1. Answers:

f = (A + C' + D'')(B' + C' + D)(A + B' + C')

* f = A'B'A + A'B'C' + A'B'D'' + A'C'C' + A'C'D + A'D''A + A'D''C' + A'D''D + B'C'C' + B'C'D + B'DA + B'DC' + B'DD''

f = A'B'A + A'B'C' + A'B'D'' + A'C' + A'C'D + A'D'' + B'C'C' + B'C'D + B'DA + B'DC' + B'DD'' [Apply the Idempotent Law (A + A = A)]

* f = A'B' + A'C' + A'D'' + A'C'D + A'D'' + B'C' + B'DA + B'DC' + B'DD'' [Apply the Absorption Law (A + AB = A)]  
  f = A'B' + A'C' + A'D'' + B'C' + B'DA + B'DC' + B'DD'' [Apply the Absorption Law]
* f = A'B' + A'C' + A'D'' + B'C' + B'DA + B'DC' + B'DD''
* Applying the Absorption Law (A + AB = A)  
  A'B' + A'DA = A'B' + A'
* Applying the Absorption Law (A + AB = A)
* f = A' + A'C' + A'D'' + B'C' + B'DA + B'DC' + B'D'
* Applying the Absorption Law (A + AB = A)  
  A'D'' + B'DC' = A' + B'DC'
* f = A' + A'C' + B'C' + B'DA + B'D + B'DC'
* Applying the Absorption Law (A + AB = A)
* A'C' + B'DC' = A' + B'DC'
* Applying the Absorption Law (A + AB = A)
* B'DA + B'D = B'DA + B'D
* f = A' + A' + B'C' + B'DA + B'DC' + B'DA + B'D
* Applying the Idempotent Law (A + A = A)
* A' + A' + B'C' + B'DA + B'DC' + B'DA + B'D = A' + B'C' + B'DA + B'DC' + B'D
* f = A' + B'C' + B'D
* Applying the Absorption Law (A + AB = A)  
  B'C' + B'D = B'C'
* f = A' + B'C'

| A | B | C | A’ | B’C’ | A’+B’C’ |
| --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 1 | 1 |

B. f = (Z + X)(Z' + Y')(Y' + X)

f = ZZ'Y' + ZZ'X + XY'Y' + XY'X [Using Distributive Law]

=ZZ'Y' + ZZ'X + XY'Y' + XY'X: [applying Identity Law , ZZ’ =0 ]

=0Y’ + 0X + XY’Y’ + XY’X

=XY' + XY’X [Applying Idempotent Law]

=XY’(1+X) [Factoring out XY’]

=XY’ [Applying Identity Law

| X | Y | Y’ | XY’ |
| --- | --- | --- | --- |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |

C. (X'Y) + (X'Y'Z')= X'Y(1 + Z') [Factoring X’Y]  
 =X'Y(1) [Apply the Identity Law (A + 1 = 1) ]

= X'Y

Truth table:

| X | Y | X’ | X’Y |
| --- | --- | --- | --- |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 |