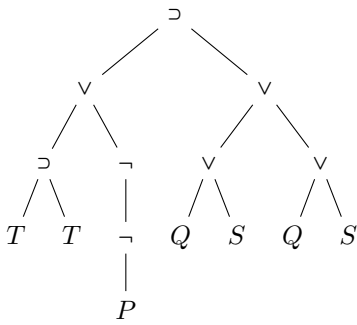For each sentence, produce its syntax tree (the simple version with only the connectives for nodes other than the leaf nodes).
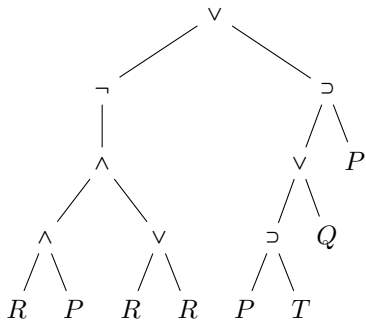
1. $\neg(R \wedge P)$
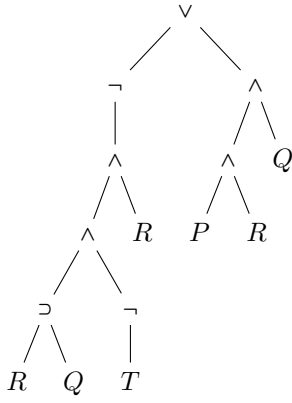
```
        ¬
        |
        ∧
       / \
      R   P
```

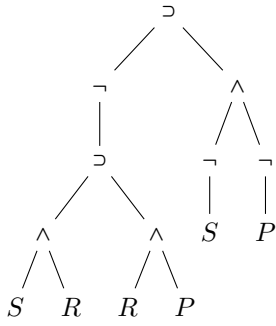2. $[(T \supset T) \vee \neg\neg P] \supset [(Q \vee S) \vee (Q \vee S)]$

```
                ⊃
             /     \
            ∨        ∨
          /  \      /  \
         ⊃    ¬    ∨    ∨
        / \   |   / \  / \
       T   T  ¬  Q  S Q  S
              |
              P
```

3. $\neg[(R \wedge P) \wedge (R \vee R)] \vee \{[(P \supset T) \vee Q] \supset P\}$

```
                ∨
             /     \
            ¬        ⊃
            |       / \
            ∧      ∨   P
           / \    / \
          ∧   ∨  ⊃   Q
         / \ / \ / \
        R P R R P  T
```
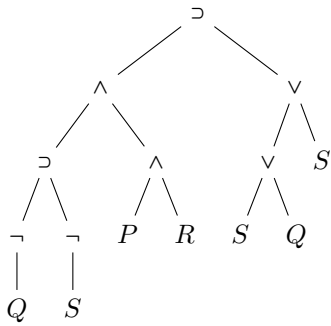
4. $\neg\{[(R \supset Q) \wedge \neg T] \wedge R\} \vee [(P \wedge R) \wedge Q]$
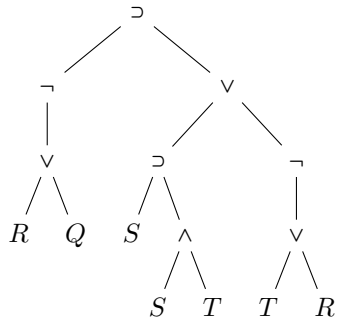
1

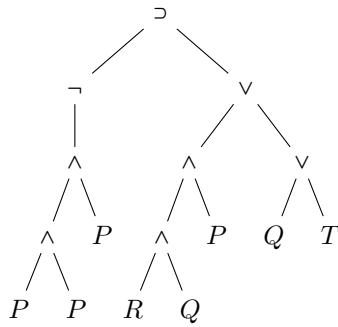5. $\neg[(S \wedge R) \supset (R \wedge P)] \supset (\neg S \wedge \neg P)$

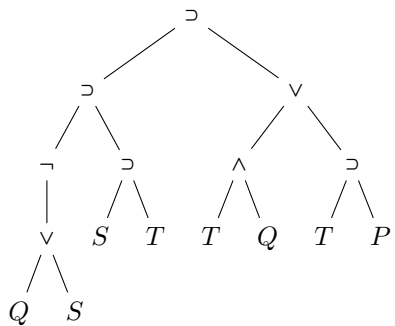6. $[(\neg Q \supset \neg S) \wedge (P \wedge R)] \supset [(S \vee Q) \vee S]$

7. $\neg(R \vee Q) \supset \{[S \supset (S \wedge T)] \vee \neg(T \vee R)\}$
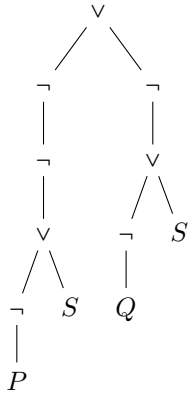
8. $\neg[(P \wedge P) \wedge P] \supset \{[(R \wedge Q) \wedge P] \vee (Q \vee T)\}$
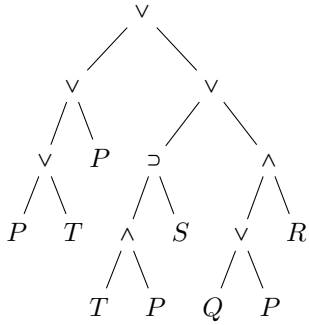
9. $[\neg(Q \vee S) \supset (S \supset T)] \supset [(T \wedge Q) \vee (T \supset P)]$
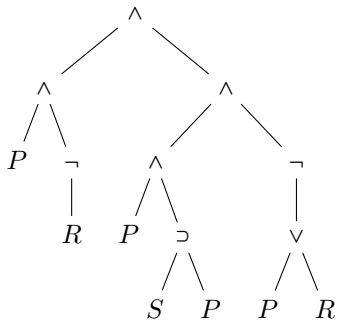
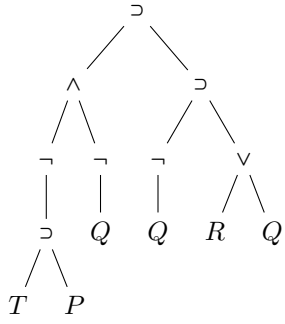10. $\neg\neg(\neg P \vee S) \vee \neg(\neg Q \vee S)$

(tree diagram)

```
            ∨
          /   \
         ¬     ¬
         |     |
         ¬     ∨
         |    / \
         ∨   ¬   S
        / \  |
       ¬   S Q
       |
       P
```

11. $[(P \lor T) \lor P] \lor \{[(T \land P) \supset S] \lor [(Q \lor P) \land R]\}$

```
              ∨
           /     \
          ∨       ∨
         / \     /  \
        ∨   P   ⊃    ∧
       / \     / \  / \
      P   T   ∧   S ∨   R
             / \    / \
            T   P  Q   P
```

12. $(P \land \neg R) \land \{[P \land (S \supset P)] \land \neg(P \lor R)\}$

```
              ∧
           /     \
          ∧       ∧
         / \     /  \
        P   ¬   ∧    ¬
            |  / \   |
            R P   ⊃  ∨
                 / \  / \
                S   P P   R
```
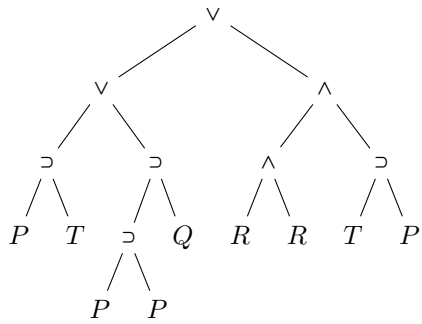
13. $[\neg(T \supset P) \land \neg Q] \supset [\neg Q \supset (R \lor Q)]$

4

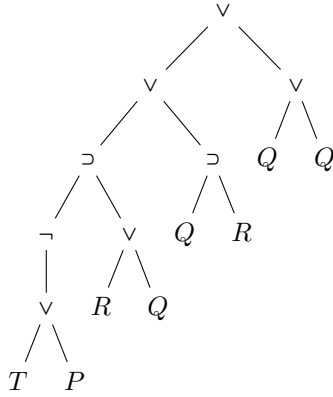14. $\{[(P \supset Q) \lor T] \supset (P \land R)\} \lor [\neg S \lor (S \lor S)]$
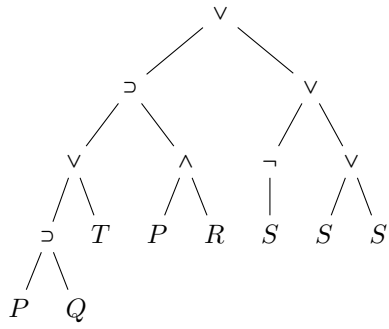
15. $\{(P \supset T) \lor [(P \supset P) \supset Q]\} \lor [(R \land R) \land (T \supset P)]$

16. $\{[(P \land S) \supset (P \land S)] \supset [(R \lor R) \land \neg P]\} \land S$
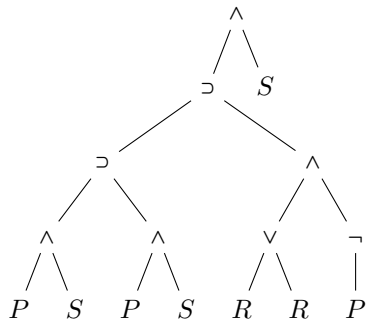
17. $\{[\neg(T \lor P) \supset (R \lor Q)] \lor (Q \supset R)\} \lor (Q \lor Q)$

18. $\Big(\{[S \lor (R \supset P)] \land (Q \land R)\} \supset R\Big) \supset (\neg Q \lor Q)$

19. $\{[S \lor (S \supset P)] \land [(T \lor S) \lor \neg R]\} \lor \neg R$

20. $\neg\{[(S \land Q) \land \neg P] \supset \neg Q\} \supset (R \land S)$

(tree diagram)

21. $\neg[R \vee (Q \wedge R)] \wedge [(S \supset \neg S) \wedge (P \vee T)]$

(tree diagram)

22. $\neg[(S \wedge Q) \vee (T \vee \neg Q)] \vee \neg\neg T$

(tree diagram)

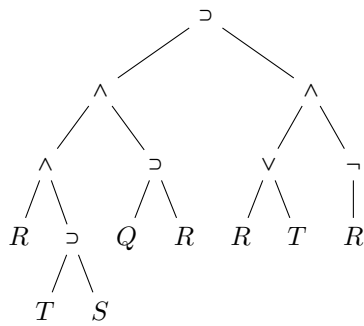23. $[\neg T \wedge (R \wedge Q)] \wedge \{[(Q \vee P) \vee (R \wedge Q)] \vee P\}$
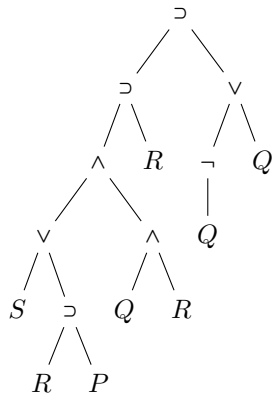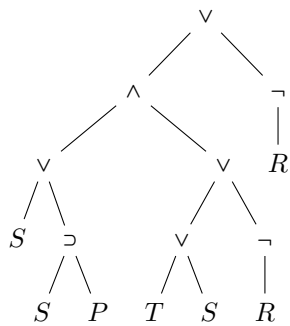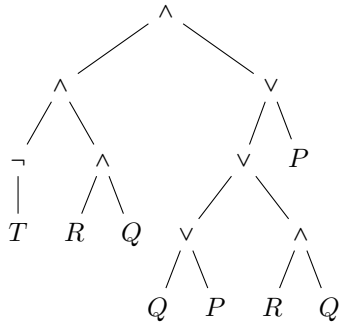
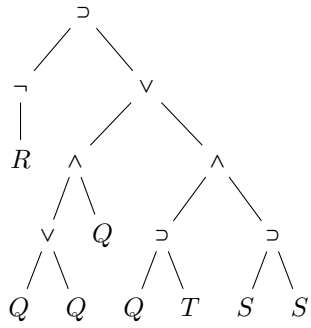24. $\neg R \vee \neg[\neg(T \supset Q) \vee \neg(T \supset T)]$
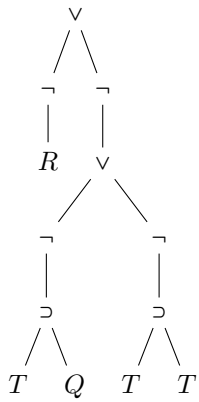
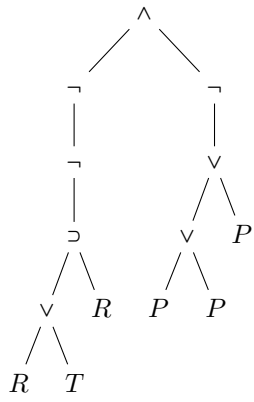25. $\{[R \wedge (T \supset S)] \wedge (Q \supset R)\} \supset [(R \vee T) \wedge \neg R]$

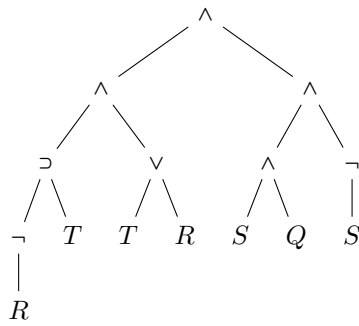26. $\neg R \supset \{[(Q \vee Q) \wedge Q] \vee [(Q \supset T) \wedge (S \supset S)]\}$
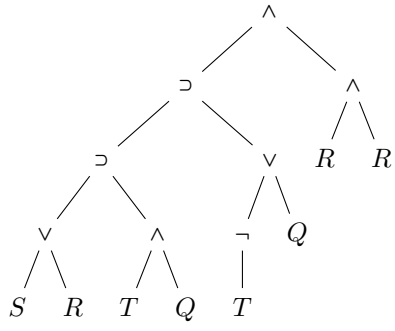
$\neg$
|
R

$\wedge$

$\vee$ Q

$\supset$

$\supset$

Q Q Q T S S

27. $\neg\neg[(R \vee T) \supset R] \wedge \neg[(P \vee P) \vee P]$

$\wedge$

$\neg$ $\neg$

$\neg$ $\vee$

$\supset$ $\vee$ P

$\vee$ R P P

R T

28. $[(\neg R \supset T) \wedge (T \vee R)] \wedge [(S \wedge Q) \wedge \neg S]$

$\wedge$

$\wedge$ $\wedge$

$\supset$ $\vee$ $\wedge$ $\neg$

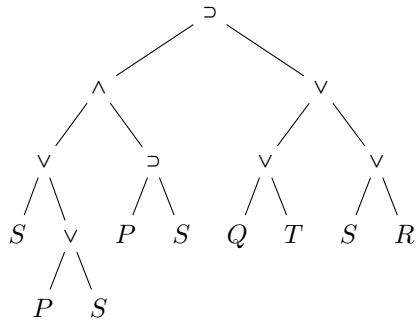$\neg$ T T R S Q S

R

29. $\{[(S \vee R) \supset (T \wedge Q)] \supset (\neg T \vee Q)\} \wedge (R \wedge R)$
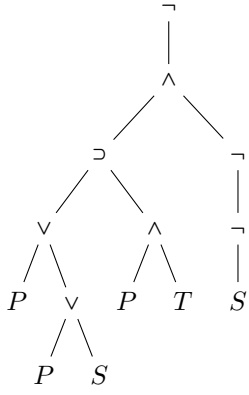
30. $\{[(R \wedge R) \supset (T \supset S)] \wedge (\neg T \wedge P)\} \supset (P \wedge T)$
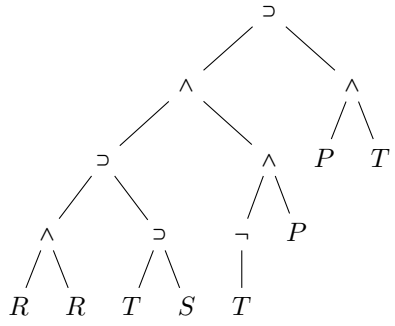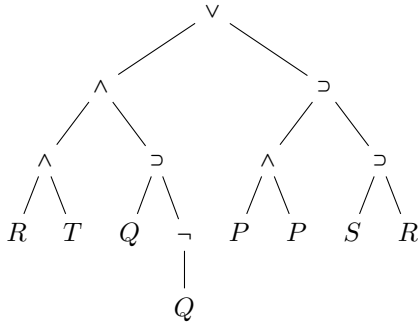
31. $\{[S \vee (P \vee S)] \wedge (P \supset S)\} \supset [(Q \vee T) \vee (S \vee R)]$
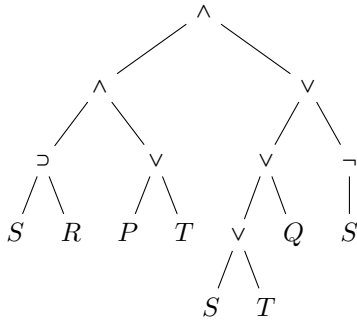
32. $\neg\Big(\{[P \vee (P \vee S)] \supset (P \wedge T)\} \wedge \neg\neg S\Big)$
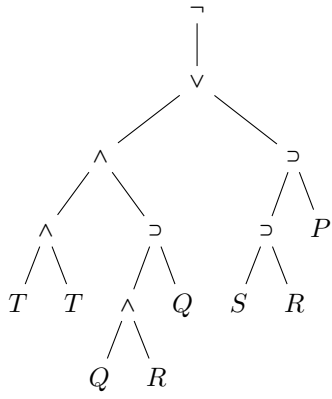
33. $[(R \wedge T) \wedge (Q \supset \neg Q)] \vee [(P \wedge P) \supset (S \supset R)]$
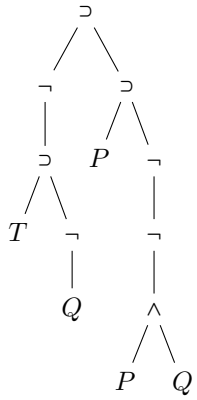
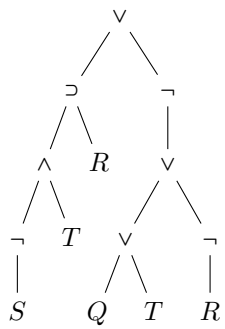34. $[(S \supset R) \wedge (P \vee T)] \wedge \{[(S \vee T) \vee Q] \vee \neg S\}$

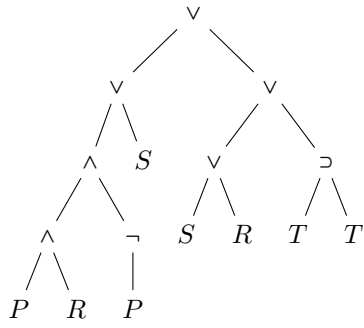35. $\neg\Big(\{(T \wedge T) \wedge [(Q \wedge R) \supset Q]\} \vee [(S \supset R) \supset P]\Big)$

```
          ¬
          |
          ∨
        /   \
       ∧     ⊃
      / \   / \
     ∧   ⊃ ⊃   P
    / \ / \ / \
   T  T ∧  Q S  R
       / \
      Q   R
```

36. $\neg(T \supset \neg Q) \supset [P \supset \neg\neg(P \land Q)]$

```
          ⊃
         /   \
        ¬     ⊃
        |    / \
        ⊃   P   ¬
       / \      |
      T   ¬     ¬
          |     |
          Q     ∧
               / \
              P   Q
```

37. $[(\neg S \land T) \supset R] \lor \neg[(Q \lor T) \lor \neg R]$

```
          ∨
        /   \
       ⊃     ¬
      / \    |
     ∧   R   ∨
    / \     / \
   ¬   T   ∨   ¬
   |      / \  |
   S     Q  T  R
```

38. $\{[(P \land R) \land \neg P] \lor S\} \lor [(S \lor R) \lor (T \supset T)]$

∨
∨　　　∨
∧　S　∨　⊃
∧　¬　S　R　T　T
P　R　P

39. $[\neg(R \lor P) \supset (T \lor T)] \land [(Q \land S) \supset \neg Q]$

∧
⊃　　　⊃
¬　∨　∧　¬
∨　T　T　Q　S　Q
R　P

40. $\{[(S \lor S) \lor Q] \supset \neg(T \lor P)\} \supset \neg\neg P$

⊃
⊃　　　¬
∨　¬　¬
∨　Q　∨　P
S　S　T　P

41. $[\neg(Q \land S) \lor (Q \land P)] \supset [(S \supset R) \lor (S \land Q)]$

⊃
∨　　　∨
¬　∧　⊃　∧
∧　Q　P　S　R　S　Q
Q　S

42. $\{\neg R \supset [\neg R \wedge (T \vee S)]\} \vee (\neg P \wedge P)$

```
                    ∨
              ⊃           ∧
          ¬       ∧     ¬     P
          R     ¬   ∨   P
                R   T S
```
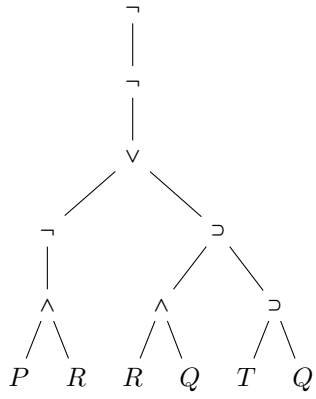
43. $\{[(P \supset Q) \vee \neg P] \wedge \neg R\} \vee [(P \supset R) \supset S]$

```
                    ∨
            ∧               ⊃
        ∨       ¬       ⊃       S
     ⊃     ¬    R     P   R
    P  Q   P
```
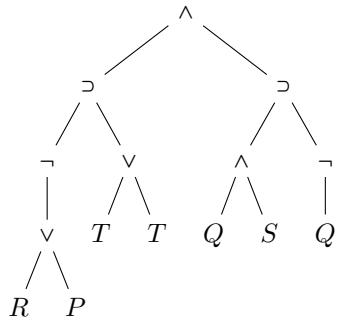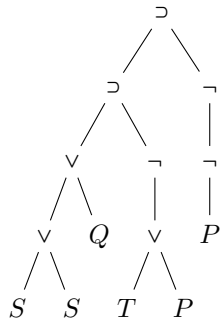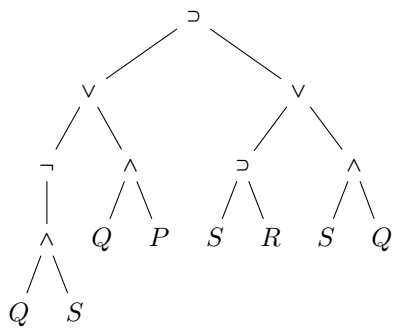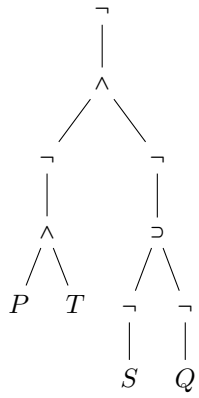
44. $[(R \vee T) \vee P] \supset \{(S \wedge S) \supset [(P \wedge T) \supset (R \supset T)]\}$

```
                    ⊃
            ∨               ⊃
         ∨     P       ∧         ⊃
        R T         S   S    ∧       ⊃
                            P  T    R  T
```
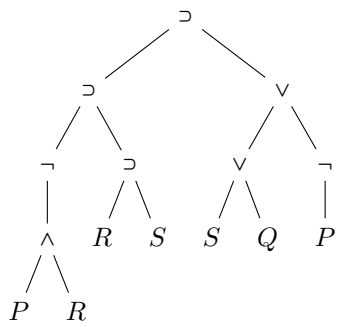
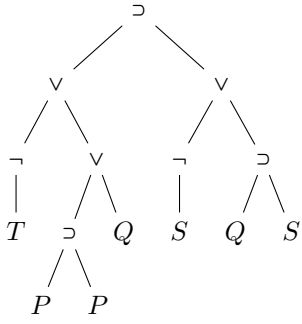45. $\neg\neg\{\neg(P \wedge R) \vee [(R \wedge Q) \supset (T \supset Q)]\}$

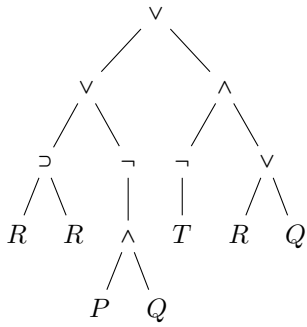46. $\neg[\neg(P \wedge T) \wedge \neg(\neg S \supset \neg Q)]$

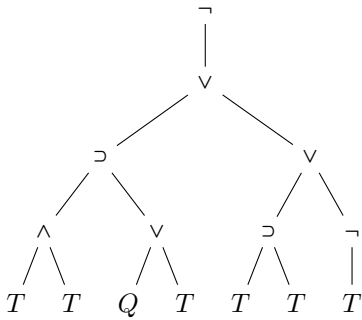47. $[\neg(P \wedge R) \supset (R \supset S)] \supset [(S \vee Q) \vee \neg P]$

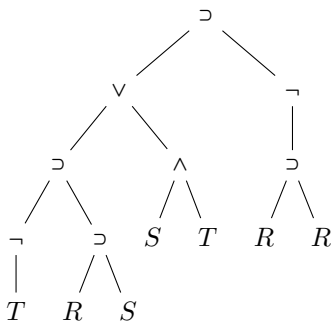48. $\{\neg T \vee [(P \supset P) \vee Q]\} \supset [\neg S \vee (Q \supset S)]$

49. $[(R \supset R) \lor \neg(P \land Q)] \lor [\neg T \land (R \lor Q)]$

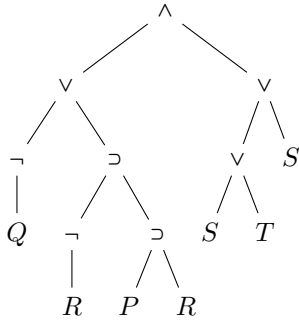50. $\neg\{[(T \land T) \supset (Q \lor T)] \lor [(T \supset T) \lor \neg T]\}$

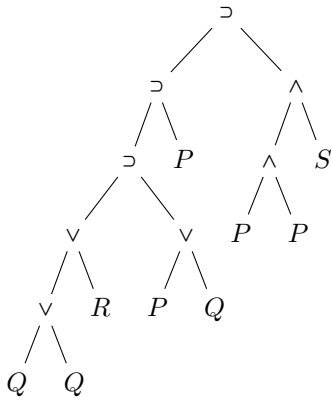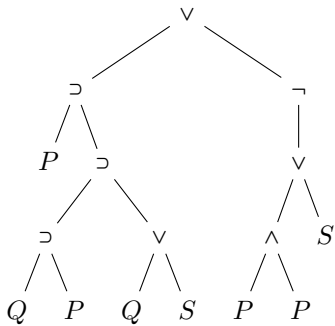51. $\{[\neg T \supset (R \supset S)] \lor (S \land T)\} \supset \neg(R \supset R)$

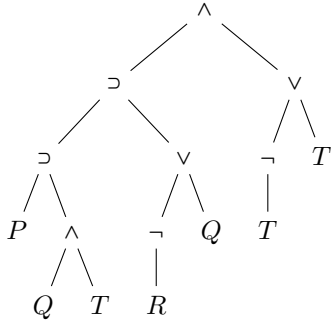52. $\{\neg Q \lor [\neg R \supset (P \supset R)]\} \land [(S \lor T) \lor S]$

```
            ∧
         /     \
        ∨       ∨
       / \     / \
      ¬   ⊃   ∨   S
      |  / \  / \
      Q ¬   ⊃ S  T
        |  / \
        R P   R
```

53. $\left(\{[(Q \lor Q) \lor R] \supset (P \lor Q)\} \supset P\right) \supset [(P \land P) \land S]$

```
              ⊃
           /     \
          ⊃       ∧
         / \     / \
        ⊃   P   ∧   S
       / \     / \
      ∨   R   P   P
     / \
    ∨   R  P   Q
   / \
  Q   Q
```

54. $\{P \supset [(Q \supset P) \supset (Q \lor S)]\} \lor \neg[(P \land P) \lor S]$

```
            ∨
         /     \
        ⊃       ¬
       / \      |
      P   ⊃     ∨
         / \   / \
        ⊃   ∨ ∧   S
       / \ / \ / \
      Q  P Q S P  P
```
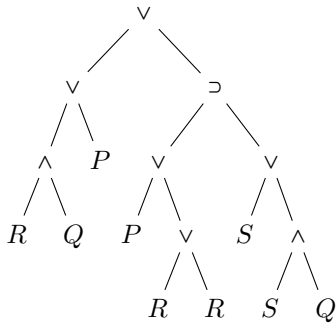
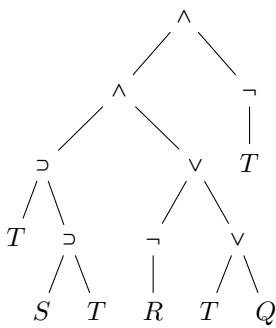55. $\{[P \supset (Q \land T)] \supset (\neg R \lor Q)\} \land (\neg T \lor T)$

56. $\{[\neg T \wedge (Q \wedge P)] \vee \neg(S \vee S)\} \supset (R \vee S)$
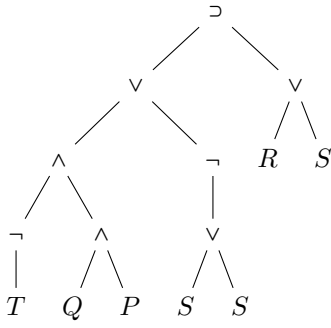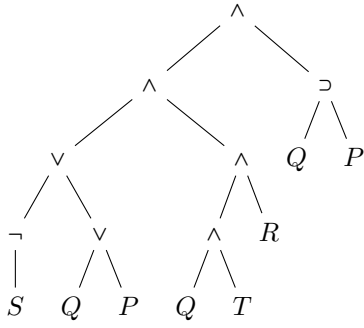

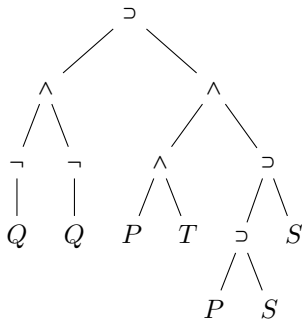57. $[(R \wedge Q) \vee P] \vee \{[P \vee (R \vee R)] \supset [S \vee (S \wedge Q)]\}$

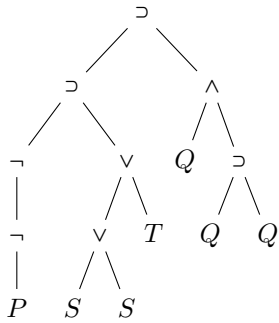58. $\{[T \supset (S \supset T)] \wedge [\neg R \vee (T \vee Q)]\} \wedge \neg T$

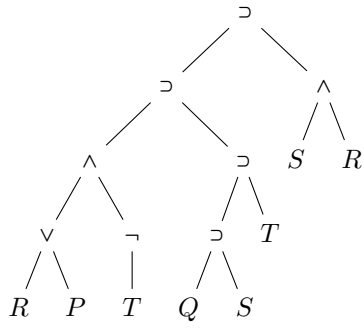59. $\{[\neg S \lor (Q \lor P)] \land [(Q \land T) \land R]\} \land (Q \supset P)$

```
                    ∧
             ∧             ⊃
          ∨       ∧      Q   P
        ¬   ∨   ∧   R
        |  / \ / \
        S  Q P Q  T
```

60. $(\neg Q \land \neg Q) \supset \{(P \land T) \land [(P \supset S) \supset S]\}$

```
                 ⊃
          ∧             ∧
       ¬    ¬        ∧       ⊃
       |    |       / \     / \
       Q    Q      P   T   ⊃   S
                          / \
                         P   S
```

61. $\{\neg\neg P \supset [(S \lor S) \lor T]\} \supset [Q \land (Q \supset Q)]$

```
                ⊃
         ⊃              ∧
       ¬     ∨       Q     ⊃
       |    / \           / \
       ¬   ∨   T         Q   Q
       |  / \
       P S   S
```
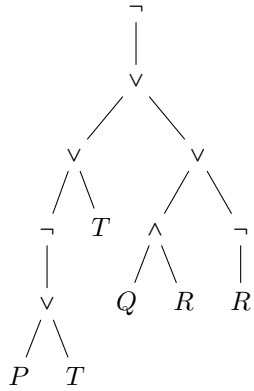
62. $\{[(R \lor P) \land \neg T] \supset [(Q \supset S) \supset T]\} \supset (S \land R)$

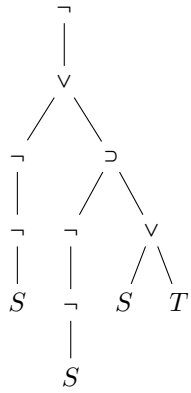63. $\left[\neg(R \supset Q) \wedge (Q \supset T)\right] \vee \left[\neg P \supset (P \vee S)\right]$
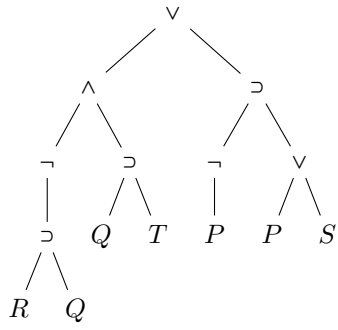
64. $\neg\{\left[\neg(P \vee T) \vee T\right] \vee \left[(Q \wedge R) \vee \neg R\right]\}$
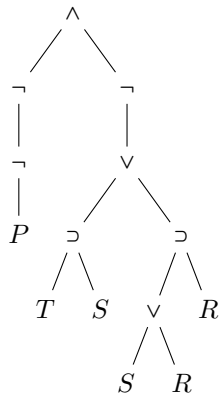

65. $\left[(\neg R \supset \neg T) \wedge (R \wedge R)\right] \vee \left[(P \wedge R) \wedge Q\right]$
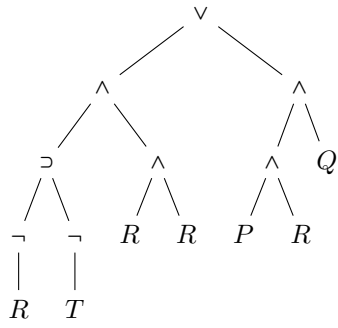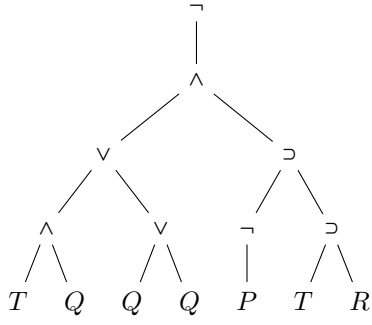
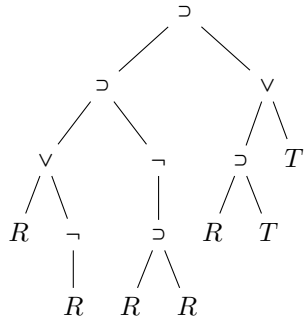66. $\neg\{\neg\neg S \vee [\neg\neg S \supset (S \vee T)]\}$

67. $\neg\neg P \wedge \neg\{(T \supset S) \vee [(S \vee R) \supset R]\}$
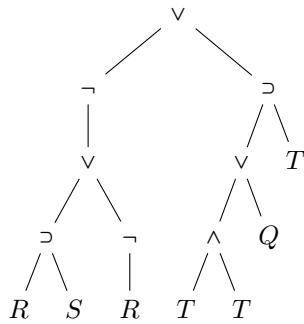
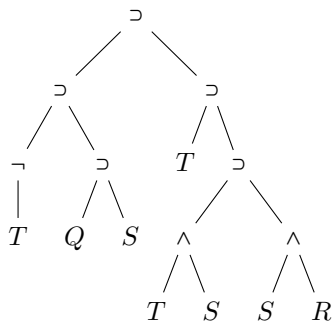68. $\neg\{[(T \wedge Q) \vee (Q \vee Q)] \wedge [\neg P \supset (T \supset R)]\}$

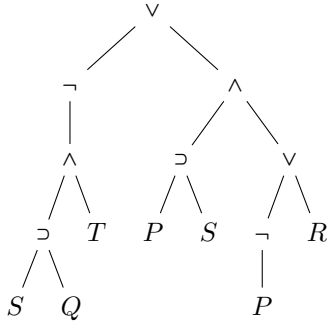69. $[(R \lor \neg R) \supset \neg(R \supset R)] \supset [(R \supset T) \lor T]$

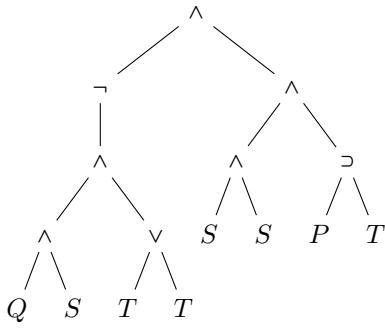70. $\neg[(R \supset S) \lor \neg R] \lor \{[(T \land T) \lor Q] \supset T\}$

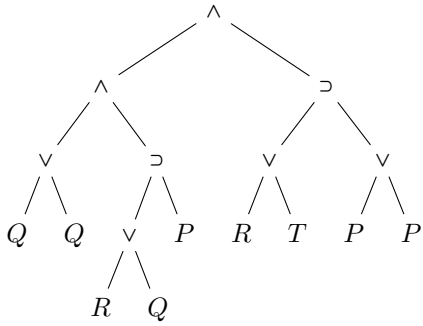71. $[\neg T \supset (Q \supset S)] \supset \{T \supset [(T \land S) \supset (S \land R)]\}$

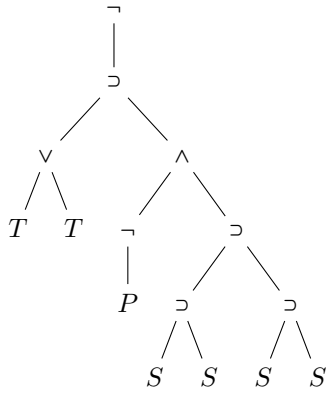72. $\neg[(S \supset Q) \wedge T] \vee [(P \supset S) \wedge (\neg P \vee R)]$

```
              ∨
          ┌───┴───┐
          ¬       ∧
          │     ┌─┴─┐
          ∧     ⊃   ∨
        ┌─┴─┐  ┌┴┐ ┌┴┐
        ⊃   T  P S ¬  R
       ┌┴┐          │
       S Q          P
```

73. $\neg[(Q \wedge S) \wedge (T \vee T)] \wedge [(S \wedge S) \wedge (P \supset T)]$

```
                    ∧
             ┌──────┴──────┐
             ¬             ∧
             │          ┌──┴──┐
             ∧          ∧     ⊃
          ┌──┴──┐     ┌─┴─┐  ┌┴┐
          ∧     ∨     S   S  P T
        ┌─┴─┐ ┌─┴─┐
        Q   S T   T
```

74. $\{(Q \vee Q) \wedge [(R \vee Q) \supset P]\} \wedge [(R \vee T) \supset (P \vee P)]$

```
                    ∧
            ┌───────┴───────┐
            ∧               ⊃
         ┌──┴──┐         ┌──┴──┐
         ∨     ⊃         ∨     ∨
        ┌┴┐  ┌─┴─┐      ┌┴┐   ┌┴┐
        Q Q  ∨   P      R T   P P
            ┌┴┐
            R Q
```
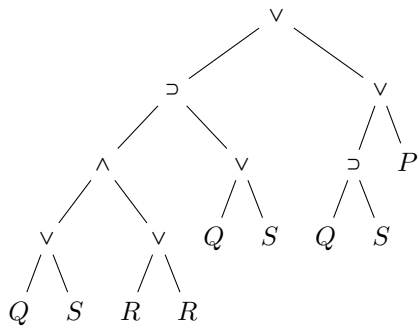
75. $\neg\Big((T \vee T) \supset \{\neg P \wedge [(S \supset S) \supset (S \supset S)]\}\Big)$

76. $\{[\neg R \wedge (T \supset P)] \wedge (S \wedge Q)\} \vee [(S \supset T) \supset R]$
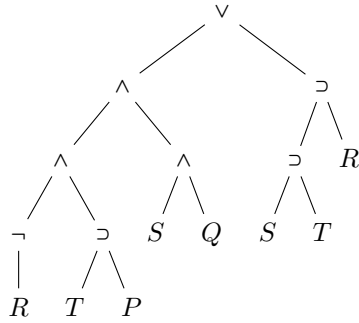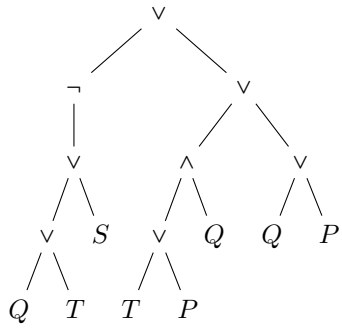
77. $\{[(Q \vee S) \wedge (R \vee R)] \supset (Q \vee S)\} \vee [(Q \supset S) \vee P]$
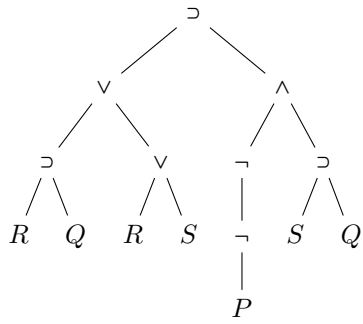
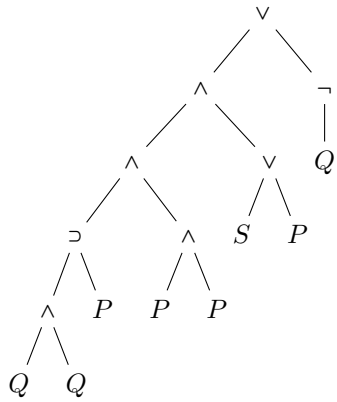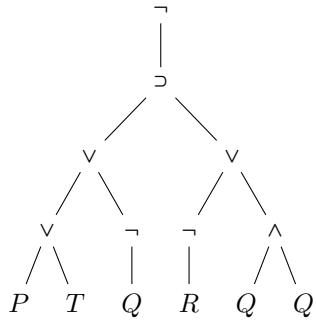78. $\neg[(Q \vee T) \vee S] \vee \{[(T \vee P) \wedge Q] \vee (Q \vee P)\}$

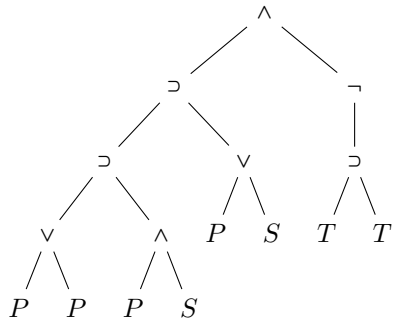79. $[(R \supset Q) \vee (R \vee S)] \supset [\neg\neg P \wedge (S \supset Q)]$

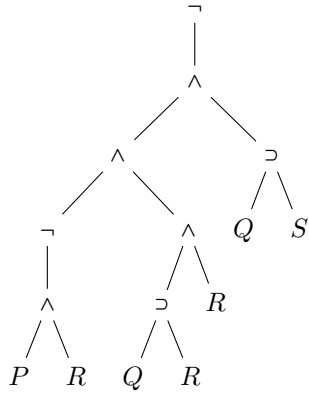80. $\Big(\{[(Q \wedge Q) \supset P] \wedge (P \wedge P)\} \wedge (S \vee P)\Big) \vee \neg Q$

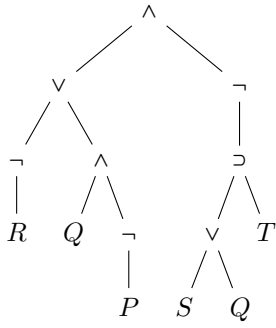81. $\neg\{[(P \vee T) \vee \neg Q] \supset [\neg R \vee (Q \wedge Q)]\}$

¬ ⊃ ∨ ∨ ∨ ¬ ¬ ∧

P   T   Q   R   Q   Q

82. $\{[(P \vee P) \supset (P \wedge S)] \supset (P \vee S)\} \wedge \neg(T \supset T)$

∧ ⊃ ¬ ⊃ ∨ ⊃ ∨ ∨ ∧ P S T T

P   P   P   S

83. $\neg\Big(\{\neg(P \wedge R) \wedge [(Q \supset R) \wedge R]\} \wedge (Q \supset S)\Big)$
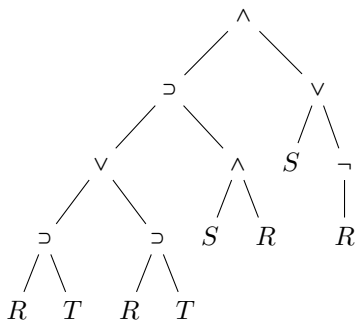
¬ ∧ ∧ ⊃ ¬ ∧ Q S ∧ ∧ ⊃ R

P   R   Q   R

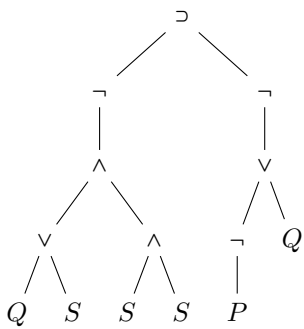84. $[\neg R \vee (Q \wedge \neg P)] \wedge \neg[(S \vee Q) \supset T]$

85. $[(R \wedge P) \vee (T \vee T)] \vee \neg[(T \wedge S) \supset (R \wedge R)]$
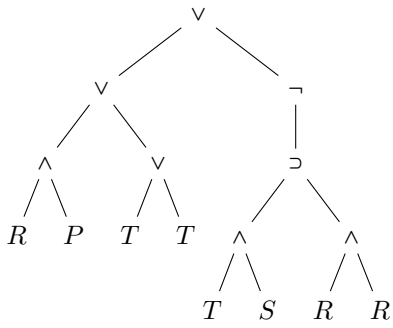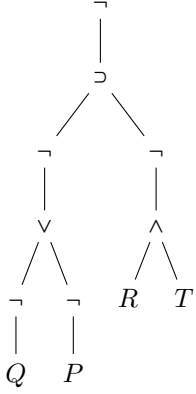
86. $\{[(R \supset T) \vee (R \supset T)] \supset (S \wedge R)\} \wedge (S \vee \neg R)$
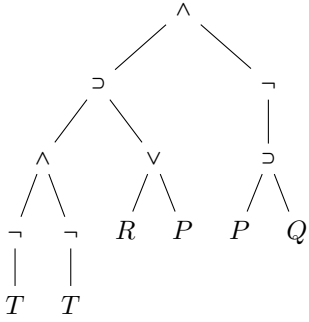
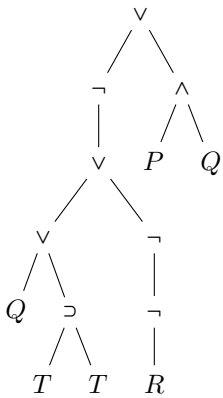87. $\neg[(Q \vee S) \wedge (S \wedge S)] \supset \neg(\neg P \vee Q)$

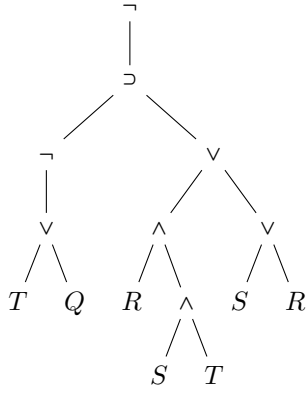88. $\neg[\neg(\neg Q \vee \neg P) \supset \neg(R \wedge T)]$

```
              ¬
              |
              ⊃
            /   \
           ¬     ¬
           |     |
           ∨     ∧
          / \   / \
         ¬   ¬ R   T
         |   |
         Q   P
```

89. $[(\neg T \wedge \neg T) \supset (R \vee P)] \wedge \neg(P \supset Q)$

```
                ∧
              /   \
             ⊃     ¬
           /   \   |
          ∧     ∨   ⊃
         / \   / \ / \
        ¬   ¬ R  P P  Q
        |   |
        T   T
```

90. $\neg\{[Q \vee (T \supset T)] \vee \neg\neg R\} \vee (P \wedge Q)$

```
              ∨
            /   \
           ¬     ∧
           |    / \
           ∨   P   Q
          /
         ∨        ¬
        / \       |
       Q   ⊃      ¬
          / \     |
         T   T    R
```
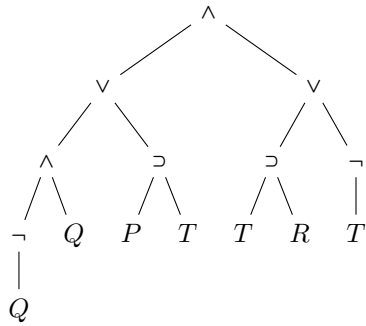
91. $\neg\Big(\neg(T \vee Q) \supset \{[R \wedge (S \wedge T)] \vee (S \vee R)\}\Big)$
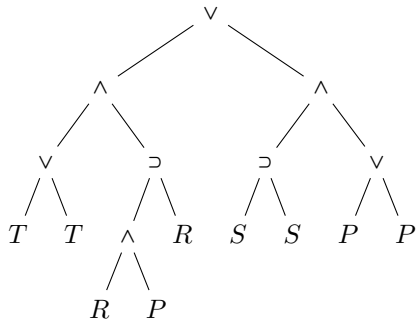
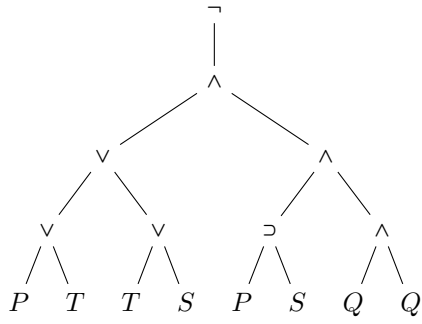92. $\{\neg(R \wedge R) \wedge [(P \vee S) \vee (Q \wedge S)]\} \supset (Q \vee T)$
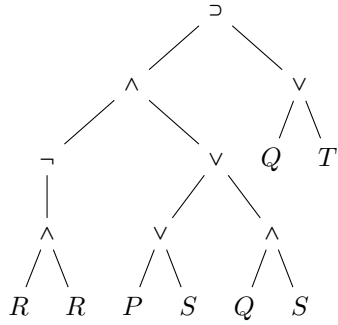
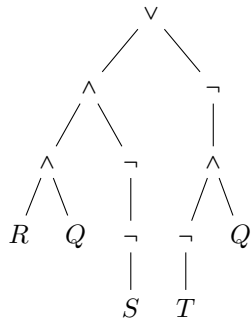93. $[(\neg Q \wedge Q) \vee (P \supset T)] \wedge [(T \supset R) \vee \neg T]$

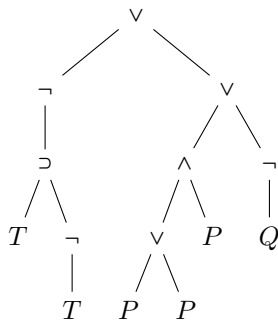94. $\{(T \vee T) \wedge [(R \wedge P) \supset R]\} \vee [(S \supset S) \wedge (P \vee P)]$

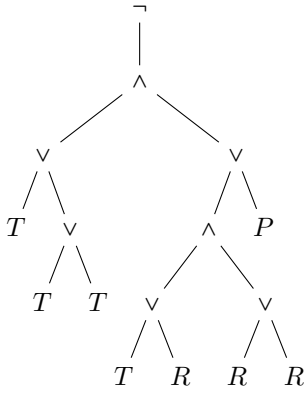95. $\neg\{[(P \lor T) \lor (T \lor S)] \land [(P \supset S) \land (Q \land Q)]\}$

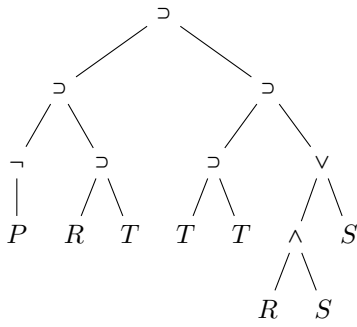96. $[(R \land Q) \land \neg\neg S] \lor \neg(\neg T \land Q)$

97. $\neg(T \supset \neg T) \lor \{[(P \lor P) \land P] \lor \neg Q\}$

98. $\neg\Big([T \vee (T \vee T)] \wedge \{[(T \vee R) \wedge (R \vee R)] \vee P\}\Big)$

99. $[\neg P \supset (R \supset T)] \supset \{(T \supset T) \supset [(R \wedge S) \vee S]\}$

100. $[(Q \supset P) \vee P] \supset \{[(P \supset R) \supset T] \wedge \neg\neg S\}$