

Exercise walk-through

5.5

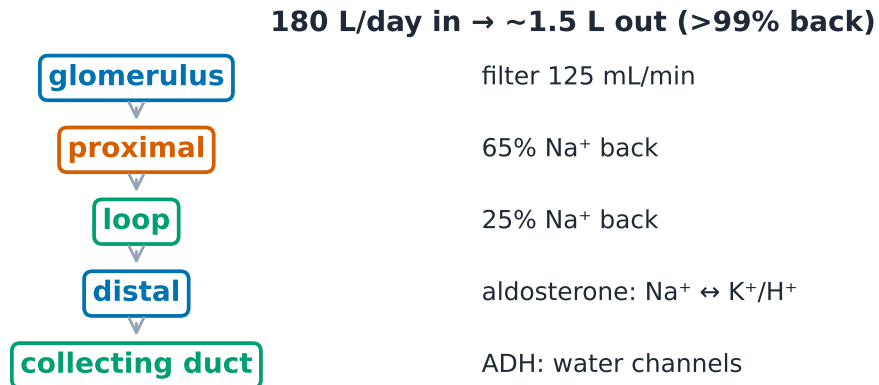
Renal physiology and acid–base

University Medicine

Renal: the chemists arithmetic

- 1 Filtration** GFR 125 mL/min $\rightarrow$ 180 L/day, >99% back: proximal 65% Na^+ , loop 25%, distal taps under **aldosterone** and ADH.
- 2 Clearance** $C = UV/P$: creatinine approximates GFR; PAH (one-pass) = renal plasma flow.
- 3 Acid-base** $\text{pH} = 6.1 + \log(\text{HCO}_3 \div (0.03 \cdot \text{PCO}_2))$; Winter: expected $\text{PCO}_2 = 1.5 \times \text{HCO}_3 + 8$ — mismatch = second disorder.

Renal physiology - transport map



The transport map with percentages and the two hormonal taps.

Exercises 2.1·2.3

2.1 Compute clearance for $U = 8 \text{ mg/mL}$, $V = 1.5 \text{ mL/min}$, $P = 0.1 \text{ mg/mL}$. [3]

2.2 What fraction of filtered Na^+ does the proximal tubule reabsorb? [3]

2.3 Compute the pH for HCO_3^- 24, P_{CO_2} 40. [3]

Exercises 2.1-2.3

2.1 Compute clearance for $U = 8 \text{ mg/mL}$, $V = 1.5 \text{ mL/min}$, $P = 0.1 \text{ mg/mL}$. [3]

2.1

- $C = 8 \times 1.5 / 0.1 = 120 \text{ mL/min}$ ✓ ($\approx \text{GFR}$).
-

2.2 What fraction of filtered Na^+ does the proximal tubule reabsorb? [3]

2.2

- About 65 %.
-

2.3 Compute the pH for HCO_3^- 24, P_{CO_2} 40. [3]

2.3

- $6.1 + \log(24/1.2) = 6.1 + 1.30 = 7.40$ ✓.

Exercises 3.1-3.2

3.1 A panel shows pH 7.20, HCO_3^- 9, P_{CO_2} 22.

Compute the expected P_{CO_2} by Winter's formula. Decide whether compensation is appropriate. Identify the acid-base disorder(s). [7]

3.2 A diabetic presents with glycosuria (fictional).

Compute the filtered glucose load at plasma 15 mmol/L. State the transport consequence above T_m . Explain the osmotic diuresis that follows. [7]

Exercises 3.1-3.2

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3.1

- Expected: $1.5 \times 9 + 8 = 21.5 \pm 2$ ✓.
- Measured 22 is inside – compensation appropriate.
- Metabolic acidosis with appropriate respiratory compensation (single disorder).

3.2 A diabetic presents with glycosuria (fictional).

Compute the filtered glucose load at plasma 15 mmol/L. State the transport consequence above T_m . Explain the osmotic diuresis that follows. [7]

3.2

- Load = $15 \times 125 = 1875$ $\mu\text{mol}/\text{min}$ ✓ (vs T_m ~2000 at saturation: borderline).
- Above T_m , transport saturates: excess glucose remains in the tubule.
- The unreabsorbed glucose holds water osmotically $\rightarrow$ polyuria; water loss drives thirst and (eventually) volume depletion.