PHA 5127
Homework 4 key
Fall 2005

1.) A new antihypertensive drug was administered to a patient intravenously by a bolus injection and plasma samples were collected over time. The dose given was 3 mg. The pharmacokinetics of the drug are linear and can be described using a 1 compartment model.

Time (hr)	0.25	1	2	3	4	5
Conc. (μg/L)	52.5	31.2	16.1	8.1	4.1	2.1

a.) Calculate the half-life ($t_{1/2}$)
b.) Calculate the volume of distribution (V_d)
c.) Calculate the clearance (Cl)
d.)What would be the clearance of the drug if a 6 mg dose is given?
(0.5 points each)

$-k_e$ = (ln 2.1-ln 52.5)/(5-0.25)
k_e = 0.68 hr^{-1} or you can calculate k_e by performing linear regression.
$C_0 = C_t/e^{-ke*t}$ = 52.5/$e^{-0.68*0.25}$ = 62.2 μg/L

a. $t_{1/2}$ = ln 2/0.68 = 1.0 hour
b. V = Dose/C_0 = 3000 ug/62.2 ug/L = 48.4 L
c. Cl = k_e * V = 0.68 hr^{-1} * 48.4 L = 32.6 L/hr
d. Cl is unchanged with an increase in dose because PK is linear

2.) A patient is admitted with an acute theophylline overdose. A serum level is measured at 45 μg/ml. Assuming an 8 hour half-life and no further drug absorption, how long dose it take for the serum level to drop to the upper limit of the therapeutic range of 20 μg/ml? (1.5 points)

$$k = \frac{0.693}{8} = 0.087h^{-1}$$

$$20 = 45 \cdot e^{-0.087 \cdot t}$$

$$\frac{20}{45} = e^{-0.087 \cdot t}$$

$$\ln(0.44) = -0.087 \cdot t$$

$$-0.811 = -0.087 \cdot t$$

t = 9.3 h

3.) A drug follows one compartment body model after an IV bolus injection. The half-life of the drug is reported as 2 hours. A plasma sample taken at 0.5 hours has a concentration of 2.3 µg/ml. The V_d is 50 L and the fraction bound to proteins (f_b) is 0.3. (0.5 points each)

a. What is the rate of elimination?
b. What is the total body clearance?
c. What is the concentration at time 0?
d. The drug is eliminated by glomerular filtration (no reabsorption or secretion), what is the renal clearance?
e. Is renal clearance the only route of elimination of the drug? If no, what is the non-renal clearance?

a. $k_e = 0.693/2 = 0.35\ hr^{-1}$
b. $Cl = k_e * V_d = 0.35 * 50 = 17.5$ L/hr
c. $C_0 = C_t/e^{-ke*t} = 2.3/e^{-0.35*0.5} = 2.74$ µg/ml
d. $Cl_{renal} = fu * GFR = 0.7 * 130$ ml/min = 91 ml/min = 5.5 L/hr
e. No, because total clearance>Cl_{renal}. $Cl_{non\text{-}renal} = 17.5 – 5.5 = 12$ L/hr

4.) The plasma concentration one hour after an i.v dose of gentamycin was 7.9 mg/L. After 6 hours, the concentration was 3.2 mg/L. What would be the concentration 10 hours after the dose? (1.5 points)

$$k = \frac{\ln \frac{7.9}{3.2}}{6-1} = 0.18 hr^{-1}$$

$$C = 3.2 * e^{-0.18*4} = \mathbf{1.56\ mg/L}$$

5.) State if the following are True or False (0.5 points each)

a. The clearance is equal to the elimination rate constant times the volume of distribution. **True**
b. If the volume of distribution increases the clearance must increase. **False**
c. "Linear pharmacokinetics" means that the plasma drug concentration versus time plots will result in a straight line. **False**
d. Hydrophobic and ionized drugs are likely to cross most biological membranes **False**
e. A large value for V_d would mean that more drug is outside the plasma. **True**