Problem 1:

1. $A = \emptyset = \{\}$

Regular?

No

Context-Free?

No

2. $B = \{0^n 1^{2n} 0^n \mid n \geq 0\}$

010

00111100

Regular?

Yes

Context-free?

$S \rightarrow 0S0 \mid 1S1 \mid \varepsilon$

Yes

3. $C = \{0^n 10^n \mid n \geq 0\}$

Regular?

No

Context-free?

Yes

010 000101010

00 1010

$S \rightarrow 0S \mid AS \mid \varepsilon$

$A \rightarrow BC$

$B \rightarrow 1$

$C \rightarrow 0$

Problem 2

1. $D = \{ wx\, w^R x^R \mid w, x \in \{0,1\}^x \}$ w^R is Reverse (x^R)

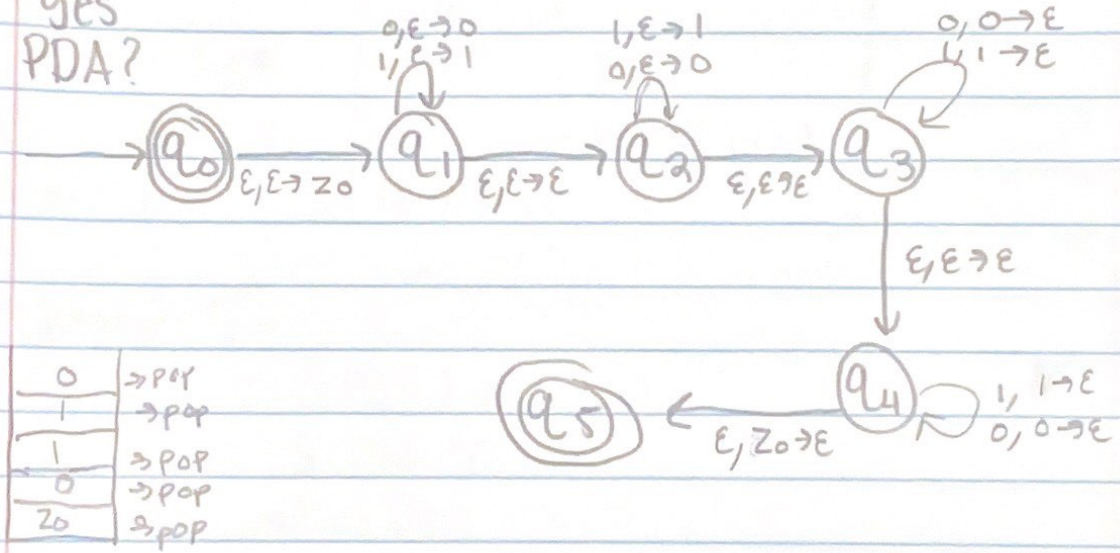
Regular?

No 0110100 1001011O

Context-free?

Yes

PDA?



2. $\Sigma = \{ wx w^R x^R \mid w, x \in \{0\}^* \}$

Regular?

No

Context-free?

No

Problem 3

$S \to TT$

$T \to USU \mid \varepsilon$

$U \to 0 \mid 1$

Step 0: new start	Step 1: ε-prod.
$S_0 \to S$	$S_0 \to S \mid \varepsilon$
$S \to TT$	$S \to TT \mid T$
$T \to USU$	$T \to USU \mid SU \mid US \mid UU$
$U \to 0 \mid 1$	$U \to 0 \mid 1$

Step 2: unit prod

$S_0 \to TT \mid USU \mid SU \mid US \mid UU \mid \varepsilon$

$S \to TT \mid USU \mid SU \mid US \mid UU$

$T \to USU \mid SU \mid US \mid UU$

$U \to 0 \mid 1$

Step 3: Cleanup (Terminals → values / Break long prod.)

$S_0 \to TT \mid VU \mid SU \mid US \mid UU \mid \varepsilon$

$S \to TT \mid VU \mid SU \mid US \mid UU$

$T \to VU \mid SU \mid US \mid UU$

$U \to WX$

$V \to US$

$W \to 0$

$X \to 1$