Consider a coin-operated tire-pressure machine that costs 15 cents to fill a tire with compressed air. There are four coin slots, three for nickels (N_1, N_2, N_3) and one for a dime (D), each with a sensor to detect whether a coin has been placed into the slot. When there is at least 15 cents in the four slots, the machine will start to dispense air into the tire and the machine will dispense any change that the user has coming to her: either a nickel change (N_{chg}) or a dime change (D_{chg}).

1.) Fill in the truth table (below) listing the potential combinations of inputs (N_1, N_2, N_3, D) and each of the corresponding outputs (START, N_{chg}, D_{chg}).
2.) Convert the truth table listings for the START output to a Karnaugh map (Part A), and then interpret the map patterns to derive the logic expression for the START signal (Part B).

N_1	N_2	N_3	D	Start	N_{chg}	D_{chg}
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1			
0	1	1	0			
0	1	1	1			
1	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			

Part 2A:

START		N_3 D: 0 0	0 1	1 1	1 0
N_1 N_2	0 0				
	0 1				
	1 1				
	1 0				

Part 2B:

START=

3.) Derive the Karnaugh map and logic expression for the signal to return a nickel of change (see #3, below).
4.) Derive the logic expression for the signal to return a dime of change (see #4, below).

#3:

Nchg		N_3 D: 0 0	0 1	1 1	1 0
N_1 N_2	0 0				
	0 1				
	1 1				
	1 0				

N_{chg}=

#4:

Dchg		N_3 D: 0 0	0 1	1 1	1 0
N_1 N_2	0 0				
	0 1				
	1 1				
	1 0				

D_{chg}=

5.) Derive the logic expression for each of the following Karnaugh maps (see below):

Part 5A:

Output X		C D: 0 0	0 1	1 1	1 0
A B	0 0	0	0	1	1
	0 1	0	0	1	1
	1 1	1	1	1	1
	1 0	1	0	0	1

X=

Part 5B:

Output Y		B C: 0 0	0 1	1 1	1 0
A	0	1	0	1	1
	1	0	0	1	0

Y=