1 a) Decrement

$$2x \to x + y$$

b) Increment

$$2x \xrightarrow{fast} x + y$$
$$x \xrightarrow{slow} 2y$$

d) Log

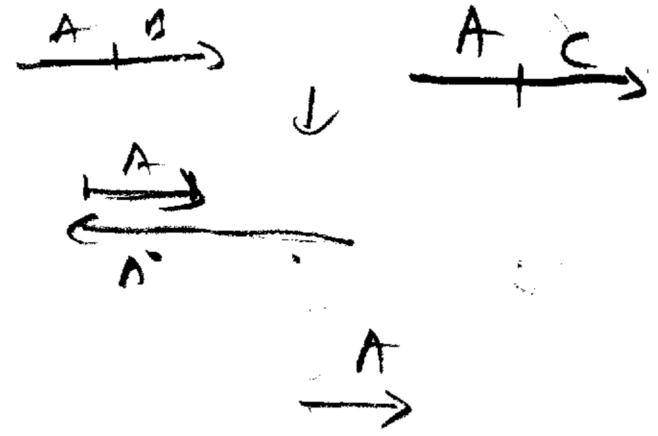
$$b \xrightarrow{slow} a + b$$
$$a + 2x \xrightarrow{faster} c + x' + a$$
$$2c \xrightarrow{faster} c$$
$$a \xrightarrow{fast} \emptyset$$
$$x' \xrightarrow{medium} x$$
$$c \xrightarrow{medium} y$$

c) Polynomial

$$2c \xrightarrow{fast} c$$
$$c \xrightarrow{slow} y$$
$$x \xrightarrow{fast} 2x' + b + 3y$$
$$x' \xrightarrow{slowest} a$$
$$a + b \xrightarrow{fastest} a + b' + y$$
$$a \xrightarrow{fast} \emptyset$$
$$b' \xrightarrow{slow} b$$

1.) * For each Input and Output there should be a corresponding DNA strand (not multiple). If this strand exists then logic 1 achieved, otherwise logic 0

- If you consider an output such that it is logic 1 if there is any of the selected multiple strands then use an extra gate to solve. These multiple strands should result in a specific strand.



- A gate is double-stranded DNA(s)

- There is no order of reactions. All happen simultaneously

5)

20

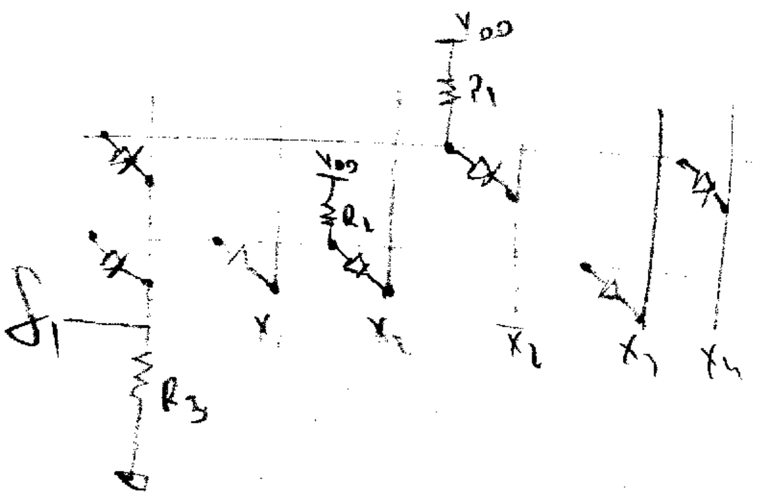
a)

$f_1 = x_1 x_2 x_3 + \bar{x}_2 x_4$

$f_1^D = \cancel{x_1 x_4} + x_2 x_4 + x_3 x_4 + x_1 \bar{x}_2 + \bar{x}_2 x_3$

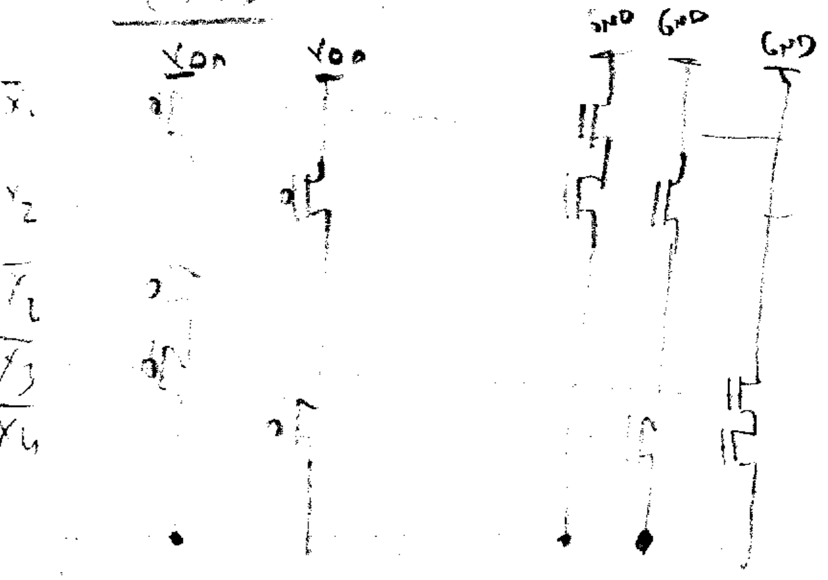
$f_1^D = x_1 \bar{x}_2 + x_2 x_4 + x_3 x_4$

Diode



$2 \times 6 = 12$ crosspoints

CMOS



$6 \times 5 = 30$ crosspoint

4-Terminal

	x_1 x_2 x_3	$\bar{x}_2$ x_4
$x_1 \bar{x}_2$	x_1	$\bar{x}_2$
$x_2 x_4$	x_2	x_4
$x_3 x_4$	x_3	x_4

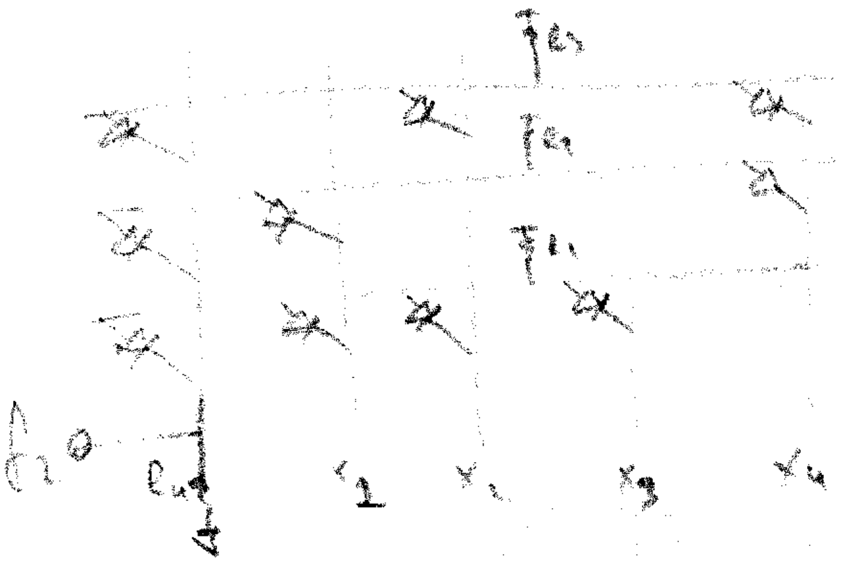
$3 \times 2 = 6$ crosspoint

$f_2 = x_1x_2x_3 + x_1x_4 + x_2x_4 = \overline{\bar{x}_1\bar{x}_2 + \bar{x}_1\bar{x}_3 + \bar{x}_2\bar{x}_4 + \bar{x}_3\bar{x}_4}$

$f_2^D = x_1x_2 + x_1x_4 + x_2x_4 + x_3x_4$

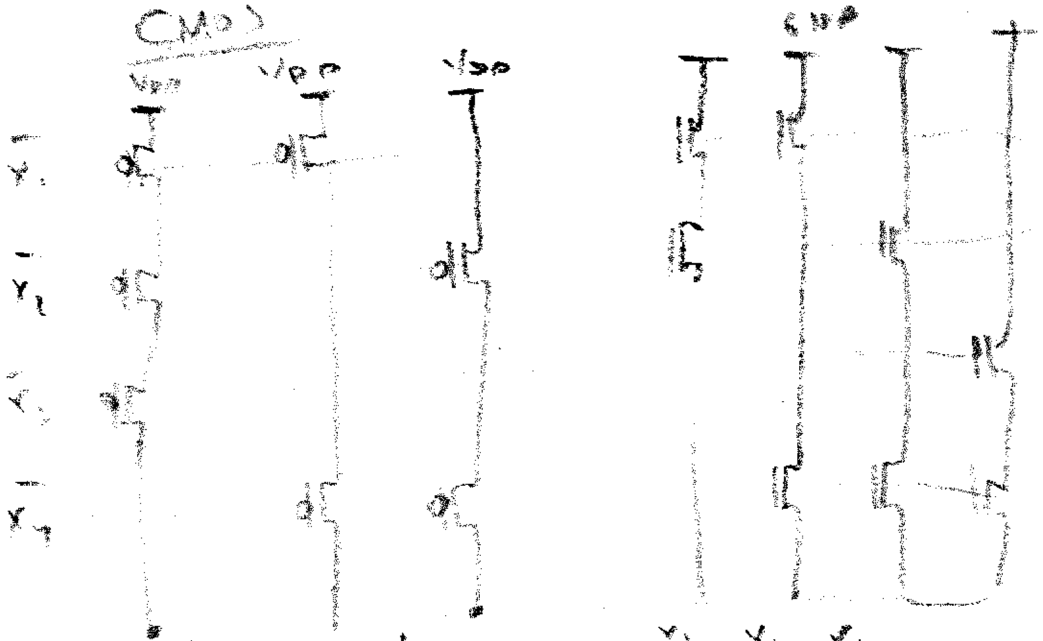
Diode

3×5=15 crosspoint



CMOS

5×7=35 crosspoint



4 terminal

4×3=12 crosspoints

	$x_1x_2x_3$	x_1x_4	x_2x_4
x_1x_2	x_1	x_1	x_2
x_1x_4	x_1	x_4	x_4
x_2x_4	x_2	x_4	x_2
x_3x_4	x_3	x_4	x_4

$f = x_1 \bar{x}_2 x_3 + x_1 \bar{x}_3 + x_2 \bar{x}_3 \bar{x}_4 = \overline{\bar{x}_1 x_2 + \bar{x}_1 x_3 + \ldots}$

$f^D = x_1 x_2 + x_1 x_3 + \bar{x}_2 \bar{x}_4 + x_3 \bar{x}_4$

Diode $\Rightarrow 3 \times 6 = 18$ crosspoint   [illegible]
CMOS $\Rightarrow 6 \times 7 = 42$ crosspoints $4 \times 3 = 12$ crosspoints

b)

f in irredundant form

Diode

$\#$ of crosspoints = ($\#$ of products in f) $\times$ ($\#$ of literals in f + 1)

$\#$ of rows $\#$ of columns

NOS

$\#$ of crosspoints = ($\#$ of literals in f + ~~1~~) ($\#$ of products in f + $\#$ of products in f^D)

$\#$ of rows $\#$ of columns

Unterminated

$\#$ of crosspoints = ($\#$ of products in f^D) ($\#$ of products in f.)