Question 1: Exercise 3.2 Part c, d

Question 2: Exercise 3.6

Question 3: Exercise 3.7

There are a few issues with this proof. Explain what each issue is, and whether it can be fixed.

Question 4: Exercise 3.8 Part b, c

Part b
If you need to test for the beginning of the tape, make sure you explain how to do that.

Part c
Your answer to this should be very short (one sentence).

Question 5: Problem 3.9

Part a
Give a language that can be recognized by a 2-PDA that cannot be recognized by a 1-PDA. Give a brief explanation of how the 2-PDA will recognize the language.

Part b0
Before proving part b, first prove that a 2-PDA can simulate a Turing machine by doing the following:

- Explain how the two stacks can used to represent a configuration $uqv$ of a TM.
- Explain how to represent the initial configuration of the TM (where its input is on the tape, and the tape head is on the first square of the tape).
- Explain how the 2-PDA will simulate the TM when it transitions to the left $\delta(q_1, a) = (q_2, b, L)$. You do not need to account for how the TM acts at the beginning of the tape.
- Explain how the 2-PDA will simulate the TM when it transitions to the right $\delta(q_1, a) = (q_2, b, R)$. You must account for how the TM acts at the end of the tape.

Part b
Now that you have proved that a 2-PDA can simulate a TM, give a short explanation, in terms of the Church-Turing hypothesis, of why a 3-PDA cannot be more powerful than a 2-PDA.

Question 6: Problem 3.15 Part b, c, d, e

Use the same style of answer as the textbook gives for part a.
Question 7: Problem 3.18

Modify the proof of theorem 3.21. You just need to give the constructions. You do not have to prove that
the constructions are correct.

For construction of the enumerator $E$, you can assume that $E$ can come up with the strings of $\Sigma^*$ in
lexigraphical order: $s_1, s_2, s_3, \ldots$. Also keep the construction of $E$ as simple as possible: do you really need
the double loop that was needed in theorem 3.21.

You can assume that the language is infinite. But explain why this assumption is needed.

Question 8: Problem 3.12

For this problem, just show that you can simulate a TM using a TM using a left-reset machine. In other
words, you just need to do one part of the ‘iff’.

Describe how tn level. In particular, describe what the reset machine will need to do for any transition of the
TM that moves the tape head left. Do not worry about the case where the TM moves left at the beginning
of the tape.