# 1. 2.30, p.157

**a.** ,

Since the pumping lemma states and , we can divide s into two cases:

**Case 1:** Either v or y contains more than one symbol (both 1s and 0s). Consider , the resulting string would consist of extra segments of symbols which is not in L because string need to be of four equal segments.

**Case 2:** Both v and y contain one symbol. Since pumping s either up or down will result in unequal amounts of either symbol and is not in L.

Therefore, s cannot be pumped and L is not context-free.

# 2.

, where *n* is a prime number.

Since , and then it follows that If we pump up once we have and therefore . However, because is prime it should not factor thus P is not context-free.

# 3.

The Kleene star can be captured by having the same variable on the left-hand side and right-hand side of a rule within a CFG. Additionally, the rule needs an ε on the RHS to capture 0 repetitions of the CFG.

So, let *G1* be some arbitrary CFG, then to produce :

or

# 4.

DCFLs are of interest to the computer science community because they are more efficient with time and space when compared to non-deterministic CFLs. Non-deterministic CFLs must make copies of the stack every time a nondeterministic step occurs.

# 5.