Section 2.1E

1.a. Both Bob jogs regularly and Carol jogs regularly.

B & C

c. Either Bob jogs regularly or Carol jogs regularly.

$B \vee C$

e. It is not the case that either Bob jogs regularly or Carol jogs regularly.

$\sim (B \vee C)$

[or]

Both it is not the case that Bob jogs regularly and it is not the case that Carol jogs regularly.

$\sim B \ \& \sim C$

g. If it is not the case that Carol jogs regularly then it is not the case that Bob jogs regularly.

$\sim C \supset \sim B$

i. Both (either Bob jogs regularly or Albert jogs regularly) and it is not the case that (both Bob jogs regularly and Albert jogs regularly).

$(B \vee A) \ \& \sim (B \ \& \ A)$

k. Both it is not the case that (either Carol jogs regularly or Bob jogs regularly) and it is not the case that Albert jogs regularly.

$\sim (C \vee B) \ \& \sim A$

m. Either Albert jogs regularly or it is not the case that Albert jogs regularly.

$A \vee \sim A$

2.a. Albert jogs regularly and so does Bob.
c. Either Albert or Carol jogs regularly.
e. Neither Albert nor Carol jogs regularly.
g. Bob jogs regularly and so does either Albert or Carol.
i. Albert, Carol, and Bob jog regularly.
k. Either Bob or Carol jogs regularly, or neither of them jogs regularly.

3. c and k are true; and a, e, g, and i are false.

4. Paraphrases

a. <u>It is not the case that</u> all joggers are marathon runners.
c. <u>It is not the case that</u> some marathon runners are lazy.
e. <u>It is not the case that</u> somebody is perfect.

Symbolizations

a. Using 'A' for 'All joggers are marathon runners':

$\sim A$

c. Using 'L' for 'Some marathon runners are lazy':

$\sim L$

e. Using 'P' for 'Somebody is perfect':

$\sim P$

5.a. <u>If</u> Bob jogs regularly <u>then</u> <u>it is not the case that</u> Bob is lazy.

$B \supset \sim L$

c. Bob jogs regularly <u>if and only if</u> <u>it is not the case that</u> Bob is lazy.

$B \equiv \sim L$

e. Carol is a marathon runner <u>if and only if</u> Carol jogs regularly.

$M \equiv C$

g. <u>If</u> (<u>both</u> Carol jogs regularly <u>and</u> Bob jogs regularly) <u>then</u> Albert jogs regularly.

$(C \& B) \supset A$

i. <u>If</u> (<u>either</u> <u>it is not the case that</u> Carol jogs regularly <u>or</u> <u>it is not the case that</u> Bob jogs regularly) <u>then</u> <u>it is not the case that</u> Albert jogs regularly.

$(\sim C \vee \sim B) \supset \sim A$

k. <u>If</u> (<u>both</u> Albert is healthy <u>and</u> <u>it is not the case that</u> Bob is lazy) <u>then</u> (<u>both</u> Albert jogs regularly <u>and</u> Bob jogs regularly).

$(H \& \sim L) \supset (A \& B)$

m. <u>If</u> <u>it is not the case that</u> Carol is a marathon runner <u>then</u> [Carol jogs regularly <u>if and only if</u> (<u>both</u> Albert jogs regularly <u>and</u> Bob jogs regularly)].

$\sim M \supset [C \equiv (A \& B)]$

o. <u>If</u> [<u>both</u> (<u>both</u> Carol is a marathon runner <u>and</u> <u>it is not the case that</u> Bob is lazy) <u>and</u> Albert is healthy] <u>then</u> [<u>both</u> Albert jogs regularly <u>and</u> (<u>both</u> Bob jogs regularly <u>and</u> Carol jogs regularly)].

$[(M \& \sim L) \& H] \supset [A \& (B \& C)]$

q. If (if Carol jogs regularly then Albert jogs regularly) then (both Albert is healthy and Carol is a marathon runner).

$(C \supset A) \supset (H \,\&\, M)$

s. If [if (either Carol jogs regularly or Bob jogs regularly) then Albert jogs regularly)] then (both Albert is healthy and it is not the case that Bob is lazy).

$[(C \vee B) \supset A] \supset (H \,\&\, \sim L)$

6.a. Either Bob is lazy or he isn't.
c. Albert jogs regularly if and only if he is healthy.
e. Neither Bob nor Carol jogs regularly.
g. If either Albert or Carol does not jog regularly, then Bob does.
i. Carol jogs regularly only if Albert does but Bob doesn't.
k. Carol does and does not jog regularly.
m. If Bob is lazy, then he is; but Bob jogs regularly.
o. If Albert doesn't jog regularly, then Bob doesn't jog regularly only if Carol doesn't.
q. Albert doesn't jog regularly, and Bob jogs regularly if and only if he is not lazy.

7.a. Both both it is not the case that men are from Mars and it is not the case that women are from Mars and both it is not the case that men are from Venus and it is not the case that women are from Venus.

$(\sim M \,\&\, \sim W) \,\&\, (\sim V \,\&\, \sim S)$

c. It is not the case that both Butch Cassidy escaped and the Sundance Kid escaped.

$\sim (B \,\&\, S)$

e. Either both that lady was cut in half and that lady was torn asunder or it was a magic trick.

$(H \,\&\, A) \vee M$

g. Either the prisoner will receive a life sentence or the prisoner will receive the death penalty.

$L \vee D$

8.

P	**Q**	**$(P \vee Q) \,\&\, \sim (P \,\&\, Q)$**	**$P \equiv \sim Q$**
T	**T**	**F**	**F**
T	**F**	**T**	**T**
F	**T**	**T**	**T**
F	**F**	**F**	**F**

Section 2.2E

1.a. Either the French team will win at least one gold medal or either the German team will win at least one gold medal or the Danish team will win at least one gold medal.

$F \vee (G \vee D)$

c. Both (either the French team will win at least one gold medal or either the German team will win at least one gold medal or the Danish team will win at least one gold medal) and (either [it is not the case that either the French team will win at least one gold medal or the German team will win at least one gold medal] or [either (it is not the case that either the French team will win at least one gold medal or the Danish team will win at least one gold medal) or (it is not the case that either the German team will win at least one gold medal or the Danish team will win at least one gold medal)]).

$[F \vee (G \vee D)]\ \&\ (\sim (F \vee G) \vee [\sim (F \vee D) \vee \sim (G \vee D)])$

e. Either both the French team will win at least one gold medal and the German team will win at least one gold medal or either both the French team will win at least one gold medal and the Danish team will win at least one gold medal or both the German team will win at least one gold medal and the Danish team will win at least one gold medal.

$(F\ \&\ G) \vee [(F\ \&\ D) \vee (G\ \&\ D)]$

g. Either both both the French team will win at least one gold medal and the German team will win at least one gold medal and it is not the case that the Danish team will win at least one gold medal or either both both the French team will win at least one gold medal and the Danish team will win at least one gold medal and it is not the case that the German team will win at least one gold medal or both both the German team will win at least one gold medal and the Danish team will win at least one gold medal and it is not the case that the French team will win at least one gold medal.

$[(F\ \&\ G)\ \&\ \sim D] \vee ([(F\ \&\ D)\ \&\ \sim G] \vee [(G\ \&\ D)\ \&\ \sim F])$

2.a. None of them will win a gold medal.
c. None of them will win a gold medal.
e. At least one of them will win a gold medal.
g. The French team will win a gold medal and exactly one of the other two teams will win a gold medal.

3.a. If either the French team will win at least one gold medal or either the German team will win at least one gold medal or the Danish team will win at least one gold medal then both the French team will win at least one gold medal and both the German team will win at least one gold medal and the Danish team will win at least one gold medal.

$$[F \vee (G \vee D)] \supset [F \& (G \& D)]$$

c. If the star German runner is disqualified then if the German team will win at least one gold medal then it is not the case that either the French team will win at least one gold medal or the Danish team will win at least one gold medal.

$$S \supset [G \supset \sim (F \vee D)]$$

e. The Danish team will win at least one gold medal if and only if both the French team is plagued with injuries and the star German runner is disqualified.

$$D \equiv (P \& S)$$

g. If the French team is plagued with injuries then if the French team will win at least one gold medal then both it is not the case that either the Danish team will win at least one gold medal or the German team will win at least one gold medal and it rains during most of the competition.

$$P \supset (F \supset [\sim (D \vee G) \& R])$$

4.a. If the German star is disqualified then the German team will not win a gold medal, and the star is disqualified.

c. The German team won't win a gold medal if and only if the Danish as well as the French will win one.

e. If a German team win guarantees a French team win and a French team win guarantees a Danish team win then a German team win guarantees a Danish team win.

g. Either at least one of the three wins a gold medal or else the French team is plagued with injuries or the star German runner is disqualified or it rains during most of the competition.

5.a. If it is not the case that the author of *Robert's Rules of Order* was a politician, then either the author of *Robert's Rules of Order* was an engineer or the author of *Robert's Rules of Order* was a clergyman.

Both the author of *Robert's Rules of Order* was motivated to write the book by an unruly church meeting and it is not the case that the author of *Robert's Rules of Order* was a clergyman.

Both it is not the case that the author of *Robert's Rules of Order* was a politician and the author of *Robert's Rules of Order* could not persuade a publisher that the book would make money forcing him to publish the book himself.

The author of *Robert's Rules of Order* was an engineer.

E: The author of *Robert's Rules of Order* was an engineer.
C: The author of *Robert's Rules of Order* was a clergyman.
P: The author of *Robert's Rules of Order* was a politician.
M: The author of *Robert's Rules of Order* was motivated to write the book by an unruly church meeting.
F: The author of *Robert's Rules of Order* could not persuade a publisher that the book would make money forcing him to publish the book himself.

$\sim P \supset (E \vee C)$

$M \,\&\, \sim C$

$\sim P \,\&\, F$

E

c. <u>Either</u> <u>either</u> the maid committed the murder <u>or</u> the butler committed the murder <u>or</u> the cook committed the murder.

<u>Both</u> (<u>if</u> the cook committed the murder <u>then</u> a knife was the murder weapon) <u>and</u> (<u>if</u> a knife was the murder weapon <u>then</u> <u>it is not the case that</u> <u>either</u> the butler committed the murder <u>or</u> the maid committed the murder).

A knife was the murder weapon.

The cook committed the murder.

M: The maid committed the murder.
B: The butler committed the murder.
C: The cook committed the murder.
K: A knife was the murder weapon.

$(M \vee B) \vee C$

$(C \supset K) \,\&\, (K \supset \sim (B \vee M))$

K

C

e. If the candidate is perceived as conservative then both it is not the case that the candidate will win New York and both the candidate will win California and the candidate will win Texas.

Both if the candidate has an effective advertising campaign then the candidate is perceived as conservative and the candidate has an effective advertising campaign.

Either both the candidate will win California and the candidate will win New York or either (both the candidate will win California and the candidate will win Texas) or (both the candidate will win New York and the candidate will win Texas).

P: The candidate is perceived as conservative.
N: The candidate will win New York.
C: The candidate will win California.
T: The candidate will win Texas.
E: The candidate has an effective advertising campaign.

$P \supset [\sim N \ \& \ (C \ \& \ T)]$

$(E \supset P) \ \& \ E$

$(C \ \& \ N) \vee [(C \ \& \ T) \vee (N \ \& \ T)]$

Section 2.3E

1. Since we do not know how these sentences are being used (e.g., as premises, conclusions, or as isolated claims) it is best to symbolize those that are non-truth-functional compounds as atomic sentences of *SL*.

a. 'It is possible that' does not have a truth-functional sense. Thus the sentence should be treated as a unit and abbreviated by one letter, for example, 'E'. Here 'E' abbreviates not just 'Every family on this continent owns a television set' but the entire original sentence, 'It is possible that every family on this continent owns a television set'.

c. 'Necessarily' has scope over the entire sentence. Abbreviate the entire sentence by one letter such as 'N'.

e. This sentence can be paraphrased as a truth-functional compound:

Both it is not the case that Tamara will stop by and Tamara promised to phone early in the evening

which can be symbolized as '~ B & E', where 'B' abbreviates 'Tamara will stop by' and 'E' abbreviates 'Tamara promised to phone early in the evening'.

g. 'John believes that' is not a truth-functional connective. Abbreviate the sentence by one letter, for example 'J'.

i. 'Only after' has no truth-functional sense. Therefore abbreviate the entire sentence as 'D'.

2.a. The paraphrase is

If the maid committed the murder then the maid believed her life was in danger.

If the butler committed the murder then (both the murder was done silently and it is not the case that the body was mutilated).

Both the murder was done silently and it is not the case that the maid's life was in danger.

The butler committed the murder if and only if it is not the case that the maid committed the murder.

The maid committed the murder.

Notice that 'The maid believed her life was in danger' (first premise) and 'The maid's life was in danger' (third premise) make different claims and cannot be treated as the same sentence. Further, since the subjunctive conditional in the original argument is a premise, it can be weakened and paraphrased as a truth-functional compound. Using the abbreviations

M: The maid committed the murder.
D: The maid believed that her life was in danger.
B: The butler committed the murder.
S: The murder was done silently.
W: The body was mutilated.
L: The maid's life was in danger.

the symbolized argument is

$M \supset D$

$B \supset (S \,\&\, {\sim} W)$

$S \,\&\, {\sim} L$

$B \equiv {\sim} M$

M

c. The paraphrase is

If (both Charles Babbage had the theory of the modern computer and Charles Babbage had modern electronic parts) then the modern computer was developed before the beginning of the twentieth century.

Both Charles Babbage lived in the early nineteenth century and Charles Babbage had the theory of the modern computer.

Both it is not the case that Charles Babbage had modern electronic parts and Charles Babbage was forced to construct his computers out of mechanical gears and levers.

If Charles Babbage had had modern electronic parts available to him then the modern computer would have been developed before the beginning of the twentieth century.

In the original argument subjunctive conditionals occur in the first premise and the conclusion. Since it is correct to weaken the premises but not the conclusion, the first premise, but not the conclusion, is given a truth-functional paraphrase. The conclusion will be abbreviated as a single sentence. Using the abbreviations

T: Charles Babbage had the theory of the modern computer.
E: Charles Babbage had modern electronic parts.
C: The modern computer was developed before the beginning of the twentieth century.
L: Charles Babbage lived in the early nineteenth century.
F: Charles Babbage was forced to construct his computers out of mechanical gears and levers.
W: If Charles Babbage had had modern electronic parts available to him then the modern computer would have been developed before the beginning of the twentieth century.

the paraphrase can be symbolized as

$(T \& E) \supset C$

$L \& T$

$\sim E \& F$

W

Section 2.4E

1. a. True

c. False. The chemical symbol names or designates the metal copper, not the word ‘copper’.

e. False. The substance copper is not its own name.

g. False. The name of copper is not a metal.

2.a. The only German word mentioned is 'Deutschland' which has eleven letters.

c. The phrase 'the German name of Germany' here refers to the word 'Deutschland', so 'Deutschland' is mentioned here.

e. The word 'Deutschland' occurs inside single quotation marks in Exercise 2.e, so it is there being mentioned, not used.

3.a. A sentence of *SL*.

c. A sentence of *SL*.

e. A sentence of *SL*.

g. A sentence of *SL*.

i. A sentence of *SL*.

4.a. The main connective is '&'. The immediate sentential components are '~ A' and 'H'. '~ A & H' is a component of itself. Another sentential component is 'A'. The atomic sentential components are 'A' and 'H'.

c. The main connective is '∨'. The immediate sentential components are '~ (S & G)' and 'B'. The other sentential components are '~ (S & G) ∨ B' itself, '(S & G)', 'S', and 'G'. The atomic components are 'B', 'S', and 'G'.

e. The main connective is the first occurrence of '∨'. The immediate sentential components are '(C ≡ K)' and '(~ H ∨ (M & N))'. Additional sentential components are the sentence itself, '~ H', '(M & N)', 'C', 'K', 'H', 'M', and 'N'. The last five sentential components listed are atomic components.

5.a. No. The sentence is a conditional, but not a conditional whose antecedent is a negation.

c. Yes. Here **P** is the sentence 'A' and **Q** is the sentence '~ B'.

e. No. The sentence is a negation, not a conditional.

g. No. The sentence is a negation, not a conditional.

i. Yes. Here **P** is 'A ∨ ~ B' and **Q** is '~ (C & ~ D)'.

6.a. 'H' can occur neither immediately to the left of '~' nor immediately to the right of 'A'. As a unary connective, '~' can immediately precede but not immediately follow sentences of *SL*. Both 'H' and 'A' are sentences of *SL*, and no sentence of *SL* can immediately precede another sentence of *SL*.

c. '(' may not occur immediately to the right of 'A', as a sentence of *SL* can be followed only by a right parentheses or by a binary connective. But '(' may occur immediately to the left of '~', as in '(~ A & B)'.

e. '[' may not occur immediately to the right of 'A' but may occur immediately to the left of '~', as it functions exactly as does '('.