

# 11.1 Pharmacokinetics

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 24 marks

KEY WORDS half-life • bioavailability

## Objective

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Compute exposure: half-life, steady state, loading logic.

## 1 Key knowledge and worked examples

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### ■ The three levers

$t_{1/2} = 0.693 \cdot V_d / CL$  ✓. Illustrative:  $V_d$  40 L,  $CL$  5 L/h  $\rightarrow t_{1/2}$  5.5 h; halve  $CL \rightarrow$  11.1 h.

### ■ Worked example: patience made arithmetic

Steady state ~90 % at 3.3 half-lives, ~97 % at 5 ✓. Loading dose  $C_{target} \cdot V_d / F$ : illustrative 10 mg/L  $\times$  40 L = 400 mg (labelled teaching value). Oral  $F$  0.6: 100 mg delivers 60 mg past the first pass ✓.

## 2 Practice

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2.1 State the half-life formula with all three symbols named. [3]

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2.2 What fraction of steady state is reached at 5 half-lives? [3]

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2.3  $V_d$  20 L,  $CL$  4 L/h – compute  $t_{1/2}$ . [3]

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### 3 Exam-style questions

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**3.1** An illustrative drug:  $V_d$  60 L,  $CL$  3 L/h, oral  $F = 0.5$ .

Compute  $t_{1/2}$  ( $0.693 \times 60 / 3 = 13.9$  h); time to ~97 % steady state on a fixed schedule ( $5 \times 13.9 \approx 69$  h); and a loading dose for a target of 8 mg/L ( $8 \times 60 = 480$  mg, illustrative) ✓. State how each answer changes if  $CL$  falls by half ✓. [8]

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**3.2** Two illustrative oral formulations of the same drug: A with  $F = 0.9$ , B with  $F = 0.5$ .

Explain what first-pass extraction differs between them, and compute the labelled circulating amount from a 200 mg dose of each (180 mg vs 100 mg) ✓. Predict what happens to B's effective exposure if the first pass is bypassed ✓. [7]

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## Solutions

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### 2.1

- $t_{1/2} = 0.693 V_d / CL$ : apparent volume, volume cleared per hour ✓.

### 2.2

- ~97 % (90 % at 3.3) ✓.

### 2.3

- $0.693 \times 20/4 = 3.5$  h ✓.

### 3.1

- $t_{1/2} = 0.693 \times 60/3 = 13.9$  h ✓.
- 97 % at 5 half-lives  $\approx 69$  h ✓.
- Loading:  $8 \text{ mg/L} \times 60 \text{ L} = 480 \text{ mg}$  (illustrative) ✓.
- $CL$  halved:  $t_{1/2}$  doubles to 27.7 h, steady state later, levels higher on the same schedule ✓.

### 3.2

- First pass: liver extraction differs – B loses 50 %, A 10 % ✓.
- $200 \text{ mg} \times 0.9 = 180 \text{ mg}$  vs  $200 \text{ mg} \times 0.5 = 100 \text{ mg}$  circulating ✓.
- Bypass removes the extraction: B's  $F$  rises toward 1.0 and exposure grows on the same tablet ✓.