

#### 4.1.xa. Exercise answers

1. a. *Tommy ate his vegetables*  $\vee$  *Tommy didn't get any dessert*  
*Tommy ate his vegetables*  $\vee$   $\neg$  *Tommy got dessert*  
 $V \vee \neg D$   
either *V* or not *D*  
[*D*: *Tommy got dessert*; *V*: *Tommy ate his vegetables*]
- b.  $\neg$  (*Mike heard either the phone or the doorbell*)  
 $\neg$  (*Mike heard the phone*  $\vee$  *Mike heard the doorbell*)  
 $\neg (P \vee D)$   
not either *P* or *D*  
[*D*: *Mike heard the doorbell*; *P*: *Mike heard the phone*]
- c. *Mike wasn't home*  $\vee$  *Mike wasn't answering the phone*  
 $\neg$  *Mike was home*  $\vee$   $\neg$  *Mike was answering the phone*  
 $\neg H \vee \neg P$   
either not *H* or not *P*  
[*H*: *Mike was home*; *P*: *Mike was answering the phone*]
- d. *The package was sent*  $\wedge$  *either the package is still on its way or it's been lost in the mail*  
*The package was sent*  $\wedge$  (*the package is still on its way*  $\vee$  *the package has been lost in the mail*)  
 $S \wedge (W \vee L)$   
both *S* and either *W* or *L*  
[*L*: *the package has been lost in the mail*; *S*: *the package was sent*; *W*: *the package is still on its way*]
- e. *Neither the House nor the Senate had acted on the bill*  $\wedge$  *the White House expressed confidence that the bill would pass*  
 $\neg$  *either the House or the Senate had acted on the bill*  $\wedge$  *the White House expressed confidence that the bill would pass*  
 $\neg$  (*the House had acted on the bill*  $\vee$  *the Senate had acted on the bill*)  $\wedge$  *the White House expressed*

*confidence that the bill would pass*

$$\neg (H \vee S) \wedge W$$

*both not either H or S and W*

[H: *the House had acted on the bill*; S: *the Senate had acted on the bill*; W: *the White House expressed confidence that the bill would pass*]

- f. *Sam will pass through without either stopping by or calling*  
 $\neg (\text{Sam will pass through} \wedge \neg \text{Sam will either stop by or call})$   
 $\neg (\text{Sam will pass through} \wedge \neg (\text{Sam will stop by} \vee \text{Sam will call}))$

$$\neg (P \wedge \neg (S \vee C))$$

*not both P and not either S or C*

[C: *Sam will call*; P: *Sam will pass through*; S: *Sam will stop by*]

- g. *Davis will take you or give you directions*  $\vee$   
*Edwards will take you or give you directions*  
(*Davis will take you*  $\vee$  *Davis will give you directions*)  
 $\vee$  (*Edwards will take you*  $\vee$  *Edwards will give you directions*)

$$(D \vee G) \vee (E \vee V)$$

*either either D or G or either E or V*

[D: *Davis will take you*; E: *Edwards will take you*; G: *Davis will give you directions*; V: *Edwards will give you directions*]

- h. *We'll have a can without an opener*  $\vee$  *we'll have an opener without a can*  
(*we'll have a can*  $\wedge$  *we won't have an opener*)  $\vee$   
(*we'll have an opener*  $\wedge$  *we won't have a can*)  
(*we'll have a can*  $\wedge$   $\neg$  *we'll have an opener*)  $\vee$  (*we'll have an opener*  $\wedge$   $\neg$  *we'll have a can*)

$$(C \wedge \neg O) \vee (O \wedge \neg C)$$

*either both C and not O or both O and not C*

[C: *we'll have a can*; O: *we'll have an opener*]

- i.  $\neg$  *either Jan or Ken had matches or a lighter*  
 $\neg$  (*Jan had matches or a lighter*  $\vee$  *Ken had matches*)

or a lighter)

$\neg ((\text{Jan had matches} \vee \text{Jan had a lighter}) \vee (\text{Ken had matches} \vee \text{Ken had a lighter}))$

$\neg ((M \vee L) \vee (K \vee G))$

not either either M or L or either K or G

[G: Ken had a lighter; K: Ken had matches; L: Jan had a lighter; M: Jan had matches]

- j. Both Ann and Bill were in town  $\wedge$  neither Ann nor Bill knew the other was in town  
(Ann was in town  $\wedge$  Bill was in town)  $\wedge$   $\neg$  either Ann or Bill knew the other was in town  
(Ann was in town  $\wedge$  Bill was in town)  $\wedge$   $\neg$  (Ann knew Bill was in town  $\vee$  Bill knew Ann was in town)

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

both both A and B and not either K or N

[A: Ann was in town; B: Bill was in town; K: Ann knew Bill was in town; N: Bill knew Ann was in town]

- k. Tom will handle both the scheduling and the publicity  $\vee$  Dick will handle both the scheduling and the publicity  $\vee$  Harry will handle both the scheduling and the publicity  
(Tom will handle the scheduling  $\wedge$  Tom will handle the publicity)  $\vee$  (Dick will handle the scheduling  $\wedge$  Dick will handle the publicity)  $\vee$  (Harry will handle the scheduling  $\wedge$  Harry will handle the publicity)

$(T \wedge P) \vee (D \wedge B) \vee (H \wedge L)$

(both T and S) or (both D and C) or (both T and S)

[B: Dick will handle the publicity; D: Dick will handle the scheduling; H: Harry will handle the scheduling; L: Harry will handle the publicity; P: Tom will handle the publicity; T: Tom will handle the scheduling]

Note: this sentence is ambiguous and could also be interpreted as equivalent to the following one.

- l. The scheduling will be handled by either Tom, Dick, or Harry  $\wedge$  the publicity will be handled by either

*Tom, Dick, or Harry*  
 (the scheduling will be handled by Tom  $\vee$  the scheduling will be handled by Dick  $\vee$  the scheduling will be handled by Harry)  $\wedge$  (the publicity will be handled by Tom  $\vee$  the publicity will be handled by Dick  $\vee$  the publicity will be handled by Harry)

$$(T \vee D \vee H) \wedge (P \vee B \vee L)$$

both (T or D or H) and (P or B or L)

[B: the publicity will be handled by Dick; D: the scheduling will be handled by Dick; H: the scheduling will be handled by Harry; L: the publicity will be handled by Harry; P: the publicity will be handled by Tom; T: the scheduling will be handled by Tom]

2. a. both A and either B or C

$$\underline{\underline{A \wedge (B \vee C)}}$$

b. either both A and B or C

$$\underline{\underline{(A \wedge B) \vee C}}$$

c.  $\neg(A \vee \neg B)$

$$\underline{\underline{\neg(A \vee \neg B)}}$$

d.  $(A \vee B) \wedge (A \vee C)$

$$\underline{\underline{(A \vee B) \wedge (A \vee C)}}$$

3. a. *It was the butler*  $\vee$  *it was the nephew*  
*It was either the butler or the nephew*

b.  $\neg$  (the alarm worked  $\vee$  the sprinkler worked)  
 $\neg$  (either the alarm or the sprinkler worked)  
 Neither the alarm nor the sprinkler worked

c.  $\neg$  the part arrived  $\vee$   $\neg$  the part was the problem  
 The part didn't arrive  $\vee$  the part wasn't the problem  
 Either the part didn't arrive or it wasn't the problem

d. *Ann has a large car*  $\vee$   $\neg$  (*Bill will ride with us*  $\wedge$  *Carol will ride with us*)  
*Ann has a large car*  $\vee$   $\neg$  *Bill and Carol will ride with us*  
*Ann has a large car*  $\vee$  *Bill and Carol won't both ride*

*with us*

*Either Ann has a large car or Bill and Carol won't both ride with us*

*Note: both is introduced here to help distinguish this sentence from  $A \vee (\neg B \wedge \neg C)$*

- e. *(it rained over night  $\vee$  there was a heavy dew)  $\wedge$  it is wet*

*It rained over night or there was a heavy dew  $\wedge$  it is wet*

*It rained over night or there was a heavy dew but, either way, it is wet*

*Note: either way here serves to indicate that the scope of the disjunction has ended and that the final clause is unhedged and but reinforces this by marking the contrast between the indefinite disjunction and the definite final clause.*

- f. *(AAA  $\wedge$  Co. will profit from the deal  $\wedge$  ZZZ Inc. will profit from the deal)  $\vee$  (the deal will fall through  $\wedge$   $\neg$  (AAA  $\wedge$  Co. will profit from the deal  $\vee$  ZZZ Inc. will profit from the deal))*

*AAA  $\wedge$  Co. and ZZZ Inc. will both profit from the deal  $\vee$  (the deal will fall through  $\wedge$   $\neg$  (either AAA  $\wedge$  Co. or ZZZ Inc. will profit from the deal))*

*AAA  $\wedge$  Co. and ZZZ Inc. will both profit from the deal  $\vee$  (the deal will fall through  $\wedge$  neither AAA  $\wedge$  Co. nor ZZZ Inc. will profit from the deal)*

*AAA  $\wedge$  Co. and ZZZ Inc. will both profit from the deal  $\vee$  the deal will fall through and neither AAA  $\wedge$  Co. nor ZZZ Inc. will profit from it)*

*Either AAA  $\wedge$  Co. and ZZZ Inc. will both profit from the deal, or the deal will fall through and neither will profit from it*