Chapter 1: Linear Equations in Linear Algebra

Section 1.6 – Applications of Linear Systems

Goal: To investigate applications of linear systems from economics, chemistry, and network flow.

Examples:

1. (§1.6 #3) Consider an economy with three sectors, Chemicals & Materials, Fuels & Power, and Machinery. Chemicals sells 30% of its output to Fuels and 50% to Machinery and retains the rest. Fuels sells 80% of its output to Chemicals and 10% to Machinery and retains the rest. Machinery sells 40% to Chemicals and 40% to Fuels and retains the rest.

   (a) Construct the exchange table for this economy.

   (b) Develop a system of equations that leads to prices at which each sector's income matches its expenses. Then write the augmented matrix that can be row reduced to find these prices.

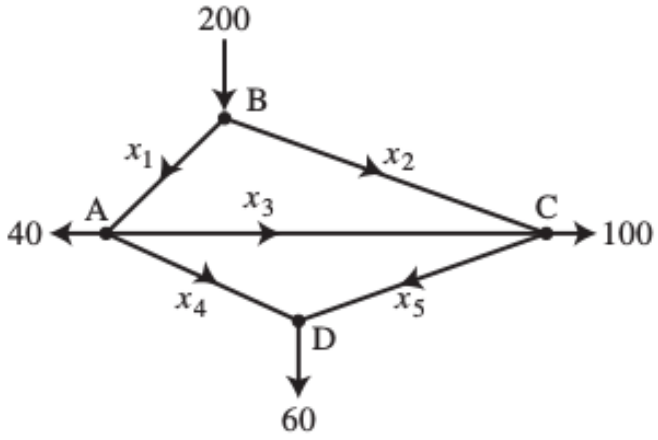
   (c) Find a set of equilibrium prices when the price for the Machinery output is 100 units.

2. (§1.6 #5) Boron sulfide reacts violently with water to form boric acid and hydrogen sulfide gas (the smell of rotten eggs). The unbalanced equation is

$$B_2S_3 + H_2O \to H_3BO_3 + H_2S.$$

Balance this equation.

3. (§1.6 #12) Consider the freeway network shown below (where flow rates are in cars/minute):



(a) Find the general traffic pattern.

(b) Describe the general traffic pattern when the road whose flow is x_4 is closed.

(c) When $x_4 = 0$, what is the minimum value of x_1?