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 opp of not P ~P

P: Today is Friday

truth value T F

p: A rectangle is a quadrilateral.

compound statement P and Q

Q = Pizza

conjunction (and) ∧ P∧Q

R = Oct.

disjunction (or) ∨ P or R

P ∨ R

truth table

Venn diagram

Compound statement:
p: Today is Thursday. T
q: September has 37 days. F

p and q
p or q
not p
not q

$P \wedge Q$ today is Thurs and Sept. 37
$T \wedge F = F$
$P \vee Q$ today Thurs or Sept. 37
$T \vee F = T$
$\sim P$ today not Thurs F
$\sim Q$ Sept. not 37 days T

p: A rectangle is a quadrilateral. T

q: A rectangle is convex. T

p and q:

$p \wedge q$

$T \wedge T = T$

"and" means both are true

p or q

$p \vee q$

$T \vee T = T$

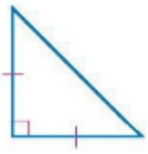
Example 1 Truth Values of Conjunctions

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*

$P \wedge r$

the fig is Δ and fig has 3 acute $\angle$s

$T \wedge F = F$

b. $q \wedge \sim r$

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

p or *q*:

P ∨ Q

F ∨ T = T

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

Example 2 Truth Values of Disjunctions

Use the following statements to write a compound statement for each disconjunction. 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 $P \vee R$ $F \vee T = T$

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

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

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2A. r or p **2B.** $q \vee \sim r$ **2C.** $p \vee \sim q$

p. 100

ConceptSummary Negation, Conjunction, Disconjunction

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 *and*	$p \wedge q$, read p and q
disconjunction	a compound statement formed by joining two or more statements using the word *or*	$p \vee q$, read p or q

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
F	T

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

P∧Q
T∧T=T
T∧F=F
F∧T=F
F∧F=F

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

T∨T
T∨F
F∨T
F∨F

negation

and

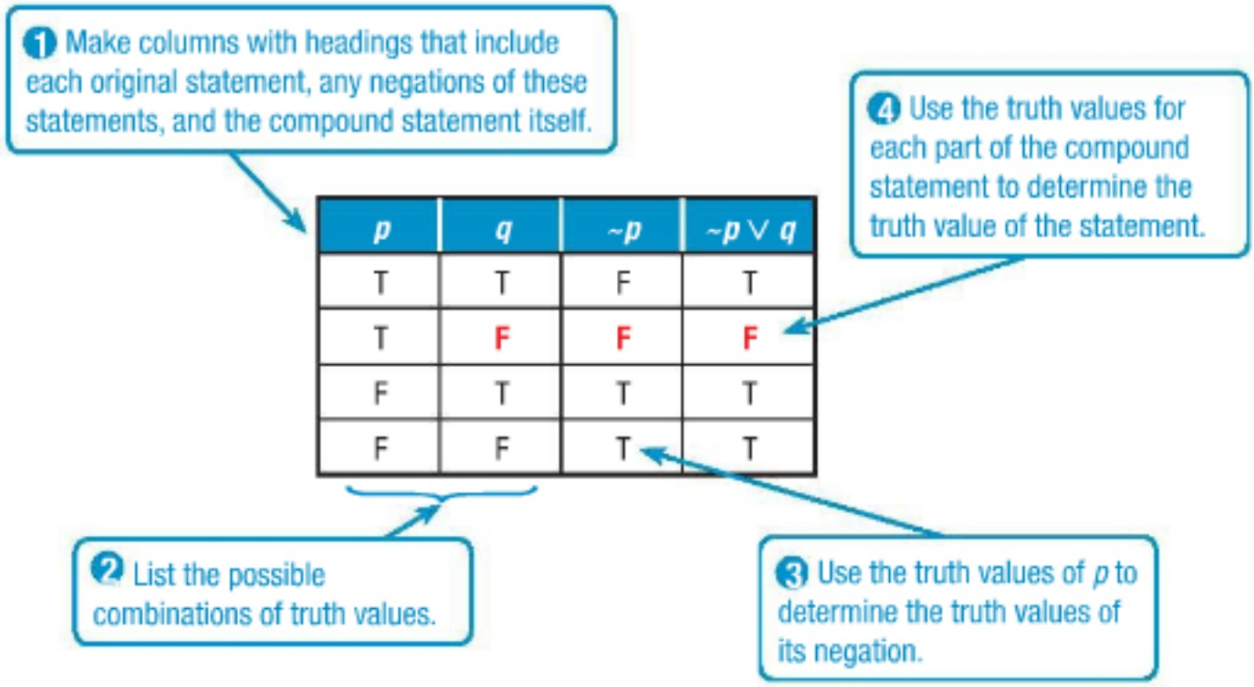
or

Start with columns for p, q

Example 3 Construct Truth Tables

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

P	Q	~P	~P V Q	ans
T	T	F	F V T	T
T	F	F	F V F	F
F	T	T	T V T	T
F	F	T	T V F	T



Add a column for your final answer

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

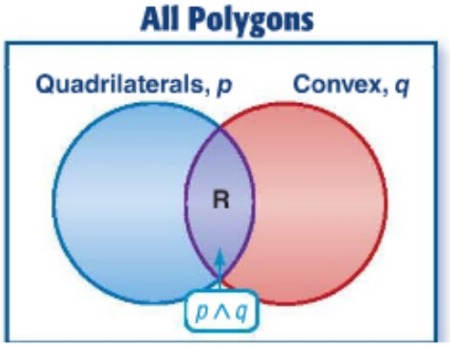
P	Q	~P	~Q	~P ∧ ~Q	ans.
T	T	F	F	F ∧ F	F
T	F	F	T	F ∧ T	F
F	T	T	F	T ∧ F	F
F	F	T	T	T ∧ T	T

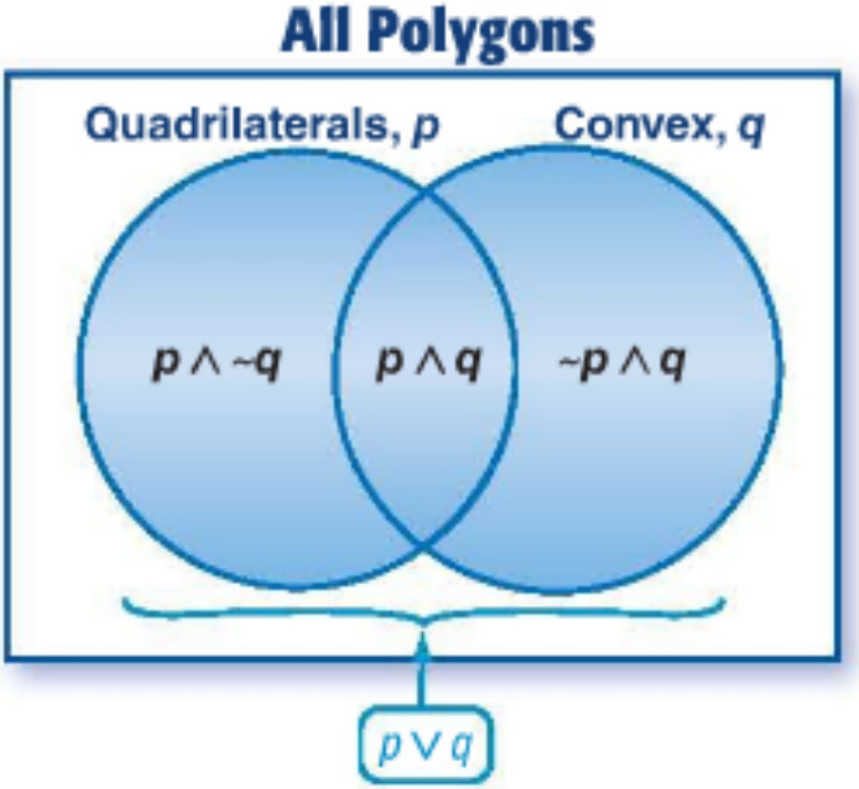
Venn diagram:
Sophomores
Boys

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.




All Polygons
Quadrilaterals, p
Convex, q
p ∧ ~q
p ∧ q
~p ∧ q
p ∨ q

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.

a. How many people can attend the May or the June meeting?

b. How many people can attend both the May and the June meetings?

c. Describe the meetings that the 14 people located in the nonintersecting portion of the June region can attend.

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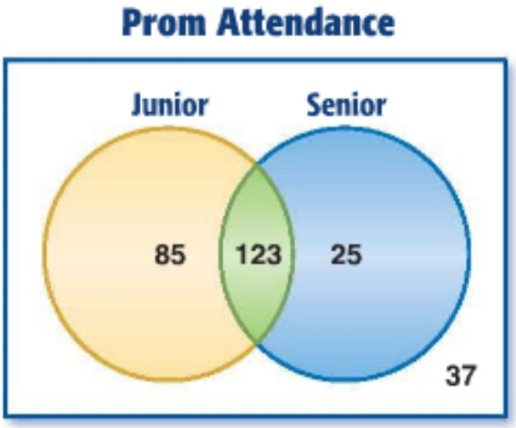
4. PROM The Venn diagram shows the number of graduates last year who did or did not attend their junior or senior prom.



A. How many graduates attended their senior but not their junior prom?

B. How many graduates attended their junior and senior proms?

C. How many graduates did not attend either of their proms?

D. How many students graduated last year? Explain your reasoning.