MATH 246 GROUP WORK 3
18 SEPT 2020, INSTRUCTOR: RUIWEN SHU

Each group only needs to submit ONE file containing your solutions!

Problem 1. A tank of capacity 10L is full with water. At some instant, sugar solution with concentration 3g/L flows into the tank at a rate of 0.5L/h. At the same time, well-stirred mixture flows out of the tank at a rate of 1.5L/h. What is the concentration of sugar when the tank is half full?

Problem 2. The population of cats $p_{cat}(t)$ grows exponentially with a growth rate $r_{cat} > 0$. The population of rats $p_{rat}(t)$ grows exponentially with a growth rate $r_{rat} > 0$, in the absence of cats. When cats and rats are together, the rats are subject to a harvest rate $h(t) = 5\sqrt{p_{cat}(t)}$.

(1) If the initial population of cats is 1000, compute $p_{cat}(t)$ (your answer should involve r_{cat}).

(2) If cats and rats are together, and their initial population are 1000 and 3000 respectively, compute $p_{rat}(t)$ (your answer should involve r_{cat} and r_{rat}).

(3) Under the same assumption as (2), in order to avoid rats from being extinct, what condition should r_{cat} and r_{rat} satisfy?