Problem Set 1: PHIL 1068 Elementary Logic **DUE 4:00PM 6 February 2012**

Student ID Number _________________ Name _______________________

1. (15 marks)
True or false? Circle '**T**' if the statement is true. Circle '**F**' if the statement is false.

a.
T Some unsound arguments have true conclusions.
Remark: An argument is unsound when it is either invalid or when it has a false premise. So some unsound arguments have true conclusions because some invalid arguments have true conclusions.
b.
F The scope of "~" in "(~(R & (Q → P)) & P)" is "(R & (Q → P))"
Remark: The scope of a connective is the shortest WFF that contains that connective. "(R & (Q → P))" does not contain "~", so it is not the scope of "~".
c.
F "(~(P v Q) → ((P v S) v Q))" is a disjunction.
Remark: "(~(P v Q) → ((P v S) v Q))" is a conditional whose antecedent is "~(P v Q)" and whose consequent is "((P v S) v Q)".
d.
F For every expression φ of SL, if φ has any parentheses, it has an even number of parentheses.
Remark: Not every expression of SL is a WFF of SL. Every WFF of SL has an even number of parentheses, but the expression "((&)" does not.
e.
F "The government plans to raise taxes are up for a vote" is syntactically ambiguous.
Remark: While the sentence can be confusing, since 'plans' can be both a noun and a verb (in general), there is only one grammatically acceptable reading (the one on which 'plans' is a noun).
f.
T No WFF of SL is both a conjunction and a biconditional.
Remark: A conjunction has "&" as its main connective and a biconditional has "↔" as its main connective. Each WFF of SL has at most one main connective, so no WFF is both a conjunction and a biconditional.
g.
T Whenever "(P v Q)" is false, "Q" is false
Remark: "(P v Q)" is true when and only when either "P" is true or "Q" is true. Thus it is false when both "P" is false and "Q" is false.
h.

T An argument is valid if and only if every logically possible situation in which all the premises are true is also a situation in which the conclusion is true.

Remark: This definition is equivalent to our official one: "an argument is valid if and only if there is no logically possible situation where all the premises are true and the conclusion is false at the same time."

i.

F "John has been cooking since we got here early this morning." is an argument.

Remark: Despite the presence of the word 'since', this is not an argument. 'Since' here describes a temporal relation (relates two events in time), not a logical one.

j.

T The first conjunct of "(~P & P)" is "~P"

Remark: This one is fairly straightforward.

k.

T If ~φ is a WFF of SL, then φ is a WFF of SL.

Remark: While this is not one of the formation rules of SL, it is still true. None of the formation rules allows you to make a WFF of SL by appending "~" to a non-WFF.

l.

T If φ is a WFF of SL, then ~φ is a WFF of SL.

Remark: This is one of our formation rules of SL, so it is true by stipulation.

m.

T "We should go to the movies tonight!" is a statement.

Remark: Don't be fooled by the exclamation mark, this is a statement because it is a complete grammatical sentence that makes a claim.

n.

F The reason logic is topic-neutral is that the principles of logic do not depend on particular accidental features of the world.

Remark: Some theologians believe that God necessarily exists. So the statement "God exists" does not depend on any accidental feature of the world. But still it is not topic-neutral—it is about a particular topic, a religious one. Logic is topic-neutral because it is about general principles that apply regardless of topic.

o.

T There are an infinite number of WFFs of SL.

"P" is a WFF of SL, because it is a sentence letter. And "~P" is a WFF, and so is "~~P" and "~~~P" and "~~~~P" etc.

2. (10 marks) Which of the following is a valid argument?
Circle "**Yes**" if it is a valid argument. Circle "**No**" if it is not a valid argument.

a.

No (Premise) The last 999 hamburgers I ate at McDonald's all made me sick.

(Conclusion) The next hamburger I eat at McDonald's will make me sick.

Remark: Although this is probably an argument you should listen to if the premise is true, it's not valid. There are possible situations where the premise is true but the conclusion is not, for example, if the first 999 hamburgers make you sick but the 1,000th one does not.

b.

No (Premise) We should go to the peak if it does not rain.
(Premise) We should go to the peak.
(Conclusion) So, it does not rain.

Remark: This is the fallacy of affirming the consequent. Don't be confused by its superficial resemblance to modus ponens—here the "if" clause comes at the end of the first premise, rather than at its beginning.

c.

Yes (Premise) Either the butler is the murderer or the gardener is the murderer.
(Premise) The butler is not the murderer.
(Conclusion) Therefore, the gardener is the murderer.

Remark: This inference is indeed valid: no possible situation where the premises are true is one where the conclusion is false. It is an instance of disjunctive syllogism.

d.

Yes (Premise) Logic is difficult.
(Conclusion) Therefore, logic is difficult.

Remark: This isn't a very convincing argument, but it is valid. Every situation where the premise is true is one where the conclusion is true, because the conclusion is identical to the premise.

e.

Yes (Premise) Pigs can fly.
(Conclusion) So, 2 + 2 = 4

Remark: There is no possible situation in which the premise is true but the conclusion is false, because there is no possible situation in which 2 + 2 does not equal 4. So the argument is valid.

3. (4 marks) Which of the following five expressions are not WFFs of SL? (Circle all that are not WFFs.)

a. ~((P & Q) → ~(~R))

b. ~~(~~~P & ~~~~Q)

c. (~(P v R) v ~(R v S))

d. (R & (P → (S ↔ (Q v (P & P)))))

e. (~R ↔ ~S ↔ ~P)

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4. 4. (16 marks)
Fill in the blanks with an SL WFF to make correct truth tables.
Each WFF must contain exactly three two-place connectives.

a.

P	**Q**	**R**	*~(~R & ~(P & (Q & Q)))*
T	T	T	T
T	T	F	T
T	F	T	T
T	F	F	F
F	T	T	T
F	T	F	F
F	F	T	T
F	F	F	F

b.

P	**Q**	**R**	*~((~P & Q) & (R & R))*
T	T	T	T
T	T	F	T
T	F	T	T
T	F	F	T
F	T	T	F
F	T	F	T
F	F	T	T
F	F	F	T

c.

P	**Q**	*(~(P ↔ Q) & ~(P ↔ Q))*
T	T	F
T	F	T
F	T	T
F	F	F

d.

P	**Q**	*(P → (Q → (P → P)))*
T	T	T
T	F	T
F	T	T
F	F	T

5. (15 marks) Make a correct truth table for each of the following WFFs of SL.

a. (R & (P ↔ Q))

P	**Q**	**R**	(R	&	(P	↔	Q))
T	**T**	**T**	T	T	T	T	T
T	**T**	**F**	F	F	T	T	T
T	**F**	**T**	T	F	T	F	F
T	**F**	**F**	F	F	T	F	F
F	**T**	**T**	T	F	F	F	T
F	**T**	**F**	F	F	F	F	T
F	**F**	**T**	T	T	F	T	F
F	**F**	**F**	F	F	F	T	F

b ((R v ~Q) & ~~P)

P	**Q**	**R**	((R	v	~	Q)	&	~	~	P)
T	**T**	**T**	T	T	F	T	T	T	F	T
T	**T**	**F**	F	F	F	T	F	T	F	T
T	**F**	**T**	T	T	T	F	T	T	F	T
T	**F**	**F**	F	T	T	F	T	T	F	T
F	**T**	**T**	T	T	F	T	F	F	T	F
F	**T**	**F**	F	F	F	T	F	F	T	F
F	**F**	**T**	T	T	T	F	F	F	T	F
F	**F**	**F**	F	T	T	F	F	F	T	F

c. ((Q & R) → (~R v P))

P	**Q**	**R**	((Q	&	R)	→	(~	R	v	P))
T	**T**	**T**	T	T	T	T	F	T	T	T
T	**T**	**F**	T	F	F	T	T	F	T	T
T	**F**	**T**	F	F	T	T	F	T	T	T
T	**F**	**F**	F	F	F	T	T	F	T	T
F	**T**	**T**	T	T	T	F	F	T	F	F
F	**T**	**F**	T	F	F	T	T	F	T	F

F	**F**	**T**	F	F	T	T	F	T	F	F
F	**F**	**F**	F	F	F	T	T	F	T	F

d. (~(P → Q) ↔ ~(~Q & P))

P	**Q**	(~	(P	→	Q)	↔	~	(~	Q	&	P))
T	**T**	F	T	T	T	F	T	F	T	F	T
T	**F**	T	T	F	F	F	F	T	F	T	T
F	**T**	F	F	T	T	F	T	F	T	F	F
F	**F**	F	F	T	F	F	T	T	F	F	F

e. (P → (Q → (P → P)))

P	**Q**	(P	→	(Q	→	(P	→	P)))
T	**T**	T	T	T	T	T	T	T
T	**F**	T	T	F	T	T	T	T
F	**T**	F	T	T	T	F	T	F
F	**F**	F	T	F	T	F	T	F