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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 be less than 1mg of the previous accumulated dose?

Question B

- (i) Mr. Jones has taking drug B which has a half-life of 6 hours. He has 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 is 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?
Time Mean is calculated by adding the known values and dividing this total by the number.

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)

Timo	Doco	Doso still procent	
TITLE	DOSE		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) 1st dose 50mg

2nd dose 50mg + 25mg remaining = 75mg

3rd dose 50mg + 37.5mg remaining = 87.5mg

4th 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 = 65The 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: 1hr + 7hrs = 8hrs 2hrs + 6hrs = 8hrs 3 hrs + 5hrs = 8hrs

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

 $400 \hspace{0.1 cm} \rightarrow 200 \rightarrow 100 \rightarrow 50 \rightarrow 25 \rightarrow 12.5 \rightarrow 6.25$

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