

### 3.3.xa. Exercise answers

1.

	$\neg (A \wedge \neg B)$	2
	A	(3)
	$\neg B$	(3)
3 Adj	A $\wedge$ $\neg B$	X,(4)
	•	
4 QED	A $\wedge$ $\neg B$	2
2 CR	$\perp$	1
1 IP	B	

2.

	J $\wedge$ $\neg (J \wedge \neg C)$	1
1 Ext	J	(3),(6)
1 Ext	$\neg (J \wedge \neg C)$	5
	•	
3 QED	J	2
	$\neg C$	(6)
6 Adj	J $\wedge$ $\neg C$	X,(7)
	•	
7 QED	J $\wedge$ $\neg C$	5
5 CR	$\perp$	4
4 IP	C	2
2 Cnj	J $\wedge$ C	

3.

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

4.

	$\neg (A \wedge \neg (B \wedge C))$	3
	A $\wedge$ $\neg$ B	2
2 Ext	A	(5)
2 Ext	$\neg$ B	(8)
	•	
5 QED	A	4
	B $\wedge$ C	7
7 Ext	B	(8)
7 Ext	C	
	•	
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	$\neg (A \wedge \neg B)$	

5.

	$\neg (A \wedge \neg B)$	3
	$\neg (B \wedge \neg C)$	7
	$A \wedge \neg C$	2
2 Ext	$A$	(5)
2 Ext	$\neg C$	(8)
	•	
	$A$	4
5 QED		
	•	
	$B$	(8)
8 Adj	$B \wedge \neg C$	X,(9)
	•	
	$B \wedge \neg C$	7
9 QED		
7 CR	$\perp$	6
6 RAA	$\neg B$	4
4 Cnj	$A \wedge \neg B$	3
3 CR	$\perp$	1
1 RAA	$\neg (A \wedge \neg C)$	

6.

	$\neg (A \wedge \neg B)$	3
	$\neg (A \wedge \neg C)$	7
	$A \wedge \neg (B \wedge C)$	2
2 Ext	A	(5),(9)
2 Ext	$\neg (B \wedge C)$	10
	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">•</div> <hr style="width: 50%; margin: 0 auto;"/> </div>	
5 QED	A	4
	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">B</div> <hr style="width: 50%; margin: 0 auto;"/> </div>	(11)
	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">•</div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	
9 QED	A	8
	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">C</div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	(11)
11 Adj	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">B <math>\wedge</math> C</div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div> </div>	X,(12)
	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">•</div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	
12 QED	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">B <math>\wedge</math> C</div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	10
10 CR	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\perp</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	9
9 RAA	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\neg C</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	8
8 Cnj	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">A <math>\wedge</math> <math>\neg C</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	7
7 CR	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\perp</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	6
6 RAA	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\neg B</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	4
4 Cnj	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;">A <math>\wedge</math> <math>\neg B</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	3
3 CR	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\perp</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	1
1 RAA	<div style="border-left: 1px solid black; padding-left: 5px;"> <div style="border-left: 1px solid black; padding-left: 5px;"> <div style="text-align: center;"><math>\neg (A \wedge \neg (B \wedge C))</math></div> <hr style="width: 50%; margin: 0 auto;"/> </div> </div>	

Choosing  $\neg (B \wedge C)$  as the resource to exploit by CR at stage 3 would lead to a somewhat shorter and simpler derivation.