Quiz 3

First Name: _____

Last Name: _____

Student Number: _____

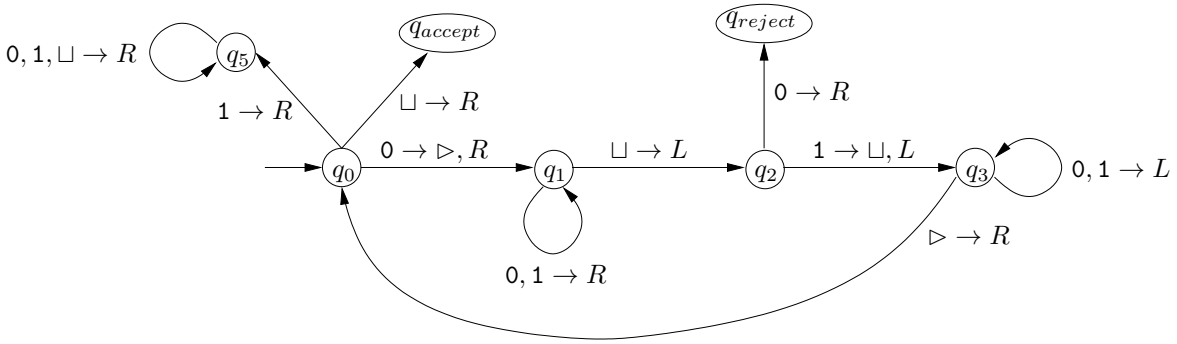
*This test lasts **60 minutes**. No aids allowed.*
Make sure your test has 4 pages, including this cover page.
*Answer in the space provided. (If you need more space, use the reverse side of the page and indicate **clearly** which part of your work should be marked.)*
Write legibly.

Question 1	/3
Question 2	/2
Question 3	/5
Question 4	/3
Question 5	/3
Total	/16

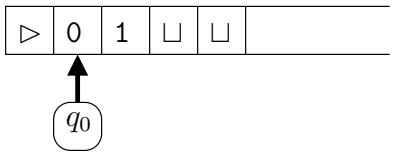
[3] **1.** Design an algorithm AllStrings(R) that takes a regular expression R as input and outputs true if R generates *all* binary strings and false otherwise.
Hint: you may use any of the algorithms we discussed in class as subroutines without having to explain how those subroutines work.

[2] **2.** State the Church-Turing Thesis in your own words.

[5] **3.** Consider the (single-tape) Turing machine whose transition diagram is given below. The input alphabet is $\Sigma = \{\texttt{0}, \texttt{1}\}$ and the tape alphabet is $\Gamma = \{\texttt{0}, \texttt{1}, \sqcup, \triangleright\}$.



If the Turing machine is initially in the configuration below (with input string `01`, show the configuration of the machine after each of its first six steps. For each configuration, show the tape contents, the position of the head on the tape and the state of the Turing machine.

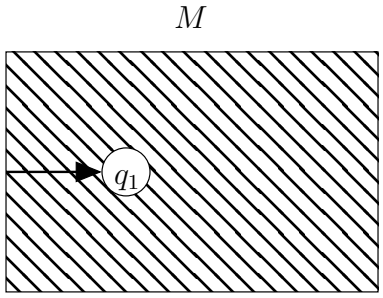


Does this Turing machine decide some language L? If your answer is yes, then say what L is. If your answer is no, explain why your answer is correct.

[3] **4.** Let M be a Turing machine with input alphabet $\Sigma = \{\texttt{0}, \texttt{1}\}$ and initial state q_1. Assume that its transition diagram is inside the shaded box below. (The details of its states and transitions are not shown in the picture, and you do not need to know what they are).

You wish to design another Turing machine M', which also has input alphabet $\{\texttt{0}, \texttt{1}\}$. When M' is given an input string z, it is supposed to erase z, write `01` on the tape and then simulate the actions of M on the input string `01`.

Draw a few additional states and transitions (outside the box) to accomplish this.



[3] **5.** Show that for all languages L, if L is decidable, then $\overline{L}$ is decidable.