Name _____ KEY _____ gtID# _____

ChBE 4300(A) – Kinetics and Reactor Design
School of Chemical & Biomolecular Engineering
Georgia Institute of Technology
Spring 2014

Quiz #1 – January 22nd, 2014
Closed Book, 10 minutes

Consider the following gas-phase reactions and equilibrium constants:

$$A \rightleftharpoons B \qquad K_{a,1} = 0.5$$
$$B + C \rightleftharpoons D \qquad K_{a,2} = 0.5$$

These reactions are occurring simultaneously in a batch reactor maintained at 2 atm and 298K. If the reactor is initially charged with 1 mole of A and 1 mole of C and the equilibrium conversion of the second reaction is 0.5, **what is the equilibrium conversion of the first reaction?**

Setup a mole table:

A	1	$-X_1$	$1-X_1$
B	0	$X_1 - X_2$	$X_1 - X_2$
C	1	$-X_2$	$-X_2$
D	0	$+X_2$	$+X_2$

$$2 - X_2 \text{ total}$$

$$K_{a1} = \frac{\dfrac{X_1 - X_2}{2 \cancel{X_2}}}{\dfrac{1 - X_1}{2 \cancel{X_2}}} = \frac{X_1 - X_2}{1 - X_1} = 0.5$$

if $X_2 = 0.5$,

$$\boxed{X_1 = 2/3}$$