**A.A.** For each string $w \in A$, it is easy to construct a DFA that accepts $w$ and no other strings. Then we can construct an NFA for $A$ by creating a start state and adding an $\epsilon$-transition from that start state to the start state of each DFA.

**A.B.** Because $A$ is finite, there is a longest string $x$ (breaking ties arbitrarily). I claim that the minimal pumping length is $p = |x| + 1$. The pumping lemma is trivially true for this $p$, because there are no strings $w \in A$ such that $w \geq p$. The pumping lemma is not true for $p = |x|$, because then the string $x$ could be pumped to produce infinitely many strings in $A$.

**B.** My regular expression is

$$(\epsilon \cup -)DD^*(\epsilon \cup .DD^*)(\epsilon \cup (e \cup E)(\epsilon \cup -)DD^*).$$

[The first chunk matches an optional `-`. The second chunk matches one or more digits — the integral part of the number. The next chunk matches an optional fractional part of the number. The final chunk matches an optional `e` or `E` construction.]

**C.A.** TRUE. [Let $G$ be a CFG for $A$ with start variable $S$. Construct a new CFG with start variable $S'$, rule $S' \to \epsilon | SS'$, and all the rules of $G$.]

**C.B.** FALSE. [We drew only three states in our construction, but there many be many additional states, hanging off the middle state, needed to push strings of variables and terminals.

**C.C.** FALSE. [Our PDAs are non-deterministic. The book also discusses DPDAs, which we mentioned in class only briefly.]

**C.D.** TRUE. [This was a homework problem. Use structural induction on the definition of regular expression.]

**C.E.** FALSE. [The "$|uvx| \leq p$" part should read "$|vxy| \leq p$".]

**D.** Assume for the sake of contradiction that $A$ is regular. Let $p$ be a pumping length for $A$. Let $w = 0^p 1 0^{2p}$. Then $w \in A$ and $|w| \geq p$, so the pumping lemma guarantees the existence of strings $x$, $y$, $z$ satisfying certain properties. Because $|xy| \leq p$, it must be true that $xy = 0^k$ for some $k \leq p$. Because $|y| \leq 1$, it must be true that $y = 0^\ell$ for some $\ell$ such that $1 \leq \ell \leq p$. Then $xy^2z = 0^{p+\ell} 1 0^{2p} \notin A$. This contradiction implies that our original assumption was false. Therefore $A$ is not regular.

**E.** [I won't draw the PDA here, but I will explain the key ideas.] First draw a PDA $P_1$ for $A_1 = \{a^i b^j c^k : i \neq j\}$. Then draw a PDA $P_2$ for $A_2 = \{a^i b^j c^k : j \neq k\}$. Then add a new start state and $\epsilon$-transitions from the new start state to the start states of $P_1$ and $P_2$. The resulting PDA accepts $A_1 \cup A_2 = A$.