

## Question 1:

### 1.1 A

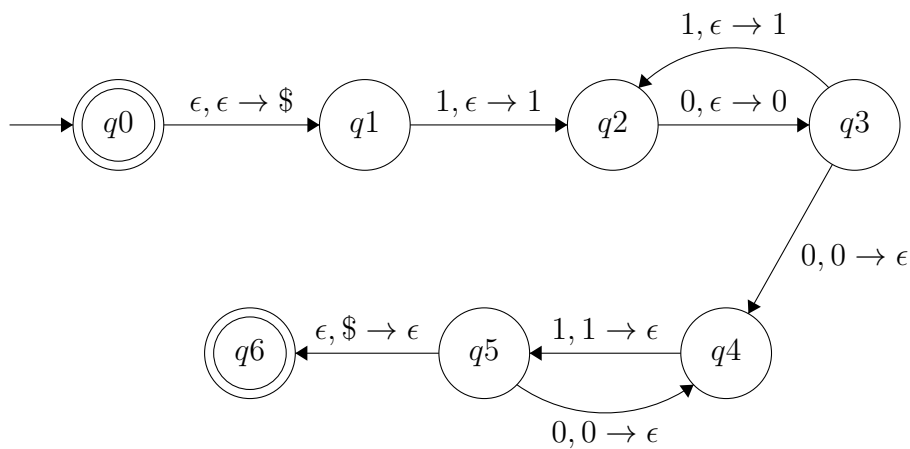
RegEx for:

$$M_A = (10)^*$$

$$M_B = (01)^*$$

### 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

[illegible]

Input Accepted.

## Question 2:

### 2.1 A

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

$$S \rightarrow 1S00 | \epsilon$$

### 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:  $uv^i xy^i z \forall i \geq 0$  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 won't 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 won't 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 won't 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:  $uv^i xy^i z \forall i \geq 0$  the condition that there are  $n$  1's followed by  $2n$  0's followed by  $n$  1's again can't possibly hold.