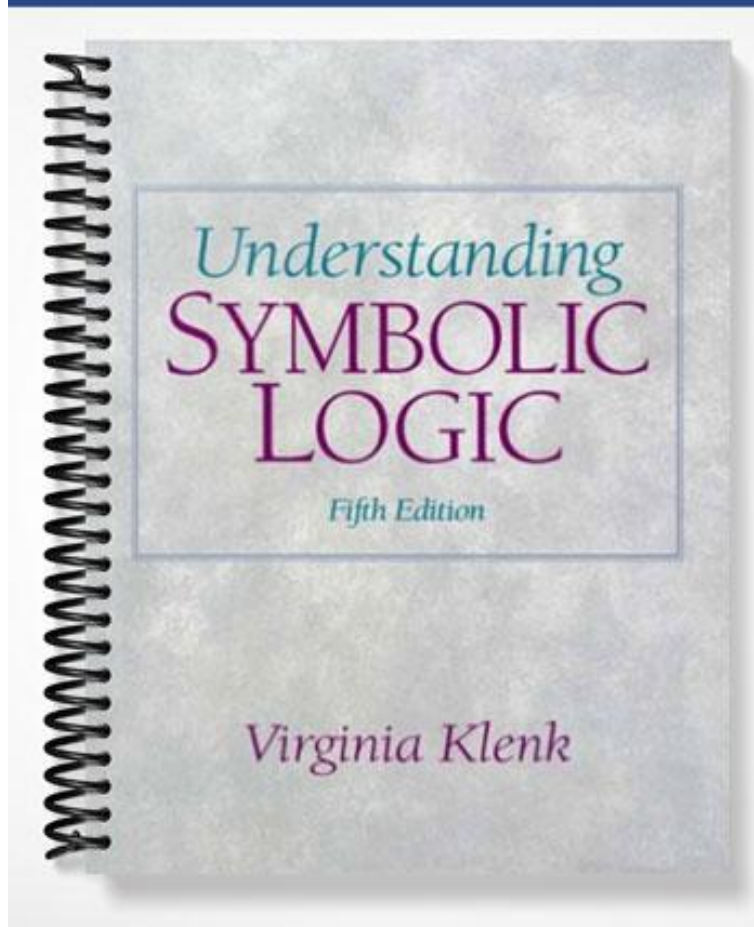


SOLUTIONS MANUAL



Answers to Exercises

Answers are provided here for problems whose answers are not given in the text, including all proofs. In general, of course, there will be any number of alternative proof constructions for more complex problems.

UNIT 1

1. b. Inductive argument. Premise: That crocodile hasn't eaten for two weeks. Conclusion: It is probably hungry.
- d. Not an argument.
- f. Inductive argument. Premises: Atmospheric carbon dioxide has increased substantially since 1800; It is known to have a "greenhouse" effect. Conclusion: It is likely that global warming is the result of burning fossil fuels.
- h. Deductive argument. Premises: It was 104° yesterday; The previous high was only 102°. Conclusion: Yesterday's heat broke a record.
- j. Deductive argument. Premises: Anyone who either insults their boss or can't use email properly deserves to be fired; I can't use email properly. Conclusion: I deserve to be fired.
- l. Deductive argument. Premises: If I live close to school I'll pay a lot in rent; If I don't live close to school I'll pay a lot for gas. Conclusion: I'll pay a lot for either rent or gas.
- n. Inductive argument. Premises: I got a speeding ticket; I was thrown in jail for evading an officer. Conclusion: My car insurance rates will probably go up.

UNIT 2

1. b. Compound; John enjoys a baseball game; John can have popcorn.
 - d. Compound; Dogs like bumblebees.
 - f. Simple
 - h. Compound; John was gaining weight.
 - j. Compound; John likes gooseberries; Mary likes gooseberries.
 - l. Compound; Life on Earth is doomed; Pollutants are reduced.
 - n. Compound; John lay down; John had a nap.
 - p. Simple
 - r. Simple
 - t. Compound; John will have to sink; John will have to swim; John's father stops supporting him.
-
2. b. Wedge
 - d. First wedge
 - f. First horseshoe
 - h. Horseshoe
 - j. Second dot
 - l. Last horseshoe
 - n. Fourth triple bar

UNIT 3

1. b. T d. F f. T h. T j. T l. T n. F p. T r. T t. T
2. b. T (both conjuncts are true, since A and B are true)
 d. T ($A \vee B$ is true, and since A is true, $(G \vee H) \supset A$ is true)
 f. T (since the antecedent, $(X \vee Y)$, is false)
 h. T (because $(X \supset Z)$ is true)
 j. T (since $\sim A$ is false, the conjunction is false, so the negated conjunction is true)
3. b. No. Since X is false, the value of $(X \vee G)$ depends on G, which we don't know.
 d. Yes. It is true; since A and B are both true, $(A \vee G)$ and $(B \vee H)$ are both true.
 f. No. $(G \cdot \sim G)$ will be false, but we need to know the value of H to determine the value of the horseshoe.
 h. No. Without knowing the value of H or G, we cannot determine the value of either $(H \equiv A)$ or $(G \equiv B)$.
 j. Yes. Since X is false, $(X \cdot G)$ is false, so $\sim(X \cdot G)$ is true.
4. b. Let 1) be " $2 + 2 = 5$ " and 2) be "The Universe was created five minutes ago." Both sentences are false, but "It is logically possible that 1)" is false, while "It is logically possible that 2)" is true.
 d. Let 1) be "Many cities are polluted" and 2) be "Smallpox has been eradicated." Both sentences are true, but "It is unfortunate that 1)" is true, while "It is unfortunate that 2)" is false.
 e. Let 1) be "The earth is nearly spherical" and 2) be "The numbers 26, 36, 7, 18, 31, and 39 were picked for the Power Ball lotto on May 22, 1993." Both sentences are true, but "It is likely that 1)" is true, while "It is likely that 2)" is false (since for any specific set of numbers, it is very unlikely that they will be selected on any given day.)

UNIT 4

1. b. $P \equiv$ Humans are descended from small primates.
 $G \equiv$ Humans are descended from great apes. $P \vee G$
 d. Not truth-functional; must be symbolized by a single letter.
 f. $H \equiv$ High-speed trains are developed.
 $D \equiv$ Automobile use will decrease. $(H \supset D)$
 h. Same as d.
 j. $V \equiv$ John drives his van.
 $C \equiv$ John is camping.
 $H \equiv$ John needs to haul large loads. $V \supset (C \vee H)$
 l. Same as d.
 n. $M \equiv$ John was married before Mary.
 $S \equiv$ John was married after Stephen. $(M \cdot S)$
 p. $J \equiv$ John wants to play pro football.
 $B \equiv$ Bob wants to play pro football.
 $A \equiv$ Andrew wants to play pro football. $((\sim J \cdot \sim B) \cdot \sim A)$ or $\sim((J \vee B) \vee A)$
 r. $T \equiv$ Ted will bring a cake with candles.
 $S \equiv$ Someone is having a birthday.
 $G \equiv$ Ted thinks that candles taste good for dessert.
 $\sim G \supset (\sim S \supset \sim T)$ or $(\sim G \cdot \sim S) \supset \sim T$ or $T \supset (G \vee S)$ or $\sim G \supset (T \supset S)$ or $T \supset (\sim G \supset S)$ (These are all equivalent.)

6 Answers to Exercises

- t. $D \equiv$ Ted will bring dessert.
 $S \equiv$ Ted will bring salad.
 $J \equiv$ John will bring salad.
 $W \equiv$ John will bring wine.
 $((D \vee S) \cdot \sim(D \cdot S)) \cdot ((J \vee W) \cdot \sim(J \cdot W))$
3. b. $L \supset M$
d. $L \equiv \sim W$
f. $\sim B \supset \sim L$ or $L \supset B$ or $B \vee \sim L$
h. $(L \vee W) \cdot \sim(L \cdot W)$
j. $M \supset (L \cdot \sim O)$
l. $\sim(O \vee L) \supset (J \cdot D)$ or $(J \cdot D) \vee (O \vee L)$
4. b. $(D \supset M) \cdot (E \supset \sim T)$
d. $\sim(L \vee P) \supset (M \supset E)$
f. $P \equiv (L \cdot \sim(D \vee E))$
h. $(\sim M \cdot \sim(S \vee R)) \supset (G \equiv \sim D)$
j. $\sim(P \vee L) \supset ((M \cdot \sim T) \supset (G \supset (D \vee E)))$ or $(\sim(P \vee L) \cdot (M \cdot \sim T) \cdot G) \supset (D \vee E)$
5. b. $\sim(N \vee K) \supset (U \vee B)$
d. $(P \supset (\sim T \cdot \sim E)) \cdot E$
f. $[P \cdot \sim(K \vee (N \vee U))] \supset (B \cdot F)$
h. $\sim(F \supset B) \cdot (\sim B \supset (\sim Q \cdot G))$
j. $(R \vee I) \supset [\sim(E \cdot T) \supset (P \cdot (B \cdot \sim(W \vee C)))]$
6. b. $(S \vee U) \supset (\sim E \cdot \sim R)$
d. $\sim C \supset (E \supset \sim R)$
f. $\sim R \supset (D \equiv (T \cdot \sim G))$
h. $\sim(J \vee H) \supset ((R \cdot \sim D) \supset (F \cdot \sim E))$
j. $(\sim U \cdot (H \vee A)) \supset \sim(F \vee S)$
l. $\sim((D \cdot E) \vee (\sim T \cdot \sim S)) \supset (F \cdot (R \vee U))$
n. $((J \cdot E) \supset (G \cdot \sim T)) \cdot ((D \supset (T \cdot \sim G)) \cdot (E \equiv D))$

UNIT 5

1. b. Invalid (3rd row)
d. Valid
f. Valid
h. Invalid (where p and r are F and q is T)
j. Invalid (where p and r are F and q is T)
l. Valid
n. Invalid (where p, q, and r are all F)
2. b. Invalid (where p = T, q = F, r = T)
e. Invalid (where p = T, q = F, r = F)
4. b. $A \supset \sim G, U \supset G, ((\sim U \vee P) \supset S) \cdot (S \supset R) \quad / \therefore \quad A \supset R$ Valid
d. $C \supset (E \cdot P), (E \vee F) \supset M, \sim(F \vee \sim P) \supset \sim H, M \equiv H \quad / \therefore \quad C \supset F$ Valid
f. $(F \supset C) \cdot (S \supset \sim C), S \supset (M \cdot O), \sim M \quad / \therefore \quad C$ Invalid
h. $(G \supset D) \cdot (D \supset M), (M \supset L) \cdot (L \supset \sim E), (\sim E \supset G) \quad / \therefore \quad G$ Invalid

j. $(B \supset R) \cdot (\sim B \supset L), (L \supset (P \cdot \sim E)) \cdot (\sim E \supset (T \cdot C)), (R \supset (S \cdot C)) \cdot (C \supset F) \quad / \therefore F$
Valid

i. $R \equiv (W \cdot \sim I), (I \supset \sim(P \vee C)), (W \supset C) \cdot (P \supset W) \quad / \therefore R \equiv C$ Invalid

UNIT 6

1. b. Contingent
d. Contingent
f. Contingent
2. b. Contingent
d. Tautology
f. Contradiction
4. b. Neither
6. b. $(S \supset F) \cdot \sim(R \vee F) \cdot S$ Contradictory
d. $\sim(R \vee F) \supset (F \supset L)$ Tautology
f. $(M \vee B) \cdot \sim(M \cdot A) \cdot \sim(B \cdot A)$ Contingent
h. $J \equiv (R \equiv \sim J)$ Contingent
j. $(L \equiv \sim P) \cdot \sim(L \vee P)$ Contradictory
7. b. 1) $I \supset W$ 2) $\sim I \supset \sim W$ Not equivalent; neither logically implies the other.
d. 1) $(P \cdot I) \supset \sim E$ 2) $E \supset (I \supset \sim P)$ The two are equivalent.
f. 1) $(T \equiv S) \supset \sim J$ 2) $\sim J \supset ((T \cdot \sim S) \vee (S \cdot \sim T))$ Neither implies the other.
h. 1) $(J \equiv B) \cdot (M \equiv \sim B)$ 2) $J \equiv \sim M$ Equivalent.
8. b. 1) $P \supset (\sim R \cdot S)$ 2) $S \equiv R$ 3) $(S \vee \sim R) \supset P$ Inconsistent set.
d. 1) $E \supset (P \cdot A)$ 2) $P \supset \sim E$ 3) $\sim E \supset \sim A$ Consistent.

UNIT 7

6. b. 1. $(T \vee W) \supset A$ Pr.
2. $C \supset \sim B$ Pr.
3. $A \supset C$ Pr.
4. $\sim \sim B$ Pr. / $\therefore \sim(T \vee W)$
5. $\sim C$ M.T. 2, 4
6. $\sim A$ M.T. 3, 5
7. $\sim(T \vee W)$ M.T. 1, 6
- d. 1. $\sim S \supset \sim T$ Pr.
2. $B \supset (X \vee Y)$ Pr.
3. $\sim T \supset B$ Pr.
4. $\sim S$ Pr. / $\therefore X \vee Y$
5. $\sim T$ M.P. 1, 4
6. B M.P. 3, 5
7. $X \vee Y$ M.P. 2, 6
- f. 1. $(A \cdot B) \supset (C \vee D)$ Pr.
2. $(B \cdot A) \supset (A \cdot B)$ Pr.
3. $(C \vee D) \supset (D \vee C)$ Pr. / $\therefore (B \cdot A) \supset (D \vee C)$

8 Answers to Exercises

- | | |
|--|-------------------------------------|
| 4. $(B \cdot A) \supset (C \vee D)$ | H.S. 1,2 |
| 5. $(B \cdot A) \supset (D \vee C)$ | H.S. 3,4 |
| h. | |
| 1. $(A \equiv B) \supset (B \supset A)$ | Pr. |
| 2. $(A \equiv \sim B) \supset \sim(B \supset A)$ | Pr. |
| 3. $(A \supset B) \supset (A \equiv \sim B)$ | Pr. |
| 4. $\sim\sim B \supset (A \supset B)$ | Pr. |
| 5. $B \supset \sim\sim B$ | Pr. |
| 6. B | Pr. / $\therefore \sim(A \equiv B)$ |
| 7. $\sim\sim B$ | M.P. 5,6 |
| 8. $A \supset B$ | M.P. 4,7 |
| 9. $A \equiv \sim B$ | M.P. 3,8 |
| 10. $\sim(B \supset A)$ | M.P. 2,9 |
| 11. $\sim(A \equiv B)$ | M.T. 1,10 |
| 7. a. | |
| 1. $(C \cdot D) \supset \sim F$ | Pr. |
| 2. $(A \supset C) \cdot (B \supset D)$ | Pr. |
| 3. $A \cdot B$ | Pr. / $\therefore \sim F$ |
| 4. A | Simp. 3 |
| 5. B | Simp. 3 |
| 6. $A \supset C$ | Simp. 2 |
| 7. $B \supset D$ | Simp. 2 |
| 8. C | M.P. 4,6 |
| 9. D | M.P. 5,7 |
| 10. $C \cdot D$ | Conj. 8,9 |
| 11. $\sim F$ | M.P. 1,10 |
| c. | |
| 1. $(A \cdot B) \supset (C \cdot D)$ | Pr. |
| 2. $(\sim F \supset B) \cdot (\sim X \supset A)$ | Pr. |
| 3. $(F \supset T) \cdot (X \supset S)$ | Pr. |
| 4. $\sim T \cdot \sim S$ | Pr. / $\therefore D$ |
| 5. $\sim T$ | Simp. 4 |
| 6. $\sim S$ | Simp. 4 |
| 7. $\sim F \supset B$ | Simp. 2 |
| 8. $\sim X \supset A$ | Simp. 2 |
| 9. $F \supset T$ | Simp. 3 |
| 10. $X \supset S$ | Simp. 3 |
| 11. $\sim F$ | M.T. 5,9 |
| 12. $\sim X$ | M.T. 6,10 |
| 13. A | M.P. 8,12 |
| 14. B | M.P. 7,11 |
| 15. $A \cdot B$ | Conj. 13,14 |
| 16. $C \cdot D$ | M.P. 1,15 |
| 17. D | Simp. 16 |
| d. | |
| 1. $(A \vee B) \supset (D \cdot C)$ | Pr. |
| 2. $\sim C \supset \sim(D \cdot C)$ | Pr. |
| 3. $\sim(A \vee B) \supset \sim A$ | Pr. |