| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(a,b,c,d) = (a+b+c’d’)(b+d) |
| --- | --- |
| **2.CO2** | Simplify the following function: ((A.B)’+(C’+D’)’)’.((A.B’)+(C.(D+A’.D))) |

**Question 1 Solution**

F(a,b,c,d)

= (a+b+c’d’)(b+d)

= (a+b+c’)(a+b+d’)(b+d)

= (a+b+c’+d’)(a+b+c’+d)(a+b+d’+c’)(a+b+d’+c)(b+d+a’)(b+d+a)

= (a+b+c’+d’)(a+b+c’+d)(a+b+d’+c’)(a+b+d’+c)(b+d+a’+c’)(b+d+a’+c)(b+d+a+c’)(b+d+a+c)

= (a+b+c’+d’)(a+b+c’+d)(a+b+c’+d’)(a+b+c+d’)(a’+b+c’+d)(a’+b+c+d)(a+b+c’+d)(a+b+c+d)

= (a+b+c’+d’)(a+b+c’+d)(a+b+c+d’)(a’+b+c’+d)(a’+b+c+d)(a+b+c+d)

= ∏ (3, 2, 1, 10, 8, 0)

= ∏ (0, 1, 2, 3, 8, 10)

**Question 2 Solution**

((A.B)’+(C’+D’)’)’.((A.B’)+(C.(D+A’.D)))

= ((AB)’)’ ((C’+D’)’)’ (AB’+CD+A’CD)

= AB (C’+D’) (AB’+CD (1+D’))

= (ABC’+ABD’) (AB’+CD)

= ABC’AB’ + ABC’CD + ABD’AB’ + ABD’CD

= 0 + 0 + 0 + 0

= 0

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(p,q,r,s) = (p+q+r’s’)(q+s) |
| --- | --- |
| **2.CO2** | Simplify the following function: ((W.X)’+(Y’+Z’)’)’.((W.X’)+(Y.(Z+W’.Z))) |

**Question 1 Solution**

F(p,q, r, s)

= (p+r’s’+q)(s+q)

= (p+q+r’)(p+q+s’)(q+s)

= (p+q+r’+s’)(p+q+r’+s)(p+q+s’+r’)(p+q+s’+r)(q+s+p’)(q+s+p)

= (p+q+r’+s’)(p+q+r’+s)(p+q+s’+r’)(p+q+s’+r)(q+s+p’+r’)(q+s+p’+r)(q+s+p+r’)(q+s+p+r)

= (p+q+r’+s’)(p+q+r’+s)(p+q+r’+s’)(p+q+r+s’)(p’+q+r’+s)(p’+q+r+s)(p+q+r’+s)(p+q+r+s)

= (p+q+r’+s’)(p+q+r’+s)(p+q+r+s’)(p’+q+r’+s)(p’+q+r+s)(p+q+r+s)

= ∏ (3, 2, 1, 10, 8, 0)

= ∏ (0, 1, 2, 3, 8, 10)

**Question 2 Solution**

((W.X)’+(Y’+Z’)’)’.((W.X’)+(Y.(Z+W’.Z)))

= ((WX)’)’ ((Y’+Z’)’)’ (WX’+YZ+W’YZ)

= WX (Y’+Z’) (WX’+YZ (1+Z’))

= (WXY’+WXZ’) (WX’+YZ)

= WXY’WX’ + WXY’YZ + WXZ’WX’ + WXZ’YZ

= 0 + 0 + 0 + 0

= 0

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(w,x,y,z) = (w+x+y’z’)(x+z) |
| --- | --- |
| **2.CO2** | Simplify the following function: ((W.X)’+(Y’+Z’)’)’.((W.X’)+(Y.(Z+W’.Z))) |

**Question 1 Solution**

F(w,x, y, z)

= (w+y’z’+x)(z+x)

= (w+x+y’)(w+x+z’)(x+z)

= (w+x+y’+z’)(w+x+y’+z)(w+x+z’+y’)(w+x+z’+y)(x+z+w’)(x+z+w)

= (w+x+y’+z’)(w+x+y’+z)(w+x+z’+y’)(w+x+z’+y)(x+z+w’+y’)(x+z+w’+y)(x+z+w+y’)(x+z+w+y)

= (w+x+y’+z’)(w+x+y’+z)(w+x+y’+z’)(w+x+y+z’)(w’+x+y’+z)(w’+x+y+z)(w+x+y’+z)(w+x+y+z)

= (w+x+y’+z’)(w+x+y’+z)(w+x+y+z’)(w’+x+y’+z)(w’+x+y+z)(w+x+y+z)

= ∏ (3, 2, 1, 10, 8, 0)

= ∏ (0, 1, 2, 3, 8, 10)

**Question 2 Solution**

((W.X)’+(Y’+Z’)’)’.((W.X’)+(Y.(Z+W’.Z)))

= ((WX)’)’ ((Y’+Z’)’)’ (WX’+YZ+W’YZ)

= WX (Y’+Z’) (WX’+YZ (1+Z’))

= (WXY’+WXZ’) (WX’+YZ)

= WXY’WX’ + WXY’YZ + WXZ’WX’ + WXZ’YZ

= 0 + 0 + 0 + 0

= 0

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(w,x,y,z) = (w+x+y’z’)(x+z) |
| --- | --- |
| **2.CO2** | Simplify the following function: ((P.Q)’+(R’+S’)’)’.((P.Q’)+(R.(S+P’.S))) |

**Question 1 Solution**

F(w,x, y, z)

= (w+y’z’+x)(z+x)

= (w+x+y’)(w+x+z’)(x+z)

= (w+x+y’+z’)(w+x+y’+z)(w+x+z’+y’)(w+x+z’+y)(x+z+w’)(x+z+w)

= (w+x+y’+z’)(w+x+y’+z)(w+x+z’+y’)(w+x+z’+y)(x+z+w’+y’)(x+z+w’+y)(x+z+w+y’)(x+z+w+y)

= (w+x+y’+z’)(w+x+y’+z)(w+x+y’+z’)(w+x+y+z’)(w’+x+y’+z)(w’+x+y+z)(w+x+y’+z)(w+x+y+z)

= (w+x+y’+z’)(w+x+y’+z)(w+x+y+z’)(w’+x+y’+z)(w’+x+y+z)(w+x+y+z)

= ∏ (3, 2, 1, 10, 8, 0)

= ∏ (0, 1, 2, 3, 8, 10)

**Question 2 Solution**

((P.Q)’+(R’+S’)’)’.((P.Q’)+(R.(S+P’.S)))

= ((PQ)’)’ ((R’+S’)’)’ (PQ’+RS+P’RS)

= PQ (R’+S’) (PQ’+RS (1+S’))

= (PQR’+PQS’) (PQ’+RS)

= PQR’PQ’ + PQR’RS + PQS’PQ’ + PQS’RS

= 0 + 0 + 0 + 0

= 0

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(a,b, c, d) = (a’+b+c’d)(b’+d) |
| --- | --- |
| **2.CO2** | Simplify the following function: A’B+(A’+B’(A(B.B’))+(A’(C.C’)))(C’+1)+AB’C’+B’C(B’+B) |

**Question 1 Solution**

F(a,b, c, d) = (a’+b+c’d)(b’+d)

= (a’+b+c’)(a’+b+d)(b’+d)

= (a’+b+c’+dd’)(a’+b+cc’+d)(aa’+b’+d)

= (a’+b+c’+d)(a’+b+c’+d’)(a’+b+c+d)(a’+b+c’+d)(a+b’+d)(a’+b’+d)

=(a’+b+c’+d)(a’+b+c’+d’)(a’+b+c+d)(a’+b+c’+d)(a+b’+cc’+d)(a’+b’+cc’+d)

=(a’+b+c’+d)(a’+b+c’+d’)(a’+b+c+d)(a’+b+c’+d)(a+b’+c+d)(a+b’+c’+d)(a’+b’+c+d)(a’+b’+c’+d)

= (1010)(1011)(1000)(1010)(0100)(0110)(1100)(1110)

= ∏ (10,11,8,10,4,6,12,14)

= ∏ (4,6,8,10,11,12,14)

**Question 2 Solution**

A’B+(A’+B’(A(B.B’))+(A’(C.C’)))(C’+1)+AB’C’+B’C(B’+B)

= A’B + (A’+0) + (0) (1) + AB’C’+B’C(1)

= A’B + A’ + AB’C’ + B’C

=A’ (B+1) + B’ (AC’+C)

= A’ + B’ (A+C) (C’+C)

= A’ + B’ (A+C) (1)

= A’ + B’ (A+C)

= A’+ AB’ + B’C

= (A’+A) (A’+B’) + B’C

= A’+B’+B’C

= A’+B’(1+C)

= A’+B’

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(w,x, y, z) = (w’+x+y’z)(x’+z) |
| --- | --- |
| **2.CO2** | Simplify the following function: P’Q+(P’+Q’(P(Q.Q’))+(P’(R.R’)))(R’+1)+PQ’R’+Q’R(Q’+Q) |

**Question 1 Solution**

F(w,x, y, z) = (w’+x+y’z)(x’+z)

= (w’+x+y’)(w’+x+z)(x’+z)

= (w’+x+y’+zz’)(w’+x+yy’+z)(ww’+x’+z)

= (w’+x+y’+z)(w’+x+y’+z’)(w’+x+y+z)(w’+x+y’+z)(w+x’+z)(w’+x’+z)

=(w’+x+y’+z)(w’+x+y’+z’)(w’+x+y+z)(w’+x+y’+z)(w+x’+yy’+z)(w’+x’+yy’+z)

=(w’+x+y’+z)(w’+x+y’+z’)(w’+x+y+z)(w’+x+y’+z)(w+x’+y+z)(w+x’+y’+z)(w’+x’+y+z)(w’+x’+y’+z)

= (1010)(1011)(1000)(1010)(0100)(0110)(1100)(1110)

= ∏ (10,11,8,10,4,6,12,14)

= ∏ (4,6,8,10,11,12,14)

**Question 2 Solution**

P’Q+(P’+Q’(P(Q.Q’))+(P’(R.R’)))(R’+1)+PQ’R’+Q’R(Q’+Q)

= P’Q+(P’+Q’(P(Q.Q’))+(P’(R.R’)))(R’+1)+PQ’R’+Q’R(Q’+Q)

= P’Q + (P’+0) + (0) (1) + PQ’R’+Q’R(1)

= P’Q + P’ + PQ’R’ + Q’R

=P’ (Q+1) + Q’ (PR’+R)

= P’ + Q’ (P+R) (R’+R)

= P’ + Q’ (P+R) (1)

= P’ + Q’ (P+R)

= P’+ PQ’ + Q’R

= (P’+P) (P’+Q’) + Q’R

= P’+Q’+Q’R

= P’+Q’(1+R)

= P’+Q’

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(w,x, y, z) = (yz+w+x’)(z’+x’) |
| --- | --- |
| **2.CO2** | Simplify the following function: (P’(R.R’)))(R’+1)+P’Q+(P’+Q’(P(Q.Q’))+PQ’R’+Q’R(Q’+Q) |

**Question 1 Solution**

F(w,x, y, z) = (yz+w+x’)(z’+x’)

= (y+w+x’)(z+w+x’)(z’+x’)

= (w+x’+y+zz’)(w+x’+yy’+z)(ww’+x’+z’)

= (w+x’+y+z)(w+x’+y+z’)(w+x’+y+z)(w+x’+y’+z)(w+x’+z’)(w’+x’+z’)

= (w+x’+y+z)(w+x’+y+z’)(w+x’+y+z)(w+x’+y’+z)(w+x’+yy’+z’)(w’+x’+yy’+z’)

= (w+x’+y+z)(w+x’+y+z’)(w+x’+y+z)(w+x’+y’+z)(w+x’+y+z’)(w+x’+y’+z’)(w’+x’+y+z’)(w’+x’+y’+z’)

= (0100)(0101)(0100)(0110)(0101)(0111)(1101)(1111)

= ∏ (4,5,4,6,5,7,13,15)

= ∏ (4,5,6,7,13,15)

**Question 2 Solution**

(P’(R.R’)))(R’+1)+P’Q+(P’+Q’(P(Q.Q’))+PQ’R’+Q’R(Q’+Q)

= P’ (0) (1) + P’Q+(P’+Q’(P(Q.Q’))+PQ’R’+Q’R(Q’+Q)

= P’Q+P’+PQ’R’+Q’R

= P’+PQ’R’+Q’R

= P’ + Q’(PR’+R)

= P’ + Q’ (P+R)

= P’+Q’P+Q’R

= (P’+P) (P’+Q’) + Q’R

= P’+Q’+Q’R

= P’+Q’(1+R)

= P’+Q’

| **1.CO2** | Convert the following function to its corresponding canonical **POS** form using boolean algebraic formulas: F(p,q, r, s) = (rs+p+q’)(s’+q’) |
| --- | --- |
| **2.CO2** | Simplify the following function: Y’Z(Y’+Y)+X’Y+(X’+Y’(X(Y.Y’))+(X’(Z.Z’)))(Z’+1)+XY’Z’ |

**Question 1 Solution**

F(p,q, r, s) = (rs+p+q’)(s’+q’)

= (r+p+q’)(s+p+q’)(s’+q’)

= (p+q’+r+ss’)(p+q’+rr’+s)(pp’+q’+s’)

= (p+q’+r+s)(p+q’+r+s’)(p+q’+r+s)(p+q’+r’+s)(p+q’+s’)(p’+q’+s’)

= (p+q’+r+s)(p+q’+r+s’)(p+q’+r+s)(p+q’+r’+s)(p+q’+rr’+s’)(p’+q’+rr’+s’)

= (p+q’+r+s)(p+q’+r+s’)(p+q’+r+s)(p+q’+r’+s)(p+q’+r+s’)(p+q’+r’+s’)(p’+q’+r+s’)(p’+q’+r’+s’)

= (0100)(0101)(0100)(0110)(0101)(0111)(1101)(1111)

= ∏ (4,5,4,6,5,7,13,15)

= ∏ (4,5,6,7,13,15)

**Question 2 Solution**

Y’Z(Y’+Y)+X’Y+(X’+Y’(X(Y.Y’))+(X’(Z.Z’)))(Z’+1)+XY’Z’

=X’Y+(X’+Y’(X(Y.Y’))+(X’(Z.Z’)))(Z’+1)+XY’Z’+Y’Z(Y’+Y)

= X’Y + (X’+0) + (0) (1) + XY’Z’+Y’Z(1)

= X’Y + X’ + XY’Z’ + Y’Z

=X’ (Y+1) + Y’ (XZ’+Z)

= X’ + Y’ (X+Z) (Z’+Z)

= X’ + Y’ (X+Z) (1)

= X’ + Y’ (X+Z)

= X’+ XY’ + Y’Z

= (X’+X) (X’+Y’) + Y’Z

= X’+Y’+Y’Z

= X’+Y’(1+Z)

= X’+Y’