I. For each of the following lists of premises, derive the conclusion and supply the justification for it. There is only one possible answer for each problem.

★(1) 1. $G \supset F$
2. $\sim F$
3. $\sim G$ MT

(2) 1. S
2. $S \supset M$
3. M MP

(3) 1. $R \supset D$
2. $E \supset R$
3. $E \supset D$ HS

★(4) 1. $B \lor C$
2. $\sim B$
3. C DS

(5) 1. N
2. $N \lor F$
3. $N \supset K$
4. K 1,3 MP

(6) 1. $\sim J \lor P$
2. $\sim J$
3. $S \supset J$
4. $\sim S$ 2,3 MT

★(7) 1. $H \supset D$
2. $F \supset T$
3. $F \supset H$
4. $F \supset D$ 1,3 HS

(8) 1. $S \supset W$
2. $\sim S$
3. $S \lor N$
4. N 2,3 DS

(9) 1. $F \supset \sim A$
2. $N \supset A$
3. $\sim F$
4. $\sim A$
5. $\sim N$ 2,4 MT

★(10) 1. $H \supset A$
2. A
3. $A \lor M$
4. $G \supset H$
5. $G \supset A$ 1,4 HS

(11) 1. $W \lor B$
2. W
3. $B \supset T$
4. $W \supset A$
5. A 2,4 MP

(12) 1. $K \supset \sim R$
2. $\sim R$
3. $R \lor S$
4. $R \supset T$
5. S 2,3 DS

★(13) 1. $\sim C \supset \sim F$
2. $L \supset F$
3. $\sim \sim F$
4. $F \lor \sim L$
5. $\sim \sim C$ 1,3 MT

(14) 1. $N \supset \sim E$
2. $\sim \sim S$
3. $\sim E \lor \sim S$
4. $\sim S \lor N$
5. N 2,4 DS

(15) 1. $\sim R \supset \sim T$
2. $\sim T \lor B$
3. $C \supset \sim R$
4. $\sim C$
5. $C \supset \sim T$ 1,3 HS

★(16) 1. $\sim K$
2. $\sim K \supset \sim P$
3. $\sim K \lor G$
4. $G \supset Q$
5. $\sim P$ 2, MP

(17) 1. $F \lor (A \supset C)$
2. $A \lor (C \supset F)$
3. A
4. $\sim F$
5. $A \supset C$ 1,4 DS

(18) 1. $(R \supset M) \supset D$
2. $M \supset C$
3. $D \supset (M \lor E)$
4. $\sim M$
5. $(R \supset M) \supset (M \lor E)$ 1,3 HS

★(19) 1. $(S \lor C) \supset L$
2. $\sim S$
3. $\sim L$
4. $S \supset (K \supset L)$
5. $\sim (S \lor C)$ 1,3 MT

(20) 1. $(A \lor W) \supset (N \supset Q)$
2. $Q \supset G$
3. $\sim A$
4. $(Q \supset G) \supset (A \lor N)$
5. $A \lor N$ 2,4 MP

II. The following symbolized arguments are missing a premise. Write the premise needed to derive the conclusion (last line), and supply the justification for the conclusion. Try to construct the simplest premise needed to derive the conclusion.

★(1) 1. $B \lor K$
2. $\sim B$
3. K 1,2 DS

(2) 1. $N \supset S$
2. N
3. S MP 1,2

(3) 1. $K \supset T$
2. $\sim T$
3. $\sim K$ 1,2 MT

★(4) 1. $C \supset H$
2. $R \supset C$
3. $R \supset H$ 1,2 HS

(5) 1. $F \supset N$
2. $N \supset T$
3. $\sim N$
4. $\sim F$ 1,3 MT

(6) 1. $W \lor T$
2. $A \supset W$
3. $W \supset T$
4. $A \supset T$ 2,3 HS

★(7) 1. $M \supset B$
2. $Q \supset M$
3. Q
4. M 2,3 MP

(8) 1. $C \lor L$
2. $L \supset T$
3. $\sim C$
4. L 1,3 DS

(9) 1. $E \supset N$
2. $T \lor \sim E$
3. $S \supset E$
4. S
5. E 3,4 MP

★(10) 1. $H \supset A$
2. $S \supset H$
3. $\sim M \lor H$
4. $\sim A$
5. $\sim H$ 1,4 MT

(11) 1. $T \supset N$
2. $G \supset T$
3. $H \lor T$
4. $F \supset G$
5. $F \supset T$ 2,4 HS

(12) 1. $G \supset C$
2. $M \lor G$
3. $T \lor \sim G$
4. $\sim M$
5. G 2,4 DS

★(13) 1. $\sim S \supset \sim B$
2. $R \lor \sim B$
3. $\sim B \supset \sim S$
4. $\sim \sim S$
5. $\sim \sim B$ 3,4 MT

(14) 1. $\sim R \supset D$
2. $\sim J \supset \sim R$
3. $N \lor \sim R$
4. $\sim F \supset \sim J$
5. $\sim F \supset \sim R$ 2,4 HS

7

(15) 1. $\sim S \lor \sim P$
2. $\sim K \supset P$
3. $\sim P \supset F$
4. $\sim \sim S$
5. $\sim P$ 1,4 DS

★(16) 1. $J \supset E$
2. $B \lor \sim J$
3. $\sim Z \supset J$
4. $\sim Z$
5. J 3,4 MP

(17) 1. $(H \supset C) \supset A$
2. $N \supset (F \supset K)$
3. $(E \cdot R) \supset K$
4. $H \supset (E \cdot R)$
5. $H \supset K$ 3,4 HS

(18) 1. $(S \supset M) \supset G$
2. $S \supset (M \cdot G)$
3. $G \supset (R \supset \sim S)$
4. $\sim (M \cdot G)$
5. $\sim S$ 2,4 MT

★(19) 1. $(W \lor \sim F) \supset H$
2. $(H \lor G) \supset \sim F$
3. $T \supset (F \supset G)$
4. $H \lor G$
5. $\sim F$ 2,4 MP

(20) 1. $(H \cdot A) \lor T$
2. $\sim S \supset (P \supset T)$
3. $(N \lor T) \supset P$
4. $\sim (H \cdot A)$
5. T 1,4 DS

III. Use the first four rules of inference to derive the conclusions of the following symbolized arguments.

★(1) 1. $\sim C \supset (A \supset C)$
2. $\sim C$ / $\sim A$

(2) 1. $F \lor (D \supset T)$
2. $\sim F$
3. D / T

(3) 1. $(K \cdot B) \lor (L \supset E)$
2. $\sim (K \cdot B)$
3. $\sim E$ / $\sim L$

★(4) 1. $P \supset (G \supset T)$
2. $Q \supset (T \supset E)$
3. P
4. Q / $G \supset E$

(5) 1. $\sim W \supset [\sim W \supset (X \supset W)]$
2. $\sim W$ / $\sim X$

(6) 1. $J \supset (K \supset L)$
2. $L \lor J$
3. $\sim L$ / $\sim K$

★(7) 1. $\sim S \supset D$
2. $\sim S \lor (\sim D \supset K)$
3. $\sim D$ / K

(8) 1. $A \supset (E \supset \sim F)$
2. $H \lor (\sim F \supset M)$
3. A
4. $\sim H$ / $E \supset M$

(9) 1. $\sim G \supset (G \lor \sim A)$
2. $\sim A \supset (C \supset A)$
3. $\sim G$ / $\sim C$

★(10) 1. $N \supset (J \supset P)$
2. $(J \supset P) \supset (N \supset J)$
3. N / P

(11) 1. $G \supset [\sim O \supset (G \supset D)]$
2. $O \lor G$
3. $\sim O$ / D

(12) 1. $\sim M \lor (B \lor \sim T)$
2. $B \supset W$
3. $\sim \sim M$
4. $\sim W$ / $\sim T$

★(13) 1. $R \supset (G \lor \sim A)$
2. $(G \lor \sim A) \supset \sim S$
3. $G \supset S$
4. R / $\sim A$

(14) 1. $(L \equiv N) \supset C$
2. $(L \equiv N) \lor (P \supset \sim E)$
3. $\sim E \supset C$
4. $\sim C$ / $\sim P$

(15) 1. $\sim J \supset [\sim A \supset (D \supset A)]$
2. $J \lor \sim A$
3. $\sim J$ / $\sim D$

Strategy 7: If the conclusion is a conjunctive statement, consider obtaining it via conjunction by first obtaining the individual conjuncts:

1. $A \supset C$
2. B
3. $\sim C$ / $B \cdot \sim C$
4. $B \cdot \sim C$ 2, 3, Conj

Strategy 8: If the conclusion is a disjunctive statement, consider obtaining it via constructive dilemma or addition:

1. $(A \supset B) \cdot (C \supset D)$
2. $B \supset C$
3. $A \vee C$ / $B \vee D$
4. $B \vee D$ 1, 3, CD

1. $A \vee C$
2. B
3. $C \supset D$ / $B \vee D$
4. $B \vee D$ 2, Add

Strategy 9: If the conclusion contains a letter not found in the premises, addition *must* be used to introduce that letter.

Strategy 10: Conjunction can be used to set up constructive dilemma:

1. $A \supset B$
2. $C \supset D$
3. $A \vee C$ / $B \vee D$
4. $(A \supset B) \cdot (C \supset D)$ 1, 2, Conj
5. $B \vee D$ 3, 4, CD

EXERCISE 7.2

I. For each of the following lists of premises, derive the indicated conclusion and complete the justification. In problems 4 and 8 you can add any statement you choose.

★(1) 1. $S \vee H$
     2. $B \cdot E$
     3. $R \supset G$
     4. __B__ ___2___, Simp

(2) 1. $(N \supset T) \cdot (F \supset Q)$
     2. $(N \supset R) \vee (F \supset M)$
     3. $N \vee F$
     4. __$T \vee Q$__ ___1,3___, CD

(3) 1. D
     2. W
     3. __$D \cdot W$__ ___1,3___, Conj

★(4) 1. H
     2. __$H \vee X$__ ___1___, Add

(5) 1. $R \cdot (N \vee K)$
     2. $(G \cdot T) \vee S$
     3. $(Q \cdot C) \supset (J \cdot L)$
     4. __R__ ___1___, Simp

(6) 1. $\sim R \vee P$
2. $(P \supset \sim D) \cdot (\sim R \supset S)$
3. $(\sim R \supset A) \cdot (P \supset \sim N)$
4. $\underline{A \vee \sim N}$ 1,3 , CD

★(7) 1. $(Q \vee K) \cdot \sim B$
2. $(M \cdot R) \supset D$
3. $(W \cdot S) \vee (G \cdot F)$
4. $\underline{Q \vee K}$ 1 , Simp

(8) 1. $E \cdot G$
2. $\underline{(E \cdot G) \vee X}$ 1 , Add

(9) 1. $\sim B$
2. $F \vee N$ 1,2
3. $\sim B \cdot (F \vee N)$, Conj

★(10) 1. $S \vee \sim C$
2. $(S \supset \sim L) \cdot (\sim C \supset M)$
3. $(\sim N \supset S) \cdot (F \supset \sim C)$
4. $\underline{\sim L \vee M}$ 1,2 , CD

II. In the following symbolized arguments, derive the line needed to obtain the conclusion (last line), and supply the justification for both lines.

★(1) 1. $G \supset N$
2. $G \cdot K$
3. $\underline{G}$ 2 Simp
4. $G \vee T$ 3 Add

(2) 1. $\sim A$
2. $A \vee E$
3. $\underline{E}$ 1,2 DS
4. $\sim A \cdot E$ 1,3 Conj

(3) 1. $B \supset N$
2. $B \vee K$
3. $K \supset R$
4. $(B \supset N) \cdot (K \supset R)$ 1,3 Conj
5. $N \vee R$ 2,4 CD

★(4) 1. T
2. $T \supset G$
3. $(T \vee U) \supset H$
4. $\underline{T \vee U}$ 1 add
5. H 3,4 MP

(5) 1. $S \supset E$
2. $E \vee (S \cdot P)$
3. $\sim E$
4. $\underline{S \cdot P}$ 2,3 DS
5. S 4 Simp

(6) 1. N
2. $N \supset F$
3. $(N \supset A) \cdot (F \supset C)$
4. $\underline{N \vee F}$ 1, Add
5. $A \vee C$ 3,4 CD

★(7) 1. J
2. $\sim L$
3. $F \supset L$
4. $\underline{\sim F}$ 2,3 MT
5. $\sim F \cdot J$ 1,4 Conj

(8) 1. $(E \supset B) \cdot (Q \supset N)$
2. $K \supset E$
3. $B \supset K$
4. $\underline{E \supset B}$ 1, Simp
5. $E \supset K$ 3,4 HS

(9) 1. $G \vee N$
2. $\sim G$
3. $\sim G \supset (H \cdot R)$
4. $\underline{H \cdot R}$ 2,3 MP
5. H 4 Simp

★(10) 1. M
2. $(M \cdot E) \supset D$
3. E
4. $\underline{M \cdot E}$ 1,3 Conj
5. D 2,4 MP

Strategy 14: Distribution can be used in two ways to set up disjunctive syllogism:

1. $(A \lor B) \cdot (A \lor C)$
2. $\sim A$
3. $A \lor (B \cdot C)$ 1, Dist
4. $B \cdot C$ 2, 3, DS

1. $A \cdot (B \lor C)$
2. $\sim(A \cdot B)$
3. $(A \cdot B) \lor (A \cdot C)$ 1, Dist
4. $A \cdot C$ 2, 3, DS

Strategy 15: Distribution can be used in two ways to set up simplification:

1. $A \lor (B \cdot C)$
2. $(A \lor B) \cdot (A \lor C)$ 1, Dist
3. $A \lor B$ 2, Simp

1. $(A \cdot B) \lor (A \cdot C)$
2. $A \cdot (B \lor C)$ 1, Dist
3. A 2, Simp

Strategy 16: If inspection of the premises does not reveal how the conclusion should be derived, consider using the rules of replacement to deconstruct the conclusion. (See the final example in this section.)

7

RCISE 7.3

I. For each of the following lists of premises, derive the indicated conclusion and complete the justification. For double negation, avoid the occurrence of triple tildes. Exercise 6 has two possible answers.

★(1) 1. $\sim(E \supset H)$
     2. $\sim(N \lor G)$
     3. $\sim A \lor D$
     4. $\underline{\sim N \cdot \sim G}$ **2**, DM

(2) 1. $G \supset (N \supset K)$
     2. $R \lor (D \supset F)$
     3. $S \cdot (T \lor U)$
     4. $\underline{(S \cdot T) \lor (S \cdot U)}$ **3**, Dist

(3) 1. $M \lor (G \lor T)$
     2. $P \cdot (S \supset N)$
     3. $D \cdot (R \lor K)$
     4. $\underline{(M \lor G) \lor T}$ **1**, Assoc

★(4) 1. $B \supset W$
     2. $G \equiv F$
     3. $S \cdot A$
     4. $\underline{A \cdot S}$ **3**, Com

(5) 1. $\sim\sim R \lor T$
    2. $\sim N \lor \sim B$
    3. $\sim A \supset \sim H$
    4. <u>$R \lor T$</u>   <u>1</u>, DN

(6) 1. $(F \lor N) \supset (K \cdot D)$
    2. $(H \cdot Z) \lor (H \cdot W)$
    3. $(P \supset H) \lor (P \supset N)$
    4. <u>$H \cdot (Z \lor W)$</u>   <u>2</u>, Dist

★(7) 1. $\sim(G \cdot \sim Q)$
    2. $\sim(K \equiv \sim B)$
    3. $\sim T \supset \sim F$
    4. <u>$\sim G \lor \sim\sim Q$</u>   <u>1</u>, DM

(8) 1. $G \supset (\sim L \supset T)$
    2. $L \equiv (\sim R \supset \sim C)$
    3. $J \supset (S \lor \sim N)$
    4. <u>$J \supset (\sim N \lor S)$</u>   <u>3</u>, Com

(9) 1. $S \supset (M \supset D)$
    2. $(K \cdot G) \lor B$
    3. $(E \cdot H) \cdot Q$
    4. <u>$E \cdot (H \cdot Q)$</u>   <u>3</u>, Assoc

★(10) 1. $\sim R \lor \sim P$
    2. $\sim F \supset \sim W$
    3. $G \cdot \sim A$
    4. <u>$\sim(R \cdot P)$</u>   <u>1</u>, DM

(11) 1. $\sim B \lor E$
    2. $\sim E \cdot \sim A$
    3. $\sim C \supset \sim R$
    4. <u>$\sim B \lor \sim\sim E$</u>   <u>1</u>, DN

(12) 1. $\sim G \cdot (S \supset A)$
    2. $\sim S \supset (B \cdot K)$
    3. $\sim Q \lor (T \cdot R)$
    4. <u>$(\sim Q \lor T) \cdot (\sim Q \lor R)$</u>   <u>3</u>, Dist

★(13) 1. $F \supset (\sim S \lor M)$
    2. $H \supset (\sim L \cdot \sim D)$
    3. $N \supset (\sim G \supset \sim C)$
    4. _____   <u>2</u>, DM $H \supset \sim(L \lor D)$

(14) 1. $F \supset (P \supset \sim E)$
    2. $C \lor (S \cdot \sim B)$
    3. $M \cdot (R \cdot \sim T)$
    4. _____   <u>3</u>, Assoc $(M \cdot R) \cdot \sim T$

(15) 1. $(D \vee \sim K) \cdot (D \vee \sim W)$
   2. $(S \vee \sim Z) \vee (P \vee \sim T)$
   3. $(Q \supset \sim N) \cdot (Q \supset \sim F)$
   4. _____ _1_, Dist $D \vee (\sim K \cdot \sim W)$

II. In the following symbolized arguments, derive the line needed to obtain the conclusion (last line), and supply the justification for both lines.

★(1) 1. $K \vee C$
   2. $\sim C$
   3. $C \vee K$ 1 Com
   4. K 2,3 DS

(2) 1. $G \supset (R \vee N)$
   2. $\sim R \cdot \sim N$
   3. $\sim (R \vee N)$ 2 DM
   4. $\sim G$ 4,3 MT

(3) 1. $H \cdot T$
   2. $T \cdot H$ 1 Com
   3. T 2 Simp

★(4) 1. $(L \cdot S) \cdot F$
   2. $L \cdot (S \cdot F)$ 1 Assoc
   3. L 2 Simp

(5) 1. $\sim B \vee K$
   2. $\sim B \vee \sim \sim K$ 1 DN
   3. $\sim (B \cdot \sim K)$ 2 DM

(6) 1. $C \supset \sim A$
   2. A
   3. $\sim \sim A$ 2 DN
   4. $\sim C$ 4,3 MT

★(7) 1. $(D \cdot M) \vee (D \cdot N)$
   2. $D \cdot (M \vee N)$ 1 Distr
   3. D 2 Simp

(8) 1. $(U \vee T) \supset R$
   2. $T \vee U$
   3. $U \vee T$ 2 Com
   4. R 4,3 MP

(9) 1. $\sim L \vee M$
   2. L
   3. $\sim \sim L$ 2 DN
   4. M 2,3 DS

★(10) 1. $D \vee (N \cdot H)$
   2. $(D \vee N) \cdot (D \vee H)$ 1, Distr
   3. $D \vee N$ 2 Simp

(11) 1. $(K \vee E) \cdot (K \vee G)$
   2. $\sim K$
   3. $K \vee (E \cdot G)$ 1 Distr
   4. $E \cdot G$ 2,3 DS

(12) 1. $(N \supset T) \cdot (F \supset Q)$
   2. $F \vee N$
   3. $N \vee F$ 2 Com
   4. $T \vee Q$ 4,3 CD

★(13) 1. $(M \vee G) \vee T$
   2. $\sim M$
   3. $M \vee (G \vee T)$ 1 Assoc
   4. $G \vee T$ 2,3 DS

(14) 1. $(\sim A \supset T) \cdot (\sim S \supset K)$
   2. $\sim (A \cdot S)$
   3. $\sim A \vee \sim S$ 2 DM
   4. $T \vee K$ 1,3 CD

(15) 1. $\sim R$
   2. $\sim R \vee \sim T$ 1, Add
   3. $\sim (R \cdot T)$ 2 DM

III. Use the first thirteen rules of inference to derive the conclusions of the following symbolized arguments:

★(1) 1. $(\sim M \supset P) \cdot (\sim N \supset Q)$
   2. $\sim (M \cdot N)$ / $P \vee Q$

(2) 1. $\sim S$ / $\sim (F \cdot S)$

(3) 1. $J \vee (K \cdot L)$
   2. $\sim K$ / J

★(4) 1. $\sim (N \cdot T)$
   2. T / $\sim N$

(5) 1. $H \supset \sim A$
   2. A / $\sim (H \vee \sim A)$

Strategy 22: Transposition can be used to set up constructive dilemma:

1. $(A \supset B) \cdot (C \supset D)$
2. $\sim B \vee \sim D$
3. $(\sim B \supset \sim A) \cdot (C \supset D)$ 1, Trans
4. $(\sim B \supset \sim A) \cdot (\sim D \supset \sim C)$ 3, Trans
5. $\sim A \vee \sim C$ 2, 4, CD

Strategy 23: Constructive dilemma can be used to set up tautology:

1. $(A \supset C) \cdot (B \supset C)$
2. $A \vee B$
3. $C \vee C$ 1, 2, CD
4. C 3, Taut

Strategy 24: Material implication can be used to set up tautology:

1. $A \supset \sim A$
2. $\sim A \vee \sim A$ 1, Impl
3. $\sim A$ 2, Taut

Strategy 25: Material implication can be used to set up distribution:

1. $A \supset (B \cdot C)$
2. $\sim A \vee (B \cdot C)$ 1, Impl
3. $(\sim A \vee B) \cdot (\sim A \vee C)$ 2, Dist

7

EXERCISE 7.4

I. For each of the following lists of premises, derive the indicated conclusion and complete the justification. For tautology, derive a conclusion that is simpler than the premise.

★(1) 1. $H \vee F$
     2. $N \vee \sim S$
     3. $\sim G \vee Q$
     4. $G \supset Q$ 3, Impl

(2) 1. $R \supset (S \supset N)$
     2. $T \supset (U \vee M)$
     3. $K \cdot (I \supset W)$
     4. $(R \cdot S) \supset N$ 1, Exp

(3) 1. $G \equiv R$
     2. $H \supset P$
     3. $\sim F \vee T$
     4. $\sim P \supset \sim H$ 2, Trans

★(4) 1. $(B \supset N) \cdot (N \supset B)$
     2. $(R \vee F) \cdot (F \vee R)$
     3. $(K \supset C) \vee (C \supset K)$
     4. $B \equiv N$ 1, Equiv

(5) 1. $E \lor \sim E$
    2. $A \lor A$
    3. $G \cdot \sim G$
    4. <u> **A**   **2** </u>, Taut

(6) 1. $S \lor \sim M$
    2. $\sim N \cdot \sim T$
    3. $\sim L \supset Q$
    4. <u>$\sim Q \supset \sim L$ **3** </u>, Trans

★(7) 1. $\sim C \supset \sim F$
    2. $D \lor \sim P$
    3. $\sim R \cdot Q$
    4. <u>$D \supset \sim P$ **2** </u>, Impl

(8) 1. $E \supset (R \cdot Q)$
    2. $(G \cdot N) \supset Z$
    3. $(S \supset M) \supset P$
    4. <u>$G \supset (N \supset Z)$ **2** </u>, Exp

(9) 1. $(D \cdot H) \lor (\sim D \cdot \sim H)$
    2. $(F \supset J) \cdot (\sim F \supset \sim J)$
    3. $(N \lor T) \cdot (\sim N \lor \sim T)$
    4. <u> $N \equiv T$ **3** </u>, Equiv

★(10) 1. $L \supset (A \supset A)$
    2. $K \supset (R \lor \sim R)$
    3. $S \supset (G \cdot G)$
    4. <u>$S \supset G$ **3** </u>, Taut

(11) 1. $K \cdot (S \lor B)$
    2. $\sim F \supset \sim J$
    3. $\sim E \lor \sim M$
    4. <u>$J \supset F$ **2** </u>, Trans

(12) 1. $H \supset (K \cdot J)$
    2. $(N \lor E) \supset B$
    3. $C \supset (H \supset A)$
    4. <u>$(C \cdot H) \supset A$ **3** </u>, Exp

★(13) 1. $(A \supset \sim C) \cdot (C \supset \sim A)$
    2. $(W \supset \sim T) \cdot (\sim T \supset W)$
    3. $(M \supset \sim E) \cdot (\sim M \supset E)$
    4. <u> $W \equiv \sim T$ **2** </u>, Equiv

(14) 1. $(\sim K \lor M) \equiv S$
    2. $T \lor (F \cdot G)$
    3. $R \equiv (N \cdot \sim H)$
    4. <u>$(K \supset M) \equiv S$ **1** </u>, Impl

(15) 1. $(S \lor S) \supset D$
    2. $K \supset (T \cdot \sim T)$
    3. $(Q \supset Q) \supset M$
    4. <u>$S \supset D$ **1** </u>, Taut

II. In the following symbolized arguments, derive the line needed to obtain the conclusion (last line), and supply the justification for both lines.

★(1) 1. ~J ∨ M
2. M ⊃ B
3. J ⊃ M   1 Impl
4. J ⊃ B   2,3 HS

(2) 1. (J • F) ⊃ N
2. J
3. J ⊃ (F ⊃ N)   1, Exp
4. F ⊃ N   2,3 MP

(3) 1. C ⊃ A
2. A ⊃ C
3. (C ⊃ A) • (A ⊃ C)   1,2 Conj
4. C ≡ A   3 Equiv

★(4) 1. (G ⊃ K) • (T ⊃ K)
2. G ∨ T
3. K ∨ K   1,2 CD
4. K   3 Taut

(5) 1. (G ⊃ B) • (~C ⊃ ~H)
2. G ∨ H
3. (G ⊃ B) • (H ⊃ C)   1 Trans
4. B ∨ C   2,3 CD

(6) 1. J ⊃ (M ⊃ Q)
2. J • M
3. (J • M) ⊃ Q   1 Trans
4. Q   2,3 MP

★(7) 1. H ⊃ (~C ∨ R)
2. H ⊃ (C ⊃ R)   1 Exp
3. (H • C) ⊃ R   2 Trans

(8) 1. ~G ⊃ ~T
2. G ⊃ N
3. T ⊃ G   1, Trans
4. T ⊃ N   2,3 HS

(9) 1. K ⊃ (A ⊃ F)
2. ~F
3. (K • A) ⊃ F   1 Exp
4. ~(K • A)   2,3,4 MT

★(10) 1. H ⊃ ~H
2. ~H ∨ ~H   1 Impl
3. ~H   2 Taut

(11) 1. ~S
2. ~S ∨ K   1 Add
3. S ⊃ K   2 Impl

(12) 1. M ⊃ (M ⊃ D)
2. (M • M) ⊃ D   1 Exp
3. M ⊃ D   2 Taut

★(13) 1. (N ⊃ A) • (~N ⊃ ~A)
2. (N ⊃ A) • (A ⊃ N)   1 Trans
3. N ≡ A   2 Equiv

(14) 1. E • R
2. (E • R) ∨ (~E • ~R)   1 Add
3. E ≡ R   2 Equiv

(15) 1. Q ⊃ (~W ⊃ ~G)
2. Q ⊃ (G ⊃ W)   1, Trans
3. (Q • G) ⊃ W   2 Exp

III. Use the eighteen rules of inference to derive the conclusions of the following symbolized arguments.

★(1) 1. (S • K) ⊃ R
2. K   / S ⊃ R

(2) 1. T ⊃ (F ∨ F)
2. ~(F • F)   / ~T

(3) 1. G ⊃ E
2. H ⊃ ~E   / G ⊃ ~H

★(4) 1. S ≡ Q
2. ~S   / ~Q

(5) 1. ~N ∨ P
2. (N ⊃ P) ⊃ T   / T

7