

**Part One: Formal Logic**

I. Lesson 1. recall that conditional (or hypothetical) propositions have the following standard form: **If (independent clause 1), then (independent clause 2).**

A. The independent clauses have names. The first is called the antecedent and the second is called the consequent.

If (**ANTECEDENT**), then (**CONSEQUENT**).

If Sara works, then she works hard.

**1. Exercise:** Memorize the formal names for the two independent clauses in a conditional claim: **antecedent** and **consequent**.

B. Conditional claims have informal variations; for example:

Sara works hard, if she works.

“She works” remains the formal antecedent, even though stated last. Note also, the “then” is dropped. Your first step in dealing with an informally expressed conditional proposition is to rewrite it in **STANDARD FORM**. Most of the following exercises will have you rewrite various informal variations into standard form.

A conditional proposition is not an argument, with premise and conclusion. The antecedent is not a premise. Note that it is not claimed to be true that Sara works. The “if” is an important word. The only claim is that a relation exists between antecedent and consequent. That’s why a conditional proposition is bracketed as one statement, not two.

You must learn to rewrite (or “translate”) informal variations into correct standard form.

**1. Exercise:** Rewrite the following into standard form.

a) I’ll lose my bet if the Tigers win.

b) if you leave, we’ll be sorry.

C. TIME. The consequent follows logically, but not necessarily in time.

Example: If the Captain was drunk, then he had been drinking.

Note that the antecedent does logically imply the consequent, even though the given consequent, “he had been drinking,” took place earlier in time.

D. ONLY IF: The term “only if” actually is a consequent indicator, as in:

I’ll be there only if I can get free.

Translated: If I’m there, then I’ll have gotten free.

**1. Exercise:** Rewrite the following into standard form.

a) You may kiss him only if you’re engaged to him.

b) You may watch TV only if your homework is done.

E. UNLESS: The term “unless” is an antecedent indicator, translating into “if...not...,” as shown:

“She’ll meet you, unless she’s out of town.”  
Translated: “If she’s not out of town, then she’ll meet you.”

1. **Exercise:** Rewrite the following into standard form.
  - a) Read this book unless you’re too busy.
  - b) Unless I win, I won’t be pleased.

II. SOME **INFORMAL ANTECEDENT INDICATORS**. “If” sometimes is replaced informally by such expressions as: “on condition that,” “provided that,” “in case,” and also by “when” or “whenever.” These all indicate a hypothetical (or merely possible, not necessarily actual condition). For example:

When I eat, I’m happy.  
Translated: If I eat, then I’m happy.

1. **Exercise:** Translate the following into standard form.
  - a) In case I’m not home, I’ll leave a note.
  - b) Whenever I sing, people leave.
  - c) Harry pouts whenever people leave.
  - d) I’ll ride with you on condition that you drive safely.

III. TRANSLATION FROM “CATEGORICAL” PROPOSITIONS. A categorical proposition states quantities such as “all” or “no.” Two types of categorical propositions can be translated into conditional propositions, which can be very useful. Examples:

Categorical: All horses are animals.  
Conditional: If it’s a horse, then it’s an animal.

Categorical: No dogs are cats.  
Conditional: If it’s a dog, then it’s not a cat.

Note that in translation of a categorical negative proposition, the denial, “not,” falls into the consequent.

1. **Exercise:** Translate into standard form conditional propositions:
  - a) All monkeys are primates.
  - b) No monkeys are human.

IV. CONTRAPOSITION. We can exchange the positions of antecedent and consequent, but only if we deny each. Example:

If a fire started, then heat was present.  
May become: If no heat was present, then no fire started.

1. **Exercise:** Contraposit the following:
  - a) If she plays, then she wins.
  - b) If Fido is breathing, then Fido is alive.

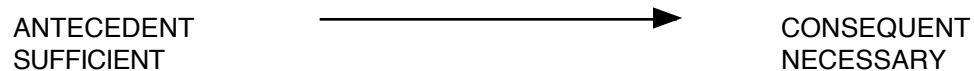
V. **CONDITIONS: SUFFICIENT** and **NECESSARY**

Recall that the standard form is **If antecedent, then consequent** where the antecedent and the consequent are each independent clauses.

The **antecedent** is also called the **sufficient condition**.  
The **consequent** is also called the **necessary condition**.

We say that the antecedent is a **SUFFICIENT** condition to guarantee the consequent. And here is a second concept: we also say that the consequent is **NECESSARY** to the antecedent (meaning that the antecedent depends on the consequent). So if the antecedent, then the consequent, but if no consequent, then no antecedent.

#### A. FORMAL RULES FOR ACCEPTABLE CONDITIONAL PROPOSITIONS



The **antecedent** condition is supposed to be **sufficient** to guarantee the consequent condition. This means that whenever you have the antecedent, you always also have the consequent (they come in pairs). Or, in other words, in every case where the antecedent is true, the consequent is claimed to be true also. If you write a conditional proposition, you are making that claim. So the antecedent is known as the sufficient condition.

And because the **consequent** is claimed to follow necessarily whenever the antecedent is true or present, the consequent is known as the **necessary** condition. In fact, it is so true, that if the consequent is not true or present, that means the antecedent can't be true or present either. So we may say that the antecedent *depends on* the consequent.

If you've ever used the phrase, "not necessarily," you probably were denying that some antecedent is sufficient to guarantee some consequent. At the same time, you also were saying that the antecedent does not necessarily depend on some claimed consequent. And so, with this dual observation, you were rejecting the acceptability of some conditional proposition.

**1. Exercise:** Practice is *necessary* to grasp these concepts. (Meaning: If you grasp these concepts, then you have practiced.) Determine which of the conditions is sufficient and which is necessary. In some cases it is *neither*, and it is possible that it is both sufficient *and* necessary. - That's called a **biconditional**, meaning really that you have two different names for the same condition.

In each of the following cases arrange the conditions as an acceptable "If...then..." conditional proposition, with the sufficient condition written in the place of the antecedent, and the necessary condition written in the place of the consequent.

Example:            Detonating dynamite                            Making an explosion.

Test it this way: Fill in an "If...then..." claim both ways. If one makes sense and the other doesn't, then the correct order is the one that makes sense.

If one is detonating dynamite then they are making an explosion.  
If they are making an explosion then one is detonating dynamite.

Notice that it is always, and without exception true that every time dynamite is detonated that there is an explosion. That proves that the first one makes sense. Let's use a counterexample to test the second one. If they are making an explosion are they necessarily detonating dynamite? No. They could be blowing up gasoline. That shows that the second one doesn't work. So, detonating dynamite is the sufficient condition, and making an explosion is necessary (every time dynamite is detonated).

Answer: If you detonate dynamite, then you make an explosion.

**Do the same thing as above with each of the following.** Write out your answer, and include a counter example, when appropriate. In the cases where the conditions are neither sufficient nor necessary, simply write, “\_\_\_\_\_is neither sufficient nor necessary to \_\_\_\_\_.” in cases where you are dealing with a biconditional, say that.

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|-----|-----------------------------|---------------------------------------|
| 1.  | being an aunt               | having a niece                        |
| 2.  | being a zebra               | being an animal                       |
| 3.  | being at least 10 feet tall | being at least 8 feet tall            |
| 4.  | weighing at least 9 pounds  | weighing exactly 20 pounds            |
| 5.  | living in France            | learning French                       |
| 6.  | having at least three legs  | being a normal horse                  |
| 7.  | being a copy of a book      | being found in the library            |
| 8.  | having a complete chess set | having all the pieces of a chess set. |
| 9.  | being an unmarried man      | being a bachelor                      |
| 10. | being arrested for a crime  | being guilty of the same crime        |

**2. Exercise:**

1. State two conditions, each necessary for being a wife.
2. State a condition that is sufficient (but not necessary) for eating cooked potatoes.