Quiz #9
Applied Calculus I – Math 131.009 – Fall 2012

Show your work for credit.

1. (2 pts) A blood-pressure drug requires concentration of 0.05 ng/mL to be effective. Suppose the target maximum concentration is 0.5 ng/mL. If the concentration in the blood follows the surge function $A e^{-0.41t}$ (with $t$ measured in days), then:

(a) how big should $A$ be? (Solve using arithmetic, not by looking at a graph.)
(b) roughly how often should the drug be administered?

(a) $C(t) = A t e^{-0.41t} \Rightarrow C'(t) = A \left[ e^{-0.41t} + (-0.41) t e^{-0.41t} \right]$  

$C'(t) = A e^{-0.41t} (1 - 0.41t) = 0 \Rightarrow \frac{1}{0.41} = t$

this is where $C$ achieves its max,

Want $0.5 = A \cdot 0.41 t e^{-0.41}$

$0.5 = \frac{A}{0.41} e^{-t}$

$0.5 \cdot 0.41 \cdot e^t = A \approx 0.557$

(b) Find $t$ so that $C(t) = 0.05$.

$0.05 = (0.557) t e^{-0.41t}$.

$t = 3 \Rightarrow C(t) = 0.488$

$t = 10 \Rightarrow C(t) = 0.092$

$t = 11.9 \Rightarrow C(t) = 0.050 \hspace{1cm} \text{close enough}
\hspace{1cm} \approx \text{Every twelve days}$
2. (2 pts) Two cyclists are traveling in the same direction. Suppose that they began alongside each other and that their velocities are represented in the figure below. When does Cyclist 2 overtake Cyclist 1?

(a) Between 0.75 and 1.25 minutes

(b) Between 1.25 and 1.75 minutes

(c) Between 1.75 and 2.25 minutes

Each has \( \bigcirc \) in common.

Need to find when \( \bigcirc \) equals \( \bigcirc \)

answer: (b)

3. (1 pt) You wish to approximate the area under the graph below.

Indicate a region where:

(a) a left-hand (Riemann) sum approximation is an over-estimate.

\[ [0,3] \quad (even \quad [-1,3]) \]

(b) a right-hand (Riemann) sum approximation is an over-estimate.

\[ [-3,-1] \]