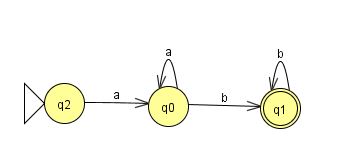
1. **Question 1, two segments**
   1. **Problem 1**
      1. |y| > 0
      2. |xy| ≤ p, and
      3. ∀i > 0, xyi z ∈ L
      4. w=0(^(2^m))
      5. 1 < k < m
      6. There m\
      7. z=0^((2^m)-r-s)
      8. R+s < m
      9. s>1
      10. Let i =2, so xy(^2) z = 0^r ((a^s)^2) z
      11. 0^((a^2) + s ∈(is not contained in)/ L, because
      12. 2^(m) < 2^(m) + s ≤ 2^(m) + m < 2^(m) + 2^(m) = 2^(m+1) , 2^(m) + s =/= 2^k for any k
      13. Thus, L is not regular
   2. **Problem 2**
      1. We will assume L is regular then by the closure property of regular languages is a regular. However L={ w : na(w) = nb(w), w {a, b}\* } contains a\*b\*, which has been proven not to be a regular language. This is a contradiction therefore L is not a regular language.
2. **Question 2, three segments:**
   1. **L = { a^n b^n : n > 0} { a^k b^m : k > 0, m > 0}** 
      1. The first language is irregular, while the second one is regular. The first language exists as a subset of the second language, so this means that we are already capable of making each expression that the first provides within the second. The first language is irregular due to the A^n B^n that was solved in class.
      2. 
   2. **L = { a^n b^m : n ≤ m ≤ 2n}** 
      1. We’re going to use the pumping lemma, so we will assume that L is a regular language, and have m be the pumping lemma constant
      2. We will choose w = a^m b^m which is in L according to the definition
      3. Factor w = xyz where 0 < |xy| <= m and |y|>= 1 and xy^(i) z for all i
      4. W = a^m b^m since |xy| <= m we know that xy is all 0’s now let y = a^k where 0<k<=m
      5. We must now find an i such that w(i) = xy^(i)z should be in L by the pumping lemma
      6. Now w(2) will give us xy^(2)z = xyyz = a^(m+k) b^m since y=a^k, and by the PL: a^(m+k) b^m ∈ L.
      7. The condition m+k <=m <= 2(m+k) does not hold, so w(2) contradicts the pumping lemma proving that L is not a regular language.
   3. **{ 0^n : n=2k for some k > 1}**
      1. We are going to use the pumping lemma, so we will assume that L is a regular language, and M will be our pumping lemma constant
      2. We will choose w = 0^(2m) which is in L according to our definition
      3. Factor w=xyz where 0 <|xy| <=m and y >= 1 and xy^(i) z for all i
      4. w=0^(2m) since |xy| <= m we know that xy is all 0’s
      5. We must now find a solution such that w(i) xy^(i)z should be in L by the pumping lemma
      6. Now w(3) will give us our xy^(3)z = 0^((2m)+k) = this is not capable of producing an odd number of 0’s so this language is not regular.
3. **True or false? Prove**
   1. This statement is false. To prove it, we offer a counter example. Let L1 = {a^n b^m : n=m} and let L2 ={a^n b^m : n ≠ m}. We have shown that both L1 and L2 are not regular. However, L1 ∪ L2 = a\*b\*, which is regular. There are plenty of other examples as well. Let L1 = {a^n: n ≥ 1 and n is prime}. Let L2 = {a^n: n ≥ 1 and n is not prime}. Neither L1 or L2 is regular. But L1 ∪ L2 = a+b, which is regular.
4. **Show that it is closed**
   1. From the definition of symmetric difference of two sets, we have that S1 S2 = (S1 ∩ S2) ∪ (S2 ∩ S1). Because of the closure of regular languages under intersection (∩), complementation (L), and union (∪), the family of regular languages is closed under symmetric difference.