Linear Differential Equations
Math 102 Section 107

Krishanu Sankar

November 10, 2017

Q1. The rate of change of an object's temperature is proportional to the difference between the object's temperature and the surrounding temperature.

Q1. The rate of change of an object's temperature is proportional to the difference between the object's temperature and the surrounding temperature.

A. $T'(t) = E - kT(t)$

B. $T'(t) = k(E - T(t))$

C. $T'(t) = kT(t) - E$

D. $T'(t) = k(T(t) - E)$

where E (constant) is the surrounding temperature and $k > 0$.

Q1. The rate of change of an object's temperature is proportional to the difference between the object's temperature and the surrounding temperature.

A. $T'(t) = E - kT(t)$

B. $T'(t) = k(E - T(t))$

C. $T'(t) = kT(t) - E$

D. $T'(t) = k(T(t) - E)$

where E (constant) is the surrounding temperature and $k > 0$.

Sanity check: If $E > T$, the temperature *increases*. If $E < T$, the temperature *decreases*.

$y' = a - by$

The general solution to the differential equation $y'(t) = a - by(t)$ is

$$y(t) = \frac{a}{b} + Ce^{-bt}$$

where C can be any constant. The solution satisfying the initial condition $y(0) = 0$ is

$$y(t) = \frac{a}{b} - \frac{a}{b}e^{-bt} = \frac{a}{b}\left(1 - e^{-bt}\right)$$

Q2. A drug is delivered to a patient by IV at a constant rate k_{IV}. The body metabolizes the drug at a rate proportional to the amount of the drug.

Q2. A drug is delivered to a patient by IV at a constant rate k_{IV}. The body metabolizes the drug at a rate proportional to the amount of the drug.

A. $d' = k_{IV} - k_m d$

B. $d' = (k_{IV} - k_m)d$

C. $d' = k_{IV} d - k_m$

D. $d' = -k_{IV} + k_m d$

Q2. A drug is delivered to a patient by IV at a constant rate k_{IV}. The body metabolizes the drug at a rate proportional to the amount of the drug.

A. $d' = k_{IV} - k_m d$

B. $d' = (k_{IV} - k_m)d$

C. $d' = k_{IV} d - k_m$

D. $d' = -k_{IV} + k_m d$

$$d' = k_{IV} - k_m d$$

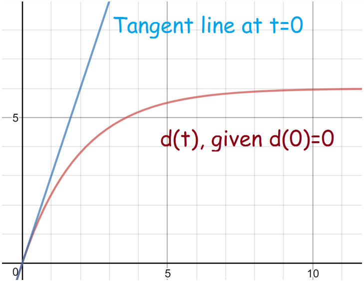
Q3. Use the graph to calculate k_{IV}.

A. $k_{IV} = 1$

B. $k_{IV} = 2$

C. $k_{IV} = 3$

D. $k_{IV} = 6$



$$d' = k_{IV} - k_m d$$

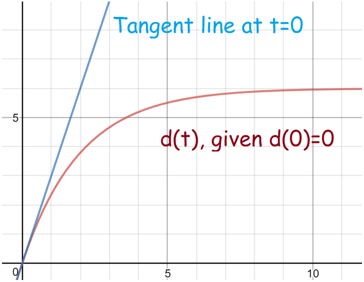
Q3. Use the graph to calculate k_{IV}.

A. $k_{IV} = 1$

B. $k_{IV} = 2$

C. $k_{IV} = 3$

D. $k_{IV} = 6$



k_{IV} is the initial rate of drug delivery, and therefore equals the slope of the tangent line at $t = 0$.

$$d(t) = \frac{k_{IV}}{k_m} - \frac{k_{IV}}{k_m}e^{-k_m t}$$

Q4. How long will it take until the drug levels reach *half* of the target dose k_{IV}/k_m?

$$d(t) = \frac{k_{IV}}{k_m} - \frac{k_{IV}}{k_m}e^{-k_m t}$$

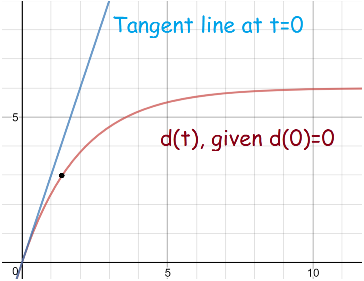
Q4. How long will it take until the drug levels reach *half* of the target dose k_{IV}/k_m?

A. $t = \frac{1}{k_m}$

B. $t = \frac{1}{k_m \ln 2}$

C. $t = \ln 2$

D. $t = \frac{\ln 2}{k_m}$



$$d(t) = \frac{k_{IV}}{k_m} - \frac{k_{IV}}{k_m} e^{-k_m t}$$

Q4. How long will it take until the drug levels reach *half* of the target dose k_{IV}/k_m?

A. $t = \frac{1}{k_m}$

B. $t = \frac{1}{k_m \ln 2}$

C. $t = \ln 2$

D. $t = \frac{\ln 2}{k_m}$