

## Central Lancashire Online Knowledge (CLoK)

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### **Calculation Skills: Plasma Half-Life**

The plasma half-life ( $t_{1/2}$ ) of a drug refers to the time it takes for the plasma concentration of a drug to decrease to half of its initial value (Trounce, 2008). The concentration of a drug in the plasma falls as it is metabolised and excreted (Alder, Astles, Bentley et al, 2015). Knowing a drug's half-life is important in determining the dose of a drug needed to achieve and maintain a therapeutic effect and to avoid toxicity (Alder et al, 2015). The accumulated dose of the drug reduces with each dose.

#### **Question A**

Drug A has a half-life of 8 hours and a strength of 200mg. The first dose is taken at 06:00 hrs and 8 hourly thereafter.

- (i) Insert the missing amounts from the table below, for the first two days of treatment with drug A.

| Time  | Dose  | Dose still present | Accumulated Dose |
|-------|-------|--------------------|------------------|
| 06:00 | 200mg | 0                  | 0                |
| 14:00 | 200mg |                    | 300mg            |
| 22:00 | 200mg | 150mg              |                  |
| 06:00 | 200mg |                    |                  |
| 14:00 | 200mg |                    |                  |
| 22:00 | 200mg |                    |                  |

- (ii) How many doses will the patient have had for the accumulated dose to have been less than 1mg of the previous accumulated dose?

#### **Question B**

- (i) Mr. Jones has taken drug B which has a half-life of 6 hours. He has a plasma level of drug B of 120mg. If Mr. Jones takes no further doses of drug B, how long will it take for the plasma level to reduce to 1.875mg?
- (ii) Mrs. Walters has commenced on drug C, taking 50mg per dose. Drug C has a half-life of 12 hours. After 36hrs, her current plasma level of drug C is 93.75mg. How many tablets has Mrs. Walters taken?

#### **Question C**

- (i) The half-life of drug D is known to be between 15 and 50 hours. What is the mean half-life of drug D?  
*Tip: Mean is calculated by adding the known values and dividing this total by the number of known values.*
- (ii) The mean half-life of drug E is 4 hours, assuming only two values (whole numbers) were available to determine the mean, what are the possible values used to determine the mean of 4 hours?

#### **Question D**

- (i) Miss Marsden is given a single dose of 400mg of drug F. After 24 hours, the plasma level of drug F is 6.25mg. What is drug F's half-life?

## References

Alder, J., Astles, A., Bentley, A. et al (2015) *The textbook of non-medical prescribing*, Chichester: Wiley  
Greenstein, B. (2008) *Trounce's clinical pharmacology for nurses*, London: Churchill Livingstone

## Calculation Answers

### Question A

(i)

| Time  | Dose  | Dose still present | Accumulated Dose |
|-------|-------|--------------------|------------------|
| 06:00 | 200mg | -                  | -                |
| 14:00 | 200mg | 100mg              | 300mg            |
| 22:00 | 200mg | 150mg              | 350mg            |
| 06:00 | 200mg | 175mg              | 375mg            |
| 14:00 | 200mg | 187.5mg            | 387.5mg          |
| 22:00 | 200mg | 193.75mg           | 393.75mg         |

(ii) Three more doses will bring the accumulated dose to 399.2 which is 0.8mg (398.4 – 399.2) more than the previous accumulated dose. The patient will have had nine doses.

### Question B

(i) 120mg to 60mg = 6hrs

60mg to 30mg = 6hrs

30mg to 15mg = 6hrs

15mg to 7.5mg = 6hrs

7.5mg to 3.75mg = 6hrs

3.75mg to 1.875mg = 6hrs

6 + 6 + 6 + 6 + 6 + 6 = 36hrs

(ii) 1<sup>st</sup> dose 50mg

2<sup>nd</sup> dose 50mg + 25mg remaining = 75mg

3<sup>rd</sup> dose 50mg + 37.5mg remaining = 87.5mg

4<sup>th</sup> dose 50mg + 43.75mg = 93.75mg

4 tablets have been taken.

### Question C

- (i) The known values are: 15 and 50 hours, so  $15 + 50 = 65$   
The number of known values is two (15 hours and 50 hours).  
To calculate the mean:  
$$\frac{15 + 50}{2} = \frac{65}{2} = 32.5$$

The mean half-life of drug D is 32.5 hours

- (ii) The sum of the two values must be 8 ( $8 \div 2 = 4$ ). The possible values could be:  
 $1\text{hr} + 7\text{hrs} = 8\text{hrs}$   
 $2\text{hrs} + 6\text{hrs} = 8\text{hrs}$   
 $3\text{ hrs} + 5\text{hrs} = 8\text{hrs}$

### Question D

Miss Marsden is given a single dose of 400mg of drug E. After 24 hours, the plasma level of drug E is 6.25mg. What is drug E's half-life?

Drug F = 400mg

$400 \rightarrow 200 \rightarrow 100 \rightarrow 50 \rightarrow 25 \rightarrow 12.5 \rightarrow 6.25$

In reducing from 400mg to 6.25mg, there are 6 half-lives. 6 half-lives took 24hrs.  
So 1 half-life =  $24 \div 6 = 4\text{hrs}$ .