Try to keep your answers succinct.

1. (10 points) Let $L$ be regular. As in the homework problem from class, define

$$\text{ALT}(L) = \{a_1a_3a_5 \cdots a_{2n-1} : a_1a_2a_3 \cdots a_{2n} \in L\}$$

If $L$ is given by the regular expression $(10)^*$, give a regular expression for $\text{ALT}(L)$.

2. Let $L$ be any infinite language that contains all but a finite number of strings.
   (a) (3 points) Give an example of such a language $L$.
   (b) (7 points) Show that any such language, $L$, is regular.

3. Language $L$ over $\Sigma = \{0, 1\}$ is defined by its complement:

$$\overline{L} = \{(01)^n : n \geq 0\}$$

So, typical strings in $L$ include 10, 0101, and 011, but the strings $\epsilon$, 01 and 01010101 are not in $L$ since 0, 1 and 4 are perfect squares.

   (a) (5 points) Show the consequence of the pumping lemma holds for $L$. I.e., prove that

   $$(\exists n)(\forall z \in L \text{ such that } |z| \geq n)(\exists uw \text{ such that } z = uww \text{ and } |uw| \leq n \text{ and } |w| \geq 1)(\forall i) : uw^iw \in L$$

   (Remember to consider that $i$ can be 0.)

   (b) (10 points) Despite part (a), prove that $L$ is not regular.