1. (M) pg 241 ex. 10

2. Consider the specific neutrophils-G-CSF model:

\[
\begin{aligned}
\frac{dx}{dt} &= a_1 x + a_2 (a_3 x + a_4) e^{-a_5 x} \\
\frac{de}{dt} &= -a_1 (\frac{1 + 0.01 x}{1 + 0.01 + x}) e
\end{aligned}
\]

where \( a_1 = 0.5, a_2 = 1.4, a_3 = 0.5, a_4 = 1, a_5 = 6 \)

(a) Find the qualitative behavior of the null-clines: show that they are monotone and can cross only once. Discuss the robustness of this statement as the parameters are varied.

(b) Find the fixed point and its stability - this fixed point corresponds to homeostasis.

(c) Prove that there can be no limit cycles in this system.

(d) Bonus: See Shochat et al. 2007 and 2008 and Malka et al. 2012 for axiomatic model construction, motivation, analysis and implications. By now there are new variants to the G-CSF injections - find how the model parameters should be changed to reflect their properties. Find how circadian oscillations in G-CSF change the systems behavior.

3. Bonus: pg 240 ex 9