Phi 270 F08 test 2

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

1. Neither Ann nor Bill got the joke, but Carol did.
answer

2. Either Ann didn't reach Bill, or he wasn't both free and able to help her.
answer

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

3. $\neg (B \vee M)$ (B: Sam had heard of the book; M: Sam had heard of the movie)
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. $A \wedge \neg B \vDash \neg (C \wedge B) \wedge A$
answer

5. $\neg (A \wedge B), A \vDash \neg B$
answer

6. $B \vee A \vDash C \vee B$
answer

For **7** you should show the ***first stage of each*** of the possible ways of beginning the derivation with the basic rules (i.e., the rules allowed in **4**-**6**); and you should ***complete one*** of these derivations. In completing it, you ***may*** use attachment and detachment rules (and their use can simplify the derivation).

7. $B \vee A \vDash A \vee B$
answer

Phi 270 F08 test 2 answers

1. Neither Ann nor Bill got the joke, but Carol did

Neither Ann nor Bill got the joke ∧ Carol got the joke

¬ either Ann or Bill got the joke ∧ Carol got the joke

¬ (Ann got the joke ∨Bill got the joke) ∧ Carol got the joke

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

both not either A or B and C

A: Ann got the joke; B: Bill got the joke; C: Carol got the joke

[$(\neg A \wedge \neg B) \wedge C$ is also correct]

2. Either Ann didn't reach Bill, or he wasn't both free and able to help her

Ann didn't reach Bill ∨ Bill wasn't both free and able to help Ann

¬ Ann reached Bill ∨ ¬ Bill was both free and able to help Ann

¬ Ann reached Bill ∨ ¬ (Bill was free ∧ Bill was able to help Ann)

$\neg R \vee \neg (F \wedge A)$

either not R or not both F and A

A: Bill was able to help Ann; F: Bill was free; R: Ann reached Bill

3. $\neg (B \vee M)$ (B: Sam had heard of the book; M: Sam had heard of the movie)

¬ (Sam had heard of the book ∨ Sam had heard of the movie)

¬ Sam had heard of either the book or the movie

Sam had heard of neither the book nor the movie

or

Sam hadn't heard of either the book or the movie

4.

	$A \wedge \neg B$	1
1 Ext	A	(6)
1 Ext	$\neg B$	(5)
	$C \wedge B$	4
4 Ext	C	
4 Ext	B	(5)
	●	
5 Nc	$\bot$	3
3 RAA	$\neg (C \wedge B)$	2
	●	
6 QED	A	2
2 Cnj	$\neg (C \wedge B) \wedge A$	

5.

```
          | ¬ (A ∧ B)   2
          | A           (4)
          |____
          | | B         (5)
          | |____
          | | | | ●
          | | | |____
4 QED     | | | | A     3
          | | | | ●
          | | | |____
5 QED     | | | | B     3
          | | |____
3 Cnj     | | | A ∧ B   2
          | |____
2 CR      | | ⊥         1
          |____
1 RAA     | ¬ B
```

6.

```
          | B ∨ A       2
          |____
          | | ¬ C
          | |____
          | | | B       (3)
          | | |____
          | | | ●
          | | |____
3 QED     | | | B       2
          | | | A
          | | |____
          | | | | ¬ B
          | | | |____
          | | | | ○     A, ¬ B, ¬ C ⊭ ⊥
          | | | |____
          | | | | ⊥     4
          | | |____
4 IP      | | | B       2
          | |____
2 PC      | | B         1
          |____
1 PE      | C ∨ B
```

A B C	B ∨ A / C ∨ B
T F F	Ⓣ Ⓕ

7. The first stages of the three derivations below show the possible ways of beginning, and the full derivations illustrate some of the ways the derivation could be completed. (You were required to complete only one derivation.)

```
          | B ∨ A       2
          |____
          | | ¬ A       (5)
          | |____
          | | | B       (3)
          | | |____
          | | | ●
          | | |____
3 QED     | | | B       2
          | | | A       (5)
          | | |____
          | | | | ¬ B
          | | | |____
          | | | | ●
          | | | |____
5 Nc      | | | | ⊥     4
          | | |____
4 IP      | | | B       2
          | |____
2 PC      | | B         1
          |____
1 PE      | A ∨ B
```

```
          | B ∨ A       2
          |____
          | | ¬ B       (2)
          | |____
2 MTP     | | A         (3)
          | | ●
          | |____
3 QED     | | A         1
          |____
1 PE      | A ∨ B
```

```
          | B ∨ A       1
          |____
          | | B         (2)
          | |____
2 Wk      | | A ∨ B     X, (3)
          | | ●
          | |____
3 QED     | | A ∨ B     1
          | | A         (4)
          | |____
4 Wk      | | A ∨ B     X, (5)
          | | ●
          | |____
5 QED     | | A ∨ B     1
          |____
1 PC      | A ∨ B
```

Phi 270 F06 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 ∧, 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. $A \wedge B \vDash \neg (C \wedge \neg B)$
answer

5. $\neg (A \wedge B), \neg A \vDash B$
answer

6. $C, A \vee B \vDash A \vee (B \wedge C)$
answer

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

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

Phi 270 F06 test 2 answers

1. Sam was cool, but he was not both calm and collected

Sam was cool ∧ Sam was not both calm and collected

Sam was cool ∧ ¬ Sam was both calm and collected

Sam was cool ∧ ¬ (Sam was calm ∧ Sam was collected)

$L \wedge \neg (M \wedge T)$

both L and not both M and T

L: Sam was cool; M: Sam was calm; T: Sam was collected

2. Tom spoke to either Al or Barb but to neither Carol nor Dave

Tom spoke to either Al or Barb ∧ Tom spoke to neither Carol nor Dave

(Tom spoke to Al ∨ Tom spoke to Barb) ∧ ¬ Tom spoke to either Carol or Dave

(Tom spoke to Al ∨ Tom spoke to Barb) ∧ ¬ (Tom spoke to Carol ∨ Tom spoke to Dave)

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

both either A or B and not either C or D

A: Tom spoke to Al; B: Tom spoke to Barb; C: Tom spoke to Carol; D: Tom spoke to Dave

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

¬ Ed worked last weekend ∨ Fred worked last weekend

Ed didn't work last weekend ∨ Fred worked last weekend

Either Ed didn't work last weekend or Fred did

4.

```
        │ A ∧ B              1
        ├──
1 Ext   │ A
1 Ext   │ B                  (4)
        │ │ C ∧ ¬ B          3
        │ ├──
3 Ext   │ │ C
3 Ext   │ │ ¬ B              (4)
        │ │ ●
        │ ├──
4 Nc    │ │ ⊥                2
2 RAA   │ ¬ (C ∧ ¬ B)
```

5.

	¬ (A ∧ B)	2
	¬ A	1
	│ ¬ B	3
	│ │ │ ¬ A	
	│ │ │ ○	¬ A, ¬ B ⊭ ⊥
	│ │ │ ⊥	4
4 IP	│ │ A	3
	│ │ │ ¬ B	
	│ │ │ ○	¬ A, ¬ B ⊭ ⊥
	│ │ │ ⊥	
5 IP	│ │ B	3
3 Cnj	│ A ∧ B	2
2 CR	│ ⊥	1
1 IP	B	

A	B	¬ (A ∧ B), ¬ A / B			
F	F	Ⓣ	F	Ⓣ	Ⓕ

6.

	C	(3)
	A ∨ B	4
	│ ¬ A	(7)
	│ │ │ A	(7)
	│ │ │ │ ¬ B	
	│ │ │ │ ●	
7 Nc	│ │ │ │ ⊥	6
6 IP	│ │ │ B	4
	│ │ │ B	(5)
	│ │ │ ●	
5 QED	│ │ │ B	4
4 PC	│ │ B	2
	│ │ ●	
3 QED	│ │ C	2
2 Cnj	│ B ∧ C	1
1 PE	A ∨ (B ∧ C)	

7.

	¬ (A ∧ C)	2
	A ∨ B	3
	│ C	(2)
2 MPT	│ ¬ A	(3)
3 MTP	│ B	(4)
	│ ●	
4 QED	│ B	1
1 PE	B ∨ ¬ C	

Phi 270 F05 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., $\varphi, \psi \vDash \bot$) 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. $\neg B \vDash \neg (A \wedge (B \wedge C))$
answer

5. $\neg (A \wedge B) \vDash \neg A$
answer

6. $(A \wedge B) \vee C \vDash C \vee B$
answer

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

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

Phi 270 F05 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 ∧ Sam didn't apply for the job

¬ the job had both good pay and flexible hours ∧ ¬ Sam applied for the job

¬ (the job had good pay ∧ the job had flexible hours) ∧ ¬ 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 ∧ either Nancy or Oscar saw the movie

¬ either Luke or Mary saw the movie ∧ (Nancy saw the movie ∨ Oscar saw the movie)

¬ (Luke saw the movie ∨ Mary saw the movie) ∧ (Nancy saw the movie ∨ 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	(4)
3 Ext	C	
	●	
4 Nc	$\bot$	1
1 RAA	$\neg (A \wedge (B \wedge C))$	

5.

	$\neg (A \wedge B)$	2
	A	(4)
	●	
4 QED	A	3
	$\neg B$	
	○	$A, \neg B \nvDash \bot$
	$\bot$	5
5 IP	B	3
3 Cnj	$A \wedge B$	2
2 CR	$\bot$	1
1 RAA	$\neg A$	

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

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	$\bot$	3
3 IP	A	1
1 PC	A	

Phi 270 F04 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. $A \land \neg C \vDash \neg (B \land C)$
   answer
5. $\neg (B \land C), A \land B \vDash A \land \neg C$
   answer
6. $A \lor B \vDash A \lor C$
   answer

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

7. $\neg (A \land B), A \lor \neg C \vDash \neg (B \land C)$
   answer

Phi 270 F04 test 2 answers

1. Dan found his wallet but not his keys

Dan found his wallet ∧ Dan didn't find his keys

Dan found his wallet ∧ ¬ Dan found his keys

$W \land \neg K$

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 ∧ either Nina or Oscar noticed the problem

¬ Mike noticed the problem ∧ (Nina noticed the problem ∨ Oscar noticed the problem)

$\neg M \land (N \lor O)$

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

¬ either the house or the apartment was both cheap and roomy

¬ (the house was both cheap and roomy ∨ the apartment was both cheap and roomy)

¬ ((the house was cheap ∧ the house was roomy) ∨ (the apartment was cheap ∧ the apartment was roomy))

$\neg ((C \land R) \lor (H \land M))$

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

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

4.

	│ $A \land \neg C$	1
1 Ext	│ A	
1 Ext	│ $\neg C$	(4)
	│ │ $B \land C$	3
3 Ext	│ │ B	
3 Ext	│ │ C	(4)
	│ │ ●	
4 Nc	│ │ $\bot$	2
2 RAA	│ $\neg (B \land C)$	

5.

	¬ (B ∧ C)	5
	A ∧ 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 ∧ C	5
5 CR	⊥	4
4 RAA	¬ C	2
2 Cnj	A ∧ ¬ C	

6.

	A ∨ B	2
	¬ C	
	A	(3)
	●	
3 QED	A	2
	B	
	¬ A	
	○	¬ A, B, ¬ C ⊭ ⊥
	⊥	4
4 IP	A	2
2 PC	A	1
1 PE	A ∨ C	

A	B	C	A ∨ B	/ A ∨ C
F	T	F	Ⓣ	Ⓕ

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

	¬ (A ∧ B)	3
	A ∨ ¬ C	4
	B ∧ C	2
2 Ext	B	(3)
2 Ext	C	(5)
3 MPT	¬ A	(4)
4 MTP	¬ C	(5)
	●	
5 Nc	⊥	1
1 RAA	¬ (B ∧ C)	

	¬ (A ∧ B)	3
	A ∨ ¬ C	6
	B ∧ C	2
2 Ext	B	(5)
2 Ext	C	(9)
	A	(7)
	●	
7 QED	A	6
	¬ C	(9)
	¬ A	
	●	
9 Nc	⊥	8
8 IP	A	6
6 PC	A	4
	●	
5 QED	B	4
4 Cnj	A ∧ B	3
3 CR	⊥	1
1 RAA	¬ (B ∧ C)	

Phi 270 F03 test 2

1. 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. Besure that the unanalyzed components of your answer are complete and independent sentences; also try to respect any grouping in the English.

2. Ann found the note but didn't recognize the signature

answer

3. 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.

4. $\neg B \vDash \neg (A \wedge B)$

answer

5. $\neg (\neg A \wedge \neg B), C \wedge \neg B \vDash A$

answer

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

6. $A \vee B \vDash C \vee D$

answer

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

answer

Phi 270 F03 test 2 answers

1. 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 ∧ Ann didn't recognize the signature

Ann found the note ∧ ¬ 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 ∨ neither themanufacturer nor the distributor changed its offer

¬ the manufacturer and the distributor were both available ∨ ¬ either the manufacturer or the distributor changed its offer

¬ (the manufacturer was available ∧ the distributor was available) ∨ ¬ (the manufacturer changed its offer ∨ 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

4.

	¬ B	(3)
	A ∧ B	2
2 Ext	A	
2 Ext	B	(3)
	●	
3 Nc	⊥	1
1 RAA	¬ (A ∧ B)	

5.

	¬ (¬ A ∧ ¬ B)	3
	C ∧ ¬ B	1
1 Ext	C	
1 Ext	¬ B	(6)
	¬ A	(5)
	●	
5 QED	¬ A	4
	●	
6 QED	¬ B	4
4 Cnj	¬ A ∧ ¬ B	3
3 CR	⊥	2
2 IP	A	

6.

	A ∨ B	2
	¬ C	
	A	
	¬ D	
	○	A, ¬ C, ¬ D ⊭ ⊥
	⊥	3
3 IP	D	2
	B	
	¬ D	
	○	B, ¬ C, ¬ D ⊭ ⊥
	⊥	4
4 IP	D	2
2 PC	D	1
1 PE	C ∨ D	

A B C D	A ∨ B / C ∨ 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.

	¬ (A ∧ C)	3
	A ∨ B	4
	¬ (B ∧ ¬ D)	5
	C ∧ ¬ D	2
2 Ext	C	(3)
2 Ext	¬ D	(6)
3 MPT	¬ A	(4)
4 MTP	B	(5)
5 MPT	D	(6)
	●	
6 Nc	⊥	1
1 RAA	¬ (C ∧ ¬ D)	

Phi 270 F02 test 2

1. Define inconsistency by completing the following:

Γ is inconsistent (i.e., Γ ⊨ ⊥) 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.

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

answer

3. 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.

4. A ∧ ¬ B ⊨ ¬ (A ∧ ¬ C)

answer

5. (A ∧ B) ∨ C, ¬ (C ∧ ¬ B) ⊨ B

answer

6. B ∨ (A ∨ C) ⊨ A ∨ B

answer

7. [This question was on a topic not covered in F08] 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 F02 test 2 answers

1. Γ ⊨ ⊥ 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 ∧ Bob didn't need both the book and the disk

(Al needed the book ∧ Al needed the disk) ∧ ¬ Bob needed both the book and the disk

(Al needed the book ∧ Al needed the disk) ∧ ¬ (Bob needed the book ∧ Bob needed the disk)

(B ∧ D) ∧ ¬ (O ∧ 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 ∨ neither Al nor Barb saw the car

¬ the car was there ∨ ¬ either Al or Barb saw the car

¬ the car was there ∨ ¬ (Al saw the car ∨ Barb saw the car)

¬ C ∨ ¬ (A ∨ 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.

	A ∧ ¬ B	1
1 Ext	A	
1 Ext	¬ B	
	│ A ∧ ¬ C	3
3 Ext	│ A	
3 Ext	│ ¬ C	
	│ ○	A, ¬ B, ¬ C ⊭ ⊥
	│ ⊥	2
2 RAA	¬ (A ∧ ¬ C)	

A B C	A ∧ ¬ B / ¬ (A ∧ ¬ C)
T F F	Ⓣ T Ⓕ T T

5.

	│ (A ∧ B) ∨ C	1
	│ ¬ (C ∧ ¬ B)	5
	│ │ A ∧ B	2
2 Ext	│ │ A	
2 Ext	│ │ B	(3)
	│ │ ●	
3 QED	│ │ B	1
	│ │ C	(6)
	│ │ │ ¬ B	(6)
6 Adj	│ │ │ │ C ∧ ¬ B	X,(7)
	│ │ │ │ ●	
7 QED	│ │ │ │ C ∧ ¬ B	5
5 CR	│ │ │ ⊥	4
4 IP	│ │ B	1
1 PC	│ B	

6.

	│ B ∨ (A ∨ C)	2
	│ │ ¬ A	(6)
	│ │ │ B	(3)
	│ │ │ ●	
3 QED	│ │ │ B	2
	│ │ │ A ∨ C	4
	│ │ │ │ A	(6)
	│ │ │ │ │ ¬ B	
	│ │ │ │ │ ●	
6 Nc	│ │ │ │ │ ⊥	5
5 IP	│ │ │ │ B	4
	│ │ │ │ C	
	│ │ │ │ │ ¬ B	
	│ │ │ │ │ ○	¬ A, ¬ B, C ⊭ ⊥
	│ │ │ │ │ ⊥	7
7 IP	│ │ │ │ B	4
4 PC	│ │ │ B	2
2 PC	│ │ B	1
1 PE	│ A ∨ B	

A	B	C	B ∨ (A ∨ C)		/ A ∨ B
F	F	T	Ⓣ	T	Ⓕ

7. [This question was on a topic not covered in F08]

A	B	C	(A ∧ B ∧ ¬ C) ∨	(A ∧ ¬ B ∧ C) ∨	(¬ A ∧ B ∧ C)	∨	(¬ A ∧ ¬ B ∧ C)
T	T	T	F	F	F	F	F
T	T	F	**T**	F	F	Ⓣ	F
T	F	T	F	**T**	F	Ⓣ	F
T	F	F	F	F	F	F	F
F	T	T	F	F	**T**	Ⓣ	F
F	T	F	F	F	F	F	F
F	F	T	F	F	F	Ⓣ	**T**
F	F	F	F	F	F	F	F

Phi 270 F00 test 2

1. Define (logical) relative inconsistency by completing the following: φ is inconsistent with Γ (i.e., Γ, φ ⊨) 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.

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

answer

3. 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.

4. $C \wedge D \vDash \neg (B \wedge \neg C)$

answer

5. $(A \wedge C) \vee (B \wedge D) \vDash B \vee C$

answer

6. $\neg (A \vee B), A \vee D, \neg (C \wedge D) \vDash C$

answer

7. [This question was on a topic not covered in F08] 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 F00 test 2 answers

1. Γ, φ ⊨ if and only if there is no possible world in which φ is true along with and all members of Γ.

2. Sam didn't eat his cake and keep it ∧ Sam wasn't disappointed

¬ Sam ate his cake and kept it ∧ Sam wasn't disappointed

¬ (Sam ate his cake ∧ Sam kept his cake) ∧ ¬ 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 ∨ the intruder was someone the cat and the dog both knew

¬ the intruder woke either the cat or the dog ∨ (the intruder was someone the cat knew ∧ the intruder was someone the dog knew)

¬ (the intruder woke the cat ∨ the intruder woke the dog ∨ (the intruder was someone the cat knew ∧ 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
2 Ext	C	(4)
2 Ext	D	
3 Ext	B	
3 Ext	¬ C	(4)
	●	
4 Nc	⊥	1
1 RAA	$\neg (B \wedge \neg C)$	

5.

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

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.

	¬ (A ∨ B)	2
	A ∨ D	4
	¬ (C ∧ D)	5
	¬ C	
	¬ A	(4)
4 MTP	D	(5)
5 MPT	¬ C	
	¬ B	
	○	¬A, ¬B, ¬C, D ⊭ ⊥
	⊥	6
6 IP	B	3
3 PE	A ∨ B	2
2 CR	⊥	1
1 IP	C	

A B C D	¬ (A ∨ B)	, A ∨ D	, ¬ (C ∧ D) / C
F F F T	Ⓣ F	Ⓣ	Ⓣ F Ⓕ

7. [This question was on a topic not covered in F08]

A ∧ ¬ (B ∧ ¬ C)

≃

A ∧ (¬ B ∨ C)

≃

(A ∧ ¬ B) ∨ (A ∧ 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 ∧ ¬ B ⊨ ¬ (B ∧ ¬ C)
   answer
4. ¬ (¬ A ∧ B) ⊨ C
   answer
5. (A ∧ B) ∨ C, ¬ (A ∧ D) ⊨ C ∨ ¬ D
   answer
6. B ∨ (C ∧ D) ⊨ A ∨ (B ∨ C)
   answer

7. [This question was on a topic not covered in F08] 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 ∧ ¬ B) ∨ 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 ∧ ¬ Fred had both a jack and a spare tire

Fred crossed the desert ∧ ¬ (Fred had a jack ∧ Fred had a spare tire)

D ∧ ¬ (J ∧ 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 ∧ neither Carol nor her luggage was there

(Bob found someone to go ∨ Bob went himself) ∧ ¬ either Carol or her luggage was there

(Bob found someone to go ∨ Bob went himself) ∧ ¬ (Carol was there ∨ Carol's luggage was there)

(F ∨ W) ∧ ¬ (C ∨ 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 ∧ ¬ B          1
        ├──
1 Ext   │A
1 Ext   │¬ B              (4)
        │ │B ∧ ¬ C        3
        │ ├──
3 Ext   │ │B              (4)
3 Ext   │ │¬ C
        │ │●
        │ ├──
4 Nc    │ │⊥              2
        ├──
2 RAA   │¬ (B ∧ ¬ C)
```

4.

```
        │¬ (¬ A ∧ B)      2
        ├──
        │ │¬ C
        │ ├──
        │ │ │ │A
        │ │ │ ├──
        │ │ │ │○          A, ¬C ⊭ ⊥
        │ │ │ ├──
        │ │ │ │⊥          4
        │ │ │ ├──
4 RAA   │ │ │ │¬ A        3
        │ │ │ │ │¬ B
        │ │ │ │ ├──
        │ │ │ │ │○        ¬B, ¬C ⊭ ⊥
        │ │ │ │ ├──
        │ │ │ │ │⊥        5
        │ │ │ ├──
5 IP    │ │ │ │B          3
        │ │ ├──
3 Cnj   │ │ │¬ A ∧ B      2
        │ ├──
2 CR    │ │⊥              1
        ├──
1 IP    │C
```

A	B	C	¬ (¬ A ∧ B) / C				
T	T	F	Ⓣ	F	F	Ⓕ	divides 1st gap
T	F	F	Ⓣ	F	F	Ⓕ	divides both gaps
F	F	F	Ⓣ	T	F	Ⓕ	divides 2nd gap

5.

```
        │(A ∧ B) ∨ C      3
        │¬ (A ∧ D)        5
        ├──
        │ │¬ C
        │ ├──
        │ │ │D            (6)
        │ │ │ │A ∧ B      4
        │ │ │ ├──
4 Ext   │ │ │ │A          (6)
4 Ext   │ │ │ │B
6 Adj   │ │ │ │ │A ∧ D    X,(7)
        │ │ │ │ │●
        │ │ │ │ ├──
7 QED   │ │ │ │ │A ∧ D    5
        │ │ │ ├──
5 CR    │ │ │ │⊥          3
        │ │ │ │C
        │ │ │ ├──
        │ │ │ ├──
        │ │ │ │⊥          3
        │ │ ├──
3 PC    │ │ │⊥            2
        │ ├──
2 RAA   │ │¬ D            1
        ├──
1 PE    │C ∨ ¬ D
```

OR

```
        │(A ∧ B) ∨ C      2
        │¬ (A ∧ D)        4
        ├──
        │ │¬ C            (2)
        │ ├──
2 MTP   │ │A ∧ B          3
3 Ext   │ │A              (4)
3 Ext   │ │B
4 MPT   │ │¬ D            (5)
        │ │●
        │ ├──
5 QED   │ │¬ D            1
        ├──
1 PE    │C ∨ ¬ D
```

6.

```
        │B ∨ (C ∧ D)      2
        ├──
        │ │¬ A
        │ ├──
        │ │ │B            (4)
        │ │ │ │¬ C
        │ │ │ ├──
        │ │ │ │●
        │ │ │ ├──
4 QED   │ │ │ │B          3
        │ │ ├──
3 PE    │ │ │B ∨ C        2
        │ │ │C ∧ D        5
        │ │ ├──
5 Ext   │ │ │C            (7)
5 Ext   │ │ │D
        │ │ │ │¬ B
        │ │ │ ├──
        │ │ │ │●
        │ │ │ ├──
7 QED   │ │ │ │C          6
        │ │ ├──
6 PE    │ │ │B ∨ C        2
        │ ├──
2 PC    │ │B ∨ C          1
        ├──
1 PE    │A ∨ (B ∨ C)
```

OR

```
        │B ∨ (C ∧ D)      3
        ├──
        │ │¬ A
        │ ├──
        │ │ │¬ B          (3)
        │ │ ├──
3 MTP   │ │ │C ∧ D        4
4 Ext   │ │ │C            (5)
4 Ext   │ │ │D
        │ │ │●
        │ │ ├──
5 QED   │ │ │C            2
        │ ├──
2 PE    │ │B ∨ C          1
        ├──
1 PE    │A ∨ (B ∨ C)
```

7. [This question was on a topic not covered in F08]

¬ ((A ∧ ¬ B) ∨ C)

≃

¬ (A ∧ ¬ B) ∧ ¬ C

≃

(¬ A ∨ B) ∧ ¬ C

≃

(¬ A ∧ ¬ C) ∨ (B ∧ ¬ 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:

¬ ((A ∧ B) ∨ (N ∧ 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 ⊨ ¬ (A ∧ ¬ B)

answer

4. ¬ (A ∧ B) ⊨ ¬ (C ∧ ¬ B)

answer

5. ¬ (A ∧ ¬ (B ∧ C)) ⊨ ¬ (A ∧ ¬ C)

answer

6. A ∨ (B ∧ C) ⊨ C ∨ A

answer

Phi 270 F98 test 2 answers

1. ¬ Bob had both fuel and either a match or a lighter

¬ (Bob had fuel ∧ Bob had either a match or a lighter)

¬ (Bob had fuel ∧ (Bob had a match ∨ Bob had a lighter))

¬ (F ∧ (M ∨ L))

not both F and either M or L

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

2. ¬ ((Carol saw Ann ∧ Carol saw Bill) ∨ (Dave saw Ann ∧ Dave saw Bill))

¬ (Carol saw both Ann and Bill ∨ Dave saw both Ann and Bill)

Neither Carol nor Dave saw both Ann and Bill

3.

	B	(3)
	A ∧ ¬ B	2
2 Ext	A	
2 Ext	¬ B	(3)
	●	
3 Nc	⊥	1
1 RAA	¬ (A ∧ ¬ B)	

4.

	¬ (A ∧ B)	3
	C ∧ ¬ B	
2 Ext	C	
2 Ext	¬ B	
	¬ A	
	○	¬A, ¬B, C ⊭ ⊥
	⊥	5
5 IP	A	4
	¬ B	
	○	¬ B, C ⊭ ⊥
	⊥	6
6 IP	B	4
4 Cnj	A ∧ B	3
3 CR	⊥	1
1 RAA	¬ (C ∧ ¬ B)	

A B C	¬ (A ∧ B) / ¬ (C ∧ ¬ B)	
T F T	Ⓣ F Ⓕ T T	divides both gaps
F F T	Ⓣ F Ⓕ T T	divides the second gap

5.

	¬ (A ∧ ¬ (B ∧ C))	3
	A ∧ ¬ C	2
2 Ext	A	(5)
2 Ext	¬ C	(8)
	●	
5 QED	A	4
	B ∧ C	7
7 Ext	B	
7 Ext	C	(8)
	●	
8 Nc	⊥	6
6 RAA	¬ (B ∧ C)	4
4 Cnj	A ∧ ¬ (B ∧ C)	3
3 CR	⊥	1
1 RAA	¬ (A ∧ ¬ C)	

OR

	¬ (A ∧ ¬ (B ∧ C))	3
	A ∧ ¬ C	2
2 Ext	A	(3)
2 Ext	¬ C	(5)
3 MPT	B ∧ C	4
4 Ext	B	
4 Ext	C	(5)
	●	
5 Nc	⊥	1
1 RAA	¬ (A ∧ ¬ C)	

6.

	A ∨ (B ∧ C)	2
	¬ C	(6)
	A	(3)
	●	
3 QED	A	2
	B ∧ C	4
4 Ext	B	
4 Ext	C	(6)
	¬ A	
	●	
6 Nc	⊥	5
5 IP	A	2
2 PC	A	1
1 PE	C ∨ A	

OR

	A ∨ (B ∧ C)	2
	¬ A	(2)
2 MTP	B ∧ C	3
3 Ext	B	
3 Ext	C	(4)
	●	
4 QED	C	1
1 PE	C ∨ A	

Phi 270 F97 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.

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

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:

$$\neg (D \lor M) \land H$$

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. $\neg B \vDash \neg (A \land (B \land C))$

answer

4. $A \lor B \vDash C \lor B$

answer

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

$$\neg ((A \lor B) \land \neg C), A \vDash C$$

answer

6. [This question was on a topic not covered in F08] Use a series of replacements to show the following:

$$\neg (A \lor (B \land C)) \simeq \neg (A \lor B) \lor (\neg A \land \neg C)$$

answer

Phi 270 F97 test 2 answers

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

¬ Sam found the problem and fixed it ∧ (the problem went away on its own ∨ there was no problem to begin with)

¬ (Sam found the problem ∧ Sam fixed the problem) ∧ (the problem went away on its own ∨ ¬ there was a problem to begin with)

$$\neg (F \land D) \land (A \lor \neg P)$$

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. ¬ (Al had directions ∨ Al had a map) ∧ Al made it home

¬ Al had directions or a map ∧ Al made it home

Al had neither directions nor a map ∧ Al made it home

Al had neither directions nor a map but he made it home

3.

	| ¬ B	(4)
	| | A ∧ (B ∧ C)	2
2 Ext	| | A	
2 Ext	| | B ∧ C	3
3 Ext	| | B	(4)
3 Ext	| | C	
	| | ●	
4 Nc	| | ⊥	1
1 RAA	| ¬ (A ∧ (B ∧ C))	

4.

	| A ∨ B	2
	| | ¬ C	
	| | | A	
	| | | | ¬ B	
	| | | | ○	A, ¬ B, ¬ C ⊭ ⊥
	| | | | ⊥	3
3 IP	| | | B	2
	| | | B	(4)
	| | | ●	
4 QED	| | | B	2
2 PC	| | B	1
1 PE	| C ∨ B	

A B C	A ∨ B / C ∨ B
T F F	Ⓣ Ⓕ

5.

	$\neg((A \vee B) \wedge \neg C)$	2
	A	(5)
	$\neg C$	(6)
	$\neg B$	
	●	
5 QED	A	4
4 PE	$A \vee B$	3
	●	
6 QED	$\neg C$	3
3 Cnj	$(A \vee B) \wedge \neg C$	2
2 CR	$\bot$	1
1 IP	C	

OR

	$\neg((A \vee B) \wedge \neg C)$	2
	A	(3)
	$\neg C$	(2)
2 MPT	$\neg(A \vee B)$	(4)
3 Wk	$A \vee B$	X,(4)
	●	
4 Nc	$\bot$	1
1 IP	C	

6. [This question was on a topic not covered in F08]

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

Phi 270 F96 test 2

1. 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

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:

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

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.

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

answer

4. $A \wedge \neg B,\ B \vee C \vDash A \wedge C$

answer

5. $\neg(A \wedge \neg B) \vDash A \vee B$

answer

6. [This question was on a topic not covered in F08] Use a series of replacements to show the following:

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

answer

Phi 270 F96 test 2 answers

1. 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

2. 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 ∧ ¬ B	1
1 Ext	A	
1 Ext	¬ B	(4)
	B ∧ C	3
3 Ext	B	(4)
3 Ext	C	
	●	
4 Nc	⊥	2
2 RAA	¬ (B ∧ C)	

4.

	A ∧ ¬ B	1
	B ∨ C	4
1 Ext	A	(3)
1 Ext	¬ B	(6)
	●	
3 QED	A	2
	B	(6)
	¬ C	
	●	
6 Nc	⊥	5
5 IP	C	4
	C	(7)
	●	
7 QED	C	4
4 PC	C	2
2 Cnj	A ∧ C	

5.

	¬ (A ∧ ¬ B)	3
	¬ A	
	¬ B	(6)
	¬ A	
	○	¬ A, ¬ B ⊭ ⊥
	⊥	5
5 IP	A	4
	●	
6 QED	¬ B	4
4 Cnj	A ∧ ¬ B	3
3 CR	⊥	2
2 IP	B	1
1 PE	A ∨ B	

A B	¬ (A ∧ ¬ B) / A ∨ B
F F	Ⓣ F T Ⓕ

6. [This question was on a topic not covered in F08]

¬ A ∧ ¬ (B ∧ C)

≃

¬ A ∧ (¬ B ∨ ¬ C)

≃

(¬ A ∧ ¬ B) ∨ (¬ A ∧ ¬ C)

≃

¬ (A ∨ B) ∨ ¬ (A ∨ C)