Say which are "TRUE" or "FALSE" (2 points each)

10. (a) If \( L \) is a language on \( \{0,1\} \), we can never have \( (L^c)^c = (L^c)^c \). 

(b) The set of all languages on the alphabet \( \{a\} \) is countable. 

(c) If \( L \) contains \( L^c \), then \( L \) has to be a infinite language. 

(d) If \( G \) has 3 productions and no useless ones, then \( L(G) \neq \emptyset \). 

(e) If a DFA \( M \) has no inaccessible states and it has a loop at an accepting state, then \( L(M) \) is infinite.

Just write down the correct answer. (3,3,4,4,4)

18. (a) Find a regular expression \( E \) for the set of all strings in \( \{0,1\}^* \) which contains at least 2 occurrences of the string 11.

Ans: \( E = \)

(b) If \( M \) is the NFA below, then \( L(M) = \)

(c) If \( G = \{S \rightarrow ASB, S \rightarrow b, A \rightarrow a, B \rightarrow b, B \rightarrow \lambda\} \), then \( L(G) = \)

(d) Find a RLG \( G \) for \( a(ab)^*a^* \)

Ans: \( G = \)

(e) Find a DFA \( M \) with \( L(M) = (0.1^*) + (0^*) \)

Ans: \( M = \)

Use the back of this paper for question #3. (4,2,2,4)

12. (a) Define what are non-terminating & unreachable productions in a CFG.

(b) Define what it means for a context-free grammar \( G \) to be ambiguous.

(c) Define what it means for a state \( B \) in DFA \( M \) to be inaccessible.

(d) Define the extended transition function of an DFA and specify its domain and co-domain.
1(a) TRUE. For any $L$, $\lambda \in (L^c)^c$ but $\lambda \notin (L^c)^c$ since $\lambda \notin L^c$.
(b) FALSE. The set of all lang. on $\{a\}$ is uncountable.
(c) FALSE. Take $L = \{a\}$. Then $L \subseteq L^*$ but $L$ is not m.f.
(d) TRUE. $L(G) \neq \emptyset$ because we have 3 useful productions.
(e) TRUE. $L(M)$ will be infinite because of the loop.

2(a) $E = (0+1)^* \cdot (111 + 11 \cdot (0+1)^* \cdot 11) \cdot (0+1)^*$
(b) $L(M) = 0^* \cdot 1 \cdot (0, 0^*)^*$
(c) $L(G) = \{a^{2n}b^k : 0 \leq k \leq n, n \geq 0\} = \{a^{2n}b^k : k \in \mathbb{N}\}$
(d) $S \rightarrow aA, A \rightarrow abA, A \rightarrow B, B \rightarrow ab, B \rightarrow \lambda$
(e) 

3(a) A non-terminating production is one which contains a variable that does not eventually terminate into terminal symbols.
(b) A CFG is ambiguous if it generates a string which has 2 or more left-most derivations in $G$.
(c) A state $B$ in a DFA $M$ is inaccessible if there is no string $y \in \Sigma^*$ such that $S^*(q_0, y) = B$. Here $q_0$ is the initial state of $M$ and $\Sigma = \text{input alphabet of } M$.
(d) The extended transition function $S^* : Q \times \Sigma^* \rightarrow Q$ of a DFA is defined recursively as follows. (a) $S^*(q, \lambda) = q$ and (b) $S^*(q, ya) = S(S^*(q, y), a)$ for any $a \in \Sigma$ and $y \in \Sigma^*$. 