

A) $\{L = 0^n 1^n \mid n \geq 1\}$

1)

- Scan for a 0 and change to a X
- Move to the right looking for a 1 and change to a Y
- Move to the left to the nearest x and continue repeating above steps
- After changing a 0 to a X, if there is no 1 found, then Reject
- After changing a 1 to a Y, if there is no 0 found, then Accept

2)

$$Q = q_o$$
$$\Sigma = \{0, 1\}$$
$$\Gamma = \{\Sigma \cup _ \cup \{X, Y\}\}$$

δ = See #3

$$q_o = q_o$$
$$q_{\text{accept}} = q \in Q$$
$$q_{\text{reject}} = q \in Q$$

3)

	0	1	X	Y	\perp
q_0	(q_1, X, R)	-	-	-	-
q_1	$(q_1, 0, R)$	(q_2, Y, L)	-	(q_1, Y, R)	-
q_2	$(q_2, 0, L)$	-	(q_0, X, R)	(q_2, Y, L)	-

4)

[illegible]

5)

	0	0	1	0
X	0	1	0	
X	0	1	0	
X	0	1	0	
X	0	Y	0	
X	0	Y	0	
X	0	Y	0	
X	0	Y	0	
X	X	Y	0	
X	X	Y	0	
X	X	Y	0	Reject

B) $L = \{w \in \{0, 1\}^* \mid |w|_0 = |w|_1\}$

1)

- Add # to mark left edge
- Move right looking for 0 and change to X
- Move left to #
- Move right looking for 1 and change to Y
- Move left to # and repeat steps
- If looking for 0 and find \sqcup , then Accept
- If looking for 1 and find \sqcup , then Reject

2)

$Q = q_0$

$\Sigma = \{0, 1\}$

$\Gamma = \{\Sigma \cup \sqcup \cup \# \cup \{X, Y\}\}$

$\delta = \text{See \#3}$

$q_0 = q_0$

$q_{\text{accept}} = q \in Q$

$q_{\text{reject}} = q \in Q$

3)

	0	1	X	Y	#	\sqcup
q_0	(q_1, X, L)	$(q_0, 1, R)$	(q_0, X, R)	(q_0, Y, R)	-	-
q_1	-	$(q_1, 1, L)$	(q_1, X, L)	(q_1, Y, L)	$(q_2, \#, R)$	-
q_2	$(q_2, 0, R)$	(q_3, Y, L)	(q_2, X, R)	(q_2, Y, R)	-	-
q_3	$(q_3, 0, L)$	-	(q_3, X, L)	(q_3, Y, L)	$(q_0, \#, R)$	-

C) By using a 2nd tape, you could simulate the stack of the PDA. On this 2nd tape, the pointer would have to point to the right most populated cell. The pointer moves to the right when a value is written to the 2nd tape, (pushed), and moves to the left when a value is read from the tape, (popped).

D) $L = \{ww \mid w \in \{0, 1\}^*\}$

- Copy contents of tape 1 to tape 2
- Starting at the left edge, move both pointers to the right
- Nondeterministically find and mark the middle cell on both tapes
- Keep pointer on tape 2 at this position
- Move pointer on tape 1 to left edge
- Move pointer on tape 1 and 2 to the right comparing the contents of each cell
- If contents differ before pointer on tape 1 reaches midpoint or pointer on tape 2 reaches \sqcup , then Reject
- If pointer on tape 2 reaches \sqcup before pointer on tape 1 reaches the midpoint, then Reject. Reject in reverse case as well
- If contents remain the same and pointer on tape 1 reaches the midpoint when the pointer on tape 2 reaches \sqcup , then Accept