Name: _____

Read each question carefully before answering. Answer all parts. Show all work, calculations, and/or reasoning, otherwise no points will be awarded. Properly labeled loops must be shown on K-maps. Point values are as indicated.

1. (30 points) Determine if $M \equiv N$. (Hint: you may first want to reduce each table to a minimum number of states!)

M

	$X = 0$	$X = 1$	
S_0	S_3	S_1	0
S_1	S_0	S_1	0
S_2	S_0	S_2	1
S_3	S_0	S_3	1

N

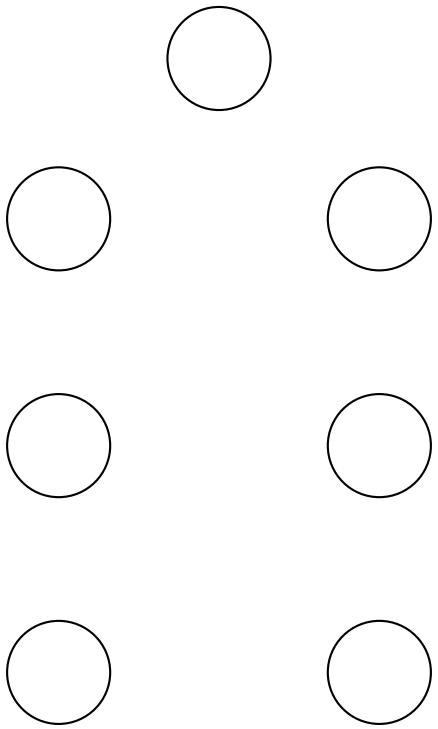
	$X = 0$	$X = 1$	
A	E	A	1
B	F	B	1
C	E	D	0
D	E	C	0
E	B	D	0
F	B	C	0

2. Create a **disjoint window** Mealy machine that detects the sequence **1101**. The output only occurs at the end of the window.

   (a) (4 points) Given the following inputs, indicate the output at each time. (Hint: do we care what the output is during the first 3 clock cycles for a disjoint window detector?)

$x =$	0	0	1	1	0	1	1	0	1	1	0	1	0	1	0	0	1	1	0	1
$z =$																				

   (b) (7 points) Fill out the following state diagram with correct state names and transition / output arrows. Do not add any extra states, the state diagram template below is sufficient to realize this circuit!



   (c) (1 point) How many flip-flops are necessary to build this sequential circuit?

(d) (28 points) Fill out the following state table.

Current State	Next State		Output	
	$X = 0$	$X = 1$	$X = 0$	$X = 1$

(e) (3 points) Use the guidelines for state assignment to find reduced binary representations for each state.

Guideline 1:

Guideline 2:

Guideline 3:

(f) (7 points) Use a K-map to determine state assignments for each state. Indicate the binary values for each state.

(g) (28 points) Fill out the following transition table.

Current State	Next State		Output	
	$X = 0$	$X = 1$	$X = 0$	$X = 1$

(h) (20 points) Using D flip-flops, derive an equation for each flip-flop.

BC \ XA	00	01	11	10
00				
01				
11				
10				

BC \ XA	00	01	11	10
00				
01				
11				
10				

BC \ XA	00	01	11	10
00				
01				
11				
10				

(i) (10 points) Derive an equation for the output.

BC \ XA	00	01	11	10
00				
01				
11				
10				