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Answers to “Programming Language System Dynamics Tutorial 1”

**Quick Review Question 1:** Consider Figure 2.5.1 of the book. Which of the symbols in the figure correspond to stock variables? Ordinary variables? Derived stock variables? Flows?

**Answer:** “Aspirin in plasma” is the only stock variable. “Half life”, “elimination constant”, and “plasma volume” constitute ordinary variables. “Plasma concentration” is a derived stock variable, and “elimination” is the flow.

**Quick Review Question 2**: Suppose simulationHours had the value 40 hours and deltaX had the value 10/60 hours (10 minutes).  
 a. How many times would the loop body be executed?   
 b. What would the value of i be for each of those iterations?   
 c. What would each value of the x vector be?   
 d. What value of time (in minutes) would each iteration represent?   
 e. What value of time (in hours) would each iteration represent?

**Answer:**   
 a. simulationHours / deltaX = 40/(10/60) = 240 times, -1 for initial values is **239 times.**  
 b. i = 2…240 (or 1…239, for 0-indexed languages)  
 c. x = 0.16…40  
 d. 60 minutes \* 10/60 hours = 10 minutes.  
 e. 10/60 hours = 0.16 hours

**Quick Review Question 3**: Evaluate “6 MOD 3,” “7 MOD 3,” “8 MOD 3,” and “9 MOD 3.”

**Answer:** 0, 1, 2, 0

**Quick Review Question 4:** Suppose *deltaX* is equal to 30/60, and *interval* is equal to 12. For what values of *i* is *itox(i) modulo interval* equal to 0?

**Answer:** Y % 12 is 0 for multiples of 12: 12, 24, 36, 48, 60, etc.  
 deltaX is 30/60, or 0.5. itox(i) therefore returns a modulo zero value at half the rate of  
deltaX. So *itox(i) % 12* returns 0 when i = 24, 48, 72, 98, 120, etc.

Experimentation

* Suppose the patient is a child, whose plasma level is only 1500 ml. Would the dosage schedule from the original file result in the child surpassing the MTC? If so, how quickly would the MTC be reached?

**Answer:** Yes, by hour 56 the MTC is surpassed.

* If such a child took 60 mg doses in place of the 100 mg doses, would this alleviate the problem?   
    
  **Answer:** Yes, this causes the concentration to exceed MEC from hour 64 onward without exceeding MTC.
* Suppose this medication can only be obtained in 100 mg doses that cannot be easily divided. If the child took the drug only once per day, what effect would that have?  
    
  **Answer:** The effect is that MEC is almost never met (3 intervals totaling 18 minutes over 10 days, and only just meeting MEC then). 100 mg every 12 hours, however, meets MEC after hour 60 without exceeding MTC.