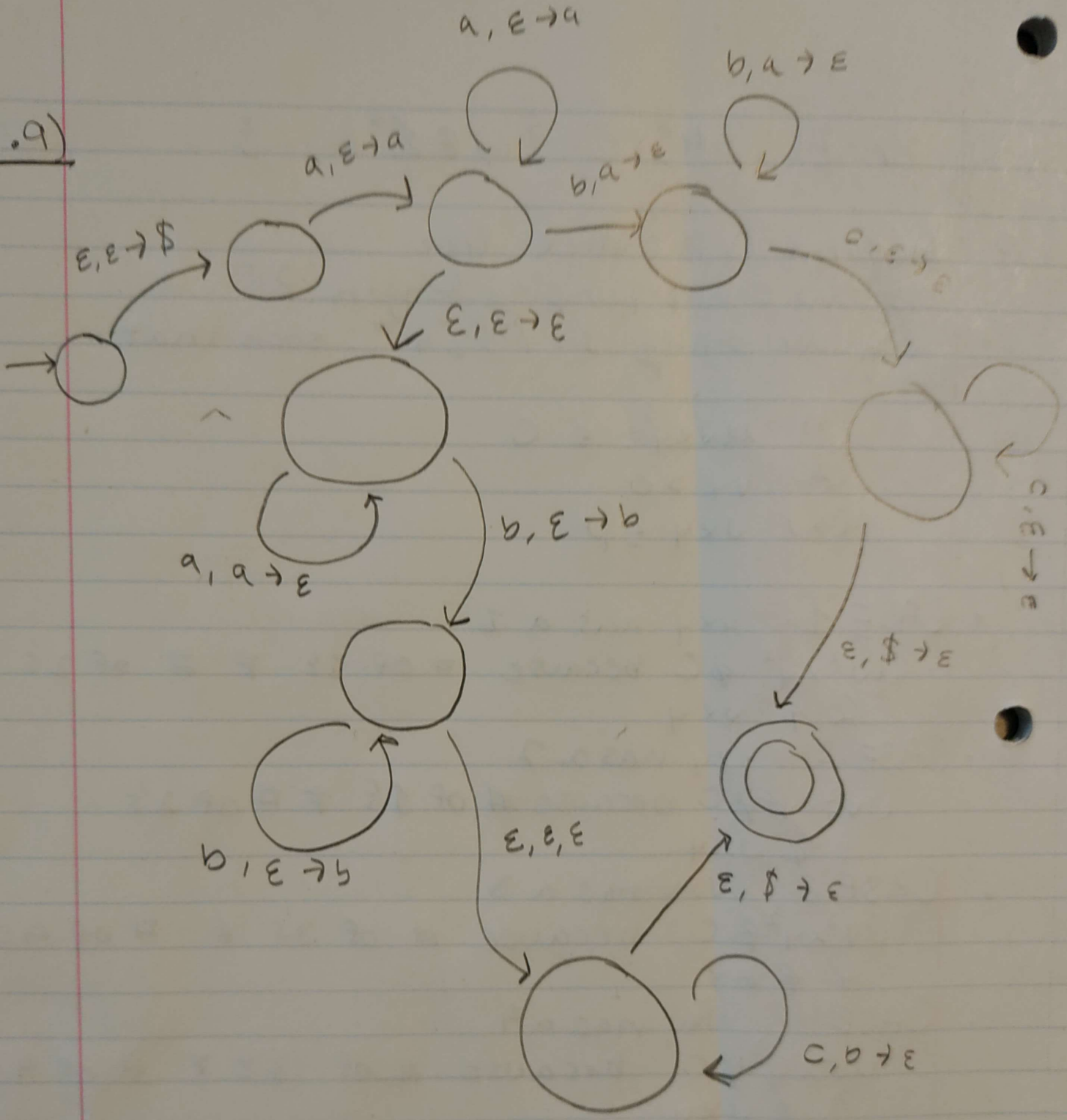
2.9)



2.11)

$E \to E + T \mid T$

$T \to T \times F \mid F$

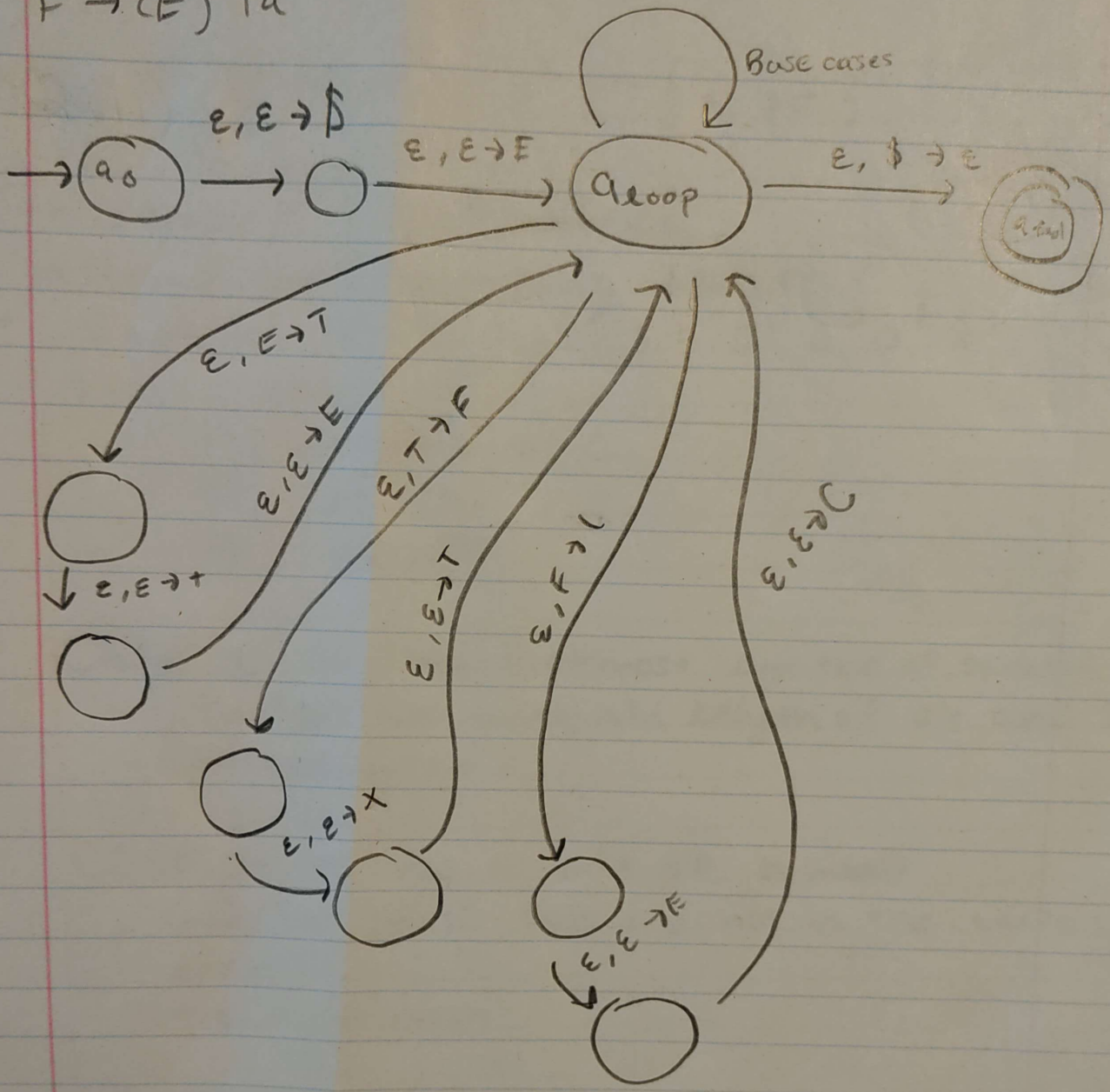
$F \to (E) \mid a$

$\varepsilon, E \to T$ $\varepsilon, T \to F$

$\varepsilon, F \to a$ $+, + \to \varepsilon$

$x, x \to \varepsilon$ $(, (\to \varepsilon$

$),) \to \varepsilon$ $a, a \to \varepsilon$



2.18)

a) Let D be a DFA that recognizes R
Let P be a PDA that recognizes C

* Prove C recognizes $C \cap R$
$\underline{Q}$ set of states of P
Q set of states of D
F_P is set of states accepted by P
F_D is set of states accepted by D

PDA that recognizes $C \cap R$ stops if
$q \in F_P \times F_D$

So $C \cap R$ is recognized by $\overline{P}$

- Therefore by proof of construction $C \cap R$ is context free

b) - R is the regular language $a^* b^* c^*$
- If A were a CFL then $A \cap R$ would be a CFL
- But since $A \cap R = \{a^n b^n c^n \mid n \geq 0\}$ proves $A \cap R$ is not context free via pumping lemma contradiction, then A is not context free.

2.30a) $C = \{0^n 1^n 0^n 1^n \mid n \geq 0\}$

- Assume C is context free
- Assume C has pumping length P
- Consider the string $S = 0^P 1^P 0^P 1^P = uvxyz$ such that
  1) $uv^i xy^i z \in C$
  2) $vy > 0$
  3) $|vxy| \leq P$

CASE 1: vy have atmost one type of symbol
uv^2xy^2z has unequal length of 0's and 1's
- contradiction

CASE 2: vy has a mix of symbols
uv^2xy^2z has symbols not in the correct order
- contradiction

By proof of contradiction C is not a context free language

2.32 $\Sigma = \{1,2,3,4\}$ $C = \{w \in \Sigma^* | \ldots\}$

- Assume C is context free
- Assume C has pumping length 'p'
- consider string $s = 1^p 3^p 2^p 4^p$ such that:

(1) $uv^i xy^i z \in C$
(2) $vy > 0$
(3) $vxy \leq p$

- CASE 1: vxy has a 1
  $uv^2xy^2 \notin C$ because # of 1's ≠ # of 2's
  $2 \notin vxy$
- CASE 2: vxy has a 2
  $uv^2xy^2 \notin C$ because # of 1's ≠ # of 2's
  $1 \notin vxy$
- CASE 3: vxy has a 3
  $uv^2xy^2 \notin C$ because # of 3's ≠ # of 4's
  $4 \notin vxy$
- CASE 4: vxy has a 4
  $uv^2xy^2 \notin C$ because # of 3's ≠ # of 4's
  $3 \notin vxy$

By proof of contradiction, C is not context free.