DLD: The final homework 4 Peter Dravlishnikov
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S.5 In a combinational circuit, a truth table represents the resulting outputs with the given inputs in a cause-and-effect relation.

In a sequential circuit, a state table represents all possible transitions and outputs (if any) with given input(s) (external or CLK)

A characteristic table represents a flip-flop's next state by the action of its inputs and the previous state (when applicable). A characteristic equation can be derived from ~~the~~ this table.

An excitation table represents the required flip-flop inputs to perform the desired state transition from the current state to the next state.

A Boolean equation describes an output based on the function of its inputs, not necessarily dependent on state or time.

A state equation describes the next state based on a (aka transition equation) function of the current state and input ~~variables~~ function.

A characteristic equation describes the next state of the flip-flop based on the ~~inputs of~~ function of the flip-flop inputs and the clock edge (when applicable)

~~flip-flop input equation describes an asynchronous reset/set function independent of the clock state~~

The flip-flop input equations describe the function of the global inputs to the flip-flop outputs for a particular output flip-flop

A state equation differs from the rest in that it abstracts the flip-flop inputs from the equation as a generic input.

A characteristic equation differs in that it only concerns the flip-flop's states.

A flip-flop input equation differs in that it only concerns the real input to the flip-flop input, not the flip-flop output

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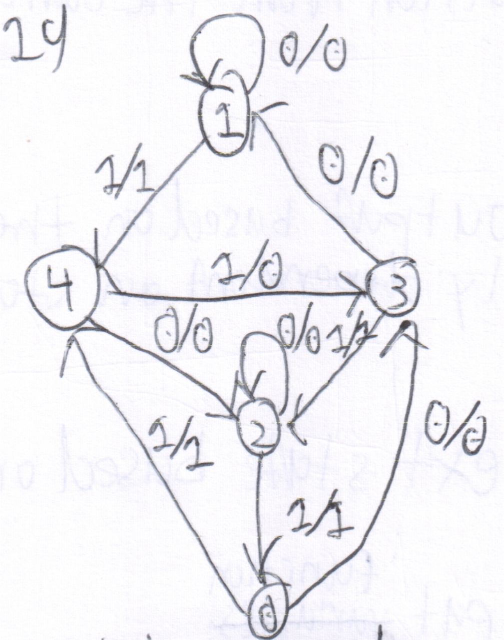
5.24



note: replaced state labels with decimal equivalent; original binary values used in tables

Present state Q	Q^+ given input: x_in 0	Q^+ given input: x_in 1	x_out output given input: x_in 0	x_out output given input: x_in 1
000	011	100	0	1
001	001	100	0	1
010	010	000	0	1
011	~~010~~ ~~100~~ 001	010	0	1
100	010	011	0	0
rest	don't care			

both parts; see next pages for ff table & implementations

5.19 cont.

d)

D	Q^+
0	0
1	1

flip-flop inputs same as Q^+ given input x_in

D inputs
3 ffs needed
same as Q^+

Q (A B C)	x_in	Q^+ (A^+ B^+ C^+)	Y_out
0 0 0	0	0 1 1	0
0 0 0	1	1 0 0	1
0 0 1	0	0 0 1	0
0 0 1	1	1 0 0	1
0 1 0	0	0 1 0	0
0 1 0	1	0 0 0	1
0 1 1	0	0 0 1	0
0 1 1	1	0 1 0	1
1 0 0	0	0 1 0	0
1 0 0	1	0 1 1	0

rest "x" don't care

$A^+ = A'B'x\_in$

A^+

AB \ Cx	00	01	11	10
00	0	1	1	0
01	0	1	0	0
11	x	x	x	x
10	0	0	x	x

$B^+ = C'x\_in' + AC' + BCx\_in$

B^+

AB \ Cx	00	01	11	10
00	1	0	0	0
01	1	0	1	0
11	x	x	x	x
10	1	1	x	x

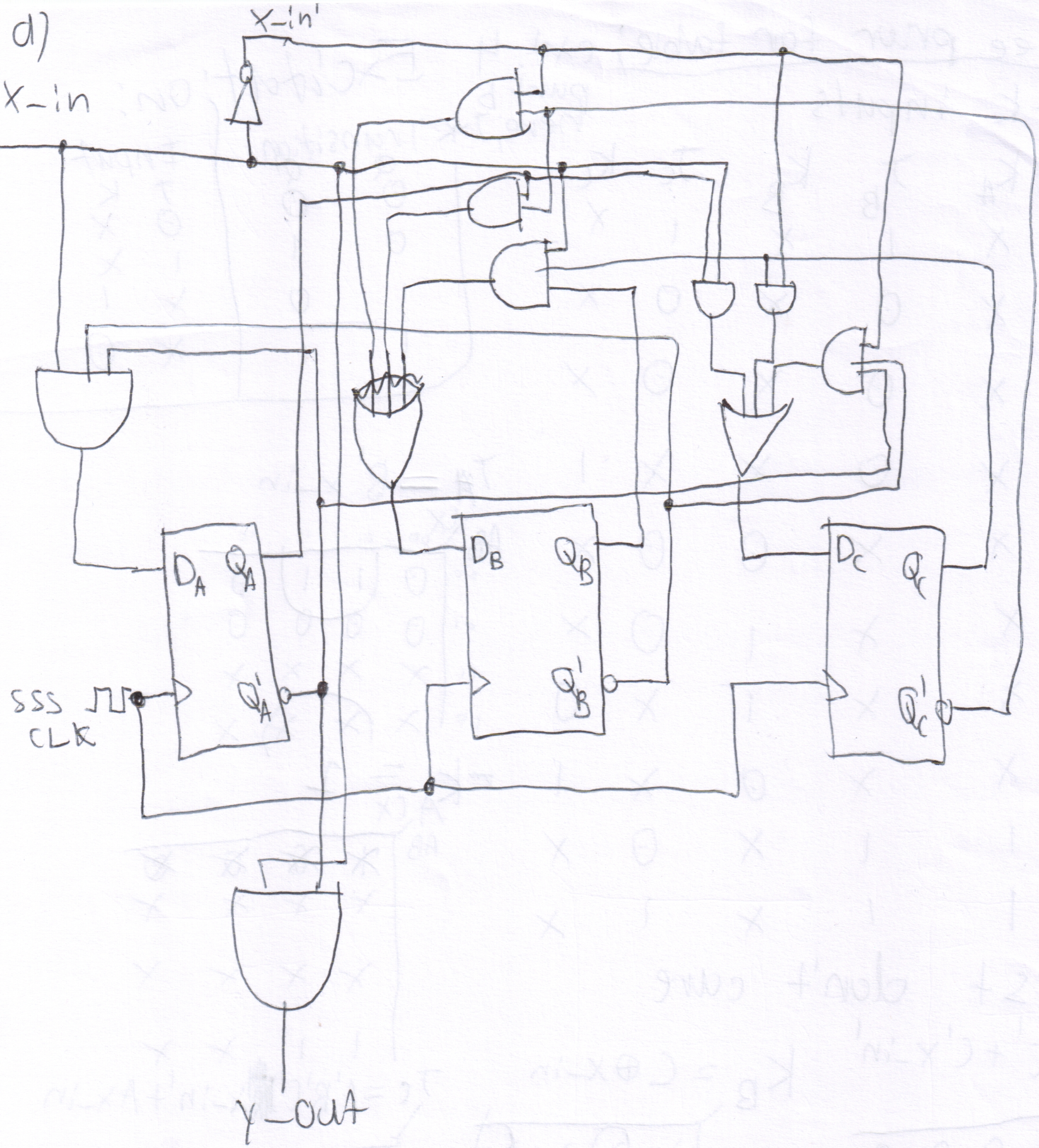
$C^+ = A'B'x\_in' + Cx\_in' + Ax\_in$

AB \ Cx	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	x	x	x	x
10	0	1	x	x

$Y\_out = A'x\_in$

AB \ Cx				
	0	1	1	0
	0	1	1	0
	x	x	x	x
	0	0	x	x

d)



b) See prior for table; ext. 4 part b here; J-K Transition Excitation:

Q	Q^+	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

J-K inputs

J_A	K_A	J_B	K_B	J_C	K_C
0	X	1	X	1	X
1	X	0	X	0	X
0	X	0	X	0	X
1	X	0	X	X	1
0	X	X	0	0	X
0	X	X	1	0	X
0	X	X	1	X	0
0	X	X	0	X	1
X	1	1	X	0	X
X	1	1	X	1	X

rest don't care

$J_A = B' x\_in$

AB \ CX	00	01	11	10
00	0	1	1	0
01	0	0	0	0
11	X	X	X	X
10	X	X	X	X

$K_A = 1$

AB \ CX				
	X	X	X	X
	X	X	X	X
	X	X	X	X
	1	1	X	X

$J_B = AC' + C'x\_in'$

AB \ CX				
	1	0	0	0
	X	X	X	X
	X	X	X	X
	1	1	X	X

$K_B = C \oplus x\_in$

X	X	X	X
0	1	0	1
X	X	X	X
X	X	X	X

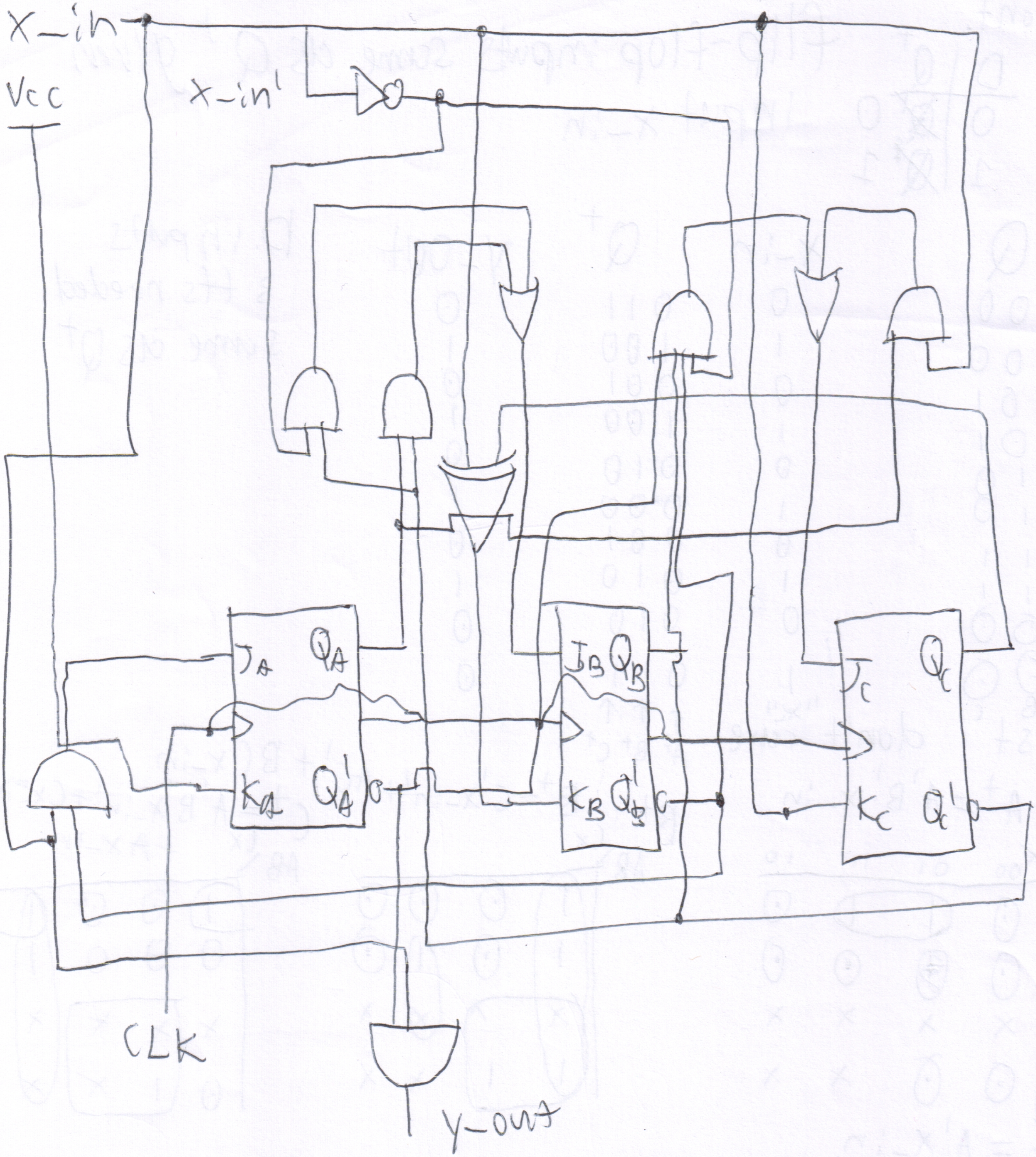
$J_C = A'B'C'x\_in' + A x\_in$

1	0	X	0
0	0	X	X
X	X	X	X
0	1	X	X

$K_C = x\_in$

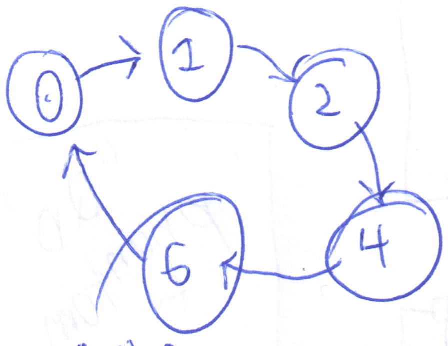
X	X	1	X
X	X	1	0
X	X	X	X
X	X	X	X

y_out is same from part a)


X_in
Vcc
x-in'
J_A
Q_A
K_A
Q_A'
J_B
Q_B
K_B
Q_B'
J_C
Q_C
K_C
Q_C'
CLK
Y-out

6.28

a) counter 0, 1, 2, 4, 6



Q: A	B	C	Q^+: A^+	B^+	C^+
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	1	0	0
1	0	0	1	1	0
1	1	0	0	0	0

D-ff same as Q^+

$A^+ = A \oplus B$

A \ BC	00	01	11	10
0	0	0	X	1
1	1	X	X	X

$B^+ = AB' + C$

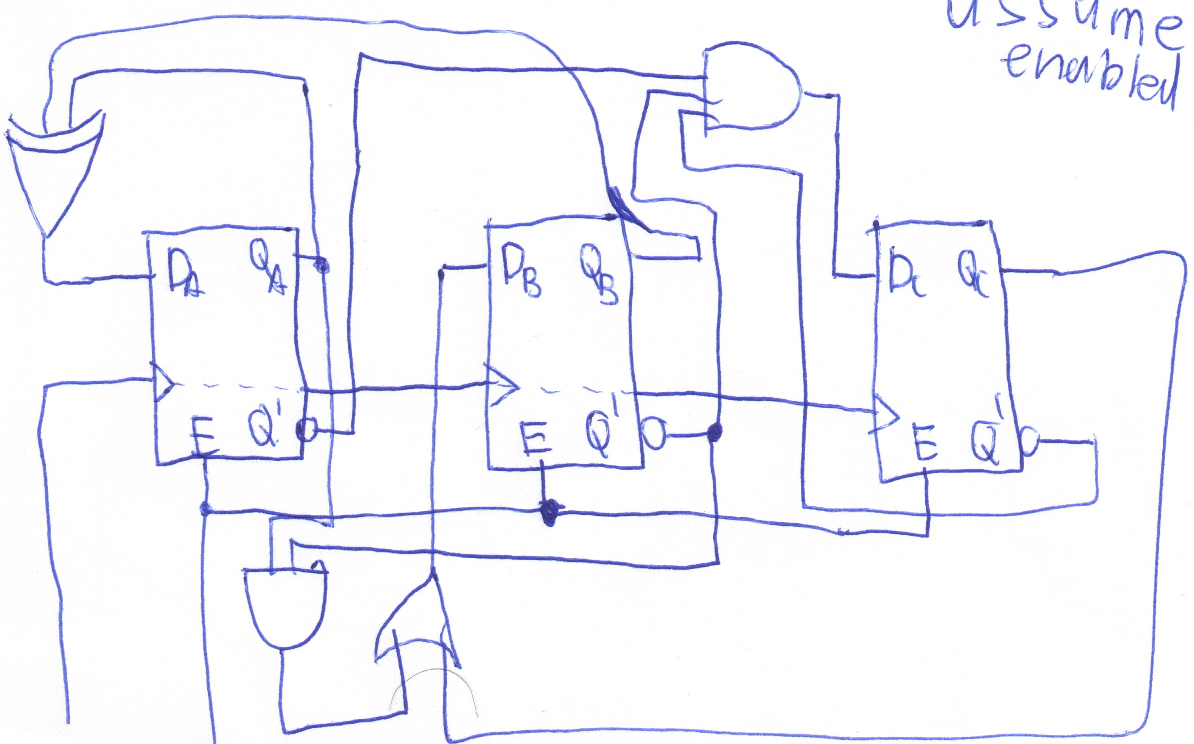
A \ BC	00	01	11	10
0	0	1	X	0
1	1	X	X	X

$C^+ = A'B'C'$

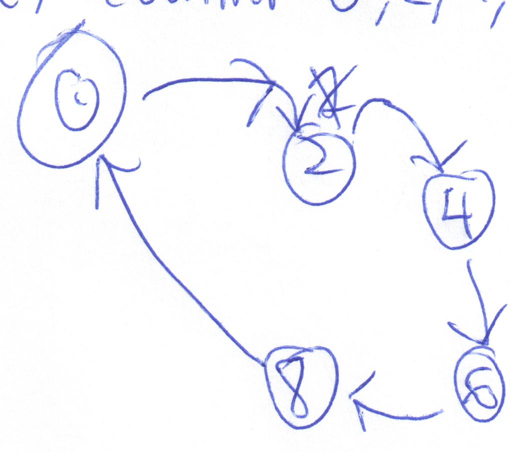
A \ BC	00	01	11	10
0	1	0	X	0
1	0	X	X	0

assume ffs enabled

b)



c) counter 0, 2, 4, 6, 8



Q: A	B	C	D	Q^+: A^+	B^+	C^+	D^+
0	0	0	0	0	0	1	0
0	0	1	0	0	1	0	0
0	1	0	0	0	1	1	0
0	1	1	0	1	0	0	0
1	0	0	0	0	0	0	0

by observation $D^+ = 0 = D$ therefore, not in kmaps (phantom flip-flop)

$A^+ = BC$

A \ BC				
0	0	X	1	0
1	0	X	X	X

$B^+ = B \oplus C$

A \ BC				
0	0	1	0	1
1	0	X	X	X

$C^+ = C'A'$

A \ BC				
0	1	0	0	1
1	0	X	X	X

d)