Problem Set N^{o} 2
Control of Microbial Growth

General directives: When doing your calculations, do not round off your intermediate numbers. Only round off the final answer. You will need to submit your answers through Blackboard. Your answers must be submitted to one significant figure after the decimal. For example, 2.0, 2.0 X 10^3, 0.02, or 0.002. The deadline for the submission will be announced in class and on Blackboard. It is strongly recommended that you submit your answers using the web browser Firefox.

1. A company has developed a new disinfectant, agent X, which they claim kills 99.999% of microorganisms following an exposure of 30 seconds. If the company's claims are correct, under the manufacturer's recommendations, agent X should reduce a bacterial load by how many logs?

2. Given the information presented in the previous question, what is the D value under the manufacturer's recommended conditions?

3. Given the information presented in question 1, how long an exposure to agent X would be required to reduce a bacterial load from 10^4 to 0.001 bacteria?

4. You test agent X on a 100 cm^2 with an average bacterial load of 86 bacteria/cm^2. Given the information presented in question 1, how long an exposure to agent X would be required to reduce the total bacterial load on the 100 cm^2 to ≤ 1 bacterium?

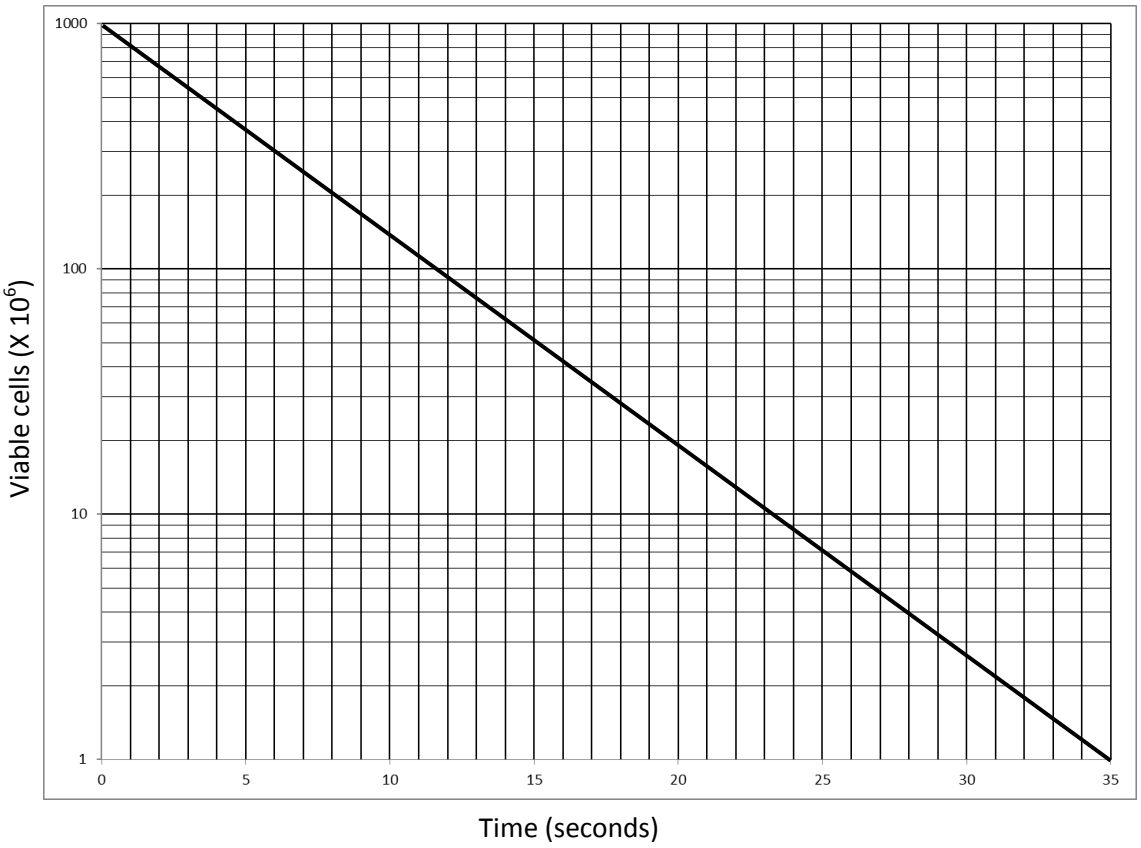
5. Given the information presented in question 1, what is the rate of mortality associated with agent X?

6. In the US, pasteurization of milk is achieved by a treatment of 30s at 63^{o}C, which represents a reduction of 3 logs. In contrast, in the UK pasteurization is carried out at 65^{o}C. Given that the k constant at 65^{o}C is 1.3 times faster, how long should the UK treat their milk to achieve the same log reduction?

7. Given the information presented in question 6, how much longer is the thermal death time associated with the US treatment as compared to that in the UK? Assume an initial microbial load of 5 000.

8. The thermal death point (TDP) of milk treated under US conditions is $55^{o}C$. What must the D_{55} value of milk be? Assume an initial microbial load of 5 000.
9. A microbial suspension contains two different bacteria with D values of 30 and 60 seconds at $100^{o}C$. Both bacterial populations are initially at a density of 10^{6} cells/mL. How many bacteria would remain after boiling the suspension for 2 minutes?
10. According to the information and the results presented in the previous question; what I the D_{100} value of the mixed culture? Give your answer in seconds.

Refer to the following graph and information to answer questions 11-16: This graph represents the mortality profile of a bacterial suspension treated at 121^{o}C which has a Z value of 1.5^{o}C.



11. The initial bacterial load was reduced by what percentage in 35 seconds?

12. What is the D value at 121^{o}C?

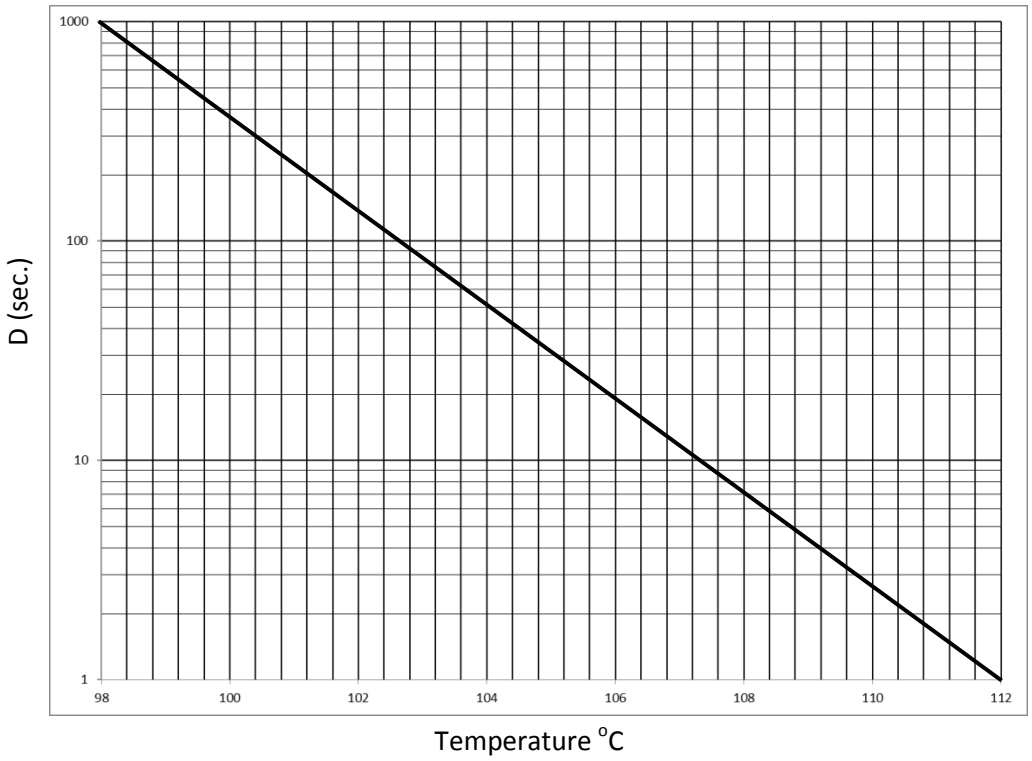
13. How many viable cells remain after a treatment of 17s?

14. What is the rate of mortality at 118^{o}C?

15. How much time would it take to sterilize this suspension at 121^{o}C given the initial burden at T_0?

16. What is the thermal death time of this suspension at 121^{o}C given the initial burden at T_0?

Refer to the following graph to answer the questions that follow.



17. How much time is required at 106^{o}C to reduce a microbial population by 90%?

18. How much time would be required to sterilize a can of carrots at 106^{o}C with an initial burden of 100 cells?

19. What is the z value of this suspension?

20. The above graph represents the data for spores of *Clostridium botulinum*. What would be the Thermal death point (TDP) of a can of carrots containing 10^3 spores?