### **MapReduce and PageRank**

**Question 1**:

Suppose our input data to a map-reduce operation consists of integer values (the keys are not important). The map function takes an integer *i* and produces the list of pairs (*p*,*i*) such that *p* is a prime divisor of *i*. For example, map(12) = [(2,12),(3,12)].

The reduce function is addition. That is, reduce(*p*,[*i*1,*i*2,...,*ik*]) is (*p*,*i*1+*i*2+...+*ik*).

Compute the output, if the input is the set of integers 15, 21, 24, 30, 49.

Solution:

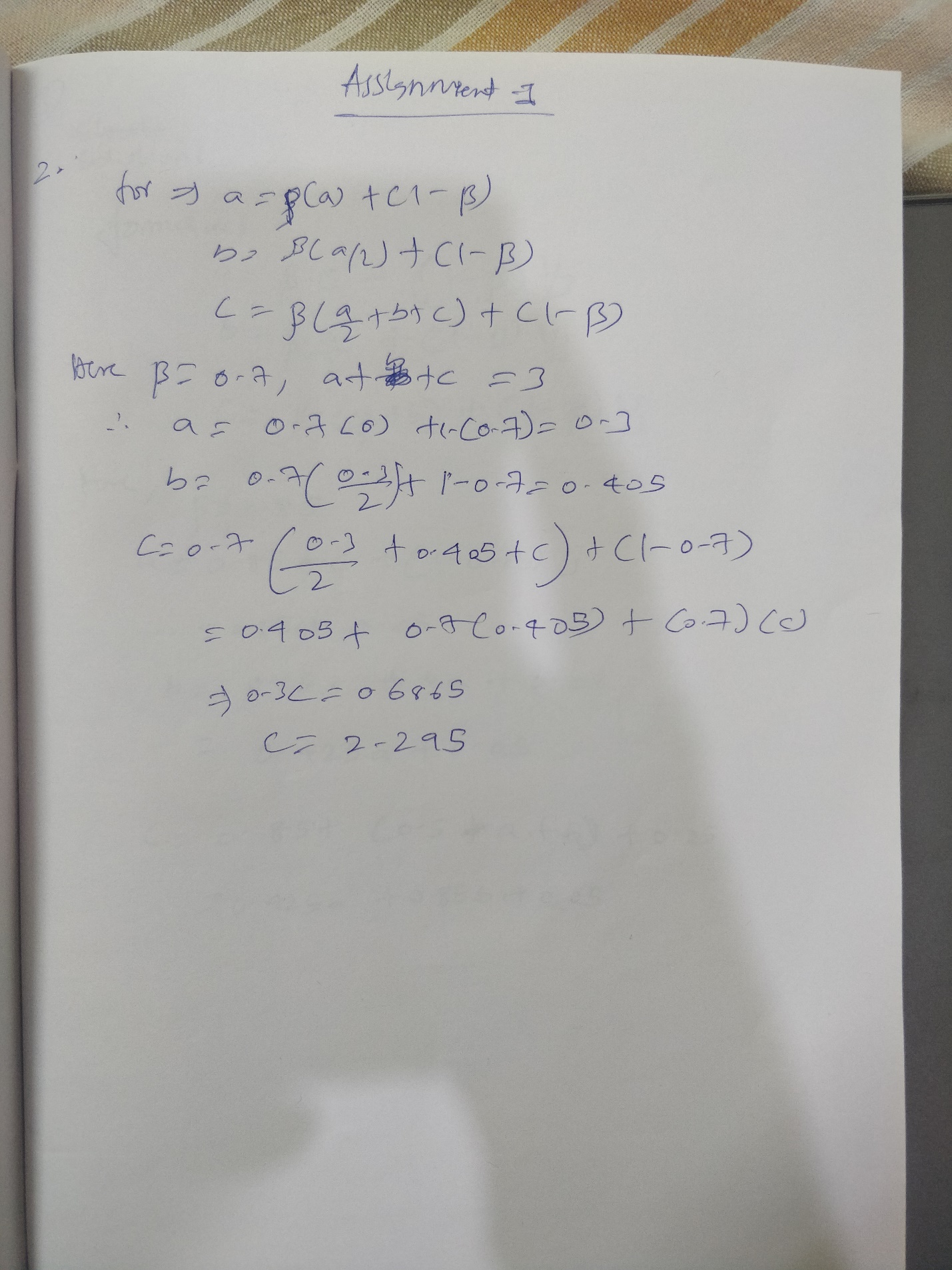
The output of map function is as follows map(15) = [(3,15),(5,15)] map(21) = [(3,21),(7,21)] map(24) = [(2,24),(3,24)] map(30) = [(2,30),(3,30),(5,30)] map(49) = [(7,49)] These are the respective prime divisors of inputs The output of reduce function is reduce(2,54),reduce(3,90),reduce(5,45), reduce(7,10).

**Question 2**:

Consider three Web pages with the following links:



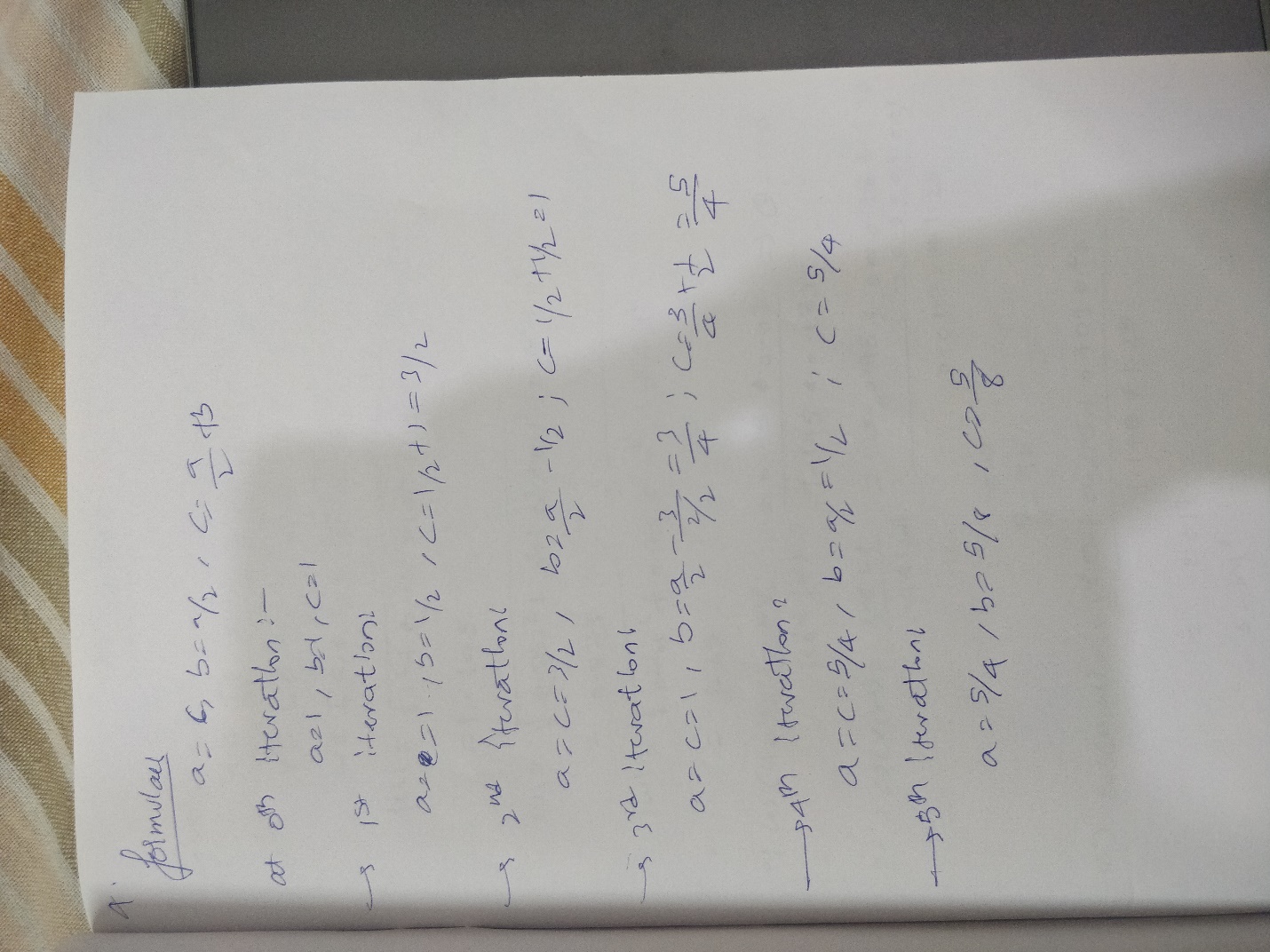
Suppose we compute PageRank with a β of 0.7, and we introduce the additional constraint that the sum of the PageRanks of the three pages must be 3, to handle the problem that otherwise any multiple of a solution will also be a solution. Compute the PageRanks *a*, *b*, and *c* of the three pages A, B, and C, respectively.



**Question 3**:



Suppose we compute PageRank with β=0.85. Write the equations for the PageRanks *a*, *b*, and *c* of the three pages A, B, and C, respectively.



**Question 4**:



Assuming no "taxation," compute the PageRanks *a*, *b*, and *c* of the three pages A, B, and C, using iteration, starting with the "0th" iteration where all three pages have rank *a = b = c* = 1. Compute as far as the 5th iteration, and also determine what the PageRanks are in the limit.

