Pharmacokinetics (Equation Sheet)

-Henderson-Hasselbalch Equation:

$$\log \frac{[\text{porotonated}]}{[\text{unprotonated}]} = \text{pKa} - \text{pH}$$

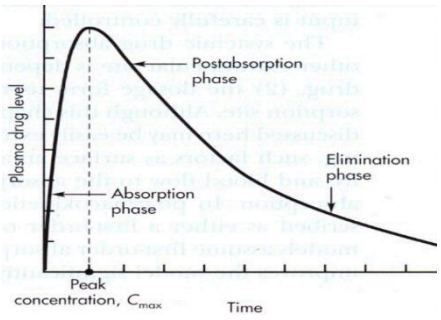
-Fick's Law of Diffusion: (theoretical)

$$\text{Flux} = C_1\text{-}C_2 \times \frac{(\text{Area} \times \text{Permeability coefficient})}{\text{Thickness}}$$

-Bioavailability (F):

F = f.(1-ER) F: Bioavailability f:absorption extent ER: extraction rate

*Can be calculated by area under the curve of Plasma conc. vs. time graph.



-Volume of Distribution (Vd):

$$\text{Vd} = \frac{\text{amount of drug in the body (total conc.)}}{\text{plasma drug conc.}}$$

Loading Volume = plasma conc. x Vd

-Drug Clearance (CL):

$$\text{Total CL} = \frac{\text{rate of elimination}}{\text{Cp}}$$

Cp: drug plasma conc.

1) Renal Clearance (CL_R):

$$CL_R = \frac{\text{Cu.V}}{\text{Cp}}$$

Cu: urine drug conc. V: urine flow rate Cp: drug plasma conc.

2)Hepatic Clearance (CL_H):

$CL_H = Q.ER$ Q:liver blood flow ER: extraction rate of the liver

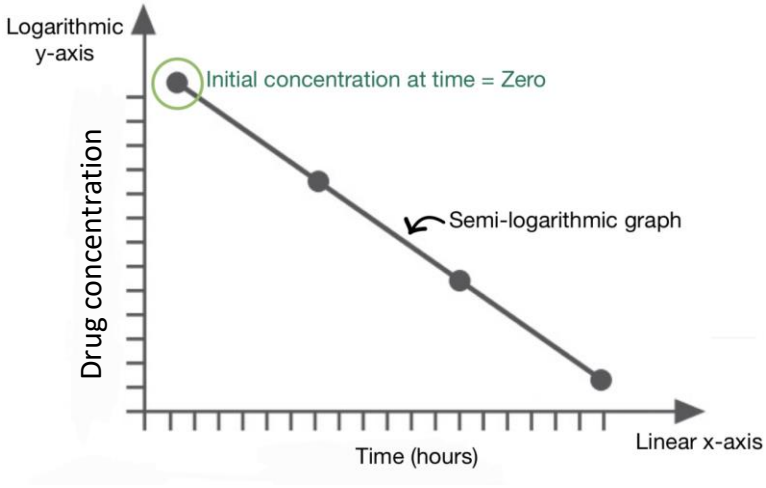
→ **ER =** $\frac{\textbf{liver clearance (CLH)}}{\textbf{liver blood flow (Q)}}$ **derived equation

$$\text{ER} = \frac{\text{Ci} - \text{Co}}{\text{Ci}}$$

C_i: drug conc. in portal vein (into the liver).

C_o: drug conc. in hepatic artery (out of liver).

First Order Elimination (Linear Pharmacokinetics)



values that can be directly calculated from the graph:

1) Volume of distribution:

$$Vd = \frac{\text{total amount of drug}}{\textbf{initial conc.(at time=zero)}}$$

2) Half-life $t_{1/2}$

3) elimination rate constant (K):

by calculating the slope

or using → $K * t_{1/2} = 0.693$

4) Drug Clearance (CL):

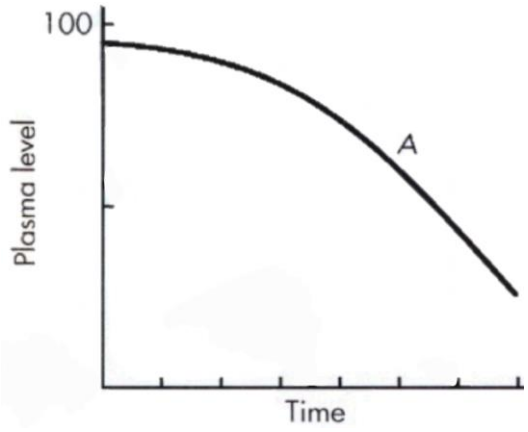
$CL = k * Vd$

→ $t_{1/2} = 0.693\ Vd/CL$

- after 4 half-lives → steady state is achieved.
- after 1 $t_{1/2}$ → 50% of the steady state is achieved.

Zero Order Elimination (Non-linear Pharmacokinetics)

- Rate of Elimination = $\frac{Vmax\ .C}{Km+C}$



semi-logarithmic graph

Side note:

C: plasma concentration can be obtained from the graph

Vmax & Km: given values from the question

- half live isn't constant→ steady state can't be determined

Steady-State related calculations

-Maintenance Dose (MD):

MD = CL . Css Css: target conc./ desired drug conc./ steady state conc.

*Needs to be multiplied by the dosing interval (example: every 8 h, 24h, etc.…)

-Loading Dose (LD):

LD = Vd. Css

Final note: for all previous calculations related to pharmacokinetics consider units conversion (mL/L), (mg/g/kg), (mins/h)

Done by: Hala Zaghloul