UNIVERSITY MEDICINE • EXERCISE SHEET

11.1 Pharmacokinetics

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS half-life • bioavailability

Objective

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

1 Key knowledge and worked examples

■ **The three levers**

$t_{1/2} = 0.693 \cdot V_d/CL$ ✓. Illustrative: V_d 40 L, CL 5 L/h → $t_{1/2}$ 5.5 h; halve CL → 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 × 40 L = 400 mg (labelled teaching value). Oral F 0.6: 100 mg delivers 60 mg past the first pass ✓.

2 Practice

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

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

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

3 Exam-style questions

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

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

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]

Solutions

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 ≈ 69 h ✓.
- Loading: 8 mg/L × 60 L = 480 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 mg × 0.9 = 180 mg vs 200 mg × 0.5 = 100 mg circulating ✓.
- Bypass removes the extraction: B's F rises toward 1.0 and exposure grows on the same tablet ✓.