Question 1:

1.1 A

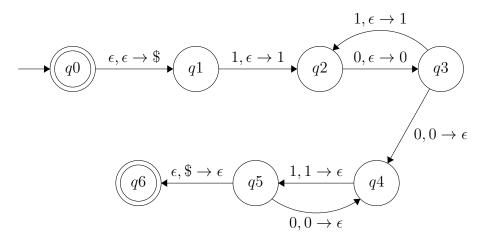
RegEx for:

$$M_A = (10)^*$$

 $M_B = (01)^*$

1.2 B

PDA for $L_{A||B} = \{uv|u \in L(M_A) \cap v \in L(M_B) \cap |u| = |v|\}$:



1.3 C

Parsing Input: 10100101

Input:								$[(q_0 \to q_1) : \epsilon, \epsilon \to \$]$
Stack:	\$	ϵ						$\boxed{ [(q_0 \rightarrow q_1) : \epsilon, \epsilon \rightarrow \emptyset] }$
Input:	1							$[(q_1 \to q_2): 1, \epsilon \to 1]$
Stack:	1	\$	ϵ					$[(q_1 \rightarrow q_2) : 1, \epsilon \rightarrow 1]$
Input:	1	0						$[(q_2 \to q_3) : 0, \epsilon \to 0]$
Stack:	0	1	\$	ϵ				$[(q_2 \rightarrow q_3) : 0, \epsilon \rightarrow 0]$
Input:	1	0	1					$[(q_3 \rightarrow q_2): 1, \epsilon \rightarrow 1]$
Stack:	1	0	1	\$	ϵ			
Input:	1	0	1	0				$[(q_2 \to q_3) : 0, \epsilon \to 0]$
Stack:	0	1	0	1	\$	ϵ		
Input:	1	0	1	0	0			$[(q_3 \to q_4): 0, 0 \to \epsilon]$
Stack:	1	0	1	\$	ϵ			$[(q_3 \rightarrow q_4) : 0, 0 \rightarrow \epsilon]$
Input:	1	0	1	0	0	1		$[(q_4 \rightarrow q_5): 1, 1 \rightarrow \epsilon]$
Stack:	0	1	\$	ϵ				$[(q_4 \rightarrow q_5) \cdot 1, 1 \rightarrow \epsilon]$
Input:	1	0	1	0	0	1	0	$[(q_5 \rightarrow q_4): 0, 0 \rightarrow \epsilon]$
Stack:	1	\$	ϵ					$[(q_5 \rightarrow q_4) : 0, 0 \rightarrow \epsilon]$
Input:	1	0	1	0	0	1	0	$\boxed{1} \boxed{ \boxed{ \boxed{1}} \boxed{ } [(q_4 \rightarrow q_5) : 1, 1 \rightarrow \epsilon]}$
Stack:	\$	ϵ						$[(q_4 \rightarrow q_5) : 1, 1 \rightarrow \epsilon]$
Input:	1	0	1	0	0	1	0	$\boxed{1} \boxed{ \boxed{ [(q_5 \to q_6) : \epsilon, \$ \to \epsilon]}}$
Stack:	ϵ							$[(q_5 \rightarrow q_6) \cdot \epsilon, \emptyset \rightarrow \epsilon]$

Input Accepted.

Question 2:

2.1 A

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Grammar for L_1 = \{1^n 0^{2n} | n \ge 0\}:

S \to 1S00 | \epsilon
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2.2 B

Considering the string $w = 1^p 0^{2p} \in L_1$:

For a split into the parts uvxyz, the pump-able segment v must consist of only 1, so v=1 and segment y must consist of only 00, y=00. So when you pump both segments as follows: $uv^ixy^iz \ \forall i \geq 0$ the condition that there are two times as many 0's as 1's will hold.

2.3 C

Considering the string $w = 1^p 0^{2p} 1^p \in L_1$:

There are a number of possible cases for a split into the parts uvxyz.

One is that the pump-able segment v would consist of 1, so v = 1 and segment y would consist of 00, so y = 00. This is not pump-able since the succeeding number of 1's wont equal the preceding number.

Another is that the pump-able segment v would consist of 10, so v = 10 and segment y would consist of 1, so y = 1. This is not pump-able since the succeeding number of 0's wont be twice the number of preceding and succeeding 1's.

Another is that the pump-able segment v would consist of 1, so v = 1 and segment y would consist of 01, so y = 01. This is not pump-able since the number of 0's wont be twice the number of preceding and succeeding 1's and they would be out of order.

Another is that the pump-able segment v would consist of 10, so v = 10 and segment y would consist of 01, so y = 01. This is not pump-able since the values would be out of order.

So in any condition, if you pump both segments as follows: $uv^ixy^iz \forall i \geq 0$ the condition that there are n 1's followed by 2n 0's followed by n 1's again can't possibly hold.