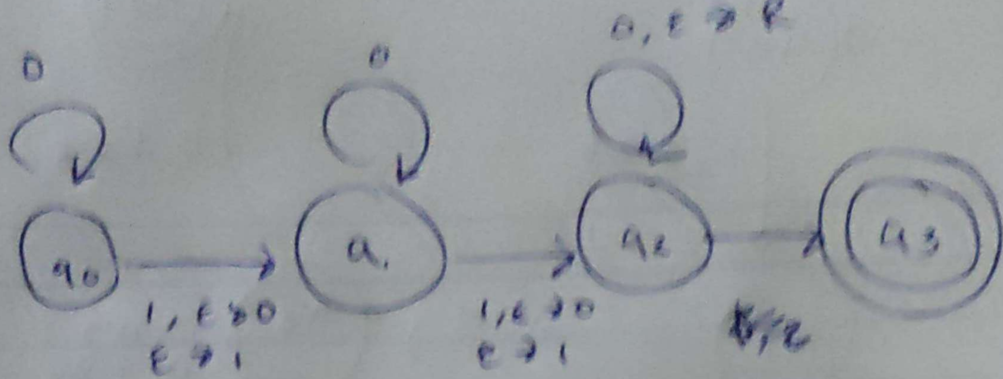
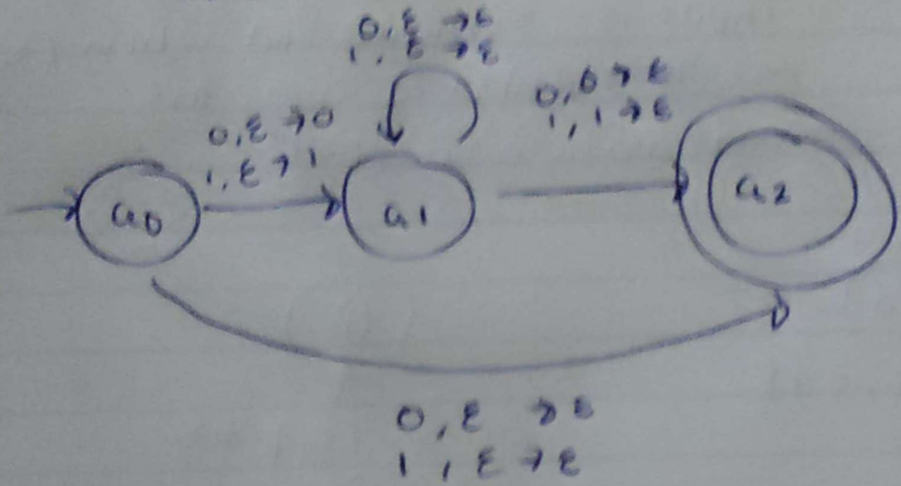
.5) a)



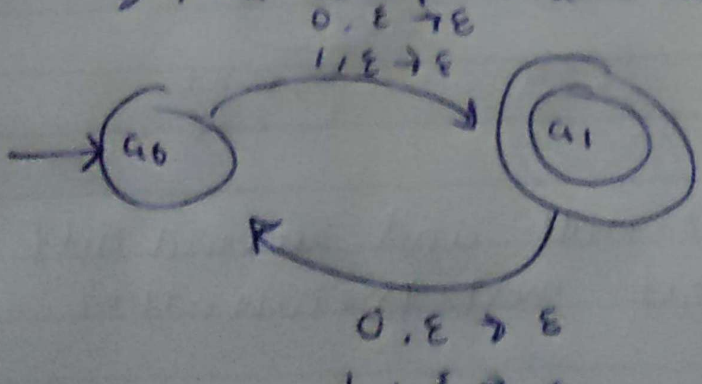
- input is read and accepted if there are at least 3 1's

b)

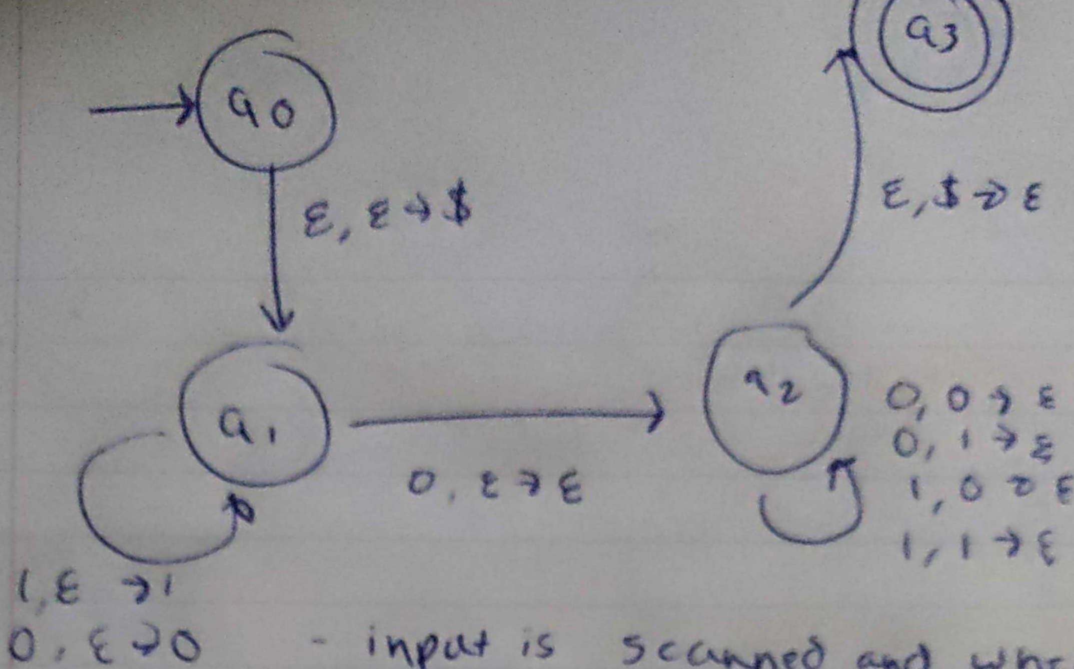


· if there is more than one symbol in the string, all are put sequentially into stack

c)

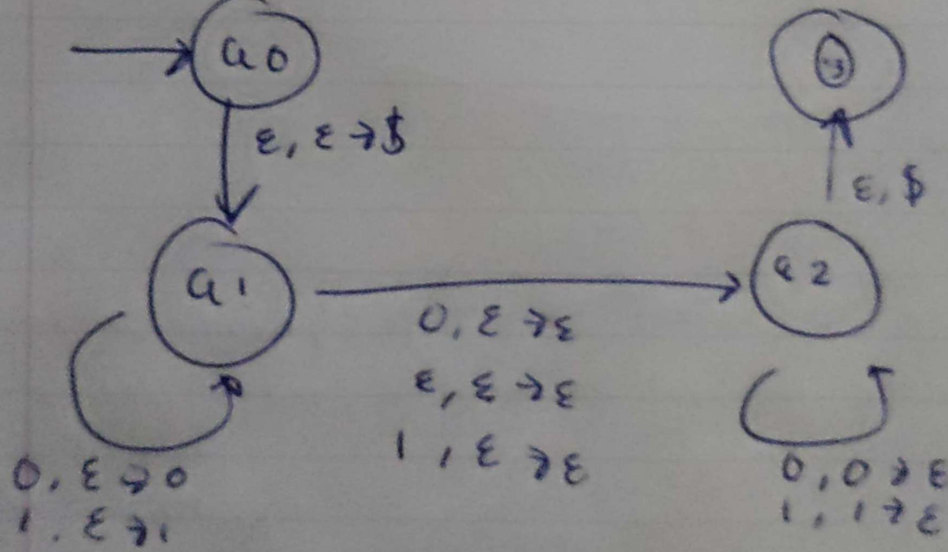


input is read when there is an odd length d)



- input is scanned and when the middle symbol is a 0, the automata is accepted

e)



- The first half and second half of the input match each other

f)

- Only accepts the empty

2.6) a) $S \to TaT$

$T \to TT \mid aTb \mid bTa \mid a \mid \varepsilon$

T generates all strings with at least as many a's as b's and S forces an extra a

b) $S \to S_1 \mid S_2$

$S_1 \to aS_1b \mid T \mid U$

$S_2 \to RbaR$

$T \to aT \mid a$

$U \to Ub \mid a$

$R \to RR \mid a \mid b \mid \varepsilon$

2.11)

$E \to E + T \mid T$

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

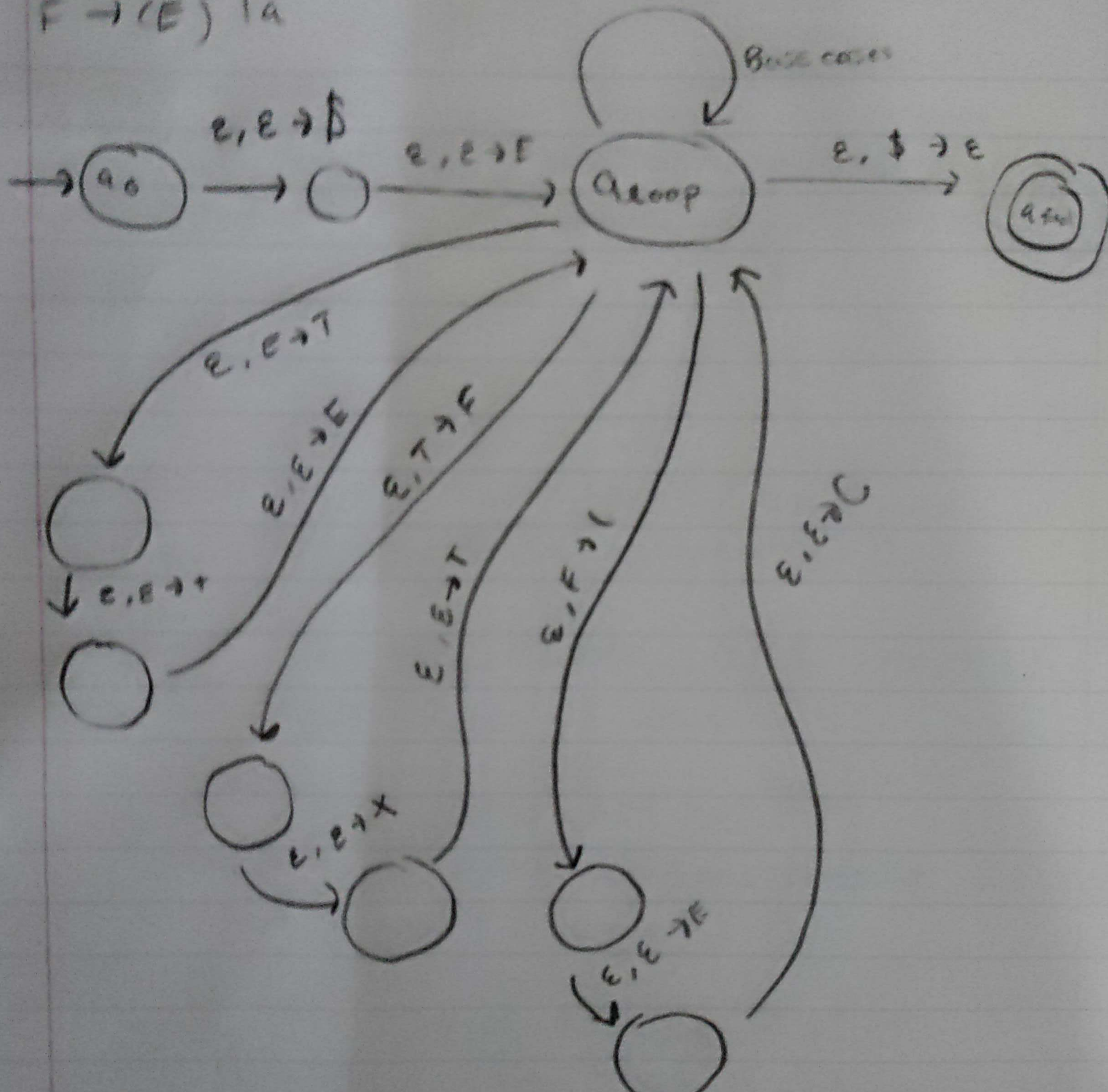
$F \to (E) \mid a$

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

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

$\times, \times \to \varepsilon$ $\quad (, (\to \varepsilon$

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



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 thar 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.

3.1 b)

* $(q_1, \underline{0}0)$
* $(q_2, \sqcup\underline{0})$
* $(q_3, \sqcup x \underline{\sqcup})$
* $(q_5, \sqcup \underline{x} \sqcup)$
* $(q_5, \underline{\sqcup} x \sqcup)$
* $(q_2, \sqcup \underline{x} \sqcup)$
* $(q_2, \sqcup x \underline{\sqcup})$
* $(q_{accept}, \sqcup x \sqcup \underline{\sqcup})$

$$\boxed{(q_{accept}, \sqcup x \sqcup \underline{\sqcup})}$$

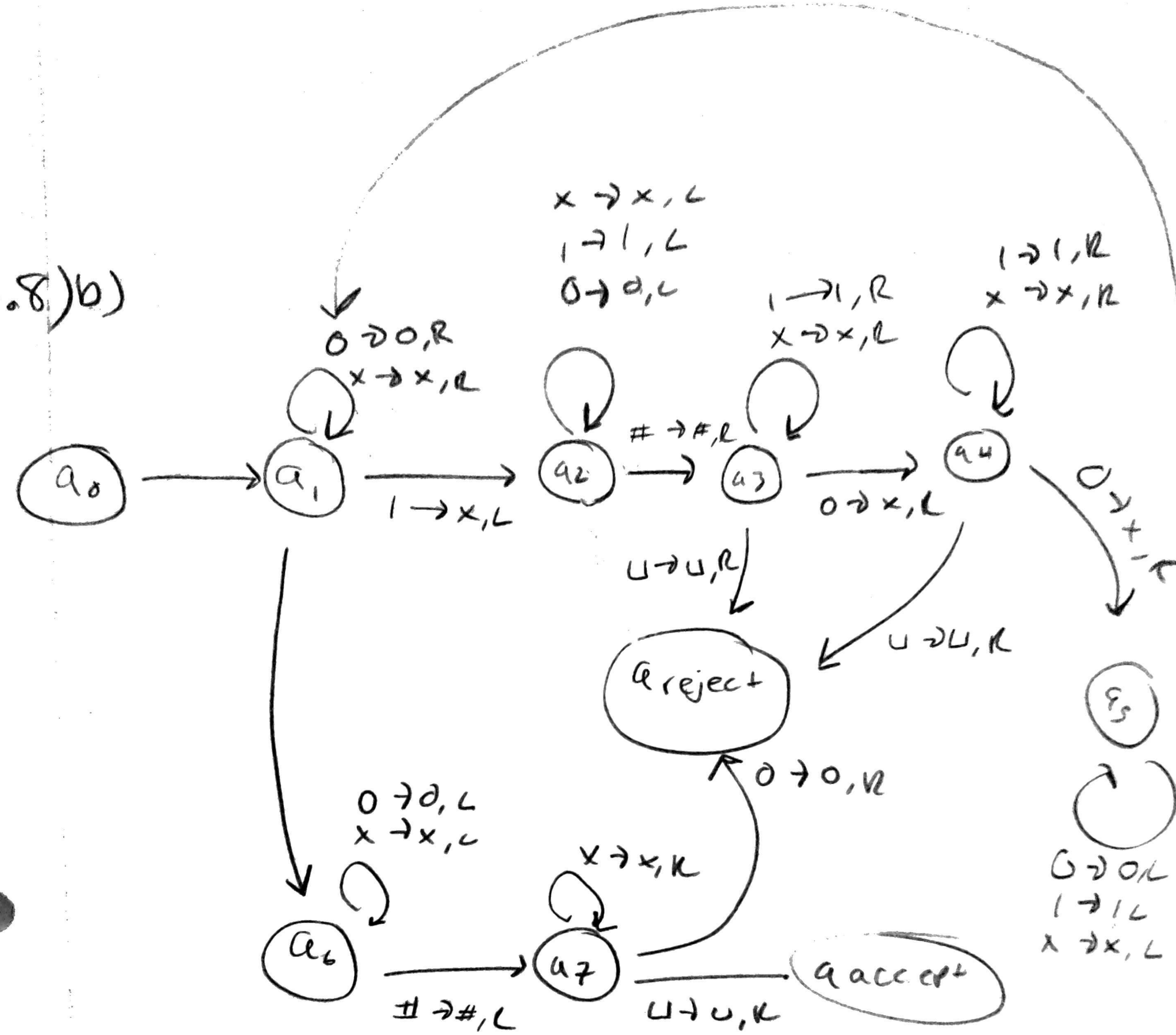
3.2 b)

1) $(q_1, \underline{1}\#1)$
2) $(q_3, x\underline{\#}1)$
3) $(q_5, x\#\underline{1})$
4) $(q_6, x\underline{\#}x)$
5) $(q_7, \underline{x}\#x)$
6) $(q_1, x\underline{\#}x)$
7) $(q_8, x\#\underline{x})$
8) $(q_8, x\#x\underline{\sqcup})$
9) $(q_{accept}, x\#x\sqcup\underline{\sqcup})$

3.2) c)
1) $(q_1, \underline{1}\#\#1)$
2) $(q_3, x\underline{\#}\#1)$
3) $(q_5, x\#\underline{\#}1)$
4) $(q_{reject}, x\#\#\underline{1})$

3.5) a) Yes. The tape Γ contains $\sqcup$. Turing machine can write any char on its tape
b) No, Σ never contains $\sqcup$. But Γ contains $\sqcup$.
c) Yes. If the Turing machine moves its head to the left-end it stays in the same cell
d) No. A Turing machine must have distinct states q_{accept} & q_{reject}

3.8) b)



q0
q1
0 → 0, R
x → x, R
1 → x, L
q2
x → x, L
1 → 1, L
0 → 0, L
→ #, R
q3
1 → 1, R
x → x, R
0 → x, L
q4
1 → 1, R
x → x, R
0 → x, L
q5
0 → 0, L
1 → 1, L
x → x, L
␣ → ␣, R
␣ → ␣, R
q reject
0 → 0, R
q6
0 → 0, L
x → x, L
→ #, L
q7
x → x, R
␣ → ␣, R
q accept

Flip accept and reject states?

3.8)
c)