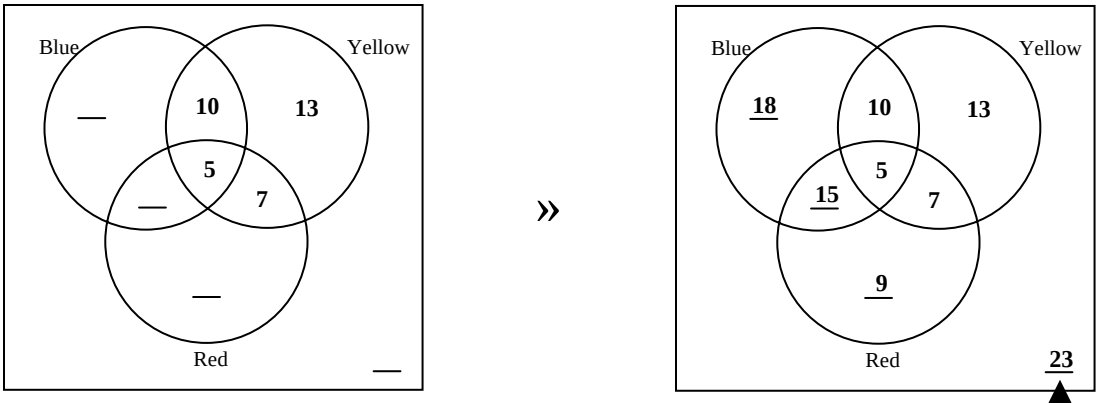
2) Next, look for numbers describing *two* things (15 people like Blue and Yellow). This number represents the overlap between the blue circle and the yellow circle. Remember, however, that you have already put 5 students in the lower part of that overlapped area, so there must only be 10 students in the upper portion (15 - 5 = 10). So, since 12 students like yellow and red, how many would be in the other portion of the overlap of the yellow and red circles: (12 – 5 = 7).



3) Now, look for numbers describing just *one* thing (35 students like Yellow). These students must fall within the yellow circle. However, we have already placed some numbers in that circle. We must remove those students from the 35, so we can find what number should go in the last section (35 – 10 – 5 – 7 = 13). Note that 13 students like only yellow, not red and not blue.



Fill out the rest of the spaces.



4) Last, subtract all of the numbers in the diagram from the total number of students (100) in order to find the number of students that did not like either blue, yellow, or red (100 – 18 – 10 – 13 – 15 – 5 – 7 – 9 = 23).

Answer these follow up questions:

What is the probability that a student likes *only* Red?
(Include only the number that appears in the red circle, but not within any other circles)

$$\frac{\text{\# of students that like only Red}}{\text{Total \# of students}} = \frac{9}{100} = .09 = 9\%$$

What is the probability that a student likes Blue *or* Red?
(Include all numbers from both the blue and red circles)

$$\frac{\text{\# of students that like Blue or Red}}{\text{Total \# of students}} = \frac{18 + 10 + 15 + 5 + 7 + 9}{100} = \frac{64}{100} = .64 = 64\%$$

What is the probability that a student likes Blue *and* Red?
(Include all numbers that are in the overlap of the blue and red circles)

$$\frac{\text{\# of students that like Blue and Red}}{\text{Total \# of students}} = \frac{15 + 5}{100} = \frac{20}{100} = .20 = 20\%$$

***Given* that a student likes Blue, what is the probability that they also like Red?**
[In the 3 probability calculations above, we are asked about the probability of events out of all possible outcomes (100). However, in this new calculation we are told (or given prior information) that the student likes blue. Knowing this means that our probability is now out of only those blue-favoring students (48). This is called a conditional probability.]

$$\frac{\text{\# of students that like Blue and Red}}{\text{\# of students that like Blue}} = \frac{20}{48} = .42 = 42\%$$