MB&B 562: Exercise 1

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Question 1

Despite not having a formal physics background from college, having taken one physics class only, the entire first chapter of the book was very easy to follow.

Question 2

The curve with amplitude 1 and time constant 0.82 appears a good fit for the given data.
(Live script PDF included in submission).

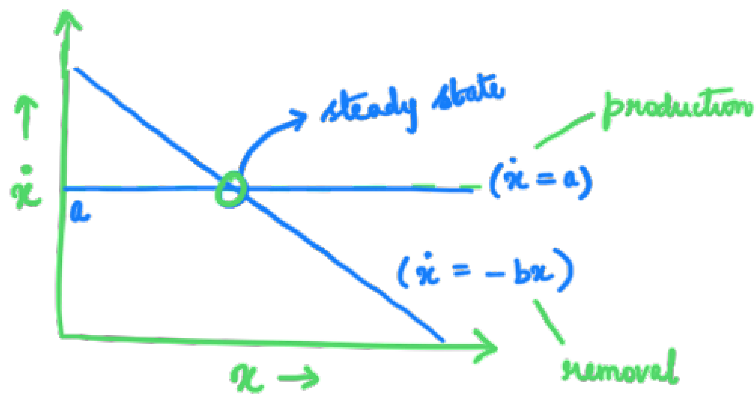
(continued on the next page…)

Question 3

Given,

$$\dot{x} = a - bx$$

(a) Plotting $\dot{x}$ against x gives,



Essentially, for no net change,

$a = bx$ [i.e. production = removal]

hence, $x = \frac{b}{a}$ is the steady state conc. of x

(b) when $a = 0$,

$$\dot{x} = -bx$$

that is, $\frac{dx}{dt} = -bx$

rearranging and integrating both sides,

$$\int \frac{dx}{x} = -b\int dt$$

$$\ln(x) = -bt + c$$

where c is the const. of integration

exponentiating both sides,

$$x = e^{-bt} \cdot e^{c}$$

Now, let $x = x_0$ be initial cond. at $t = 0$.

We have,

$$x_0 = e^{-b(0)} \cdot e^{c}$$

$$\boxed{e^{c} = x_0}$$

Hence, the solution becomes,

$$x = x_0 e^{-bt}$$

At half-life, $t = t_{1/2}$ and $x = \frac{x_0}{2}$

So, $\frac{x_0}{2} = x_0 e^{-bt_{1/2}}$

$$\ln(1/2) = -bt_{1/2}$$

$$\boxed{t_{1/2} = \frac{\ln(2)}{b}}$$