

Geometry 2.2

Determine truth values of conjunctions, disjunctions, negations
Represent conjunctions, disjunctions, negations using Venn diagrams
Determine counterexamples

statement (proposition) Can be T or F

negation not that $\sim p$

truth value T or F

P: Today is Friday F

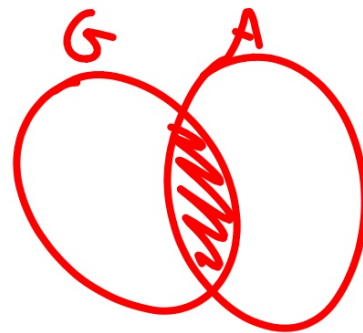
compound statement 2 + statements p: A rectangle is a quadrilateral. T

conjunction (and) $\wedge$

disjunction (or) $\vee$

truth table way to organize

Venn diagram



Compound statement:

p: Today is Wednesday. (T)

q: September has 37 days. (F)

$$T \wedge F = F$$

p and q

p or q

not p

not q

$P \wedge q$ Today is Wed and Sept.
has 37 days.

$P \vee q$

$T \vee F = T$ Today is w. or Sept. 37 days

$\sim p$ Today isn't Wed.

F

$\sim q$ Sept not 37 days

p : A rectangle is a quadrilateral. T
 q : A rectangle is convex. T

p and q :

$$p \wedge q = T$$
$$T \wedge T$$

"and" means both are true

Symbol:

Example 1 Truth Values of Conjunctions

Use the following statements to write a compound statement for each conjunction. Then find its truth value. Explain your reasoning.

p : The figure is a triangle. T

q : The figure has two congruent sides. T

r : The figure has three acute angles. F

a. p and r

$$\boxed{p \wedge r}$$

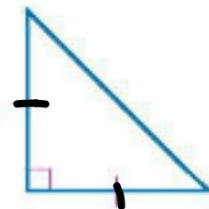
$$T \wedge F = F$$

$$p \vee r$$

$$p \vee r = T$$

$$T \vee F$$

b. $q \wedge \sim r$



$$q \wedge \sim r = T$$
$$T \wedge T$$

p: Today is Tuesday. **F**
q: October has 31 days. **T**

$$\text{p or q} \quad p \vee q = T$$
$$F \vee T$$

"Or" means at least one is true...could be both

Symbol:

Example 2 Truth Values of Disjunctions

Use the following statements to write a compound statement for each disjunction. Then find its truth value. Explain your reasoning.

p : January is a fall month. **F**

q : January has only 30 days. **F**

r : January 1 is the first day of a new year. **T**



a. p or r $p \vee r = T$
 $F \vee T$

b. $p \vee q$ $p \vee q = F$
 $F \vee F$

c. $\sim p \vee r$ $\sim p \vee r = T$
 $T \vee T$

Guided Practice

2A. r or p

2B. $q \vee \sim r$

2C. $p \vee \sim q$

P. 100

ConceptSummary Negation, Conjunction, Disjunction		
Statement	Words	Symbols
negation	a statement that has the opposite meaning and truth value of an original statement	$\sim p$ read not p
conjunction	a compound statement formed by joining two or more statements using the word <i>and</i>	$p \wedge q$, read p and q $T \wedge T = T$
disjunction	a compound statement formed by joining two or more statements using the word <i>or</i>	$p \vee q$, read p or q $T \vee T = T$ $T \vee F = T$ $F \vee T = T$

Truth Tables are generic:
When you don't have the actual statement(s) yet.

A convenient method for organizing the truth values of statements is to use a **truth table**. Truth tables can be used to determine truth values of negations and compound statements.

Negation	
p	$\sim p$
T	F

p $\sim p$
 T F

negation

Conjunction		
p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

ans
T
F
F
F

and

Disjunction		
p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

T
T
T
F

or

Start with columns for p, q

Example 3 Construct Truth Tables



Construct a truth table for $\sim p \vee q$.

p	q	$\sim p$	$\sim p \vee q$	ans
T	T	F	F $\vee$ T	T
T	F	F	F $\vee$ F	F
F	T	T	T $\vee$ T	T
F	F	T	T $\vee$ F	T

1 Make columns with headings that include each original statement, any negations of these statements, and the compound statement itself.

$p: 101$

4 Use the truth values for each part of the compound statement to determine the truth value of the statement.

p	q	$\sim p$	$\sim p \vee q$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	T

2 List the possible combinations of truth values.

3 Use the truth values of p to determine the truth values of its negation.

Add a column for your final answer

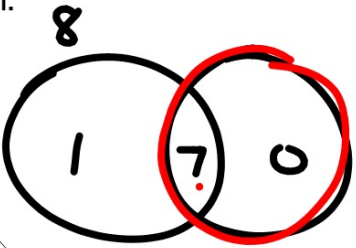
Guided Practice

3. Construct a truth table for $\sim p \wedge \sim q$.

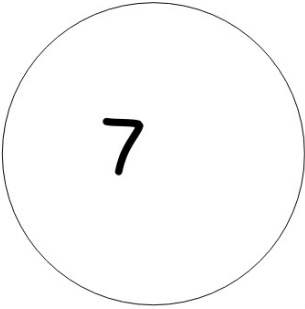
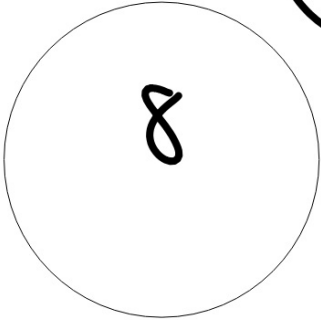
p	q	$\sim p$	$\sim q$	$\sim p \wedge \sim q$	ans
T	T	F	F	$F \wedge F$	F
T	F	F	T	$F \wedge T$	F
F	T	T	F	$T \wedge F$	F
F	F	T	T	$T \wedge T$	T

p	q	r
T	T	T
T	T	F
T	F	T
T	F	F
F	T	T
F	T	F
F	F	T
F	F	F

Venn diagram:
Sophomores



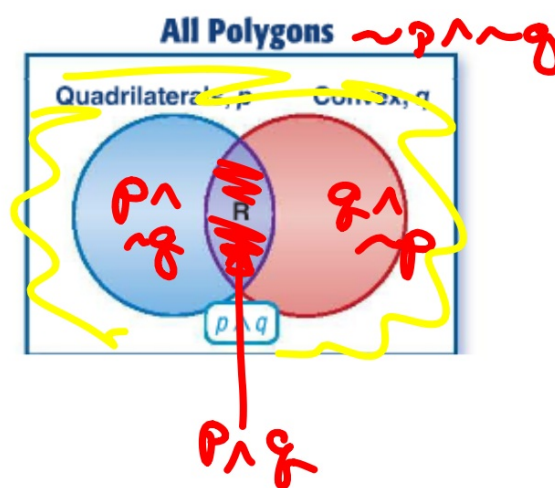
Spanish

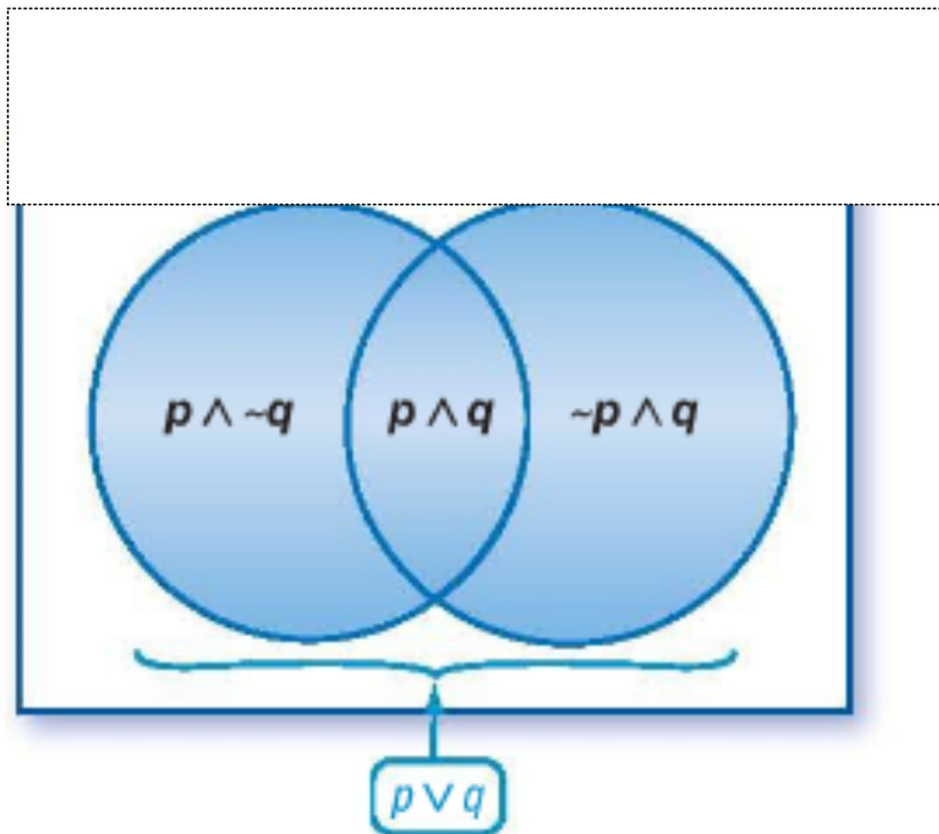


2 Venn Diagrams Conjunctions can be illustrated with Venn diagrams. Consider the conjunction given at the beginning of the lesson.

p and q : **A rectangle is a quadrilateral**, and
a rectangle is convex.

The Venn diagram shows that a rectangle (R) is located in the *intersection* of the set of quadrilaterals and the set of convex polygons. In other words, rectangles must be in the set containing quadrilaterals *and* in the set of convex polygons.





Real-World Example 4 Use Venn Diagrams

SCHEDULING The Venn diagram shows the number of people who can or cannot attend the May or the June Spanish Club meetings.

- How many people can attend the May or the June meeting?
- How many people can attend both the May and the June meetings?
- Describe the meetings that the 14 people located in the nonintersecting portion of the June region can attend.



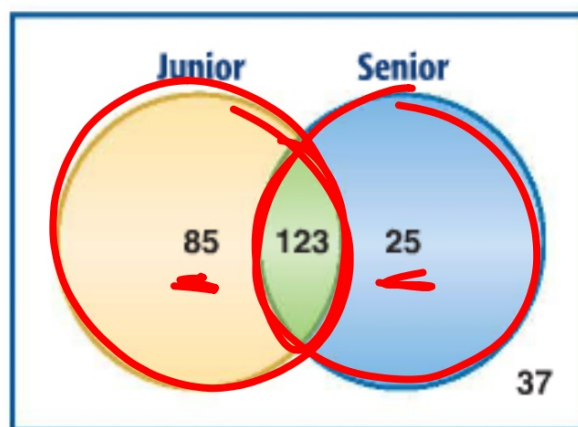
$$\begin{array}{r} 5 \\ 14 \\ 6 \\ \hline 25 \end{array}$$

$\begin{matrix} & 37 \\ \text{Jrs} & 208 \\ \text{Srs} & 148 \end{matrix}$

Guided Practice

4. **PROM** The Venn diagram shows the number of graduates last year who did or did not attend their junior or senior prom.

- How many graduates attended their senior but not their junior prom?
- How many graduates attended their junior and senior proms?
- How many graduates did not attend either of their proms?
- How many students graduated last year? Explain your reasoning.



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