GEOMETRY

2.2 Inductive and Deductive Reasoning
Rewrite the sentence as a conditional statement in if-then form. Then write the converse, inverse and contrapositive statements.

3. An angle with a measure of 110° is an obtuse angle.

Conditional: ____________________________________________________________

Converse: ______________________________________________________________

Inverse: _________________________________________________________________

Contrapositive: _________________________________________________________
2.1 ESSENTIAL QUESTION

How can you use reasoning to solve problems?
GOALS

Use inductive and deductive reasoning.
Form conclusions using logic.
LET’S REVIEW

Conditional:  \( P \rightarrow Q \)
Converse: \( Q \rightarrow P \)
Biconditional: \( P \leftrightarrow Q \)
Inverse: \( \sim P \rightarrow \sim Q \)
Contrapositive: \( \sim Q \rightarrow \sim P \)
EXAMPLE

P: it is Halloween

Q: it is October

~P: It is not Halloween.

~P → ~Q: If it is not Halloween, then it is not October.

Q → P: If it is October, then it is Halloween.
YOUR TURN. WRITE YOUR ANSWERS DOWN ON YOUR PAPER.

P: I will take my driving test
Q: I will get my driver’s license

1. What is \( P \rightarrow Q? \)
   If I will take my driving test, then I will get my driver’s license.

2. What is \( \neg Q \rightarrow \neg P? \)
   If I will not get my driver’s license, then I will not take my driving test.

3. Write \( \neg P \rightarrow \neg Q. \)
   If I will not take my driving test, then I will not get my driver’s license.
INDUCTIVE REASONING

We use patterns and examples to make conjectures.

“Find the next three numbers in this sequence...”
EXAMPLE 1

Describe how to sketch the fourth figure in the pattern. Then sketch the fourth figure.
EXAMPLE 2

Sketch the next figure in each pattern below.

a.

b.
EXAMPLE 3

Numbers such as 3, 4, and 5 are called consecutive integers. Make and test a conjecture about the sum of any three consecutive integers.

Test it:

Conjecture:

*The sum of any three consecutive integers is three times the second number.*
DEDUCTIVE REASONING

Uses facts, definitions and properties in a logical order to make a logical argument.

Geometric proofs always use deductive reasoning.
RULES OF DEDUCTION

1. Law of Detachment
2. Law of Syllogism
If \( P \rightarrow Q \) is true, and \( P \) is true, then \( Q \) is true.

Example:

If I get an A in Geometry, then I will get a new car.

I get an A in Geometry.

Conclude:

I get a new car.
EXAMPLE 4

Judy’s parents tell her that if she washes the windows on Saturday, then she can go to the movies that night.

Judy gets up Saturday and washes all the windows.

What do we conclude?

Judy can go to the movies that night.
WHAT ABOUT THIS?

If two angles form a linear pair, then they are supplementary.

∠A and ∠B are supplementary.

Conclusion: ∠A and ∠B form a linear pair.

WRONG!

This is saying $P \rightarrow Q$, and $Q$ is true. This doesn’t make $P$ true. $P \rightarrow Q$ is like a one-way street. $P$ leads to $Q$, but $Q$ does not lead to $P$.

$\angle 1$ and $\angle 2$ are supp, but not a linear pair.
If there is a storm, then the power will go out”, said Marco.

Suddenly the power goes out, leaving everyone in the dark.

“Gee, I guess there is a storm!”, exclaims Marco.

“No, crazy: you forgot to pay the electric bill”, said his sister.

*Just because the conclusion is true, does not mean that the hypothesis is true.*
LAW OF DETACHMENT (AGAIN)

P → Q is true.
P is true.
Conclusion: Q is true.
ASSIGNMENT DAY 1

2.2 PAGE 80
#4, 7, 10, 12, 13, 15, 18, 20, 22, 23, 24
2.2 Warm-Up

Describe the pattern. Then write the next two numbers.

1) ... , 16, 25, 36, 49, ...  
2) 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, ...

Rewrite the definition as a conditional statement using If-then. Then write the converse and biconditional.

3) **Between:** When three points are collinear, one point is between the other two.

Conditional Statement:

________________________________________________________________________

Inverse:

________________________________________________________________________

Biconditional:

________________________________________________________________________

Find a counterexample to show that the conjecture is false.

4.) The difference of a positive and negative number is always negative.
LAW OF SYLLOGISM

In symbols:
If \( P \rightarrow Q \) is true, and \( Q \rightarrow R \) is true, then \( P \rightarrow R \) is also true.

Example:
If Sam gets an A in math, then he can buy a car.
If he can buy a car, then he will be popular.

Conclusion:
If Sam gets an A in math, then he will be popular.
EXAMPLE 5

Write the conclusion that we can make based on the law of syllogism.

If I watch too much TV, then I will be dumb.
If I am dumb, then I won’t get an A in math.

Conclusion:
If I watch too much TV, then I won’t get an A in math.
EXTENDING A SYLLOGISM

If I wake up, then I can get dressed.
If I get dressed, then I can go to school.
If I go to school, then I can walk to class.
If I walk to class, then I will meet the school bully.
If I meet the school bully, then I will get in a fight.
If I get in a fight, then I will be suspended.
If I get suspended, then I will stay home.
If I stay home, then I will go to sleep.

Conclusion:
If I wake up, then I will go to sleep.
CAN YOU PUT THE STATEMENTS IN ORDER?

1. If I go to the movie, then I’ll eat popcorn.
2. If I eat popcorn, then I’ll be thirsty.
3. If I’m thirsty, then I’ll get a soda.
4. If I get a soda, then I’ll enjoy the movie.

Start with the hypothesis that is not written as a conclusion.

Thirsty $\rightarrow$ soda
Popcorn $\rightarrow$ thirsty
Soda $\rightarrow$ enjoy movie
Go to Movie $\rightarrow$ popcorn
Go to Movie $\rightarrow$ popcorn
Popcorn $\rightarrow$ thirsty
Soda $\rightarrow$ enjoy movie

Conclusion: If I go to the movie, then I will enjoy the movie.
If angles form a linear pair, then they are supplementary.

If angles are supplementary, then their sum is $180^\circ$.

**Conclusion:**

If angles form a linear pair, then their sum is $180^\circ$.

We have just proved a theorem!
SYLLOGISM (AGAIN)

If $P \rightarrow Q$, and $Q \rightarrow R$, then $P \rightarrow R$

Jump from beginning to the end.

These are the same means...
PUTTING TWO LAWS TOGETHER

If Jake gets a job, then he can pay for football camp. If he goes to football camp, then he will make the varsity team. If he makes varsity, then he will be Homecoming King.

Jake gets a job.

**Conclusion:** Jake will be Homecoming King.
Any Questions?
**Mindset Review**

Inductive Reasoning:

Example:

Rules of Deductive Reasoning:
- Law of Detachment
- Law of Syllogism
LET’S PRACTICE

1. Decide whether inductive reasoning or deductive reasoning is used to reach the conclusion. Explain your reasoning.

   a. Each time Monica kicks a ball up in the air, it returns to the ground. So the next time Monica kicks the ball up in the air, it will return to the ground.

   b. All reptiles are cold-blooded. Parrots are not cold-blooded. Sue’s pet parrot is not a reptile.
2. Determine if statement (3) follows from statements (1) and (2). If so, what Law was used?

(1) If you eat sushi, then you will get sick.
(2) You eat sushi.
(3) You get sick. Yes this follows, by Law of Detachment.
3. Determine if statement (3) follows from statements (1) and (2). If so, what Law was used?

(1) If \( x = 10 \), then \( y = 20 \).
(2) If \( y = 20 \), then \( z = 25 \).
(3) If \( x = 10 \), then \( z = 25 \).

Yes this follows by the Law of Syllogism.
4. Determine if statement (3) follows from statements (1) and (2). If so, what Law was used?

(1) If you are a lawyer, then you will be rich.

(2) You are rich.

(3) Then you are a lawyer.

No, this doesn’t follow. The argument is invalid.

You could get rich another way.
5. If Jim talks back to his boss, then he will lose his job. If he loses his job, he will have to sell his car. Jim talks back to the boss. What’s the conclusion?

Jim has to sell his car.

\[ P \rightarrow Q, \ Q \rightarrow R \]

means \[ P \rightarrow R \] (Syllogism)

\[ P \rightarrow R \]

P is True

R is True (Detachment)
ASSIGNMENT DAY 2

2.2 PAGES 81 — 82

# 32, 34, 40, 45,  CHALLENGE PROBLEM #46