

Quiz 6—Microbial Growth
 CENG 340—Introduction to Environmental Engineering
 Instructor: Deborah Sills, 15 November, 2013

Name:

KEY

Environmental engineers use a mixed-order kinetic model (the Monod model), described by Eq.1 and presented in Fig. 1, to estimate the net growth rate of bacteria in biological treatment reactors.

$$\frac{dX}{dt} = \frac{\mu_{\max}XS}{K_s + S} \quad (1)$$

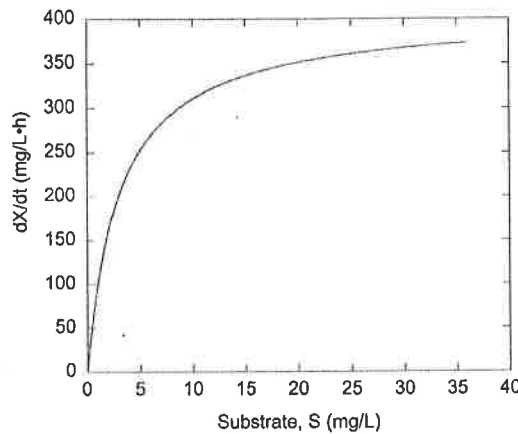


Figure 1: Net growth rate of microroganisms as a function of substrate concentration.

1. (5 pts) Describe very briefly under what conditions the growth rate ($\frac{dX}{dt}$) is zero order with respect to S, and write the resulting zero-order rate equation.

$\frac{dX}{dt}$ is zero order w.r.t. S when $S \gg K_s$:

$$\frac{dX}{dt} = \mu_{\max} X$$

2. (5 pts) Describe very briefly under what conditions the growth rate ($\frac{dX}{dt}$) is first order with respect to S, and write the resulting first-order rate equation.

$\frac{dX}{dt}$ is first order w.r.t. S when $S \ll K_s$:

$$\frac{dX}{dt} = \frac{\mu_{\max} X}{K_s} \times S$$