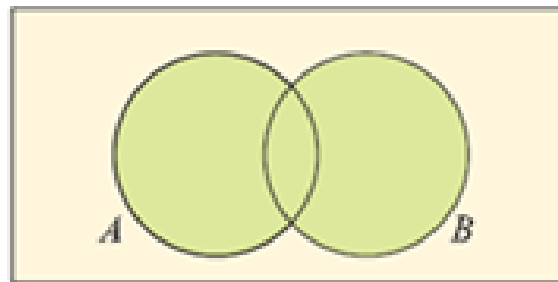


## 22H – Sets and Venn Diagrams

A Venn diagram consists of a universal set  $U$  (a rectangle) and sets  $S$ , within it (circles).  $U$

The **complement** of a set,  $S$ , consists of all the members of  $U$  which are not in  $S$ .

**Union:**



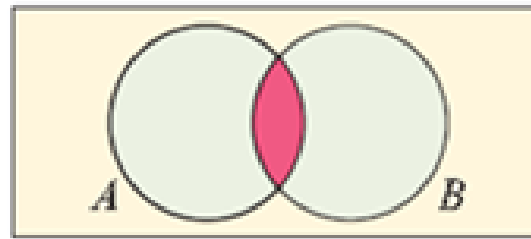
$A \cup B$  is shaded green.

When Venn diagrams overlap, we say there is a **union** of the two sets,  $A \cup B$ .

Set notation:  $A \cup B = \{x \mid x \in A \text{ or } x \in B\}$

(the set of all real  $x$  such that  $x$  belongs to  $A$  or  $B$  or both  $A$  and  $B$ )

## Intersection:



overlap

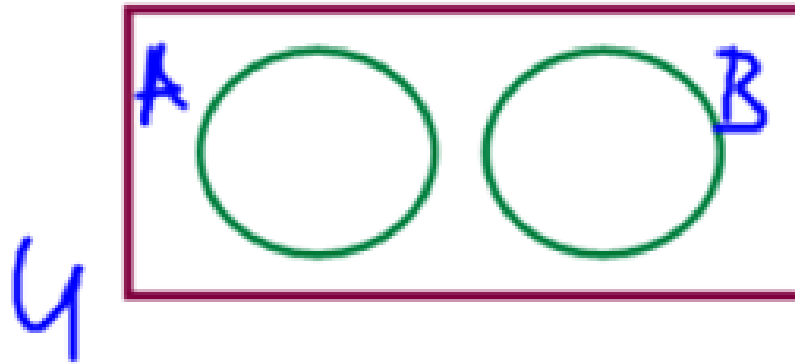
$A \cap B$  is shaded red.

$A \cap B$  is the intersection of sets  $A$  and  $B$ . Contains only elements in both sets.

Set notation:  $A \cap B = \{x \mid x \in A \text{ and } x \in B\}$

Two sets are said to be **disjoint** if they have no elements in common:

$$A \cap B = \phi$$



If A and B have elements in common then they are **non-disjoint**.

## Examples:

1. Given the following information:

$$U = \{x \mid 0 \leq x \leq 12, x \in \mathbb{N}\}$$

$$A = \{\text{primes} < 12\}$$

$$B = \{\text{factors of } 12\}$$

(a) Find all elements in  $U$ .  $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

(b) Find all elements in  $A$ .  $\{2, 3, 5, 7, 11\}$

(c) Find all elements in  $B$ .  $\{1, 2, 3, 4, 6, 12\}$

(d) Draw a Venn diagram.

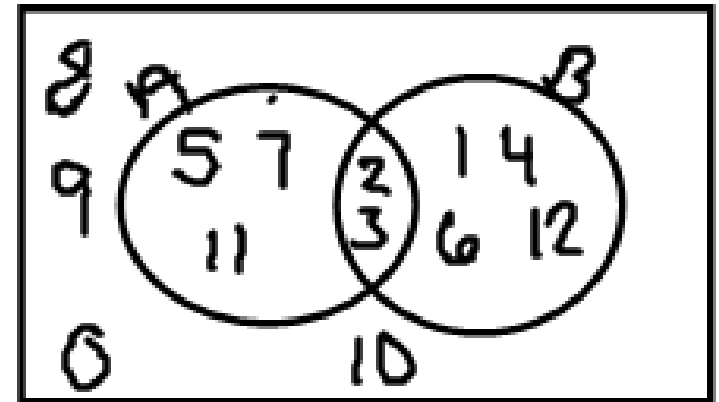
(e) List the elements in:

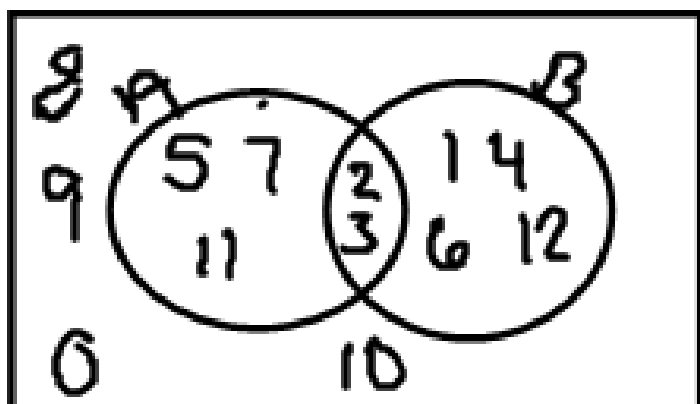
i.  $A \cup B$

ii.  $A \cap B$

iii.  $A'$

(f) Find  $n(B)$





(e) List the elements in:

i.  $A \cup B$

A or B

$\{1, 2, 3, 4, 5, 6, 7, 11, 12\}$

ii.  $A \cap B$

A and B

$\{2, 3\}$

Complement

↓

iii.  $A'$

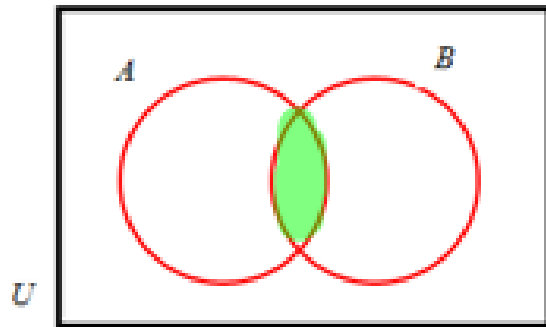
Everything not in A.

$\{0, 1, 4, 6, 8, 9, 10, 12\}$

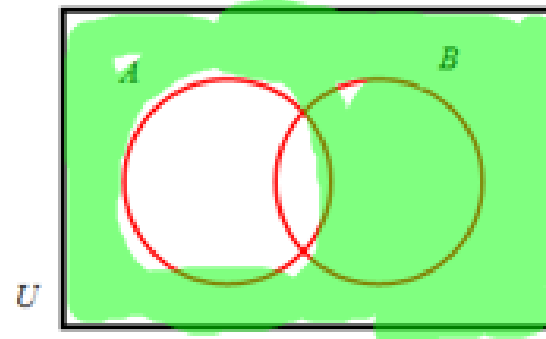
f) Find  $n(B) = 6$   
 ↑ # of element



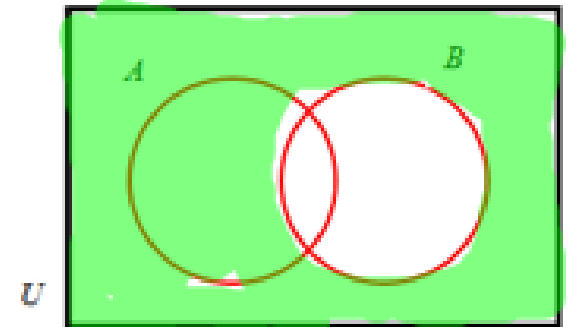
2. Verify:  $(A \cap B)' = A' \cup B'$



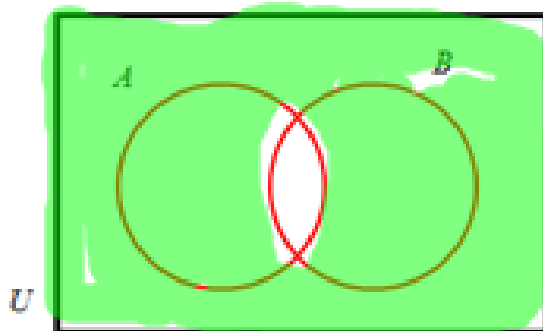
$A \cap B$



$A'$

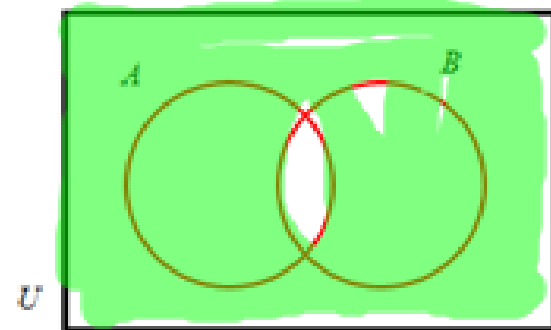


$B'$



$(A \cap B)'$

↔  
the same



$(A \cap B)' = A' \cup B'$

3.

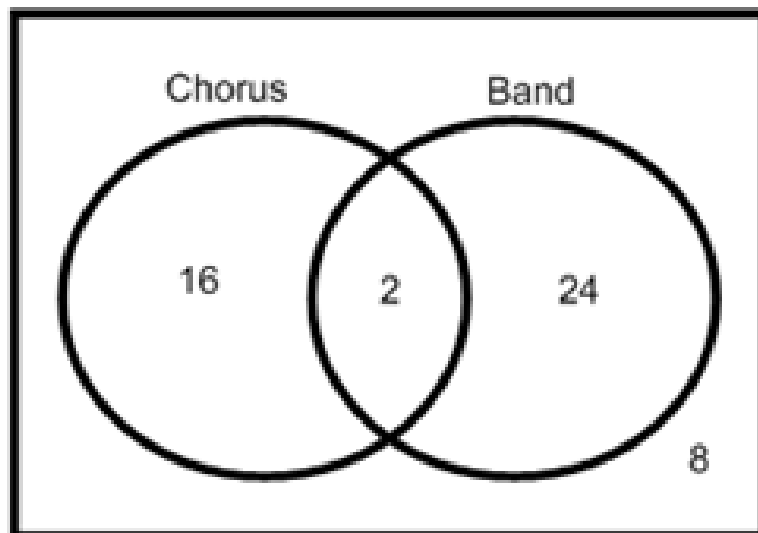
(a) How many students take Chorus?

$$16 + 2 = 18$$

(b) How many students take Band?

$$2 + 24 = 26$$

(c) How many students are not enrolled in either class? 8



(d) How many students are there in total?  $16 + 2 + 24 + 8 = 50$

(e) Determine the probability that a student takes both chorus and band.

$$\frac{2}{50}$$

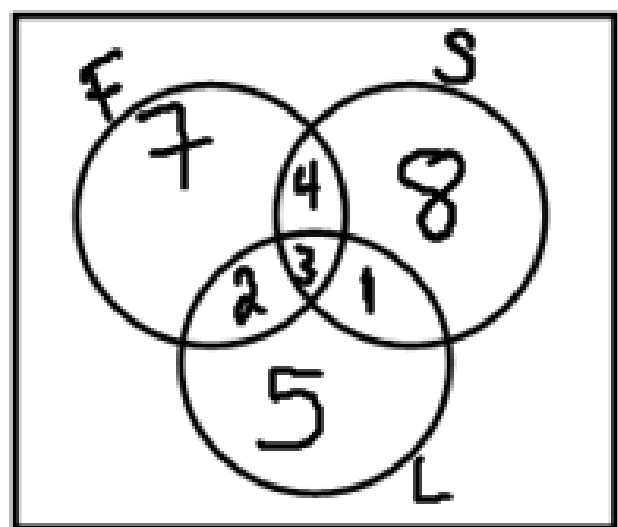
↓ overlap

(f) Determine the probability that a student takes at least one of chorus or band.

$$\frac{16 + 2 + 24}{50} = \frac{42}{50}$$



4. A guidance counsellor is planning schedules for 30 students. 16 students say they want to take French, 16 want to take Spanish, and 11 want to take Latin. 5 say they want to take both French and Latin, 7 students want to take French and Spanish, and 4 students say they want to take Latin and Spanish. Determine the probability a student takes exactly one language.



→ There are only 30 students, so 13 will take more than 1 language

There are only 13 students who take more than 1 lang. but we 16. This means 3 take All three languages

$$\begin{aligned} F + L &= 5 \\ F + S &= 7 \\ L + S &= 4 \\ \hline &16 \end{aligned}$$

$$P(1 \text{ lang}) = \frac{5 + 7 + 8}{30} = \frac{20}{30}$$

$$\begin{array}{r} \text{Universe } 30 \\ \hline \text{French} = 16 \\ \text{Spanish} = 16 \\ \text{Latin} = 11 \\ \hline 43 \end{array}$$