

Topics for test 2

The following are the topics to be covered. The proportion of the test covering each will approximate the proportion of the classes so far that have been devoted to that topic. Your homework and the collection of old tests will provide specific examples of the kinds of questions I might ask.

Analysis. Be able to analyze the logical form of a sentence as fully as possible using conjunction, negation, and disjunction and present the form in both symbolic and English notation.

Synthesis. Be able to synthesize an English sentence that has a given logical form.

Derivations. Be able to construct derivations to show that entailments hold and to show that they fail. I may tell you in advance whether an entailment holds or leave it to you to check that using derivations. There may be a derivation where detachment and attachment rules may be used and where they will shorten the proof; but there will be other derivations where you must rely on the basic rules, either because detachment and attachment rules do not apply or because I tell you not to use them.

I might also ask you to answer a question about derivations, either one you have given or derivations in general. For example, you might be asked about a particular point in a derivation to list the active resources and goal or to indicate all the basic rules that could be applied. I might also ask, though this is less likely, that you explain why a given derivation rule is legitimate. (You've seen questions of the first sort in your homework; for an example of the second sort, see question 8 of test 1 from fall 2000.)

Phi 270 Fo6 test 2

Analyze each sentence below in as much detail as possible, presenting the result in *both symbols and English notation* (using both ... and, etc., as well as \wedge , etc.). Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

1. Sam was cool, but he was not both calm and collected.
answer
2. Tom spoke to either Al or Barb but to neither Carol nor Dave.
answer

Synthesize an English sentence (the more idiomatic the better) that has the following analysis:

3. $\neg E \vee F$ (E: Ed worked last weekend; F: Fred worked last weekend)
answer

Use derivations to check whether each of the entailments below holds. If one fails, present a counterexample by providing a table in which you calculate the truth values of the premises and conclusion on an extensional interpretation (i.e., an assignment of truth values) that divides an open gap.

Do not use attachment or detachment rules in 4-6. That is, do not use Adj or the rules MTP, MPT, and Wk of §4.3; instead use only the basic rules for exploiting resources, planning for goals, and closing gaps.

4. $A \wedge B \Rightarrow \neg (C \wedge \neg B)$
answer
5. $\neg (A \wedge B), \neg A \Rightarrow B$
answer
6. $C, A \vee B \Rightarrow A \vee (B \wedge C)$
answer

In 7 you **may** use attachment and detachment rules (and their use can simplify the derivation).

7. $\neg (A \wedge C), A \vee B \Rightarrow B \vee \neg C$
answer

Phi 270 Fo6 test 2 answers

1. Sam was cool, but he was not both calm and collected
Sam was cool \wedge Sam was not both calm and collected
Sam was cool \wedge \neg Sam was both calm and collected
Sam was cool \wedge \neg (Sam was calm \wedge Sam was collected)

7.

	$\neg (A \wedge C)$	2
	$A \vee B$	3
	C	(2)
2 MPT	$\neg A$	(3)
3 MTP	B	(4)
	•	
4 QED	B	1
1 PE	$B \vee \neg C$	

Phi 270 Fo5 test 2

Complete the following to give a definition in terms of truth values and possible worlds.

1. ϕ and ψ are mutually exclusive (i.e., $\phi, \psi \Rightarrow \perp$) if and only if ...

.....
answer

Analyze each sentence below in as much detail as possible, presenting the result using both in symbols and using English notation (i.e., **both ... and**, etc.). Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

2. **The job didn't have both good pay and flexible hours, and Sam didn't apply for it.**

.....
answer

3. **Although neither Luke nor Mary saw the movie, either Nancy or Oscar did.**

.....
answer

Use derivations to check whether each of the entailments below holds. If one fails, present a counterexample by providing a table in which you calculate the truth values of the premises and conclusion on an extensional interpretation (i.e., an assignment of truth values) that divides an open gap.

Do not use attachment or detachment rules in **4-6**. That is, do not use Adj or the rules MTP, MPT, and Wk of §4.3; instead use only the basic rules for exploiting resources, planning for goals, and closing gaps.

4. $\neg B \Rightarrow \neg (A \wedge (B \wedge C))$

.....
answer

5. $\neg (A \wedge B) \Rightarrow \neg A$

.....
answer

6. $(A \wedge B) \vee C \Rightarrow C \vee B$

.....
answer

In 7 you **may** use attachment and detachment rules (and their use can simplify the derivation).

7. $A \vee B, \neg (B \wedge C), C \Rightarrow A$

.....
answer

Phi 270 Fo5 test 2 answers

1. ϕ and ψ are mutually exclusive if and only if there is no possible world in which both are true (or: ... if and only if, in every possible world, at least one is false)

2. The job didn't have both good pay and flexible hours, and Sam didn't apply for it
 The job didn't have both good pay and flexible hours \wedge Sam didn't apply for the job
 \neg the job had both good pay and flexible hours \wedge \neg Sam applied for the job
 \neg (the job had good pay \wedge the job had flexible hours) \wedge \neg Sam applied for the job

$$\neg (G \wedge F) \wedge \neg A$$

both not both G and F and not A

A: Sam applied for the job; F: the job had flexible hours; G: the job had good pay

$(\neg G \wedge \neg F) \wedge \neg A$ would say that the job had neither good pay nor flexible hours, so it is not equivalent to $\neg (G \wedge F) \wedge \neg A$ and it's not correct; $(\neg G \vee \neg F) \wedge \neg A$ would be equivalent, but it is pretty far from the form of the English.

3. Although neither Luke nor Mary saw the movie, either Nancy or Oscar did.
 neither Luke nor Mary saw the movie \wedge either Nancy or Oscar saw the movie
 \neg either Luke or Mary saw the movie \wedge (Nancy saw the movie \vee Oscar saw the movie)
 \neg (Luke saw the movie \vee Mary saw the movie) \wedge (Nancy saw the movie \vee Oscar saw the movie)

$$\neg (L \vee M) \wedge (N \vee O)$$

both not either L or M and either N or O

L: Luke saw the movie; M: Mary saw the movie; N: Nancy saw the movie; O: Oscar saw the movie

$(\neg L \wedge \neg M) \wedge (N \vee O)$ is equivalent to the answer above and is also correct.

- 4.
- | | | |
|-------|--------------------------------|-----|
| | $\neg B$ | (4) |
| | $A \wedge (B \wedge C)$ | 2 |
| 2 Ext | A | |
| 2 Ext | $B \wedge C$ | 3 |
| 3 Ext | B | |
| 3 Ext | C | (4) |
| | • | |
| 4 Nc | \perp | 1 |
| 1 RAA | $\neg (A \wedge (B \wedge C))$ | |

- 5.
- | | | | |
|-------|---------------------|------------------------|--|
| | $\neg (A \wedge B)$ | 2 | $\frac{A \ B}{T \ F} \mid \frac{\neg (A \wedge B)}{\oplus} / \frac{\neg A}{\ominus}$ |
| | A | (4) | |
| 4 QED | A | 3 | |
| | $\neg B$ | | |
| | \circ | $A, \neg B \neq \perp$ | |
| | \perp | 5 | |
| 5 IP | B | 3 | |
| 3 Cnj | $A \wedge B$ | 2 | |
| 2 CR | \perp | 1 | |
| 1 RAA | $\neg A$ | | |
- 6.
- | | | |
|-------|-----------------------|-----|
| | $(A \wedge B) \vee C$ | 1 |
| | $A \wedge B$ | 2 |
| 2 Ext | A | |
| 2 Ext | B | (4) |
| | $\neg C$ | |
| | • | |
| 4 QED | B | 3 |
| 3 PE | $C \vee B$ | 1 |
| | C | (6) |
| | $\neg B$ | |
| | • | |
| 6 QED | C | 5 |
| 5 PE | $C \vee B$ | 1 |
| 1 PC | $C \vee B$ | |

It is also possible to begin with PE; if that's done, IP and Nc will be needed to close one of the gaps.

7. The first answer below uses detachment rules while the second shows one way to construct a derivation without them.

	$A \vee B$	2
	$\neg(B \wedge C)$	1
	C	(1)
1 MPT	$\neg B$	(2)
2 MTP	A	(3)
	•	
3 QED	A	

	$A \vee B$	1
	$\neg(B \wedge C)$	4
	C	(7)
	A	(2)
	•	
2 QED	A	1
	B	(6)
	$\neg A$	
	•	
6 QED	B	5
	•	
7 QED	C	5
5 Cnj	$B \wedge C$	4
4 CR	\perp	3
3 IP	A	1
1 PC	A	

Phi 270 Fo4 test 2

Analyze each sentence below in as much detail as possible, presenting the result using both in symbols and using English notation (i.e., **both ... and**, etc.). Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

1. Dan found his wallet but not his keys
answer
2. Mike didn't notice the problem, but either Nina or Oscar did
answer
3. Neither the house nor the apartment was both cheap and roomy
answer

Use derivations to check whether each of the entailments below holds. If one fails, present a counterexample by providing a table in which you calculate the truth values of the premises and conclusion on an extensional interpretation (i.e., an assignment of truth values) that divides an open gap.

Do not use attachment or detachment rules in **4-6**. That is, do not use Adj or the rules MTP, MPT, and Wk of 4.3; instead use only the basic rules for exploiting resources, planning for goals, and closing gaps.

4. $A \wedge \neg C \Rightarrow \neg(B \wedge C)$
answer
5. $\neg(B \wedge C), A \wedge B \Rightarrow A \wedge \neg C$
answer
6. $A \vee B \Rightarrow A \vee C$
answer

In 7 you **may** use attachment and detachment rules (and their use can simplify the derivation).

7. $\neg(A \wedge B), A \vee \neg C \Rightarrow \neg(B \wedge C)$
answer

Phi 270 Fo4 test 2 answers

1. Dan found his wallet but not his keys
Dan found his wallet \wedge Dan didn't find his keys
Dan found his wallet $\wedge \neg$ Dan found his keys
 $W \wedge \neg K$
both W and not K
K: Dan found his keys; W: Dan found his wallet
2. Mike didn't notice the problem, but either Nina or Oscar did

Mike didn't notice the problem \wedge either Nina or Oscar noticed the problem

\neg Mike noticed the problem \wedge (Nina noticed the problem \vee Oscar noticed the problem)

$$\neg M \wedge (N \vee O)$$

both not M and either N or O

M: Mike noticed the problem; N: Nina noticed the problem; O: Oscar noticed the problem

3. Neither the house nor the apartment was both cheap and roomy

\neg either the house or the apartment was both cheap and roomy

\neg (the house was both cheap and roomy \vee the apartment was both cheap and roomy)

\neg ((the house was cheap \wedge the house was roomy) \vee (the apartment was cheap \wedge the apartment was roomy))

$$\neg ((C \wedge R) \vee (H \wedge M))$$

not either both C and R or both H and M

C: the house was cheap; H: the apartment was cheap; R: the house was roomy; M: the apartment was roomy

$\neg (C \wedge R) \wedge \neg (H \wedge M)$ and $(\neg C \vee \neg R) \wedge (\neg H \vee \neg M)$ are also equivalent (though further from the English); however, $(\neg C \wedge \neg R) \wedge (\neg H \wedge \neg M)$ is not equivalent to these sentences. The latter is equivalent to $\neg (C \vee R) \wedge \neg (H \vee M)$ and $\neg ((C \vee R) \vee (H \vee M))$, and those sentences say: neither the house nor the apartment was either cheap or roomy.

4.	$A \wedge \neg C$	1
1 Ext	A	
1 Ext	$\neg C$	(4)
	$B \wedge C$	3
3 Ext	B	
3 Ext	C	(4)
	•	
4 Nc	\perp	2
2 RAA	$\neg (B \wedge C)$	

5.	$\neg (B \wedge C)$	5
	$A \wedge B$	1
1 Ext	A	(3)
1 Ext	B	(7)
	•	
3 QED	A	2
	C	(8)
	•	
7 QED	B	6
	•	
8 QED	C	6
6 Cnj	$B \wedge C$	5
5 CR	\perp	4
4 RAA	$\neg C$	2
2 Cnj	$A \wedge \neg C$	

6.	$A \vee B$	2	$\frac{A \ B \ C}{F \ T \ F} \mid \frac{A \vee B}{\textcircled{1}} / \frac{A \vee C}{\textcircled{2}}$
	$\neg C$		
	A	(3)	
	•		
3 QED	A	2	
	B		
	$\neg A$		
	○		$\neg A, B, \neg C \not\Rightarrow \perp$
	\perp	4	
4 IP	A	2	
2 PC	A	1	
1 PE	$A \vee C$		

7. The first answer below uses detachment rules while the second shows how to construct a derivation in this case without them.

<table style="border-collapse: collapse; width: 100%;"> <tr> <td style="border-right: 1px solid black; padding: 5px;">$\neg(A \wedge B)$</td> <td style="padding: 5px;">3</td> <td style="border-right: 1px solid black; padding: 5px;">$\neg(A \wedge B)$</td> <td style="padding: 5px;">3</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">$A \vee \neg C$</td> <td style="padding: 5px;">4</td> <td style="border-right: 1px solid black; padding: 5px;">$A \vee \neg C$</td> <td style="padding: 5px;">6</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">$B \wedge C$</td> <td style="padding: 5px;">2</td> <td style="border-right: 1px solid black; padding: 5px;">$B \wedge C$</td> <td style="padding: 5px;">2</td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">B</td> <td style="padding: 5px;">(3)</td> <td style="border-right: 1px solid black; padding: 5px;">B</td> <td style="padding: 5px;">(5)</td> </tr> <tr> <td style="border-right: 1px solid black; 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Phi 270 Fo3 test 2

- Define contradictoriness by completing the following:
 ϕ and ψ are contradictory if and only if ...
 (Your answer should define contradictoriness in terms of truth values and possible worlds.)

answer

Analyze each sentence below in as much detail as possible, presenting the result using both symbolic and English notation for the connectives. Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

- Ann found the note but didn't recognize the signature
- Either the manufacturer and the distributor weren't both available or neither of them changed its offer

answer

Use derivations to check whether each of the entailments below holds. If one fails, present a counterexample by providing a table in which you calculate the truth values of the premises and conclusion on an extensional interpretation (i.e., an assignment of truth values) which divides an open gap.

Do not use attachment or detachment rules in **4** and **5**. That is, do not use Adj or the new rules of 4.3; instead use only the basic rules for exploiting resources, planning for goals, and closing gaps.

- $\neg B \Rightarrow \neg(A \wedge B)$
- $\neg(\neg A \wedge \neg B), C \wedge \neg B \Rightarrow A$

answer

In **6** and **7** you **may** use attachment and detachment rules if you have an opportunity to do so.

- $A \vee B \Rightarrow C \vee D$
- $\neg(A \wedge C), A \vee B, \neg(B \wedge \neg D) \Rightarrow \neg(C \wedge \neg D)$

answer

Phi 270 Fo3 test 2 answers

- ϕ and ψ are contradictory if and only if there is no possible world where they have the same truth value.

2. Ann found the note but didn't recognize the signature
 Ann found the note \wedge Ann didn't recognize the signature
 Ann found the note $\wedge \neg$ Ann recognized the signature
 $F \wedge \neg R$
 both F and not R

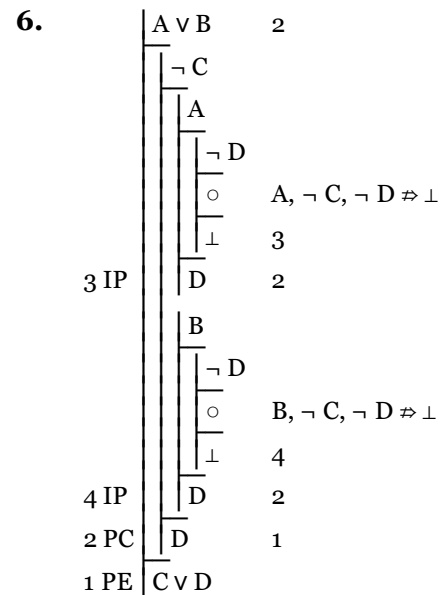
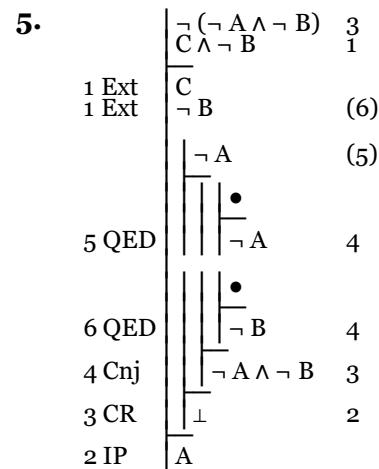
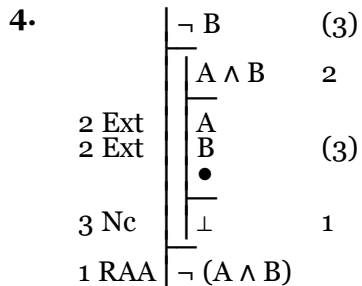
F: Ann found the note; R: Ann recognized the signature

3. Either the manufacturer and the distributor weren't both available or neither of them changed its offer
 the manufacturer and the distributor weren't both available \vee neither the manufacturer nor the distributor changed its offer
 \neg the manufacturer and the distributor were both available $\vee \neg$ either the manufacturer or the distributor changed its offer
 \neg (the manufacturer was available \wedge the distributor was available) $\vee \neg$ (the manufacturer changed its offer \vee the distributor changed its offer)

$$\neg (A \wedge V) \vee \neg (C \vee H)$$

either not both A and V or not either C or H

A: the manufacturer was available; C: the manufacturer changed its offer; H: the distributor changed its offer; V: the distributor was available



A	B	C	D	$A \vee B$	$C \vee D$	
T	F	F	F	⊕	⊖	divides 1st open gap
T	T	F	F	⊕	⊖	divides both open gaps
F	T	F	F	⊕	⊖	divides 2nd open gap

7.

	$\neg(A \wedge C)$	3
	$A \vee B$	4
	$\neg(B \wedge \neg D)$	5
	$C \wedge \neg D$	2
2 Ext	C	(3)
2 Ext	$\neg D$	(6)
3 MPT	$\neg A$	(4)
4 MTP	B	(5)
5 MPT	D	(6)
	•	
	\perp	1
1 RAA	$\neg(C \wedge \neg D)$	

Phi 270 Fo2 test 2

- Define inconsistency by completing the following:
 Γ is inconsistent (i.e., $\Gamma \Rightarrow \perp$) if and only if
 (Your answer need not replicate the wording of the text's definitions, but it should define equivalence in terms of truth values and possible worlds.)

answer

Analyze each sentence below in as much detail as possible, presenting the result in both symbolic and English notation. Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

- Al needed both the book and the disk but Bob didn't.

answer

- The car wasn't there or neither Al nor Barb saw it.

answer

Use derivations to check whether each of the entailments below holds. You may use detachment and attachment rules. If an entailment fails, present a counterexample that divides an open gap.

- $A \wedge \neg B \Rightarrow \neg(A \wedge \neg C)$
answer
- $(A \wedge B) \vee C, \neg(C \wedge \neg B) \Rightarrow B$
answer
- $B \vee (A \vee C) \Rightarrow A \vee B$
answer

- [This question was on a topic not covered in Fo8] Construct a sentence in symbolic notation that has the following truth table:

A	B	C	?
T	T	T	F
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

answer

Phi 270 Fo2 test 2 answers

- $\Gamma \Rightarrow \perp$ if and only if there is no possible world in which all members of Γ are true.

2. Al needed both the book and the disk \wedge Bob didn't need both the book and the disk
 (Al needed the book \wedge Al needed the disk) \wedge \neg (Bob needed both the book and the disk)
 (Al needed the book \wedge Al needed the disk) \wedge \neg (Bob needed the book \wedge Bob needed the disk)

$$(B \wedge D) \wedge \neg (O \wedge S)$$

both both B and D and not both O and S

B: Al needed the book; D: Al needed the disk; O: Bob needed the book; S: Bob needed the disk

3. The car wasn't there \vee neither Al nor Barb saw the car
 \neg the car was there \vee \neg either Al or Barb saw the car
 \neg the car was there \vee \neg (Al saw the car \vee Barb saw the car)
 \neg C \vee \neg (A \vee B)

either not C or not either A or B

A: Al saw the car; B: Barb saw the car; C: the car was there

4.

1 Ext	A \wedge \neg B	1
1 Ext	A	
	\neg B	
3 Ext	A \wedge \neg C	3
3 Ext	A	
	\neg C	
	o	A, \neg B, \neg C \neq \perp
	\perp	2
2 RAA	\neg (A \wedge \neg C)	

A B C	A \wedge \neg B / \neg (A \wedge \neg C)	T T	T T
T F F	T T	T	F

5.

	(A \wedge B) \vee C	1
	\neg (C \wedge \neg B)	5
	A \wedge B	2
2 Ext	A	
2 Ext	B	(3)
	•	
3 QED	B	1
	C	(6)
	\neg B	(6)
6 Adj		
	C \wedge \neg B	X, (7)
	•	
7 QED	C \wedge \neg B	5
5 CR		
	\perp	4
4 IP	B	1
1 PC	B	

6.

	B \vee (A \vee C)	2
	\neg A	(6)
	B	(3)
	•	
3 QED	B	2
	A \vee C	4
	A	(6)
	\neg B	
	•	
	\perp	5
6 Nc	B	4
5 IP	B	4
	C	
	\neg B	
	o	\neg A, \neg B, C \neq \perp
	\perp	7
7 IP	B	4
4 PC	B	2
2 PC	B	1
1 PE	A \vee B	

A B C	B \vee (A \vee C) / A \vee B	T	T	F
F F T	T	T	F	F

7. [This question was on a topic not covered in Fo8]

A	B	C	$(A \wedge B \wedge \neg C) \vee (A \wedge \neg B \wedge C) \vee (\neg A \wedge B \wedge C) \vee (\neg A \wedge \neg B \wedge C)$
T	T	T	F
T	T	F	T
T	F	T	F
T	F	F	F
F	T	T	F
F	T	F	F
F	F	T	F
F	F	F	F

Phi 270 Foo test 2

- Define (logical) relative inconsistency by completing the following: ϕ is inconsistent with Γ (i.e., $\Gamma, \phi \Rightarrow$) if and only if (Your answer need not replicate the wording of the text's definitions, but it should define equivalence in terms of truth values and possible worlds.)

answer

Analyze the sentences below in as much detail as possible, presenting the result in both symbolic and English notation. Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

- Sam didn't eat his cake and keep it, too, but he wasn't disappointed.

answer

- Either the intruder woke neither the cat nor the dog or it was someone they both knew.

answer

Use derivations to check whether each of the entailments below holds. You may use detachment and attachment rules. If an entailment fails, present a counterexample that divides an open gap.

- $C \wedge D \Rightarrow \neg (B \wedge \neg C)$

answer

- $(A \wedge C) \vee (B \wedge D) \Rightarrow B \vee C$

answer

- $\neg (A \vee B), A \vee D, \neg (C \wedge D) \Rightarrow C$

answer

- [This question was on a topic not covered in Fo8] Use replacement principles to put the following sentence into disjunctive normal form (in which there are no negated compounds and no conjunction has a disjunction as a component):

$$A \wedge \neg (B \wedge \neg C)$$

answer

Phi 270 Foo test 2 answers

- $\Gamma, \phi \Rightarrow$ if and only if there is no possible world in which ϕ is true along with and all members of Γ .
- Sam didn't eat his cake and keep it \wedge Sam wasn't disappointed
 \neg Sam ate his cake and kept it \wedge Sam wasn't disappointed
 \neg (Sam ate his cake \wedge Sam kept his cake) \wedge \neg Sam was disappointed
 $\neg (A \wedge K) \wedge \neg D$
 both not both J and S and not D

A: Sam ate his cake; D: Sam was disappointed; K: Sam kept his cake

3. the intruder woke neither the cat nor the dog \vee the intruder was someone the cat and the dog both knew

\neg the intruder woke either the cat or the dog \vee (the intruder was someone the cat knew \wedge the intruder was someone the dog knew)

\neg (the intruder woke the cat \vee the intruder woke the dog \vee (the intruder was someone the cat knew \wedge the intruder was someone the dog knew))

$$\neg (C \vee D) \vee (K \wedge N)$$

either not either C or D or both K and N

C: the intruder woke the cat; D: the intruder woke the dog; K: the intruder was someone the cat knew; N: the intruder was someone the dog knew

4.

C \wedge D	2
B \wedge \neg C	3
C	(4)
D	
B	
\neg C	(4)
•	
\perp	1
\neg (B \wedge \neg C)	

5.

(A \wedge C) \vee (B \wedge D)	1
A \wedge C	2
A	
C	(4)
\neg B	
•	
C	3
B \vee C	1
B \wedge D	5
B	
D	(7)
\neg C	
•	
B	6
B \vee C	1
B \vee C	

6. This answer illustrates the use of detachment rules; other, longer, derivations are possible without them. IP is used at the first stage in order to make it possible to exploit the first premise by CR, the only rule available for exploiting negated disjunctions.

\neg (A \vee B)	2
A \vee D	4
\neg (C \wedge D)	5
\neg C	
\neg A	(4)
D	(5)
\neg C	
\neg B	
o	\neg A, \neg B, \neg C, D \nRightarrow \perp
\perp	6
B	3
A \vee B	2
\perp	1
C	1 IP

A	B	C	D	\neg (A \vee B)	,	A \vee D	,	\neg (C \wedge D)	/	C
F	F	F	T	⊕	F	⊕	⊕	⊕	F	⊕

7. [This question was on a topic not covered in FO8]

$$A \wedge \neg (B \wedge \neg C)$$

$$\Leftrightarrow$$

$$A \wedge (\neg B \vee C)$$

$$\Leftrightarrow$$

$$(A \wedge \neg B) \vee (A \wedge C)$$

Phi 270 F99 test 2

Analyze the sentence below in as much detail as possible, presenting the result in both symbolic and English notation. Be sure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

1. Fred crossed the desert without having both a jack and a spare tire.

answer

2. Bob either found someone to go or went himself, but neither Carol nor her luggage was there.

answer

Use derivations to check whether each of the entailments below holds. You may use detachment and attachment rules. If an entailment fails, provide a table in which you calculate the truth values of the premises and conclusion on an extensional interpretation (i.e., an assignment of truth values) that divides an open gap.

3. $A \wedge \neg B \Rightarrow \neg (B \wedge \neg C)$

answer

4. $\neg (\neg A \wedge B) \Rightarrow C$

answer

5. $(A \wedge B) \vee C, \neg (A \wedge D) \Rightarrow C \vee \neg D$

answer

6. $B \vee (C \wedge D) \Rightarrow A \vee (B \vee C)$

answer

7. [This question was on a topic not covered in Fo8] Use replacement principles to put the following sentence into disjunctive normal form (in which there are no negated compounds and no conjunction has a disjunction as a component):

$$\neg ((A \wedge \neg B) \vee C)$$

answer

Phi 270 F99 test 2 answers

1. Fred crossed the desert without having both a jack and a spare tire
 Fred crossed the desert $\wedge \neg$ Fred had both a jack and a spare tire
 Fred crossed the desert $\wedge \neg$ (Fred had a jack \wedge Fred had a spare tire)

$$D \wedge \neg (J \wedge S)$$

both D and not both J and S

D: Fred crossed the desert; J: Fred had a jack; S: Fred had a spare

tire

2. Bob either found someone to go or went himself, but neither Carol nor her luggage was there
 Bob either found someone to go or went himself \wedge neither Carol nor her luggage was there

(Bob found someone to go \vee Bob went himself) $\wedge \neg$ either Carol or her luggage was there

(Bob found someone to go \vee Bob went himself) $\wedge \neg$ (Carol was there \vee Carol's luggage was there)

$$(F \vee W) \wedge \neg (C \vee L)$$

both either F or W and not either C or L

F: Bob found someone to go; W: Bob went himself; C: Carol was there; L: Carol's luggage was there

3.

$A \wedge \neg B$	1
1 Ext	A
1 Ext	$\neg B$
	(4)
	$B \wedge \neg C$
	3
3 Ext	B
3 Ext	$\neg C$
	(4)
	•
4 Nc	\perp
	2
2 RAA	$\neg (B \wedge \neg C)$

4.

$\neg (\neg A \wedge B)$	2	$A \ B \ C$	$\neg (\neg A \wedge B) / C$		
	$\neg C$	T T F	⊕ F F	⊖	divides 1st gap
	A	T F F	⊕ F F	⊖	divides both gaps
	○	F F F	⊕ T F	⊖	divides 2nd gap
	\perp				
4 RAA	$\neg A$				
	$\neg B$				
	○				$\neg B, \neg C \neq \perp$
	\perp				
5 IP	B				
3 Cnj	$\neg A \wedge B$				
2 CR	\perp				
1 IP	C				

5.

	$(A \wedge B) \vee C$	3
	$\neg(A \wedge D)$	5
	$\neg C$	
	D	(6)
	$A \wedge B$	4
4 Ext	A	(6)
4 Ext	B	
6 Adj	$A \wedge D$	X,(7)
	•	
7 QED	$A \wedge D$	5
5 CR	\perp	3
	C	
	\perp	3
3 PC	\perp	2
2 RAA	$\neg D$	1
1 PE	$C \vee \neg D$	

OR

	$(A \wedge B) \vee C$	2
	$\neg(A \wedge D)$	4
	$\neg C$	(2)
	$A \wedge B$	3
2 MTP	A	(4)
3 Ext	B	
3 Ext	$\neg D$	(5)
4 MPT	•	
	$\neg D$	1
5 QED	$\neg D$	
1 PE	$C \vee \neg D$	

6.

	$B \vee (C \wedge D)$	2
	$\neg A$	
	B	(4)
	$\neg C$	
	•	
4 QED	B	3
3 PE	$B \vee C$	2
	$C \wedge D$	5
5 Ext	C	(7)
5 Ext	D	
	$\neg B$	
	•	
7 QED	C	6
6 PE	$B \vee C$	2
2 PC	$B \vee C$	1
1 PE	$A \vee (B \vee C)$	

OR

	$B \vee (C \wedge D)$	3
	$\neg A$	
	$\neg B$	(3)
	$C \wedge D$	4
3 MTP	C	(5)
4 Ext	D	
4 Ext	•	
	C	2
5 QED	C	
2 PE	$B \vee C$	1
1 PE	$A \vee (B \vee C)$	

7. [This question was on a topic not covered in FO8]

$$\neg((A \wedge \neg B) \vee C)$$

 \Leftrightarrow

$$\neg(A \wedge \neg B) \wedge \neg C$$

 \Leftrightarrow

$$(\neg A \vee B) \wedge \neg C$$

 \Leftrightarrow

$$(\neg A \wedge \neg C) \vee (B \wedge \neg C)$$

Phi 270 F98 test 2

1. Analyze the sentence below in as much detail as possible and express the result in both symbolic and English notation. Be sure that the unanalyzed components of your answer are complete and independent sentences and try to respect any grouping in the original sentence.

Bob didn't have both fuel and either a match or a lighter

answer

2. Synthesize an idiomatic English sentence expressing the proposition which is assigned to the symbolic form below by the intensional interpretation to its right—i.e., give an English sentence whose analysis would be the following:

$$\neg ((A \wedge B) \vee (N \wedge L))$$

A: Carol saw Ann; B: Carol saw Bill; N: Dave saw Ann; L: Dave saw Bill

answer

Use derivations to check each of the following claims of entailment. You may use the detachment rule MPT but not MTP; although the use of MPT is not necessary, it can shorten a couple of the derivations. If a derivation fails, present a counterexample that divides an open gap.

3. $B \Rightarrow \neg (A \wedge \neg B)$

answer

4. $\neg (A \wedge B) \Rightarrow \neg (C \wedge \neg B)$

answer

5. $\neg (A \wedge \neg (B \wedge C)) \Rightarrow \neg (A \wedge \neg C)$

answer

6. $A \vee (B \wedge C) \Rightarrow C \vee A$

answer

Phi 270 F98 test 2 answers

1. \neg Bob had both fuel and either a match or a lighter
 \neg (Bob had fuel \wedge Bob had either a match or a lighter)
 \neg (Bob had fuel \wedge (Bob had a match \vee Bob had a lighter))

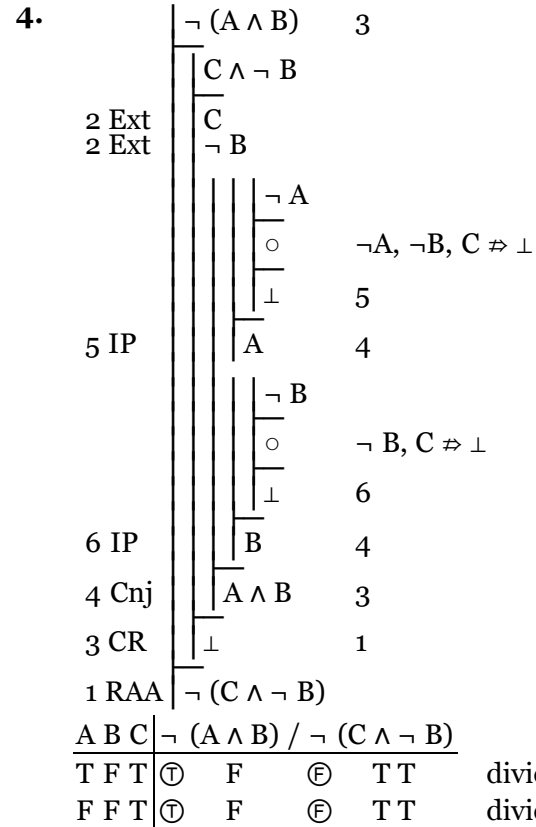
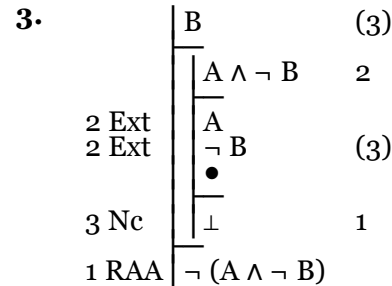
$$\neg (F \wedge (M \vee L))$$

not both F and either M or L

F: Bob had fuel; L: Bob had a lighter; M: Bob had a match

2. \neg ((Carol saw Ann \wedge Carol saw Bill) \vee (Dave saw Ann \wedge Dave saw Bill))
 \neg (Carol saw both Ann and Bill \vee Dave saw both Ann and Bill)

Neither Carol nor Dave saw both Ann and Bill



5.	$\neg(A \wedge \neg(B \wedge C))$	3	OR	$\neg(A \wedge \neg(B \wedge C))$	3
	$A \wedge \neg C$	2		$A \wedge \neg C$	2
2 Ext	A	(5)		A	(3)
2 Ext	$\neg C$	(8)		$\neg C$	(5)
				$B \wedge C$	4
				B	
				C	(5)
				•	
5 QED	A	4		\perp	1
				$\neg(A \wedge \neg C)$	
	$B \wedge C$	7	5 Nc		
7 Ext	B		1 RAA		
7 Ext	C	(8)			
8 Nc	\perp	6			
6 RAA	$\neg(B \wedge C)$	4			
4 Cnj	$A \wedge \neg(B \wedge C)$	3			
3 CR	\perp	1			
1 RAA	$\neg(A \wedge \neg C)$				

6.	$A \vee (B \wedge C)$	2	OR	$A \vee (B \wedge C)$	2
	$\neg C$	(6)		$\neg A$	(2)
				$B \wedge C$	3
				B	
				C	(4)
				•	
3 QED	A	2		C	1
				$C \vee A$	
	$B \wedge C$	4	2 MTP		
4 Ext	B		3 Ext		
4 Ext	C	(6)	3 Ext		
6 Nc	\perp	5	4 QED		
5 IP	A	2	1 PE		
2 PC	A	1			
1 PE	$C \vee A$				

Phi 270 F97 test 2

- Analyze the sentence below in as much detail as possible and express the result in both symbolic and English notation. Be sure that the unanalyzed components of your answer are complete and independent sentences and try to respect any grouping in the original sentence.

Sam didn't both find the problem and fix it, but either it went away on its own or there was no problem to begin with

answer

- Synthesize an idiomatic English sentence expressing the proposition which is assigned to the symbolic form below by the intensional interpretation to its right—i.e., give an English sentence whose analysis would be the following:

$$\neg(D \vee M) \wedge H$$

D: Al had directions; H: Al made it home; M: Al had a map

answer

Check each of the following claims of entailment. Do not use attachment rules but you may use detachment rules. If a derivation fails, present a counterexample that divides its premises from its conclusion.

$$3. \neg B \Rightarrow \neg(A \wedge (B \wedge C))$$

answer

$$4. A \vee B \Rightarrow C \vee B$$

answer

- Use derivations to show the following entailment. You may use attachment rules and using them may make the derivation somewhat shorter.

$$\neg((A \vee B) \wedge \neg C), A \Rightarrow C$$

answer

- [This question was on a topic not covered in FO8] Use a series of replacements to show the following:

$$\neg(A \vee (B \wedge C)) \Leftrightarrow \neg(A \vee B) \vee (\neg A \wedge \neg C)$$

answer

Phi 270 F97 test 2 answers

- Sam didn't both find the problem and fix it \wedge either the problem went away on its own or there was no problem to begin with
 \neg Sam found the problem and fixed it \wedge (the problem went away on its own \vee there was no problem to begin with)
 \neg (Sam found the problem \wedge Sam fixed the problem) \wedge (the problem went away on its own \vee \neg there was a problem to begin with)

$$\neg (F \wedge D) \wedge (A \vee \neg P)$$

both not both F and D and either A or not P

A: the problem went away on its own; D: Sam fixed the problem; F: Sam found the problem; P: there was a problem to begin with

2. $\neg (A \text{ had directions } \vee A \text{ had a map}) \wedge A \text{ made it home}$

$\neg A \text{ had directions or a map } \wedge A \text{ made it home}$

$A \text{ had neither directions nor a map } \wedge A \text{ made it home}$

$A \text{ had neither directions nor a map but he made it home}$

3.

$\neg B$	(4)
$A \wedge (B \wedge C)$	2
2 Ext A	
2 Ext $B \wedge C$	3
3 Ext B	(4)
3 Ext C	
•	
4 Nc \perp	1
1 RAA $\neg (A \wedge (B \wedge C))$	

4.

$A \vee B$	2
$\neg C$	
A	
$\neg B$	
○	$A, \neg B, \neg C \neq \perp$
3 IP \perp	3
B	2
B	(4)
•	
4 QED B	2
2 PC B	1
1 PE $C \vee B$	

A B C	$A \vee B / C \vee B$	
T F F	\textcircled{T}	\textcircled{F}

5.

$\neg ((A \vee B) \wedge \neg C)$	2	OR	$\neg ((A \vee B) \wedge \neg C)$	2
A	(5)		A	(3)
$\neg C$	(6)		$\neg C$	(2)
$\neg B$			$\neg (A \vee B)$	(4)
•			$A \vee B$	X,(4)
5 QED A	4		\perp	1
4 PE $A \vee B$	3		C	
•				
6 QED $\neg C$	3			
3 Cnj $(A \vee B) \wedge \neg C$	2			
2 CR \perp	1			
1 IP C				

6. [This question was on a topic not covered in Fo8]

$$\neg (A \vee (B \wedge C))$$

$$\Leftrightarrow$$

$$\neg A \wedge \neg (B \wedge C)$$

$$\Leftrightarrow$$

$$\neg A \wedge (\neg B \vee \neg C)$$

$$\Leftrightarrow$$

$$(\neg A \wedge \neg B) \vee (\neg A \wedge \neg C)$$

$$\Leftrightarrow$$

$$\neg (A \vee B) \vee (\neg A \wedge \neg C)$$

Phi 270 F96 test 2

- Analyze the sentence below in as much detail as possible. Be sure that the unanalyzed components of your answer are complete and independent sentences and that you respect any grouping in the English.

Either Bob didn't call or neither Alice nor Carol was home

answer

- Synthesize an idiomatic English sentence expressing the proposition which is assigned to the symbolic form below by the intensional interpretation to its right—i.e., give an English sentence whose analysis would be the following:

$$P \wedge \neg (S \wedge V)$$

P: Ralph went to Portland; S: Ralph went to Seattle; V: Ralph went to Vancouver

answer

Check each of the following claims of entailment. Do not use detachment or attachment rules. If a derivation fails, present a counterexample that divides an open gap.

- $A \wedge \neg B \Rightarrow \neg (B \wedge C)$
answer
- $A \wedge \neg B, B \vee C \Rightarrow A \wedge C$
answer
- $\neg (A \wedge \neg B) \Rightarrow A \vee B$
answer

- [This question was on a topic not covered in Fo8] Use a series of replacements to show the following:

$$\neg A \wedge \neg (B \wedge C) \Leftrightarrow \neg (A \vee B) \vee \neg (A \vee C)$$

answer

Phi 270 F96 test 2 answers

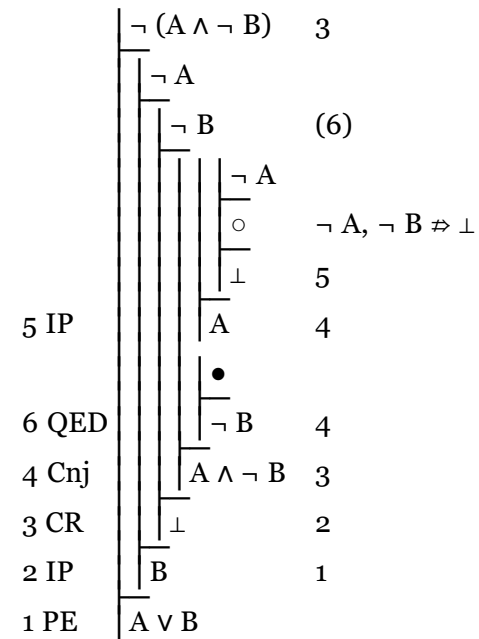
- Bob didn't call \vee neither Alice nor Carol was home
 \neg Bob called $\vee \neg$ (Alice was home \vee Carol was home)
 $\neg B \vee \neg (A \vee C)$
 either not B or not either A or C
 A: Alice was home; B: Bob called ; C: Carol was home
- Ralph went to Portland $\wedge \neg$ (Ralph went to Seattle \wedge Ralph went to Vancouver)
 Ralph went to Portland $\wedge \neg$ Ralph went to both Seattle and Vancouver
 Ralph went to Portland \wedge Ralph didn't go to both Seattle and

Vancouver

Ralph went to Portland but he didn't go to both Seattle and Vancouver

3.	$A \wedge \neg B$	1
1 Ext	A	
1 Ext	$\neg B$	(4)
	$B \wedge C$	3
3 Ext	B	
3 Ext	C	(4)
	\bullet	
4 Nc	\perp	2
2 RAA	$\neg (B \wedge C)$	
4.	$A \wedge \neg B$	1
	$B \vee C$	4
1 Ext	A	(3)
1 Ext	$\neg B$	(6)
	\bullet	
3 QED	A	2
	B	(6)
	$\neg C$	
	\bullet	
6 Nc	\perp	5
5 IP	C	4
	C	(7)
	\bullet	
7 QED	C	4
4 PC	C	2
2 Cnj	$A \wedge C$	

5.



A	B	$\neg(A \wedge \neg B)$	/	$A \vee B$
F	F	T	⊕	⊕
F	T	F	⊕	⊕

6. [This question was on a topic not covered in Fo8]

$$\begin{aligned}
 & \neg A \wedge \neg (B \wedge C) \\
 & \Leftrightarrow \\
 & \neg A \wedge (\neg B \vee \neg C) \\
 & \Leftrightarrow \\
 & (\neg A \wedge \neg B) \vee (\neg A \wedge \neg C) \\
 & \Leftrightarrow \\
 & \neg (A \vee B) \vee \neg (A \vee C)
 \end{aligned}$$