

Class 15 - September 30
Practice with Proofs (§7.1 - §7.4)

1. 1. $A \supset B$
 2. $(E \vee D) \supset \sim B$ / $A \supset (\sim E \cdot \sim D)$
2. 1. $\sim(G \cdot H) \supset I$
 2. $\sim(I \vee J)$
 3. $\sim J \supset F$ / $(F \cdot G) \cdot H$
3. 1. $P \vee O$
 2. $Q \supset \sim O$ / $\sim Q \vee P$
4. 1. $T \equiv V$
 2. $\sim T \vee \sim V$ / $\sim T$
5. 1. $(K \supset \sim M) \cdot [(L \cdot N) \supset \sim M]$
 2. $(K \vee L) \cdot (K \vee N)$ / $\sim M$
6. 1. $(X \vee Y) \cdot (Z \supset W)$
 2. $\sim(Y \cdot W)$ / $\sim(\sim X \cdot Z)$
7. 1. $X \vee Z$
 2. $Z \supset \sim Y$
 3. $X \supset Y$ / $\sim X \equiv Z$
8. 1. $A \supset B$
 2. $B \supset \sim A$
 3. $(A \vee D) \vee E$
 4. $(D \vee E) \supset F$ / F
9. 1. $G \supset (H \supset I)$
 2. $I \supset (J \cdot K)$ / $G \supset (H \supset J)$
10. 1. $(\sim L \vee M) \cdot (L \vee N)$
 2. $\sim O \supset \sim N$ / $M \vee O$
11. 1. $(P \supset Q) \cdot (R \supset S)$ / $(P \cdot R) \supset (Q \cdot S)$
12. 1. $(T \supset W) \cdot (X \supset Y)$
 2. $T \vee X$
 3. $(T \supset \sim Y) \cdot (X \supset \sim W)$
 4. $(W \cdot \sim Y) \supset Z$
 5. $Y \supset (W \vee A)$ / $Z \vee A$

Sample Solutions

1.
 1. $A \supset B$
 2. $(E \vee D) \supset \sim B$ $/A \supset (\sim E \cdot \sim D)$
 3. $B \supset \sim(E \vee D)$ 2, Trans, DN
 4. $A \supset \sim(E \vee D)$ 1, 3, HS
 5. $A \supset (\sim E \cdot \sim D)$ 4, DM

QED

2.
 1. $\sim(G \cdot H) \supset I$
 2. $\sim(I \vee J)$
 3. $\sim J \supset F$ $/(F \cdot G) \cdot H$
 4. $\sim I \cdot \sim J$ 2, DM
 5. $\sim I$ 4, Simp
 6. $G \cdot H$ 1, 5, MT, DN
 7. $\sim J$ 4, Com, Simp
 8. F 3, 7, MP
 9. $F \cdot (G \cdot H)$ 8, 6, Conj
 10. $(F \cdot G) \cdot H$ 9, Assoc

QED

3.
 1. $P \vee O$
 2. $Q \supset \sim O$ $/\sim Q \vee P$
 3. $\sim O \supset P$ 1, Com, DN, Impl
 4. $Q \supset P$ 2, 3, HS
 5. $\sim Q \supset P$ 4, Impl

QED

4.
 1. $T \equiv V$
 2. $\sim T \vee \sim V$ $/\sim T$
 3. $(T \cdot V) \vee (\sim T \cdot \sim V)$ 1, Equiv
 4. $\sim(T \cdot V)$ 2, DM
 5. $\sim T \cdot \sim V$ 3, 4, DS
 6. $\sim T$ 5, Simp

QED

5.
 1. $(K \supset \sim M) \cdot [(L \cdot N) \supset \sim M]$
 2. $(K \vee L) \cdot (K \vee N)$ $/\sim M$
 3. $K \vee (L \cdot N)$ 2, Dist
 4. $\sim M \vee \sim M$ 1, 3, CD
 5. $\sim M$ 4, Taut

QED

- 6.
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|---|-------------------------|
| 1. $(X \vee Y) \cdot (Z \supset W)$ | |
| 2. $\sim(Y \cdot W)$ | $/\sim(\sim X \cdot Z)$ |
| 3. $\sim Y \vee \sim W$ | 2, DM |
| 4. $(Y \vee X) \cdot (Z \supset W)$ | 1, Com |
| 5. $(\sim Y \supset X) \cdot (Z \supset W)$ | 4, DN, Impl |
| 6. $(\sim Y \supset X) \cdot (\sim W \supset \sim Z)$ | 5, Trans |
| 7. $X \vee \sim Z$ | 6, 3, CD |
| 8. $\sim\sim(X \vee \sim Z)$ | 7, DN |
| 9. $\sim(\sim X \cdot Z)$ | 8, DM, DN |

QED

- 7.
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|--|--------------------|
| 1. $X \vee Z$ | |
| 2. $Z \supset \sim Y$ | |
| 3. $X \supset Y$ | $/\sim X \equiv Z$ |
| 4. $\sim Y \supset \sim X$ | 3, Trans |
| 5. $Z \supset \sim X$ | 2, 4, HS |
| 6. $\sim X \supset Z$ | 1, DN, Impl |
| 7. $(\sim X \supset Z) \cdot (Z \supset \sim X)$ | 6, 5, Conj |
| 8. $\sim X \equiv Z$ | 7, Equiv |

QED

- 8.
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|--------------------------------|-------------|
| 1. $A \supset B$ | |
| 2. $B \supset \sim A$ | |
| 3. $(A \vee D) \vee E$ | |
| 4. $(D \vee E) \supset F$ | $/F$ |
| 5. $A \supset \sim A$ | 1, 2, HS |
| 6. $\sim A \vee \sim A$ | 5, Impl |
| 7. $\sim A$ | 6, Taut |
| 8. $A \vee (D \vee E)$ | 3, Assoc |
| 9. $\sim A \supset (D \vee E)$ | 8, Dn, Impl |
| 10. $D \vee E$ | 9, 7, MP |
| 11. F | 4, 10, MP |

QED

- 9.
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|--|----------------------------|
| 1. $G \supset (H \supset I)$ | |
| 2. $I \supset (J \cdot K)$ | $/G \supset (H \supset J)$ |
| 3. $(G \cdot H) \supset I$ | 1, Exp |
| 4. $\sim I \vee (J \cdot K)$ | 2, Impl |
| 5. $(\sim I \vee J) \cdot (\sim I \vee K)$ | 4, Dist |
| 6. $\sim I \vee J$ | 5, Simp |
| 7. $I \supset J$ | 6, Impl |
| 8. $(G \cdot H) \supset J$ | 3, 7, HS |
| 9. $G \supset (H \supset J)$ | 8, Impl |

QED

10. 1. $(\sim L \vee M) \cdot (L \vee N)$
 2. $\sim O \supset \sim N$ / $M \vee O$
 3. $\sim L \vee M$ 1, Simp
 4. $L \supset M$ 3, Impl
 5. $\sim M \supset \sim L$ 4, Trans
 6. $L \vee N$ 1, Com, Simp
 7. $\sim L \supset N$ 6, DN, Impl
 8. $\sim M \supset N$ 5, 7, HS
 9. $N \supset O$ 2, Trans
 10. $\sim M \supset O$ 8, 9, HS
 11. $M \vee O$ 10, Impl, DN

QED

11. 1. $(P \supset Q) \cdot (R \supset S)$ / $(P \cdot R) \supset (Q \cdot S)$
 2. $P \supset Q$ 1, Simp
 3. $\sim P \vee Q$ 2, Impl
 4. $(\sim P \vee Q) \vee \sim R$ 3, Add
 5. $\sim P \vee (Q \vee \sim R)$ 4, Assoc
 6. $R \supset S$ 1, Com, Simp
 7. $\sim R \vee S$ 6, Impl
 8. $\sim P \vee (\sim R \vee S)$ 7, Add, Com
 9. $[\sim P \vee (Q \vee \sim R)] \cdot [\sim P \vee (\sim R \vee S)]$ 5, 8, Conj
 10. $\sim P \vee [(Q \vee \sim R) \cdot (\sim R \vee S)]$ 9, Dist
 11. $\sim P \vee [(\sim R \vee Q) \cdot (\sim R \vee S)]$ 10, Com
 12. $\sim P \vee [\sim R \vee (Q \cdot S)]$ 11, Dist
 13. $P \supset [R \supset (Q \cdot S)]$ 12, Impl, Impl
 14. $(P \cdot R) \supset (Q \cdot S)$ 13, Exp

QED

12. 1. $(T \supset W) \cdot (X \supset Y)$
 2. $T \vee X$
 3. $(T \supset \sim Y) \cdot (X \supset \sim W)$
 4. $(W \cdot \sim Y) \supset Z$
 5. $Y \supset (W \vee A)$ / $Z \vee A$
 6. $W \vee Y$ 1, 2, CD
 7. $\sim Y \vee \sim W$ 3, 2, CD
 8. $\sim W \supset Y$ 6, DN, Impl
 9. $Y \supset \sim W$ 7, Impl
 10. $(\sim W \supset Y) \cdot (Y \supset \sim W)$ 8, 9, Conj
 11. $\sim W \equiv Y$ 10, Equiv
 12. $(W \cdot \sim Y) \vee (\sim W \cdot Y)$ 11, Equiv, DN
 13. $\sim Y \vee (W \vee A)$ 5, Impl
 14. $(\sim Y \vee W) \vee A$ 13, Assoc
 15. $\sim(\sim Y \vee W) \supset A$ 14, Impl, DN
 16. $(\sim W \cdot Y) \supset A$ 15, DM, DN, Com
 17. $[(W \cdot \sim Y) \supset Z] \cdot [(\sim W \cdot Y) \supset A]$ 4, 16, Conj
 18. $Z \vee A$ 17, 12, CD

QED