1. a. $AB + \bar{A}B + \bar{B}\bar{C} + \bar{B}C$

$= B\underbrace{(A+\bar{A})}_{1} + \bar{B}\underbrace{(\bar{C}+C)}_{1}$

$= B + \bar{B} = 1$ (a constant)

b. $\bar{C}D + \bar{C}B\bar{D} + BC + B\bar{C}A$

$= \bar{C}[D + \bar{D}B] + B[C + \bar{C}A]$

$= \bar{C}[\underbrace{(D+\bar{D})}_{1}(D+B)] + B[\underbrace{(C+\bar{C})}_{1}(C+A)]$

$= \bar{C}(D+B) + B(C+A)$

$= \bar{C}D + \bar{C}B + CB + AB$

$= \bar{C}D + B[\underbrace{C+\bar{C}}_{1} + A]$

$= \bar{C}D + B\underbrace{[1+A]}_{1} = B + \bar{C}D$ (3 literals)

c. $(\overline{X+Z} + Z)Y + X$

$= (\bar{X}\bar{Z} + Z)Y + X$

$= (Z + \bar{Z}\bar{X})Y + X = \underbrace{(Z+\bar{Z})}_{1}(Z+\bar{X})Y + X$

$= (Z+\bar{X})Y + X$

$= YZ + \bar{X}Y + X$

$= YZ + \underbrace{(X+\bar{X})}_{1}\cdot(X+Y)$

$= X + Y + YZ = X + Y\underbrace{(1+Z)}_{1}$

$= X + Y$ (2 literals)

d. $ABC + A\bar{B}C + A\bar{B}\bar{C}$

$= ABC + A\bar{B}\underbrace{(C+\bar{C})}_{1}$

$= A[\bar{B} + BC]$

$= A[\underbrace{(\bar{B}+B)}_{1}(\bar{B}+C)] = A[\bar{B}+C]$ (3 literals)

e. $\bar{X}\bar{Y} + YZ + \bar{X}Y\bar{Z}$

$= \bar{X}\bar{Y} + Y[Z + \bar{Z}\bar{X}]$

$= \bar{X}\bar{Y} + Y[\underbrace{(Z+\bar{Z})}_{=1}(Z+\bar{X})$

$= \bar{X}\bar{Y} + YZ + Y\bar{X}$

$= \bar{X}\bar{Y} + \bar{X}Y + YZ$

$= \bar{X}(\underbrace{\bar{Y}+Y}_{1}) + YZ = \bar{X} + YZ$ (3 literals)

f. $(b'+c)(b'+c') = b' + b'c' + b'c + \underbrace{cc'}_{0}$

$= b'[\underbrace{1+c'+c}_{1}]$

$= b'$ (1 literal)

2. a. $(\overline{A+B})\cdot(\overline{\bar{A}\,\bar{B}}) = (\bar{A}\cdot\bar{B})\cdot(A+B)$

$= \underbrace{\bar{A}A}_{0}\bar{B} + \bar{A}\underbrace{\bar{B}B}_{0} = 0$

b. $(x+y)(x+\bar{y}) + xyz + \bar{x}y + xy\bar{z}$

$= \underbrace{\cancel{xx}}_{x} + xy + x\bar{y} + \underbrace{\cancel{y\bar{y}}}_{0} + xyz + \bar{x}y + xy\bar{z}$

$= x[\underbrace{1+y+\bar{y}}_{1}] + \bar{x}y + xy(\underbrace{z+\bar{z}}_{1})$

$= x + y(\underbrace{x+\bar{x}}_{1}) = x + y$

c. $\bar{w}x\bar{z} + xw + \bar{w}x\bar{y}z + x\bar{w}yz$

$= x[\bar{w}\bar{z} + w + \bar{w}\bar{y}z + \bar{w}yz]$

$= x[w + \bar{w}\bar{z} + \bar{w}z\underbrace{(y+\bar{y})}$

$= x[\underbrace{(w+\bar{w})}_{1}(w+\bar{z}) + \bar{w}z]$

$= x[w + \bar{w}z + \bar{z}]$

$= x[\underbrace{(w+\bar{w})}_{1}(w+z) + \bar{z}]$

$= x[w + \underbrace{z+\bar{z}}_{1}]$

$= x[\underbrace{1+w}_{1}]$

$= x$

2, contd.

d. $CD + (\bar{A}\bar{B})C + (A+B)D$

Let $A+B = W \rightarrow \bar{A}\bar{B} = \bar{W}$

$CD + \bar{W}C + WD = \bar{W}C + WD$

$= \bar{A}\bar{B}C + (A+B)D$

$= \bar{A}\bar{B}C + AD + BD$

3. $F = (AB' + C'D)(DE' + W)$

(i) Using DeMorgan's

$\bar{F} = \overline{(AB' + C'D).(DE' + W)}$

$= \overline{(AB' + C'D)} + \overline{(DE' + W)}$

$= \overline{AB'} . \overline{C'D} + \overline{DE'} . W'$

$= (A' + B)(C + D') + (D' + E)W'$

$= A'C + BC + A'D' + BD' + D'W' + EW'$ (SOP) (1)

(ii) Using Duality.

$F_{dual} = [(A + B')(C' + D)] + [(D + E')(W)]$

$= AC' + B'C' + AD + B'D + DW + E'W$

$\bar{F} = F_{dual}$, with literals complemented $= A'C + BC + A'D' + BD' + D'W' + EW'$

= expression in (1) above ✓

4. $F = EW' + (AB')(C'+D)$

$$F = \overline{\overline{F}} = \overline{\overline{EW' + AB'(C'+D)}}$$

$$= \overline{\overline{EW'} \cdot \overline{AB'(C'+D)}}$$

a. Using AND, NOT gates: $C' + D = \overline{C \cdot D'}$

OR = NOT-AND-NOT

$$F = \overline{\overline{EW'} \cdot \overline{(AB') \cdot \overline{C \cdot D'}}}$$

b. Using OR, NOT gates:

$$F = \overline{\overline{EW'} \cdot \overline{AB'(C'+D)}}$$

$$= \overline{(E'+W) \cdot [\overline{AB'} + \overline{(C'+D)}]}$$

$$= \overline{(E'+W) \cdot [(A'+B) + \overline{(C'+D)}]}$$

$$= \overline{(E'+W)} + \overline{[(A'+B) + \overline{(C'+D)}]}$$

5. a. $F = (A+\bar{B})C$

$$\bar{F} = \overline{(A+\bar{B}) \cdot C} = \overline{(A+\bar{B})} + \bar{C}$$

$$= \bar{A}B + \bar{C}$$

b.

i.

A	B	C	$F = AC + \bar{B}C$	$\bar{F} = \bar{A}B + \bar{C}$
0	0	0		1
0	0	1	1	
0	1	0		1
0	1	1		1
1	0	0		1
1	0	1	1	
1	1	0		1
1	1	1	1	

From the truth table $\bar{F}$ is the complement of F ✓

5 b ii. $F\bar{F} = \left[(A+\bar{B})C\right]\left[\bar{A}B+\bar{C}\right]$

$= \left[AC+\bar{B}C\right]\left[\bar{A}B+\bar{C}\right]$

$= \underbrace{AC\bar{A}B}_{0} + \underbrace{\bar{B}C\bar{A}B}_{0} + \underbrace{AC\bar{C}}_{0} + \underbrace{\bar{B}C\bar{C}}_{0}$

$= 0$ ✓

$F+\bar{F} = (A+\bar{B})C + \bar{A}B + \bar{C}$

$= AC + \bar{B}C + \bar{A}B + \bar{C}$

$= \bar{C} + AC + \bar{B}C + \bar{A}B$

$= \underbrace{(\bar{C}+C)}_{1}(\bar{C}+A) + \bar{B}C + \bar{A}B$

$= \bar{C} + \bar{B}C + A + \bar{A}B$

$= (\bar{C}+C)(\bar{C}+\bar{B}) + (A+\bar{A})(A+B)$

$= \bar{C} + \underbrace{\bar{B}+B}_{1} + A$

$= 1 + A + \bar{C} = 1$ ✓

6. $(A\bar{C}+BA)\overline{(C+A\bar{B})}$

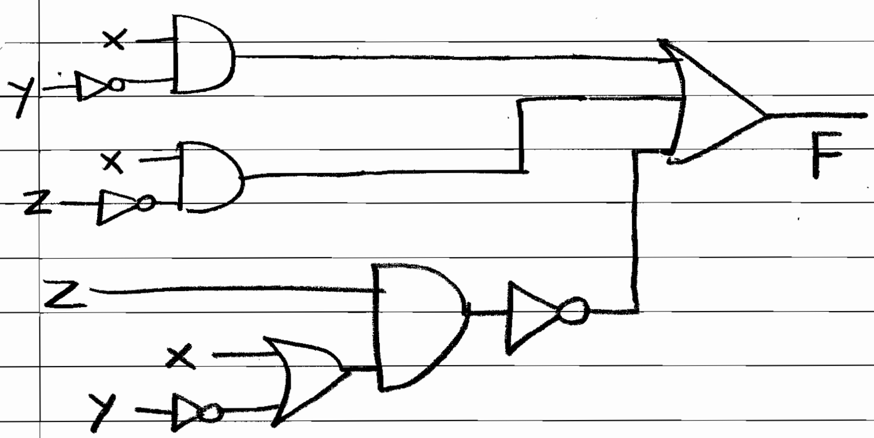
Dual:

$\left[(A+\bar{C})\cdot(B+A)\right] + \overline{C\cdot(A+\bar{B})}$

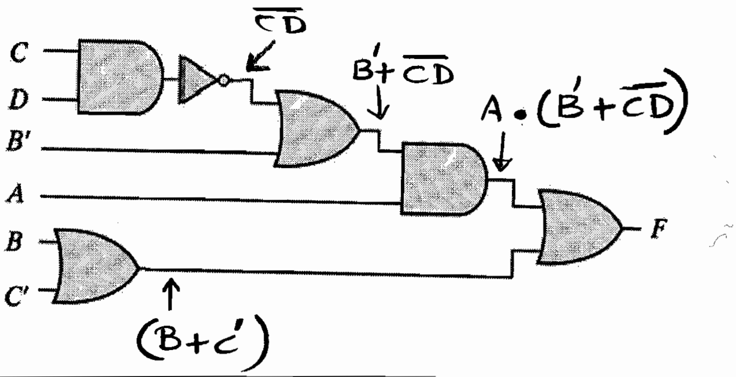
7. $F(x,y,z) = xy' + xz' + \overline{z(x+y')}$

x	y	z	xy'	xz'	$(x+y')$	$z(x+y)$	$\overline{z(x+\bar{y})}$	F
0	0	0			1		1	1
0	0	1			1	1		0
0	1	0					1	1
0	1	1					1	1
1	0	0	1	1	1		1	1
1	0	1	1		1	1		1
1	1	0		1	1		1	1
1	1	1			1	1		0

H2 - 8



8.



$$F = A \cdot (B' + \overline{CD}) + (B + C')$$

$$F(A,B,C,D) = B + C' + A \cdot (B' + \overline{CD})$$

$$F(1,0,1,1) = 0 + 0 + 1 \cdot (1 + \overline{1 \cdot 1}) = 1 \cdot 1 = 1$$