Assignment#1; Due January 22 at start of class
Review of Formal Languages

Consider some language **L**. For each of the following cases, write in one of **(i)** through **(vi)**, to indicate what you can say conclusively about **L**'s complexity, where

(i) **L** is definitely regular
(ii) **L** is context-free, possibly not regular, but then again it might be regular
(iii) **L** is context-free, and definitely not regular
(iv) **L** might not even be context-free, but then again it might even be regular
(v) **L** is definitely not regular, and it may or may not be context-free
(vi) **L** is definitely not even context-free

Follow each answer with example languages **A** (and **B**, where appropriate) to back up the complexity claims inherent in your answer; and/or state some known closure property that reflects a bound on the complexity of **L**.

Example.) **L = A ∪ B**, where **A** and **B** are both context free, and definitely not regular

L can be characterized by **Property (ii)**, above.
L is context-free, since the class of context-free languages is closed under union.
L can be regular. For example,
$\mathbf{A = \{ a^n b^m \mid m \geq n \}}$, $\mathbf{B = \{ a^n b^m \mid m \leq n \}}$,
$\mathbf{L = A \cup B = \{ a^n b^m \mid n, m \geq 0 \}}$, which is regular since it can be represented by the regular expression **a*b***.
But **L** is in general not guaranteed to be regular, e.g., if we just make **A** and **B** the same context-free, non-regular set, then **L = A ∪ A = A**, which is not regular.

a.) **L = A ∩ B**, where **A** and **B** are both context-free, non-regular

b.) **L = A ∩ B**, where **A** is context-free, non-regular and **B** is regular

c.) **A = B – L**, where **A** is context-free, non-regular and **B** is regular

d.) **A ⊂ L**, where **A** is Regular