

**Worth:** 2%

**Due:** By 6pm on Wednesday 18 November

For each question, please write up detailed answers carefully. Make sure that you use notation and terminology correctly, and that you explain and justify what you are doing. Marks **will** be deducted for incorrect or ambiguous use of notation and terminology, and for making incorrect, unjustified, ambiguous, or vague claims in your solutions.

For each language  $L$  below, give a regular expression  $R$  for  $L$  (*i.e.*, such that  $L(R) = L$ ). Justify briefly that each of your regular expressions is correct—do **not** write formal proofs; instead, just explain why your regular expression describes every string in  $L$  but no string outside of  $L$ .

1.  $L_1 = \{s \in \{a, b, c\}^* : |s| = 3k \text{ for some } k \geq 0\}$ .
2.  $L_2 = \{s \in \{0, 1\}^* : \text{every } 0 \text{ in } s \text{ is } \textit{eventually} \text{ followed by a } 1\}$ .

For example,  $001 \in L_2$  because there is a 1 following each 0 in the string, even though the first 0 is not *immediately* followed by a 1.

3.  $L_3 = \{s \in \{\Delta, \square\}^* : s \text{ contains an odd number of } \Delta\text{'s}\}$ .