Chem Lab Follow-up

Here is the model for the reversible reaction:

$$\frac{d[\mathrm{A}]}{dt} = -k_1[\mathrm{A}] + k_2[\mathrm{B}]$$

$$\frac{d[\mathrm{B}]}{dt} = \quad k_1[\mathrm{A}] - k_2[\mathrm{B}]$$ with the conditions that $[\mathrm{A}](0) = \mathrm{A}_0$ and $[\mathrm{B}](0) = \mathrm{B}_0$

Notes: [A](0) represents the value of the <u>function</u> $[\mathrm{A}](t)$ at time $t = 0$.
The symbol A_0 represents a "known" constant (not an "arbitrary constant").

If we use the same method we used in lab to solve the problems in Part II and Practice Problem #2, we can show that the following are the general solutions.

$$[\mathrm{A}](t) = \frac{k_1\mathrm{A}_0 - k_2\mathrm{B}_0}{k_1+k_2} e^{-(k_1+k_2)t} + \frac{k_2}{k_1+k_2}(\mathrm{A}_0 + \mathrm{B}_0)$$

$$[\mathrm{B}](t) = \frac{k_2 B_0 - k_1\mathrm{A}_0}{k_1+k_2} e^{-(k_1+k_2)t} + \frac{k_1}{k_1+k_2}(\mathrm{A}_0 + \mathrm{B}_0)$$

Part 3

Steps (a) and (b): Let $\overline{a} = \lim_{t\to\infty}[\mathrm{A}](\mathrm{t})$ and let $\overline{\mathrm{b}} = \lim_{t\to\infty}[\mathrm{B}](\mathrm{t})$. Compute $\overline{a}$ and $\overline{\mathrm{b}}$.

Step (c): In the DEs at the top of the page, substitute the values you computed for $\overline{a}$ and $\overline{\mathrm{b}}$ in place of $[\mathrm{A}](t)$ and $[\mathrm{B}](t)$. What do you get for the values of $\frac{d[\mathrm{A}]}{dt}$ and $\frac{d[\mathrm{B}]}{dt}$? Why does this make sense?

Step (d): Using your values for $\overline{a}$ and $\overline{\mathrm{b}}$ compute $\overline{a} + \overline{\mathrm{b}}$. Why does this make sense?

Step (e): Show how to find the values of $\overline{a}$ and $\overline{\mathrm{b}}$ without solving the DEs.

Step (f): Compare the graphs on the handouts.