Includes ANSWER KEY

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. If the Tigers win, then I'll lose my bet.
b) if you leave, we'll be sorry. If you leave, then 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.
   If you may kiss hime, then you’re engaged to him.
   b) You may watch TV only if your homework is done.
   If you may watch TV, then 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.
   If you’re **not** too busy, then read this book.

   b) Unless I win, I won’t be pleased.
   If I don’t win, then 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.
   If I’m not home, then I’ll leave a note.
   b) Whenever I sing, people leave.
   If I sing, then people leave.
   c) Harry pouts whenever people leave.
   If people leave, then Harry pouts.
   d) I’ll ride with you on condition that you drive safely.
   If you drive safely, then I’ll ride with you.

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.
   If it’s a monkey, then it’s a primate.
   b) No monkeys are human.
   If it’s a monkey, then it’s not a 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.
   If she doesn’t win, then she doesn’t play.
   b) If Fido is breathing, then Fido is alive.
   If Fido is not alive, then Fido is not breathing.

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

ANTECEDENT	CONSEQUENT
SUFFICIENT	NECESSARY

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, the 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.

1. being an aunt having a niece
   Neither sufficient nor necessary. I could be an uncle, or I could have a nephew.
2. being a zebra being an animal
   Zebra is sufficient for being an animal and being an animal is necessary for being a zebra.
3. being at least 10 feet tall being at least 8 feet tall
   Being ≥10 feet tall is sufficient, because everyone who is ≥10 feet tall is ≥8 feet tall.
4. weighing at least 9 pounds weighing exactly 20 pounds
   Weighing exactly 20 lbs. is sufficient and it is necessary to weigh at least 9 lbs. in order to weigh exactly 20 lbs.
5. living in France learning French
   Neither is sufficient or necessary. One can learn French and not live in France. One can live in France and avoid learning French.
6. having at least three legs being a normal horse
   Being a normal horse is sufficient and having at least three legs is necessary. Every normal horse has four legs (that's at least three). Lots of things have at least three legs that are not horses, so that's not sufficient.
7. being a copy of a book being found in the library
   Neither. You can find a book in your book bag. You can find librarians in libraries.
8. having a complete chess set having all the pieces of a chess set.
   Biconditional, if you consider the board a "piece." Chess players don't So, that would make having a complete chess set the sufficient condition and having all the pieces the necessary condition.
9. being an unmarried man being a bachelor
   Biconditional. One means the other.
10. being arrested for a crime being guilty of the same crime
    Neither.

2. Exercise:
1. State two conditions, each necessary for being a wife.
If you are a wife, then you are a woman. If you are a wife, then you are married.
2. State a condition that is sufficient (but not necessary) for eating cooked potatoes.
If you are eating French fries, then you are eating cooked potatoes.