For each of the following languages, show whether it is a “regular language”.

1. \{x \in a, b^*\} with equal number of a’s and b’s.
   Choose string \(a^n b^n\) and this should easily lead to showing the language is not regular.

2. \{x \in a, b^*\} with more a’s than b’s.
   Let \(x = a^{k+1} b^k\) \(|x| \geq k\)
   Since \(|x| = 2k + 1\) and \(x \in L\), there must be \(u, v, w\) such that \(x = uvw\), \(|uv| \leq k\), \(y \neq \epsilon\). Given that \(|uv| < k\), \(uv = a^p\) where \(p \geq 1\). Thus \(x = a^{k+1-p} a^p b^k\), with \(u = a^{k+1-p}, v = a^p, w = b^k\).
   This guarantees more a’s than b’s as long \(p > 0\). So far, so good. But the pumping lemma says we can “pump” \(v\) 0 times and remain in \(L\). But, pumping 0 times would lead to there NOT being more a’s than b’s and thus the language is NOT regular.

3. \{a^i b^j c^k i > 0, j > 0, k > 0\}
   Yes, its regular, try \(a^* b^* c^*\)

4. \{xx^R : x \in a, b^*\}
   Not regular. Choose string \(a^n b^n a^n\) and it should be easy to show its not regular by use of pumping lemma.

5. \{xx : x \in a, b^*\}
   Not regular. Choose string \(a^n b^n a^n b^n\) and it should be easy to show its not regular by use of pumping lemma.

6. \{a^{2k+1} : k > 0\}
   Yes, its regular, try \(a(aa)(aa)^*\)