

5.1.xa. Exercise answers

1. a. *It was raining* \rightarrow *the roads were slippery*

$$R \rightarrow S$$

if R then S

[R: *it was raining*; S: *the roads were slippery*]

- b. *He was home* \leftarrow *the light was on*

$$H \leftarrow L$$

$$L \rightarrow H$$

if L then H

[H: *he was home*; L: *the light was on*]

- c. *Ann and Bill helped* \leftarrow *Carol was away*

(*Ann helped* \wedge *Bill helped*) \leftarrow *Carol was away*

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

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

if C then both A and B

[A: *Ann helped*; B: *Bill helped*; C: *Carol was away*]

- d. *Sam will help* \wedge *Tom will help if we ask him*

Sam will help \wedge (*Tom will help* \leftarrow *we will ask Tom to help*)

$$S \wedge (T \leftarrow A)$$

$$S \wedge (A \rightarrow T)$$

both S and if A then T

[A: *we will ask Tom to help*; S: *Sam will help*; T: *Tom will help*]

- e. *it was warm* \rightarrow *they ate outside provided it didn't rain*

it was warm \rightarrow (*they ate outside* \leftarrow *it didn't rain*)

it was warm \rightarrow (*they ate outside* \leftarrow \neg *it rained*)

$$W \rightarrow (O \leftarrow \neg R)$$

$$W \rightarrow (\neg R \rightarrow O)$$

if W then if not R then O

[O: *they ate outside*; R: *it rained*; W: *it was warm*]

- f. *the new project was approved* \rightarrow *Carol started work on the new project and so did Dave if he was finished with the last one*

the new project was approved \rightarrow (*Carol started work on the new project* \wedge *Dave started work on the new project if he was finished with the last one*)

the new project was approved \rightarrow (*Carol started work on the new project* \wedge (*Dave started work on the new*

project ← *Dave was finished with the last project*)

$$A \rightarrow (C \wedge (D \leftarrow F))$$

$$A \rightarrow (C \wedge (F \rightarrow D))$$

if A **then both** C **and if** F **then** D

[A: *the new project was approved*; C: *Carol started work on the new project*; D: *Dave started work on the new project*; F: *Dave was finished with the last project*]

- g. *If he found the instructions, Tom set up the new machine*
 \wedge *if Tom didn't find the instructions, he packed up the old machine*

(*Tom found the instructions* → *Tom set up the new machine*) \wedge (*Tom didn't find the instructions* → *Tom packed up the old machine*)

(*Tom found the instructions* → *Tom set up the new machine*) \wedge (\neg *Tom found the instructions* → *Tom packed up the old machine*)

$$(F \rightarrow S) \wedge (\neg F \rightarrow P)$$

both if F **then** S **and if not** F **then** P

[F: *Tom found the instructions*; P: *Tom packed up the old machine*; S: *Tom set up the new machine*]

2. a. both A and if B then C

- b. if both A and B then C

- c. A → (B ∧ (C → D))

- d. (A → B) ∧ (¬ A → ¬ B)

3. a. \neg *I'll see it* → \neg *I'll believe it*

I won't see it → *I won't believe it*

If I don't see it, I won't believe it

- b. *It was sunny* → \neg (*it rained* \vee *it snowed*)

It was sunny → \neg *it rained or snowed*

It was sunny → *it didn't rain or snow*

If it was sunny, it didn't rain or snow

- c. \neg the set works $\leftarrow \neg$ (the set is plugged in $\wedge \neg$ the set is broken)
 \neg the set works $\leftarrow \neg$ (the set is plugged in \wedge the set isn't broken)
 \neg the set works $\leftarrow \neg$ (the set is plugged in and isn't broken)

The set doesn't work if it isn't both plugged in and unbroken

- d. \neg (Adams will back out \vee Brown will back out) \rightarrow (the deal will go through $\leftarrow \neg$ (Collins will have trouble with financing \vee Davis will have trouble with financing))
 \neg Adams or Brown will back out \rightarrow (the deal will go through $\leftarrow \neg$ (Collins or Davis will have trouble with financing))
 \neg Adams or Brown will back out \rightarrow (the deal will go through \leftarrow neither Collins nor Davis will have trouble with financing)
 \neg Adams or Brown will back out \rightarrow the deal will go through provided neither Collins nor Davis has trouble with financing

If neither Adams nor Brown backs out, the deal will go through provided neither Collins nor Davis has trouble with financing

4. Numbers below the tables indicate the order in which values were computed.

a.

A	B	$(A \rightarrow B) \wedge (B \rightarrow A)$		
T	T	T	Ⓓ	T
T	F	F	Ⓕ	T
F	T	T	Ⓕ	F
F	F	T	Ⓓ	T
		1	2	1

b.

A	B	$\neg (A \wedge B) \rightarrow (\neg B \vee A)$				
T	T	F	T	Ⓓ	F	T
T	F	T	F	Ⓓ	T	T
F	T	T	F	Ⓕ	F	F
F	F	T	F	Ⓓ	T	T
		2	1	3	1	2

c.

A	B	C	$(A \rightarrow C) \wedge (B \rightarrow \neg C)$		
T	T	T	T	Ⓕ	F F
T	T	F	F	Ⓕ	T T
T	F	T	T	Ⓓ	T F
T	F	F	F	Ⓕ	T T
F	T	T	T	Ⓕ	F F
F	T	F	T	Ⓓ	T T
F	F	T	T	Ⓓ	T F
F	F	F	T	Ⓓ	T T

d.

A	B	C	$\neg (A \rightarrow C) \wedge (\neg B \rightarrow C)$				
T	T	T	F	T	Ⓕ	F	T
T	T	F	T	F	Ⓓ	F	T
T	F	T	F	T	Ⓕ	T	T
T	F	F	T	F	Ⓕ	T	F
F	T	T	F	T	Ⓕ	F	T
F	T	F	F	T	Ⓕ	F	T
F	F	T	F	T	Ⓕ	T	T
F	F	F	F	T	Ⓕ	T	F

1
3
2
1

2
1
3
1
2