Boolean Algebra Simplifications

Simplification Exercises

Simplify the follow expressions. Remember that there is more than one form of some Laws, so saying 'Apply the Absorption Law' does not always mean exactly the same thing.

1. $C = G + GY$ (Apply the Absorption Law)
2. $X = TR + R$ (Apply the Absorption Law)
3. $T = PQR + PQRS$ (Apply the Absorption Law)
4. $W = ZYQF + FYQ$ (Remember: the Commutative Law says that the order of terms does not matter. So apply the Absorption Law)
5. $Q = T + \overline{T}U$ (Apply the Absorption Law)
6. $W = ZY\overline{Q} + Q$ (Apply the Absorption Law)
7. $P = C + \overline{C}D$ (Apply the Absorption Law)
8. $Q = \overline{S} + \overline{S}R$ (Apply the Absorption Law)
9. $F = QW + QY$ (Apply the Distributive Law)
10. $Y = WQ + EW$ (Apply the Distributive Law)
11. $Z = BR + BRL$ (Two steps: Apply the Distributive Law to take *B* outside the brackets. Then apply the Absorption Law to what is left in the brackets)
12. $U = FYT + FYTL$ (Two steps: Apply the Distributive Law to take *FY* outside the brackets. Then apply the Absorption Law to what is left in the brackets)
13. $Q = P + P$
14. $H = TU + T\overline{U}$ (Apply the Distributive Law. What can you do with what is left in the brackets?)
15. $W = T + \overline{T}$
16. $G = H.H$
17. $J = KL + LK$
18. $F = R.S.Q.S.R.R$
19. $Q = \overline{CB} + CB$ (Hint: you don't need De-Morgan's Law)
20. $T = \overline{U} + \overline{V}$ (Apply De-Morgan's Law)
21. $X = \overline{Y} + Z$ (Apply De-Morgan's Law)
22. $K = \overline{LM}$ (Apply De-Morgan's Law)
23. $D = \overline{\overline{E}F}$ (Apply De-Morgan's Law)
24. $H = \overline{F + G + J}$ (Apply De-Morgan's Law)
25. $M = \overline{\overline{N} + \overline{P}}$ (Apply De-Morgan's Law)
26. $X = \overline{\overline{AB} + \overline{CD}}$ (Apply De-Morgan's Law to the NOR gate)
27. $Z = \overline{A + \overline{A}B}$ (Apply the Absorption Law first and then apply De-Morgan's Law)
28. $S = \overline{\overline{P} + Q} + \overline{\overline{P} + \overline{Q}}$ (Apply De-Morgan's Law to each NOR gate, then see what you can do)
29. $F = G(H + J + K + L + G)$

Further Simplification Exercises

Simplify the following expressions.

1. $F(K+R)+SV+W\overline{X}+VS+\overline{X}W+(R+K)F$
2. $A\overline{B}+\overline{B}A+CDE+\overline{C}DE+E\overline{C}D$
3. $AB+AC+BA$
4. $FE+FF+FG$
5. $(PQ+R+ST)ST$
6. $TUV+XY+Y$
7. $X=A\overline{B}C+\overline{A}.\overline{B}C+\overline{A}B\overline{C}+AB$
8. $Y=P\overline{Q}+PQR+\overline{P}.\overline{Q}.R$
9. $Z=EFGH+\overline{E}.\overline{F}.\overline{G}.\overline{H}+\overline{E}.\overline{F}G\overline{H}$
10. $X=\overline{A}.\overline{B}+\overline{A}B$
11. $X=\overline{A}B+A\overline{B}+AB$
12. $Y=\overline{A}.\overline{B}C+AB\overline{C}+ABC$
13. $Y=\overline{A}B\overline{C}+A\overline{B}.\overline{C}+A\overline{B}C+ABC$
14. $Z=\overline{A}.\overline{B}.\overline{C}+\overline{A}.\overline{B}C+A\overline{B}.\overline{C}+A\overline{B}C$
15. $Z=\overline{A}.\overline{B}.\overline{C}+\overline{A}.\overline{B}C+\overline{A}BC+A\overline{B}.\overline{C}+AB\overline{C}+ABC$

Show that:

16. $(BE+C+F)C=C$
17. $Y\left(W+X+\overline{\overline{Y}+\overline{Z}}\right)Z=YZ$
18. $\left(\overline{A+B}\right).\left(\overline{\overline{A}+\overline{B}}\right)=0$
19. $A+\overline{A}B+\overline{A}.\overline{B}=1$