MA211: Assignment #1

Required Reading.

- §1.1-1.3, and 2.1.

Quiz on Sept. 12th. Any problems marked with * require the use of maple. All other problems are to be done by hand. Any problems marked with # can be submitted for review by the grader.

1. Textbook §1.1: 2, 3, 12, 16#, 17, 19*, 22, 30#, 43
2. Textbook §1.2: 3#, 9, 29c
3. Textbook §1.3: 6, 7, 8#, 9#, 18, 27
4. Textbook §2.1: 1*, 8*#, 21#, 28, 42ab
5. Molecules of two types are reacting. First, molecule A is transformed into molecule B. Then, A and B combine to form two molecules of A.

$$A \rightleftharpoons B$$
$$A + B \rightleftharpoons 2A$$

Let $x(t)$ be the concentration of molecule A and $y(t)$ be the concentration of molecule B.

(a) Explain why the correct ODE model for this reaction system is of the form

$$x' = -k_1^+ x + k_1^- y + (?)k_2^+ xy + (?)k_2^- x^2$$
$$y' = k_1^+ x - k_1^- y + (?)k_2^+ xy + (?)k_2^- x^2 \quad .$$

What integers should you replace the (?)'s with?

(b) As we did in class, show that there is a conservation law. Prove it mathematically, but also explain why it makes sense from a chemistry point of view. Hint: as in class, it's easiest to deduce the conservation law by thinking about the chemistry.

(c) Use this conservation law to write an ODE for $x(t)$ only. It should not have $y(t)$ in it.